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CONTENTS

This issue of the *Journal* takes us from the lab to the field and from Mexico to New Guinea. The geographical and topical diversity of these offerings are matched by the diversity of backgrounds of the authors—the five articles for this issue are one reflection of the breadth of on-going research in ethnobiology.

We begin in the lab with experimental research on charring maize. It is noteworthy that this research, which will have wide application in paleoethnobotany, was conducted by undergraduates under the direction of Christine Hastorf and Sissel Johannessen. The next three articles each echo, in varying degrees, the theme of sustainable use of natural resources: what can be learned from peoples living in traditional relationships with the natural world? The first takes us to the Sierra de Manantlan, Mexico, and a report of long-term, collaborative research into mestizo plant use by Bruce Benz and colleagues. George Estabrook then presents the implications of fuel choice on maintaining biodiversity in Portugal. Christopher Healey's paper comparing patterns of exploitation of birds in Borneo and New Guinea brings out the importance of understanding the wider social and political contexts of human-animal interrelationships. We end with a paper by Steven Goodman and Joseph Hobbs on the ethnozoology of reptiles in Egypt; this original research contributes much to knowledge of the distribution and classification of this often understudied group.

To facilitate finding reviews of books in which you are interested, beginning with this issue we are listing book reviews by title, author, and reviewer (rather than just page number). Note also that there is a change in how back issues of the *Journal* are distributed: in a moment of weakness Cecil Brown volunteered to store and send these out. Write him at the Department of Anthropology, Northern Illinois University, DeKalb, IL 60115-2854 (Ph. 815-753-0246) to inquire about the availability and price of issues you may be missing.

Finally, I would like to welcome H. Sorayya Carr and Gayle J. Fritz to the Editorial Board of the *Journal*. These new board members represent an expansion of the board, to insure that manuscript flow in any one research area does not overwhelm an individual board member. Let me take this opportunity to thank all Board Members for their hard work, and especially their efforts to speed up the manuscript review process. It still takes longer than we'd like to get manuscripts through the complete review process; I thank our contributors for their patience—everyone involved with reviewing, editing, and compiling the *Journal* are volunteers who squeeze the *Journal* into already busy schedules.

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TOWARD RECONSTRUCTING ANCIENT MAIZE: EXPERIMENTS IN PROCESSING AND CHARRING

SUSAN GOETTE
Anthropology Department
University of Minnesota, Minneapolis MN

MICHELE WILLIAMS
Anthropology Department
Washington University, St. Louis MO

SISSEL JOHANNESSEN
Army Corps of Engineers
St. Paul MN

CHRISTINE A. HASTORF
Anthropology Department
University of California, Berkeley CA

ABSTRACT.—We report the results of two experiments designed to assess the effects of processing and charring on maize fragments, so as to allow improved interpretation of maize remains recovered from archaeological sites. In the first experiment, kernels of three varieties of modern Andean maize were processed by three methods—toasting, sprouting, and boiling with wood ash—and then charred. The three processing techniques produced diagnostic characteristics that survived charring. It was also found that dimensional changes with charring were greater in processed kernels than unprocessed kernels. In the second experiment, after establishing a set of charring conditions, ears of six varieties of Andean maize were fragmented and the kernels and cupules measured before and after charring to determine the direction, degree, and variability of distortion.

RESUMEN.—Reportamos los resultados de dos experimentos diseñados para evaluar los efectos del procesamiento alimentario y la carbonización de fragmentos de maíz, a fin de permitir una mejor interpretación de los restos de maíz provenientes de sitios arqueológicos. En el primer experimento, se procesaron granos de tres variedades de maíz andino contemporáneo mediante tres métodos: fueron tostados, germinados, o hervidos con ceniza, y todos fueron después carbonizados. Las tres técnicas de procesamiento produjeron características que perduraron después de la carbonización y que pueden servir como diagnóstico. Se encontró también que los cambios de dimensiones ocasionados por la carbonización fueron mayores en granos procesados que en granos no procesados. En el segundo experimento, después de establecer ciertas condiciones de carbonización, se fragmentaron mazorcas de seis variedades de maíz andino y se midieron los granos y las cúpulas antes y después de la carbonización para determinar la dirección, grado y variabilidad de la deformación.

RÉSUMÉ.—Nous reportons les résultats de deux expériences destinées à évaluer les effects d'utilization culinaire et de carbonization sur les fragments de mais, de façon à améliorer l'interprétation des restes de mais provenant de contextes archaéologiques. Dans la première expérience, les graines de trois variétes de mais moderne des Andes ont été grillées, germinées, et bouilliees avec des cendres de bois, puis carbonizées. Ces trois techniques ont produit des charactéristiques diagnostiques qui ont survécu la carbonization. Entre autre, les changements dans les dimensions dus à la carbonization sont plus importants dans les graines préparées que nonpréparées. Dans la deuxième expérience, après avoir établi certaines conditions de carbonization, les épis de six variétés de mais andéens ont été fragmentés et les graines et cupules mesurées avant et après la carbonization, de façon à préciser la direction, le degré et la variabilité des distortions.

INTRODUCTION

Domesticated maize (*Zea mays* subsp. *mays*) achieved perhaps the widest prehistoric distribution of any New World crop, spread by human agency from Mesoamerica north to the boreal forests of Canada and south to Argentina and Chile. In the process the maize ear underwent phenotypic and genotypic variation into a myriad of colors, sizes, shapes, and textures. Hundreds of maize varieties were in use in the Americas at the time of European contact. These varieties, created and maintained by human groups each for its own particular purpose, were cultural artifacts. The recognition of these varietal differences in ancient maize remains recovered from archaeological sites is important for understanding the long and complex interaction between people and maize.

The difficulty inherent in distinguishing maize varieties on the basis of the morphologies of a few specimens (Bird 1970; Bird and Goodman 1978; Goodman and Paterniani 1969; King 1987) is increased by the fact that in many archaeological sites maize is preserved only if it was charred in antiquity. Further, maize ears generally have been fragmented through processing, charring, and other depositional forces into loose kernels, kernel fragments, and cob fragments consisting of the hard cupules that held the kernels. Several researchers (Benz 1994; Bird and Bird 1980; Cutler 1956; Cutler and Blake 1973; Pearsall 1980; Johannessen et al. 1990; King 1987, 1994; Miksicek et al. 1981) have addressed the problem of developing methods of measurement and statistical analysis that can be applied to classifying these charred fragmentary maize remains.

If archaeological maize types are to be reconstructed, it is essential to know how accurately measurements taken on charred fragments reflect the attributes of the original ear. Heating and charring distort the size and shape of kernels and cupules. Also, various types of maize processing undoubtedly changed kernel characteristics. The effects of charring and processing can be assessed by experimental means, and here we report on two experiments toward this end. The results should be understood only as one piece of the complex puzzle of reconstructing ancient maize. The myriad varieties of maize as well as variables in processing and charring conditions make it unwise to use the results as formulas to be applied to every set of archaeological maize fragments.

Several previous researchers have approached this same problem. Cutler (1956) and Cutler and Blake (1973) give the approximate effect of charring on cob parts and on kernels, but it is not clear whether their conclusions are based on observations of archaeological material or on experimental reconstructions. Pearsall (1980) experimented with charring and parching modern maize kernels in order to arrive at an appropriate adjustment to reconstruct the original size and shape of a cache of charred archaeological kernels. However, she was not successful in replicating the condition of the archaeological kernels, which appeared to have little distortion, pericarp splitting, or extrusion of the endosperm. After heating for 1.5 hours in sand over a Bunsen burner, the modern charred kernels were extremely swollen and broken, which Pearsall attributes to too high heat or too rapid heating. Modern kernels that were parched but not charred showed less distortion, and Pearsall estimated that ancient charring produced size increases of 5% in length, 10% in width, and 50% in thickness, percentages midway between the changes in the experimental charred and parched kernels. More recently, King (1987, 1994) has experimented with the effect of different charring regimes, as well as differences with variation in processing techniques (boiling and alkali treatment) and endosperm types. She too was unable to reproduce by experiment the condition of archaeological kernels, her various charring regimes producing kernels that were either uncharred, or broken and fragile (neither of which would survive well in the archaeological record). She therefore also used parched rather than charred kernels to estimate change with charring. She found, with some variation, for 105 kernels of seven different cultivars the width and length increased about 3% but the thickness increased about 38% (King 1987:136). She also found that kernels previously boiled or made into hominy showed greater change after charring than did charred unprocessed kernels (King 1987:146–147). An experiment by Benz (1994), which used entire cobs rather than fragments, found that the charred cobs, although variably distorted, were still readily distinguishable as to race in a multivariate comparison.

These studies form a useful basis for understanding the effects of charring and processing, each pointing out directions for further work. First, a method must be found to char maize that replicates the appearance of archaeological kernels. Further, in any experiment the sample size should be substantial and include several varieties, the methods described in detail, and full range of variation in the resultant data presented.

In the present experiments we contribute to improved interpretation of ancient charred maize fragments by refining our assessments of the effects of charring and of various maize processing techniques. The experiments were designed to aid in analysis of charred fragmented maize recovered from sites in the Mantaro Valley (Johannessen and Hastorf 1989), an intermontane Andean valley in Peru, and the results should be applied with caution to other situations.

In the first experiment, which assesses the effects of processing, the shelled kernels of three varieties of Andean maize were processed by three common and ancient Andean techniques (toasting, sprouting, and boiling with wood ash) and the processed kernels were then charred. Kernels were measured and their characteristics were noted at each stage. In the second experiment, dealing with the effects of charring, a method of charring that replicates the condition of archaeological maize was developed. Then a sample of over 400 kernels and 200 cupules from ears of six modern Andean maize varieties were measured, charred, and remeasured, and the changes produced by the charring were analyzed statistically. These two experiments allowed us to replicate archaeological maize characteristics and provided insights into signs of maize processing that may remain in the archaeological record.

EXPERIMENT ONE: THE EFFECTS OF PROCESSING

In this experiment we wanted to see if different processing techniques resulted in distinctive kernels whose characteristics might be expected to survive charring and be distinguishable in the archaeological record. We tested the effects of three common Andean maize processing techniques on traditional varieties of modern maize. For each of the processes, we noted the appearance of the kernels before processing, after processing, and after the processed kernels were charred. Measurements and photographs were taken at each stage.

The three traditional processing techniques chosen were toasting, boiling with wood ash, and sprouting. Currently in the Peruvian Andes maize is commonly processed for ***kancha*** (toasted maize), ***mote*** (boiled hominy), and *chicha* or ***ahka*** (beer). For ***kancha***, kernels of soft or sweet maize are parched in a clay vessel over the fire until crunchy. For ***mote***, kernels are boiled with wood ash until the pericarp is loosened. These are rubbed off by hand, and the resulting *maiz pelado* (peeled maize) is dried for storage. For *chicha*, the kernels are soaked for several days and then kept moist until they germinate. The ***wiñapo***, or sprouted maize, is dried, milled, boiled with water, strained, and fermented to make the beer (Bird 1970; Cutler and Cárdenas 1947; Gade 1975; Mejía Xesppe 1978).

The antiquity of these processes is apparent in their descriptions in early ethnohistoric documents, and in old Quechua names such as ***moti***, ***camcha***, and ***wiñapo aque*** (*chicha* from sprouted maize) (Horkheimer 1973). Garcilaso de la Vega, born of an Inca mother in 1539, describes the traditional preparation of ***motis***, ***camcha***, and ***wiñapo*** as outlined above; "all this," he says, "I saw with my own eyes, and I was nourished until I was nine or ten with ***çara***, which is maize" (Garcilaso de la Vega 1985 [1609–1617]:341). Prehistoric maize processing has also been discernable in some archaeological examples. Dried germinated maize, presumably stored for *chicha*-making and dating to ca. A.D. 900–1400, has been recovered uncharred under very good conditions of preservation on the arid coast of Peru (Moore 1989). In wetter highland sites, however, where charring is necessary for preservation, the recognition of processed maize is more difficult. We wanted to see if these processing techniques resulted in characteristic kernels even after charring.

Materials and methods.—Gade (1975), Bird (1970), Cutler and Cárdenas (1947), Nicholson (1960), and Rick and Anderson (1949) discuss the varieties of Andean maize traditionally preferred for each of these three processes. For the experiment, we selected a characteristic variety for each process: the sweet corn *Chullpi* for making ***kancha***, the large-kernelled flour variety *Cuzco* for ***mote***, and a flour variety *Huilcaparu* for making *chicha*. The maize types were obtained in 1989 as shelled kernels in Bolivian markets in Cochabamba and La Paz. We chose shelled

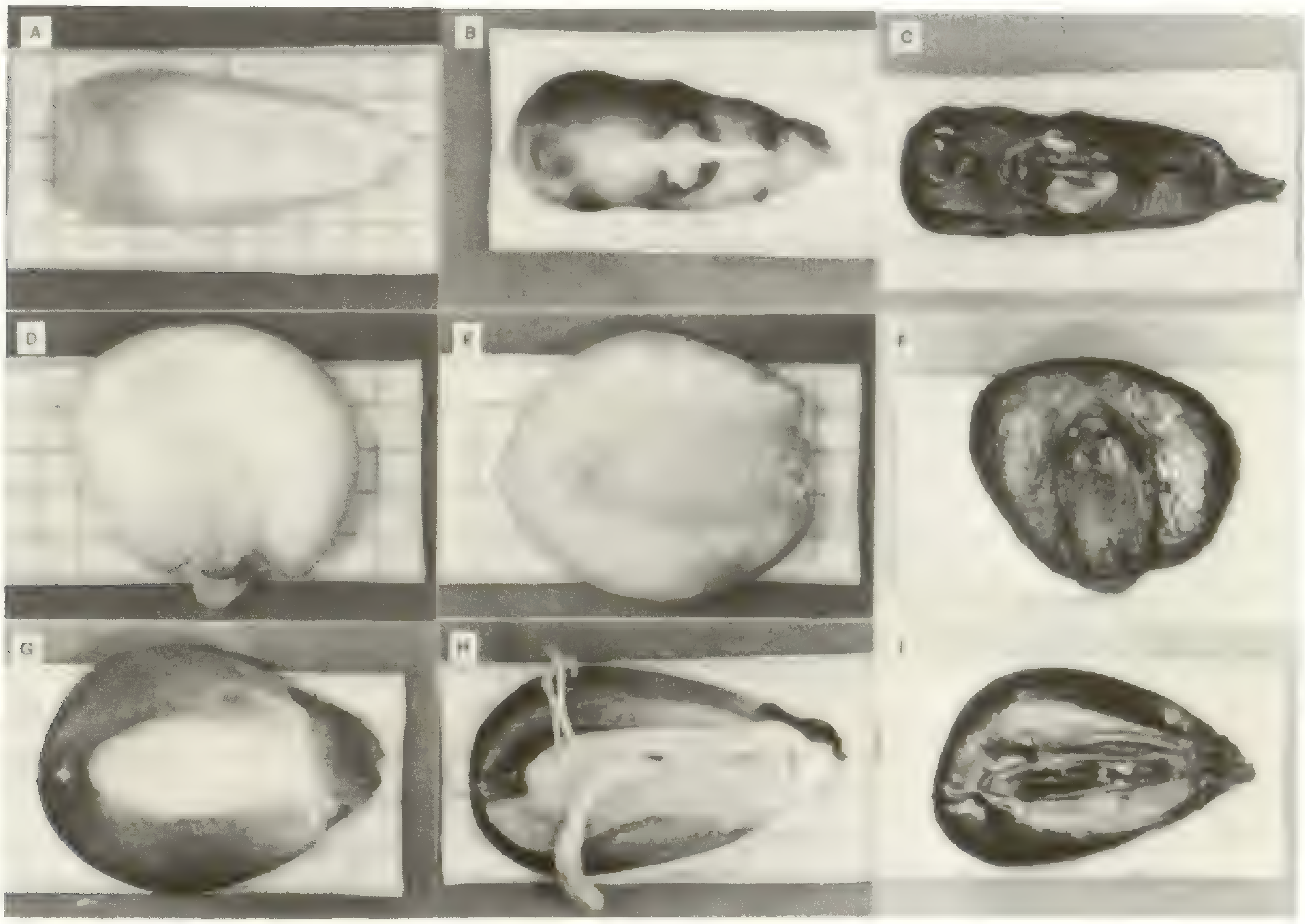

FIG. 1.—Kernels of three maize types at stages of the three processing techniques. A: unprocessed *Chullpi* (note the shriveled endosperm of this sweet corn); B: *Chullpi* toasted for ***kancha*** (shows vertical split down back of kernel); C: charred ***kancha*** (vertical split down embryo); D: unprocessed *Cuzco*; E: pericarp and point of attachment removed by wood-ash processing for ***mote***; F: charred ***mote***; G: unprocessed *Huilcaparu*; H: sprouted ***wiñapo*** for *chicha* (note pericarp over embryo pushed away by hypocotyl and radicle); I: charred ***wiñapo*** with hypocotyl and radicle burned away.

maize over whole ears because sources indicate that maize is traditionally graded and stored after shelling, and it is then this sample that is processed.

The *Chullpi* used for ***kancha*** is an Andean sweet corn with very long kernels (Fig. 1a). The ***kancha*** process is very simple; dried *Chullpi* kernels are placed in a clay pot (we used a ***kancha*** pot from the central Andes) over high heat. A handful of kernels is toasted in three or four minutes while stirring constantly. The resulting maize is toasted yellow with browned areas scattered across the swollen surface of the kernel. A distinctive crack in the pericarp occurs lengthwise either down the embryo area or the back of the kernel due to the puffing of the formerly shrunken "sugar" portion of the kernel (Fig. 1b). The radicle of the embryo protrudes upward through the cracked pericarp in many specimens.

Mote, which is similar to North American hominy, is prepared in the Vilcanota Valley of Peru with the large floury kernels of *Cuzco* (Fig. 1d) (Gade 1975). We used approximately one cup of hardwood ashes in two quarts of water to process 50–100 kernels of *Cuzco*. The water and wood ash form a lye solution with a pH of about 10. Once the ash and water mixture is boiling the kernels are added. The pericarps began to loosen after ten minutes of boiling over a medium-high flame. The kernels were then rinsed under running water while being rubbed together, removing any remaining pericarps and many of the points of attachment (Fig. 1e). *Maiz pelado* has a distinctive "hominy" smell and is light buttery yellow in color. Traditionally the peeled maize is added to soups or dried and stored for later use (Gade 1975). A second boiling in soup causes an enormous expansion of the kernels as they absorb water; the characteristic puffy appearance of ***mote*** or hominy results.

Huilcaparu is a variety widely grown and commonly used to make *chicha* in the Cochabamba Valley (Cutler and Cárdenas 1947:250) (Fig. 1g). The *chicha*-making process is long and complex, as illustrated by Cutler and Cárdenas (1947). Freshly sprouted kernels (the malted grains introduce the enzyme diastase that changes sugars to alcohol through fermentation) are dried and then milled. The resulting flour is boiled, allowed to settle, and the supernatant is removed for fermentation. The fermenting process takes 3–5 days.

The *chicha* processing technique we used was as follows: the maize was soaked overnight in water and a vermiculite mixture, and then sprouted for five days at 25°C in the moist vermiculite. When the majority of the kernels (15–20% of the kernels did not germinate) had radicles as long as the body of the seed, they were removed from the vermiculite and air-dried overnight. During germination the expanding radicle and hypocotyl pushed away the pericarp covering the embryo (Fig. 1h). The moist sprouted kernels were swollen to the limits of their pericarps, causing a puckered appearance across the tops of the kernels that was retained after drying. As the kernels dried, the radicle and hypocotyl became very delicate and broke off easily as did the pericarp covering the embryo. Nicholson (1960) states that in modern Peru the broken embryo parts are collected and saved for *chicha* production. Our processing sequence stopped here since in the next step the kernels are milled. Nicholson (1960) indicates that in the Andes maize is often sold or stored in the sprouted and dried state, and as we have seen, prehistoric examples of maize stored in this state have been found.

The products of these three processing techniques were then charred by the method described in the next section of this paper, in sand over a Bunsen burner with intervals of cooling. Samples of the sprouted kernels were charred both in the wet and dried state. The toasted ***kancha*** kernels unexpectedly took the longest time to char—up to 60 hours. The sprouted kernels took 24–50 hours, and the peeled and dried ***mote*** kernels took only 12 hours to char. The amount of endosperm extrusion (that is, the percentage of all charred kernels in which the endosperm expanded greatly with the heat and bubbled out through a split pericarp causing a fragile and greatly distorted kernel) ranged from 5–35% overall and correlated with the processing method. The ***mote*** kernels had the lowest percentage similar extrusion percentages of about 10–15%. The dry-charred *chicha* kernels had a very high extrusion percentage of 20–35%. This variation in the percentage of kernels that extrude with charring may be a reflection of the relative ability of kernels processed by various methods to become part of the archaeological record, since extruded kernels are very fragile and unlikely to survive.

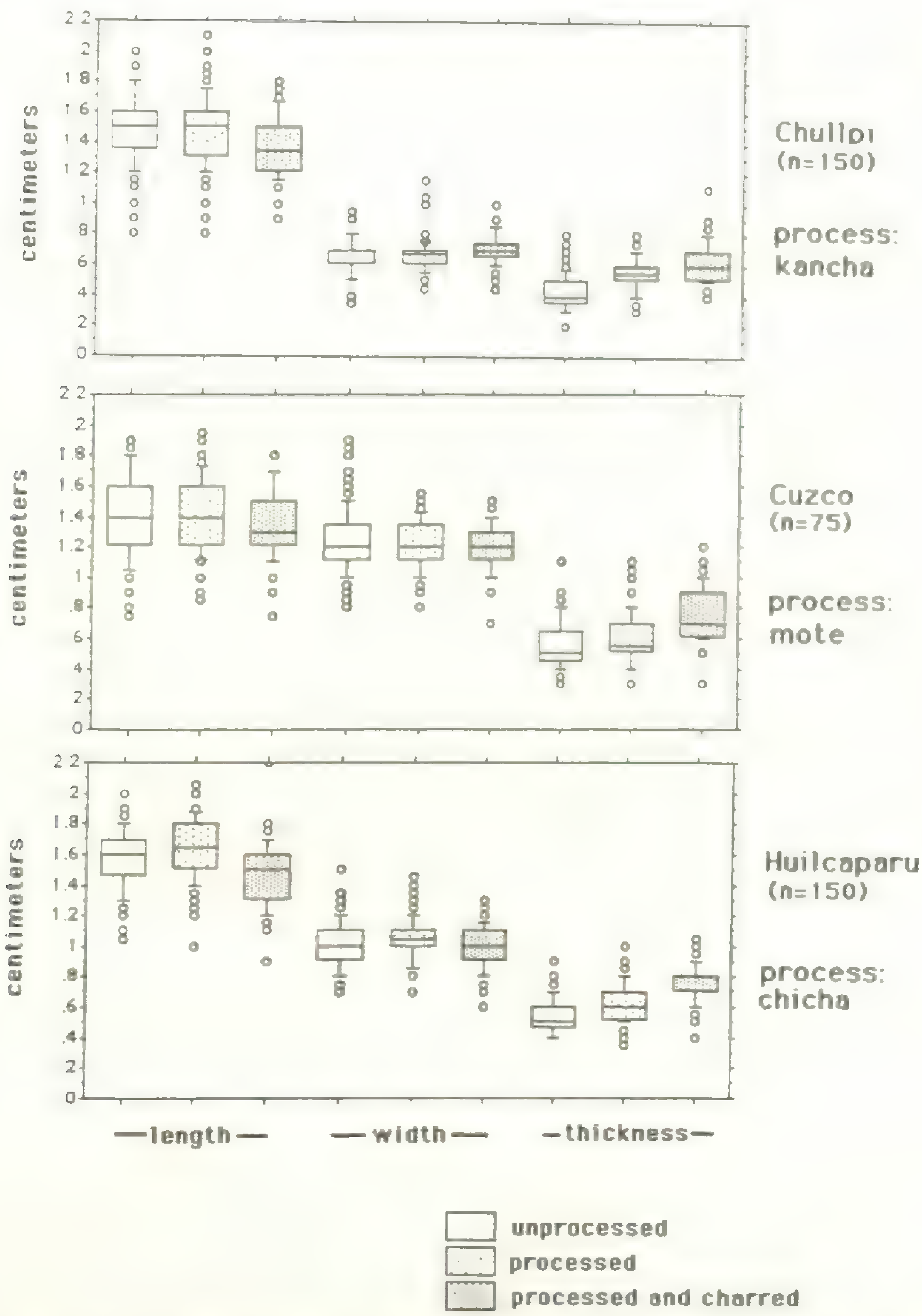

FIG. 2.—Range, variation, and change in the kernel measurments with processing and charring. The five bars of all box-plots mark the 10th, 25th, 50th (mode), 75th, and 90th percentiles.

To determine the metric changes resulting from the processing techniques, the kernels were measured at each stage; unprocessed, processed, and charred-processed. The measurements taken were length, width, thickness, and the angle of the two long sides (see below and Fig. 4 for details). One hundred and fifty kernels each of *Chullpi* and *Huilcaparu* and 75 kernels of *Cuzco* were measured at each stage.

Results.—Results of the maize kernel measurements are illustrated in Fig. 2, which shows the range of variability and change in length, width, and thickness with each stage of the three techniques. In general we see the same directional changes in the charred processed kernels as we do in charred unprocessed kernels (see below and Table 2). The greatest change is in increased thickness, with a slight decrease in length, and little change in width. Fig. 2 shows that in most cases the change in shape takes place during charring rather than processing. Table 1 gives

TABLE 1.—Average percentage change in kernel variables with processing and charring.

Maize type (process)	**Chullpi** ***(kancha)***		**Cuzco** ***(mote)***		**Huilcaparu** ***(chicha)***	
Dimensions	P	P&C	P	P&C	P	P&C
length	−2.0	−8.0	+1.2	+4.3	+1.1	−9.7
width	+1.0	+4.5	−2.3	−4.2	+4.0	−1.6
thickness	+29.9	+39.0	+4.1	+38.0	+13.1	+42.8
angle	+31.0	+68.0	+15.6	+10.3	+5.8	+5.5

P: processed; P&C: processed and charred. Figures are percentage change in mean dimensions from the unprocessed kernels.

the mean changes in percentage for each type after processing and again after the processed kernels are charred. We can see by a comparison with Table 2 that the processed kernels get much thicker with charring than do the unprocessed kernels (mean increase of 40% as opposed to 13%), although the other dimensions undergo much the same amount of change. This confirms King's (1987) findings that processing does have a role in determining charred kernel shape, and further specifies that the major change is in the thickness.

Perhaps more important is the *appearance* of the charred and processed kernels (Fig. 1c,f,i). The toasted *Chullpi* ***kancha*** kernels kept their characteristic vertically cracked embryo or kernel back after charring. Even the protruding radicles survived charring intact. The browned and puffed areas of the pericarp became fragile after charring but the pericarp retained its integrity. Charring increased the overall puffiness of the **kancha** kernels. The sprouted *Huilcaparu* lost the delicate hypocotyls and radicles with charring, leaving holes where they had emerged from the embryo. The pericarp covering the embryo was also lost during charring. Processed and charred sprouted *Huilcaparu* kernels have a vertical crack down the embryo, similar to that of the toasted *Chullpi* kernels, but are distinctive in that their embryos are depleted and sunken. Those kernels most resembling archaeological maize were the carbonized lye-treated ***mote*** kernels. The endosperm of the *Cuzco*, having lost its restricting pericarp in processing, expanded greatly with charring. The expansion left the embryo with a sunken appearance. Although sunken, the embryo was still persistent on most kernels even after the boiling and charring processes.

Of the three processing techniques, the ***mote*** kernels were the quickest to char and were the most durable after charring, thereby making them the strongest candidates for preservation. In addition, they show the closest resemblance to much archaeological maize in lacking their pericarps, often their points of attachment, and occasionally their embryos. Processing maize with wood ash was a widespread practice in the Americas; the results of this process could make up much of the maize debris recovered from archaeological sites. King (1987:146) also reached this conclusion as a result of her experiments.

Conclusions.—We believe that the products of *chicha*, ***kancha***, and ***mote*** production, as produced in our experiments, would be distinctive in the archaeological record. The remains of *chicha* production could be identified by the distinctive radicle/hypocotyl holes and the missing embryo pericarp. The *chicha* characteristics might occur in any sprouted maize so archaeological context must be considered. ***Kancha*** kernels might be less distinctive because unprocessed kernels also puff during charring. However, the protruding radicle and the embryo crack would be good distinguishing characteristics for kernels that had been quickly parched over a hot fire. ***Mote*** kernels were the most distinctive products of the three processes in lacking the pericarp, often the point of attachment, and occasionally the embryo.

EXPERIMENT TWO: THE EFFECTS OF CHARRING

This experiment was designed, first of all, to devise a system of charring that would replicate the appearance of most charred archaeological maize. This would allow a more realistic estimate of the amount of distortion produced by such a charring method, and also provide insight into the kinds of conditions that may have preserved the maize we find archaeologically. Further, the experiment was intended to assess the effects of this charring on samples of kernels and cupules from a number of maize varieties. We concentrated in this case on loose kernels and cupules, rather than whole ears or cobs, since in our experience most charred archaeological maize is found in a fragmented state. Overall, 434 kernels and 221 cupules from six maize varieties were measured both before and after charring.

Materials and methods.—Specimens of six cultivars of modern Andean maize were used for this experiment. The varieties were selected to give variation in size, shape, and endosperm type so that differences in the effect of charring could be assessed. The six varieties are (1) *Confite puntiagudo*, a popcorn with small pointed kernels, (2) *Chullpi*, a many-rowed sweet corn, (3) an unnamed variegated flour variety with imbricated yellow and red striped kernels, (4) *San Geronimo*, a white flour variety, (5) *Morocho*, a flint type with characteristic round kernels, and (6) *Cuzco morado*, a dark red, large-kernelled 8-row flour variety (Fig. 3). The four endosperm types represented have the following characteristics. Popcorn grains are composed mostly of a very hard vitreous endosperm with a small amount of soft starch in the center. Steam generated in the soft center causes it to explode with heating. Flint-type kernels also have a hard translucent endosperm with starch in the center, the proportions varying by variety. In flour varieties the endosperm consists of soft starch. In sweet corn much of the sugars are not converted into starches with maturation, and the kernels are translucent and shrivelled when dry (Sturtevant 1899; Purseglove 1972:303–304).

Two ears of each variety were selected to provide the kernels and cupules for analysis. The two ears from each variety had the following row numbers: *Confite*, one 12-row and one 16-row; *Chullpi*, one 14-row and one 16-row; variegated, both 10-row; *San Geronimo*, both 10-row; *Morocho*, one 10-row and one with very irregular rows that was counted as 9-row; and *Cuzco morado*, one 8-row and one 10-row. The sample of kernels and cupules from the two ears of each maize variety is of

FIG. 3.—Six Andean maize types used in the charring experiment. A: *Confite puntiagudo*; B: *Chullpi*; C: Variegated; D: *San Geronimo*; E: *Morocho*; F: *Cuzco morado*. Scale is in centimeters.

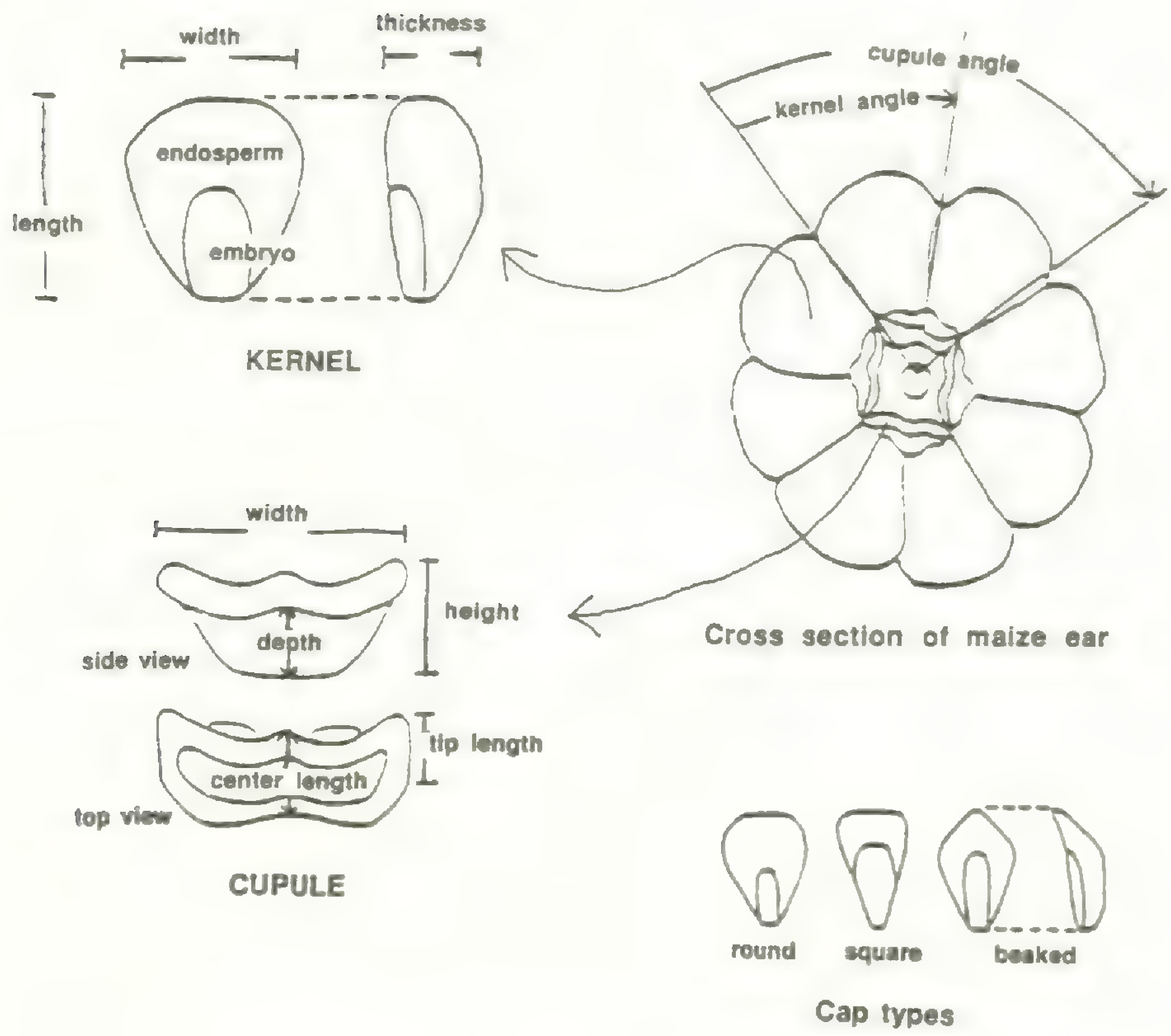

FIG. 4.—Kernel and cupule measurements used.

course by no means considered representative of the morphological variation within the variety as a whole; the emphasis here is rather on the change and variation that comes about with charring. The ears were all collected from Andean markets or farmers 6–10 years ago, and have since been stored in a herbarium cabinet, and thus were thoroughly air-dry.

Twenty percent of the kernels and cupules from each ear were measured. First, the length, center width, row number, and total number of kernels of each ear were recorded. All kernels were removed from each ear and 20% of the total were selected by picking blind-folded from a box. Selection of the cupule sample was more difficult, since cupules cannot readily be separated from an uncharred cob. Therefore, before charring, the cupule measurements had to be taken on the cob, and access to the cupules became the limiting factor in determining the sample. We experimented with sawing (Benz 1986), hammering, and hand-breaking to expose cob cross-sections. Because of the alternating arrangement of the cupule rows, sawing damaged the walls of the cupules, and hammering mashed the cupules. Hand-breaking best exposed a cross-section with intact cupules. Three breaks were made of each cob, one in the center and one toward each end. The cupules in the six exposed cross-sections were those used in the study, for roughly a 20% sample from each ear.

Measurements of the kernels and cupules taken before and after charring were those that can readily be taken on archaeological specimens (Fig. 4). Kernel measurements were length, width, thickness, and angle of the two long sides. Kernel cap types were coded as round, square, or beaked. Cupule measurements were width, height, depth, center length, wing length, and angle. All measurements except angles and cupule depth were taken with sliding calipers to the nearest 0.05 cm. Angles were measured to the nearest 5° by laying the kernel or cupule on a piece of laminated polar coordinate graph paper (delineating the 360° of a circle), lining one of the long sides on the 0° line and moving the kernel or cupule until the other long side was flush with a degree line. Cupule depths were measured from the front lip to the deepest part of the cupule pocket using a calibrated metal probe.

Previous experiments in charring maize have resulted in extensively swollen, broken, extruded and fragile kernels (King 1987; Pearsall 1980). Not only are such kernels unlikely candidates for preservation, but both King and Pearsall note that archaeological maize remains often appear well-preserved with little apparent distortion, although often the kernel embryos are missing as well as much of the pericarp. The ancient conditions of charring that produced such maize remains have thus far been unduplicated experimentally.

In this experiment we tried a number of charring techniques to find that which produced the least fragile and least distorted charred maize fragments. The most successful method was slow charring in a reducing atmosphere at relatively low temperatures, with periodic intervals of cooling. Test kernels and cupules were charred in sand over a Bunsen burner at a temperature of about 180–190° C. The fragments were heated for 1.5 hours, allowed to cool completely, heated again for 1.5 hours, cooled, and so on until completely charred through to the center. This method took an average of 16 hours burning time to char one sample of kernels. Kernels charred at the same temperature but without the cooling intervals showed more frequent endosperm extrusion; 25% of the kernels as compared to 17% with the cooling intervals. Cupules were charred on the cob using the same method, with a shorter charring time of 10–12 hours per cob. We found that kernels and cupules left to burn after they have been fully charred retain their integrity. They do not disintegrate, crumble, or become more fragile.

The kernels and cupules from the six modern Andean maize varieties were then charred following this successful method, and the charred fragments were remeasured.

Change in kernels and cupules.—The maize kernels generally became shorter, wider, and thicker with charring. The percentile box-plots in Fig. 5 show the range of variation and the change with charring in length, width, and thickness for each of the six maize types. The box-plots have the properties of (a) showing the central tendencies and full range of variation for the samples for each maize type and each variable, and (b) allowing comparison of sizes and shapes among varieties. Overall *mean* change for the kernels consisted of a 6% decrease in length, width was minimally affected with an increase of only 1%, and thickness increased most to an average of 13% (Table 2). These findings differ from previous experiments using parched maize (King 1987; Pearsall 1980), where it was reported that all three dimensions increased. The measured angles of the kernels undergo a slight average increase of about 6%. The kernel caps tended to become slightly more round; 8% of the square cap types and 6% of the beaked types became round after charring. Two indices useful in describing the shape of kernels from the front and the top, ratios of width/length and width/thickness respectively, also change with charring. Since width generally increases as length decreases, the width/

TABLE 2.—Average percentage changes due to charring in six maize types. Figures show direction and percentage of change before and after charring.

Dimensions	Confite	Morocho	Chullpi	Cuzco	San Ger	Variegated	All Ears
Kernels	(n = 94)	(n = 64)	(n = 85)	(n = 75)	(n = 72)	(n = 54)	(n = 437)
Length	−1.4	−3.7	−7.6	−4.1	−6.8	−8.8	−5.5
Width	−0.4	+3.6	+2.0	0.0	+0.8	−0.6	+1.2
Thickness	+10.4	+17.2	+13.1	+20.6	+10.0	+5.1	+12.5
Angle	−2.7	+6.7	+1.6	−1.9	+21.2	+13.4	+5.5
Cupules	(n = 47)	(n = 32)	(n = 42)	(n = 37)	(n = 36)	(n = 27)	(n = 221)
Height	+6.0	−14.9	−9.1	−12.3	−12.7	−10.3	−8.2
Width	−15.7	−13.5	+6.3	−8.6	−17.1	−8.4	−9.7
Depth	−38.5	−18.2	−54.5	−22.7	−4.0	−29.1	−30.5
Center Length	+9.6	+14.8	+44.8	+23.4	+26.7	+57.8	+26.4
Wing Length	+9.7	+14.6	+44.2	+0.6	+2.8	+37.0	+15.7

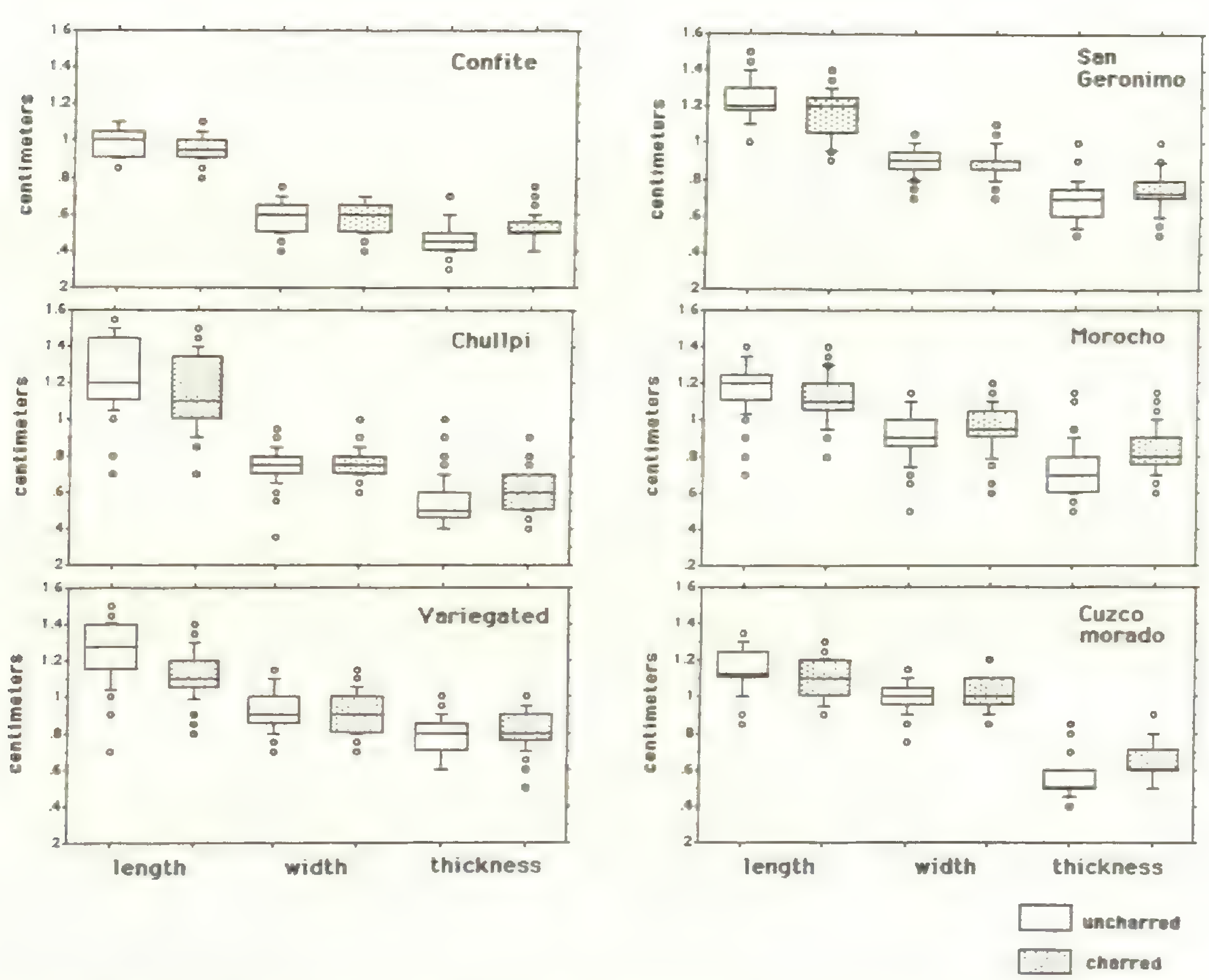

FIG. 5.—Range and variation (shown by percentile box-plots) in kernel measurements for each maize type before and after charring.

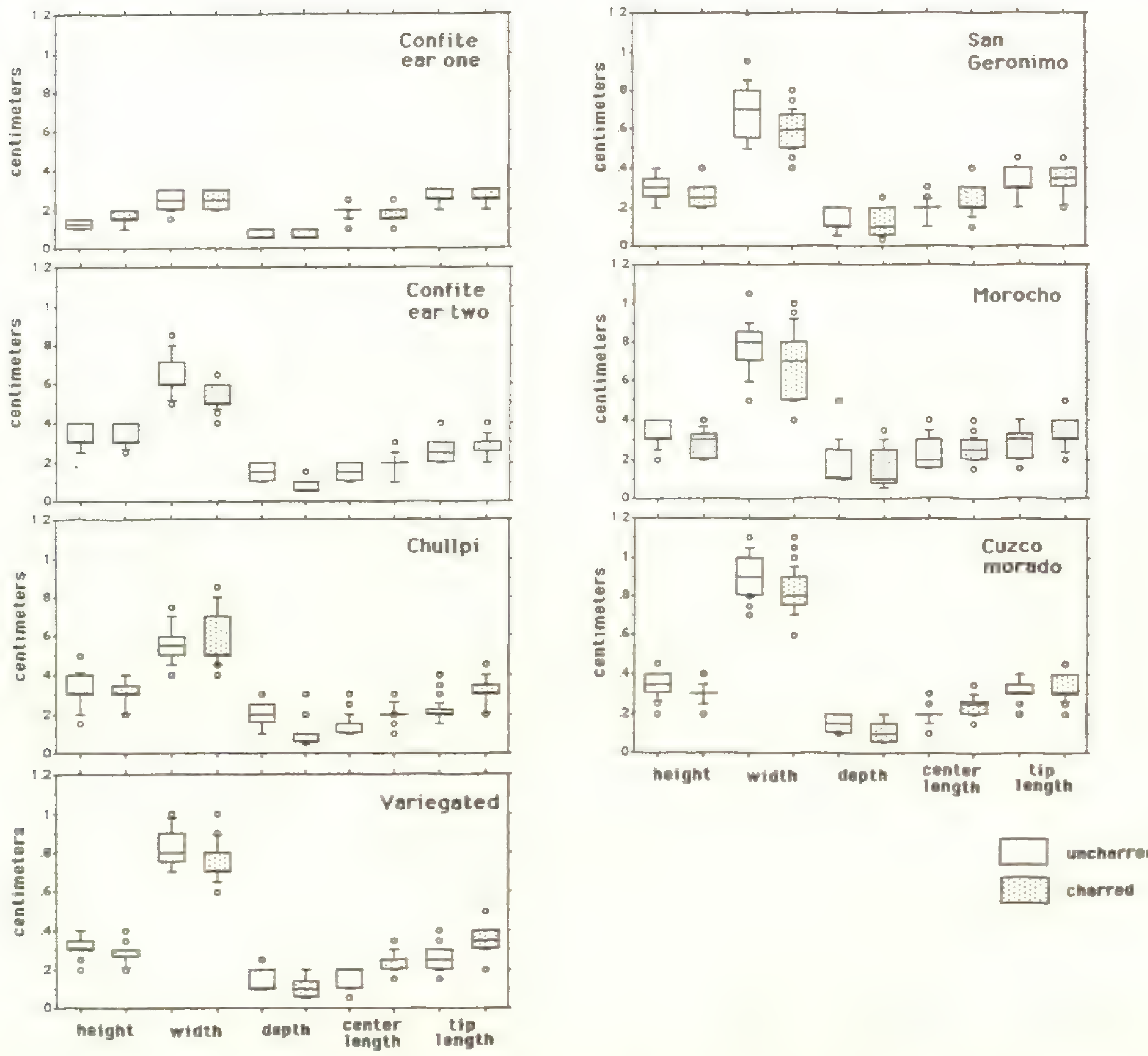

FIG. 6.—Range and variation in cupule measurements for each maize type before and after charring. Measurements for the two ears of *Confite* are shown separately, because it was found after removal of the kernels that the cupules of the two ears were quite different.

length ratio increases an average of 7%. Since thickness increases more than width, the width/thickness ratio decreases due to charring by an average of 12%. Fig. 5 and Table 2 show that although kernels of most varieties show the same general tendency for increase or decrease in each variable, the amount of change varies considerably. The amount of change does not correlate with endosperm type; the three flour varieties together show a wider range of variation than among the three other endosperm types (pop, flint, and sweet).

For the cupules, we found that the cupule height, depth, and width decreased while the center and wing lengths increased with charring (Fig. 6). Mean overall change consists of a 8% decrease in height, a 30% decrease in depth, a 10% decrease in width, a 30% increase in center length, and a 16% increase in wing length. Table 2 shows that, again, while the *direction* of change was consistent in most varieties the *amount* of change varies greatly.

Predicting row number from angle.—The row number of a ear of corn is held to be among the more reliable indicators of its variety (Bird 1970; Cutler and Blake 1973; Goodman and Paterniani 1969). With fragmented archaeological maize where the row number can no longer be counted from the ear or cob, many researchers have used the angle measured on the two long sides of a kernel or cupule to approximate the original row number. This is based on the portion of the 360° occupied by the kernel or cupule; in an eight-row ear, for example, a kernel will occupy 45° (one-eighth of a circle) and a cupule 90° (each cupule bears two kernels). However, this angle can be affected by the fact that kernels are generally offset slightly so that their edges do not abut, and in some types the rows are irregularly arranged. Thus the generalization that row number = 360/ angle-of-kernel (or row number = angle-of-cupule X 2) does not necessarily reflect reality. Some attempts have been made to assess the accuracy of the angle method of determining row number. Pearsall (1980) measured the angles of 25 kernels from ears of known row number (8, 10, 12, and 14-row cobs), with limited success in predicting row number. She found that the 8- and 10-rowed measured as either 8 or 10 but couldn't be further segregated; that kernels from 12-row ear measured as 8, 10, or 12-row; and that the 14-row measured fairly accurately. The measurements were made by the Cutler and Blake (1973) method of best-fit of the kernel to a number of pre-cut angles of 45° (8-row), 36° (10-row), and so on. Bohrer (1986), in an experiment measuring the kernels from two cobs (12- and 14-rowed), found that only 31% of the kernels from the 12-row cob and only 7% of the kernels from the 14-row cob gave measured angles that would have classified the kernels correctly. She does not state how the angles were measured. King (1987:128–129) found from measuring the angles of 160 kernels of eight varieties (measured by photo-copying the kernels and then drawing and measuring the angles), that 68% of the kernel angle measurements resulted in incorrect row number determinations.

We tested the degree of accuracy of using angles to predict row number by plotting the measured angles against the angles calculated from the actual row number of the original ears. Fig. 7 shows the scatterplots, regression, and correlation for actual vs. expected angle for the kernels (uncharred and charred) and for the charred cupules (uncharred cupule angles could not be measured since they couldn't be detached from the cob). The figure shows considerable variation in the measured angles of kernels from ears of the same row number, and overlap between and among row numbers. For uncharred kernels, only about 43% of the total variation in measured angles is attributable to the difference in row number. The predictive value of angles measured on the charred kernels was somewhat better ($R^2 = .57$). The angles measured on charred cupules were the best predictors of row number ($R^2 = .64$). This may be due to the fact that the expected angles of cupules are farther apart than those of kernels by a factor of two. In other words, 60° and 72° (cupule angles from 10- and 12-row cobs) are more easily discriminated than 30° and 36° (kernel angles from 10- and 12-row cobs).

An analysis of variance, however, does reveal significant differences (at 95%) in angle measurements between samples from most row numbers. The mean angle measurements of the kernels and cupules were very close to their expected angles (Fig. 8) in most cases. However, the kernels from the 14-row ears and the

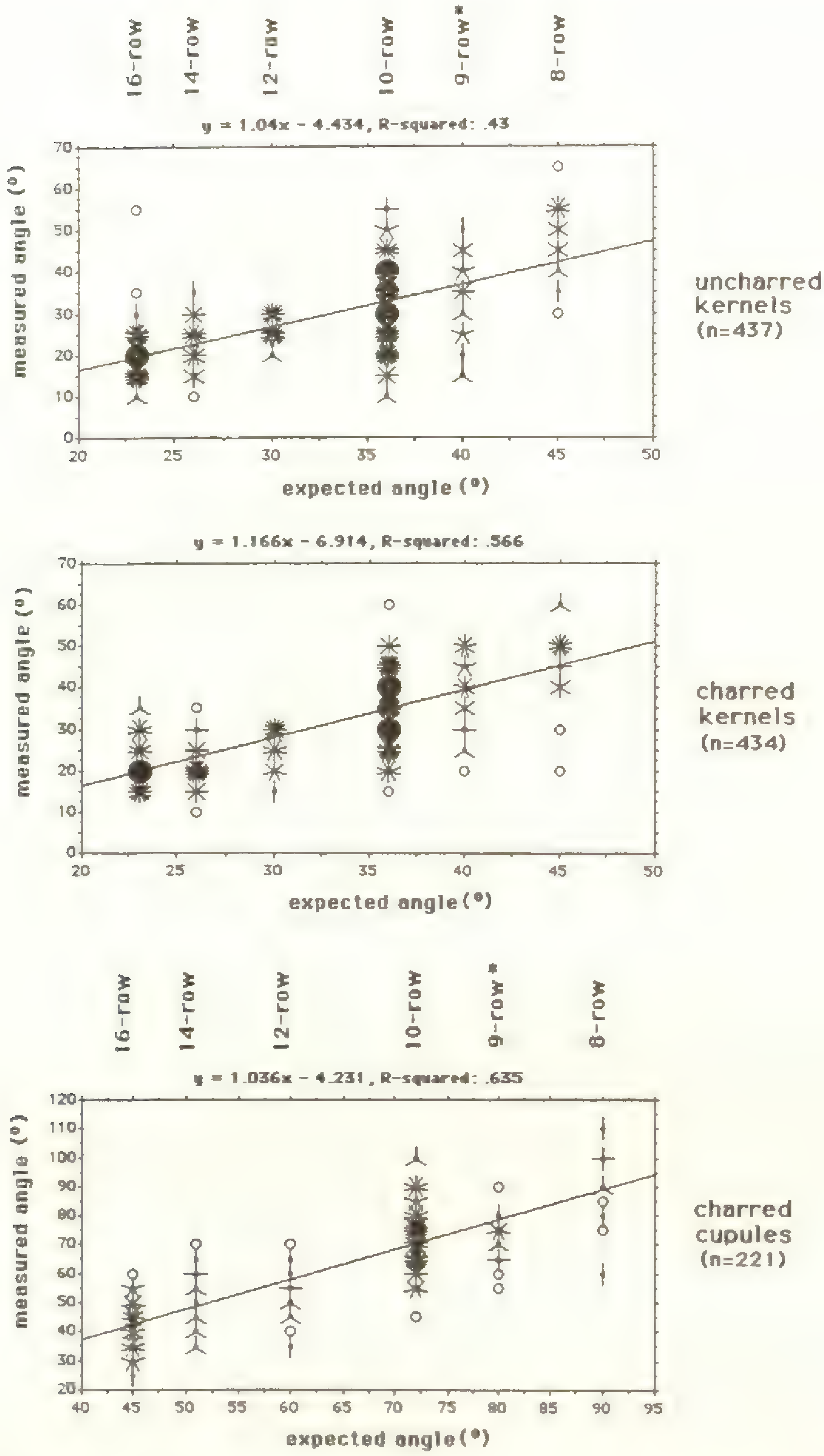

FIG. 7.—Describing variance in measured angles. Scatterplots, regression, and correlation of the measured vs. expected angles assess the accuracy of using kernel and cupule angle measurement to reconstruct row number. Overlapping points are indicated by "sunflowers." *One ear with uneven and varied rows was counted as a 9-row ear.

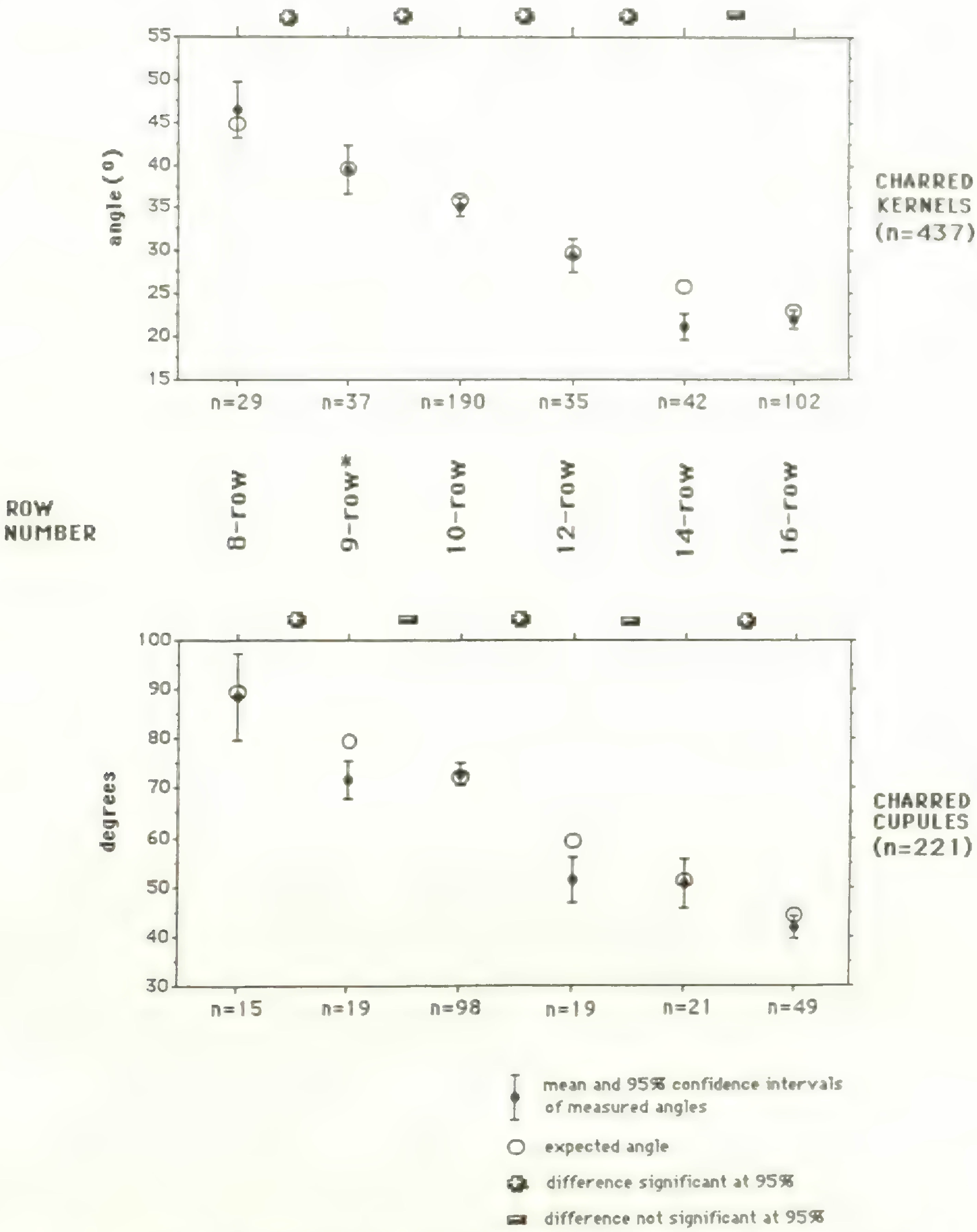

FIG. 8.—Analysis of variance in measured angles. The figure shows the mean angles and 95% confidence intervals of kernel and cupule samples from different row numbered ears, compares sample means to expected angles, and indicates the significance level of differences between groups (derived from analysis of variance).

cupules from the 9-row (one ear of *Morocho* had irregular and varied rows and was counted as being 9-row) had measured angles lower than expected, and thus the differences between the 14- and 16- row kernels and the 9- and 10-row and the 12- and 14-row cupules were not significant statistically. This suggests that measured angles from kernels and cupules often do reflect the actual row number *on a statistical* basis, although measurements on individual fragments have limited accuracy.

A note on processing.—An unexpected outcome of the experiment was the condition of the charred kernels. Of over 400 kernels, none lost their pericarps or embryos during the burning process. Charred archaeological kernels, otherwise well-preserved, are often missing all or most of their pericarps and often their embryos, and we have tacitly assumed that these were lost during the charring process. However, this may not be so, since in this experiment every kernel without exception retained its pericarp and embryo intact, even after 20 hours of burning. It seems plausible that the loss of pericarp and embryo from archaeological kernels with minimal distortion may have resulted from processing *before* they became charred, rather than from the charring itself. This bears out the findings from the experiment described above, from which we concluded that kernels processed with lye to remove their pericarps have the best chance of being preserved in the archaeological record.

SUMMARY, DISCUSSION, AND CONCLUSIONS

Our first experiment resulted in distinctive appearances for charred maize kernels subjected to three common Andean forms of processing. There is presently enormous variation in the maize varieties preferred for ***mote***, ***kancha***, and *chicha*, and it is probably safe to assume that the prehistoric people of the Andes had as widely varied tastes as the modern residents. Since we know that different types of maize react somewhat differently to charring, we cannot make a direct comparison between the appearance of archaeological maize and our modern processed and charred maize. However, we believe that the distinguishing characteristics described in Experiment One are the results of the processing method and not just the maize variety.

We cannot predict how hundreds of years in the soil affect charred maize. The grinding force of freezing and thawing could wear away at the persistent but fragile pericarps of ***kancha*** and *chicha* kernels leaving them naked like ***mote*** kernels. The embryos of the kernels could be preferred by animals or soil microbes, removing them before complete charring occurred. We can only suggest the many forces that could occur before, during, and after deposition, and thus cannot make direct comparisons between experimental processed and charred kernels produced in the laboratory and those recovered from archaeological sites. But we do know that charred processed maize is quite distinct from unprocessed charred maize, and that the results of the three methods were distinct from each other, and that these attributes may be preserved in ancient kernels. Finally, we recognize ***mote*** or hominy (pericarps removed by boiling with lye) as the process that results in maize most likely to be preserved and most resembling the condition of archaeological kernels.

In the second of these experiments we found a method of charring maize successfully, and assessed the effects of charring on the size and shape of the kernels and cupules of six varieties of maize. Long, slow, intermittent heating in a reducing atmosphere produced charred kernels and cupules that were not excessively distorted or fragile; i.e., were good candidates for the kind of long-term preservation we see in archaeological maize fragments. These conditions may be similar to those that charred the ancient maize that we find—burial in soil or ash near hearths that were periodically kindled.

Our research question concerned the degree to which measurements taken on charred maize fragments accurately reflect attributes of the original material. We found (a) that all measurements taken on a kernel or cupule are not affected to the same degree by charring, therefore the fragments change in shape as well as size; (b) kernels generally stay about the same width, and get slightly shorter and quite a bit thicker, while cupules decrease in all dimensions except length; (c) whereas the *direction* of change in a certain dimension was generally the same for the six varieties, we found considerable variation in the *amount* of change among varieties. Therefore no formula will entirely accurate in reconstructing the precharred attributes of maize kernels or cupules. Our results suggest generally that kernels stay about the same width, get about 5% shorter, and about 15% thicker, thus affecting the shape of the kernels, especially the width/thickness ratio. The height and width of cupules were found to decrease about 10%, and the length to increase roughly 20%, so that the most radical change is in the shape of the cupule from the top, becoming longer and narrower. We also found, as have previous researchers, that angle measurement of single kernels and cupules is not an accurate predictor of row number, having about 50% or less chance of accuracy with kernels and a somewhat better chance with cupules. However, the mean of a sample of measurements does often accurately reflect the row number.

Our experiments have detailed the effects of only a few of many possible conditions of charring and processing. The variation in morphological changes in charred maize kernels and cupules, as well as the many unknown biases that occurred in the processes of deposition, preservation, and recovery, make the reconstruction of ancient maize types and their uses a daunting problem. We believe that the most fruitful avenue of research lies in a combination of multivariate statistical analysis of large systematic samples of ancient maize fragments, and continuing experimental work, not only on the conditions producing morphological change, but on the structure of variability within and between maize types (Johannessen et al. 1990; Johannessen and Hastorf 1989).

All will agree that it is risky to draw conclusions about types and usage from a small sample of archaeological maize fragments. Nevertheless, standardized description and reporting of the raw data (so as to give the full range of variability) from even small samples can eventually build up large data bases that in conjunction with results of experiments on modern maize can give a more confident picture of local and regional patterns of ancient maize use.

ACKNOWLEDGEMENTS

We wish to thank Frances King and Deborah Pearsall for advice in designing the experiments. The research represents two Research Experiences for Undergraduates grants awarded under National Science Foundation grant BNS 84–51369.

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BOOK REVIEW

Oat Bran. Peter J. Wood (editor). St. Paul, Minnesota: American Association of Cereal Chemists (3340 Pilot Knob Road, St. Paul, MN 55121–2097). 1993. Pp. 164. $90. No ISBN given.

This compact volume of six chapters by nine recognised experts satisfies a need which is clearly set forth in the Foreword by the editor, Dr. P.J. Wood: "In 1989, the public appetite for oat bran was at its peak. Both the product itself and media reports describing miraculous health benefits were avidly consumed. . . . the American Association of Cereal Chemists. . . . suggested that a book be compiled that would attempt to describe the nature of oat bran, its means of manufacture and properties and what was known about its physiological effects." This book fully satisfies the worthwhile attempt to set forth the actual facts and it does it with full coverage of the subject.

The chapters describe: 1) Structure of Oat Bran and Distribution of Dietary Fiber components (R. Gary Fulcher and S. Shea Miller); 2) Current Practice and Novel Processes (D. Paton and M.K. Lenz); 3) Comparisons of Dietary Fiber and Selected Nutrient Compositions of Oat and Other Grain Fractions (J.A. Marlett); 4) Physiochemical Characteristics and Physiological Properties of Oat (1–3), (1–4)-B-D-Glutean (P.J. Wood); Physiological Responses to Dietary Oats in Animal Models (F.L. Schinnick and J.A. Marlett); 6) Hypocholesterolemic Effects of Oat Bran in Humans (J.A. Anderson and S.R. Bridges). Each chapter contains a comprehensive bibliography of literature cited, and there follows a detailed index.

The American Association of Cereal Chemists has published a number of outstanding books which I have reviewed. I consider this volume to be one of the finest, particularly from the point of view of coverage and presentation of the latest scientific data which corrects some of the misunderstandings and misinformation that has been in circulation.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138

BOOK REVIEW

Prosiding seminar dan lokakarya nasional etnobotani, Cisarua-Bogor, 19–20 Februari 1992. Rusdy E. Nasution, Soedarsono Riswan, Prabowo Tjitropranoto, Eko Baroto Waluyo, Wahyono Martowikrido, Harini Roemantyo, and Salikin S. Wardoyo (editors). Jakarta: Departemen Pertanian dan Lembaga Ilmu Pengetahuan Indonesia (LIPI) (Herbarium Bogoriense, Jalan Raya Juanda 22–24, Bogor, Indonesia), 1992. Pp. viii, 432. $11.25 U.S. (Rp 22500) (paperbound). ISBN 979–8006–71–2.

Indonesia is biologically and culturally one of the most diverse countries in the world. An archipelago of over 17,000 islands covered largely by tropical rainforest, it contains upwards of 30,000 plant species and over a hundred distinct cultural units.

Not surprizingly, there is a great deal of ethnobotanical knowledge present in the islands, much of which is being lost very rapidly. Some of this information has been collected by Indonesian ethnobotanists across the country. To date, the results of these studies have been scattered across publications of a variety of disciplines, mostly Indonesian publications. In 1992, however, a conference was held in Bogor to attempt to bring together ethnobotanists from across the country. This book is a collection of 61 papers presented at the conference. All the papers are by Indonesian authors, and all are in Indonesian with English abstracts.

Most of the papers are purely descriptive, some containing long tables listing names and uses of plants in one or another section of the country. Discussed also are plants used for food, fiber, medicine, contraception, and cosmetics, as well as in ethnoveterinary treatments and in traditional ceremonies. There is little of the theoretical bases pervasive in much European and North American ethnobotanical literature, such as ethnotaxonomy, chemical ecology, or optimization theory. Nevertheless, the book is remarkable for the breadth and diversity of topics covered, and for the wealth of valuable information contained in its pages.

This book will prove to be immensely useful to anyone working on the ethnobotany of insular Southeast Asia. Such progress deserves to be encouraged and fostered.

Joseph E. Laferrière
Arnold Arboretum of Harvard University
22 Divinity Ave.
Cambridge MA 02138 USA

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CHARACTERIZATION OF MESTIZO PLANT USE IN THE SIERRA DE MANANTLAN, JALISCO-COLIMA, MEXICO

BRUCE F. BENZ
FRANCISCO SANTANA M.
ROSARIO PINEDA L.
JUDITH CEVALLOS E.
LUIS ROBLES H.
DOMITILA DE NIZ L.
Instituto Manantlán de Ecología y
Conservación de la Biodiversidad
Universidad de Guadalajara
Apartado Postal 1-3933
Guadalajara, Jalisco
MEXICO, C.P. 44100

ABSTRACT.—Ethnobotanical research in the Sierra de Manantlan Biosphere Reserve seeks to promote a local conservation ethic through acknowledgement, documentation, and application of existing indigenous knowledge and use of the local flora by the rural population. Use of and knowledge about the native plant species has been documented in nine rural communities over a three year period through interviews with more than 100 informants. Informants have been selected on the basis of their self-acknowledged experience and willingness to collaborate. More than half of the more than 650 plant species discussed in interviews have been reported to be employed for one or more purposes.

Knowledge of a plant species' use appears to be related to relative floristic abundance while various categories of use tend to focus on certain specific vegetation types. The most frequently cited species are those which are either naturally widely distributed or respond positively to human disturbance. Information elicited from more than 100 informants suggests that a considerable amount of empirical knowledge is not shared among informants. For example, more than 20% of the species reported as useful are reported as such only by individual informants. This pattern appears to be independent of the rural community or general use category examined. Such idiosyncratic variability may stem from active experimentation by individuals or from local erosion of traditional knowledge through acculturation.

RESUMEN.—Investigaciones etnobotánicas en la Reserva de la Biosfera Sierra de Manantlán intentan promover una ética conservacionista local a través del reconocimiento, documentación, y aplicación del conocimiento existente y uso de la flora local por parte de la población rural. El uso y conocimiento concerniente a las especies nativas de plantas se ha documentado por medio de entrevistas con más de 100 informantes en nueve comunidades a través de tres años. Se seleccionaron los informantes en base de su propio conocimiento temático y su disposición a colaborar. Más de la mitad de las 650 especies de plantas utilizadas en entrevistas han sido reportadas como utiles para uno o más propósitos.

Parece que el uso de las plantas depende de la abundancia relativa en la flora y varias categorias de uso parecen enforcarse en las especies de ciertos tipos de vegetación. Las especies más frecuentemente citadas como útiles son aquellas que tienen una distribución geográfica amplia o responden positivamente a la perturbación antropogénica. Información obtenida de informantes indica que una cantidad considerable de conocimiento empírico no está compartido entre ellos. Por ejemplo, más de viente porciento de las especies reportadas como útiles se reportan como tal solo por informantes individuales. Este patrón parece ser independiente de la comunidad o categoría general de uso examinado. Tal variabilidad de idiosincratismo podría deberse a la experimentación activa o de erosión de conocimiento tradicional impulsado por la aculturación.

RÉSUMÉ.—La recherche ethnobotanique an sein de la Sierra de Manantlán cherche à promouvoir une éthique de conservation locale en s'appuyant sur les connaissances existantes et l'utilisation de la flaure locale par la population autochtone. Des interviews ont été réalisées avec plus de 100 informateurs dans neuf communautés et sur une période de trois ans afin de connaitre les espèces de plantes originaires et de savoir leur utilisation. Les informateurs ont été sélectionnés en fonction de leur connaissance thématique et de leur disposition à répondre. Plus de la moitié des plus de 650 espèces de plantes mentionnées dans les questionnaires sont utilisées pour une ou plusieurs fins.

L'utilisation des espèces de plantes semble dépendre d'une abondance flauristique relative; et certains types d'utilisation semblent dépendre de certains types de végétation. Les espèces les plus fréquemment utilisées sont celles que l'on rencontre en abondance de façon naturelle, ou qui réagissent positivement à des perturbations d'origine humaine. Les renseignements obtenus des informateurs montrent qu'un nombre considérable de connaissance empirique n'est apparemment pas divulgué entre les informateurs. Par exemple, 20% des espèces reportées comme étant utiles sont mentionnées par un seul et unique informateur. Ceci semble être indépendant de la communauté ou du type d'utilisation examiné. Une telle variabilité idiosyncratique pourrait être ralentie à travers une expérimentation active ou une érosion des connaissances traditionnelles par acculturation.

INTRODUCTION

The Sierra de Manantlan is situated along the border of Jalisco-Colima approximately 50 km north of the port of Manzanillo and 20 km west of Volcan Colima (Fig. 1) in western Mexico. This small mountain range is situated at the confluence of three of Mexico's major mountain systems: at the western margin of the Mexican Neo-volcanic axis, at the southern end of the Sierra Madre Occidental, and at the northern-most extent of the Sierra Madre del Sur (Rzedowski 1978; Tamayo 1980).

Recognition of the biological importance of this mountain range led to its being set aside to conserve its remarkable biodiversity (Jardel 1992). In fact, the present-day vegetation of this region, a mosaic of eight broadly defined types (Rzedowski 1978), contains a veritable wealth of plant and animal species, with more than 2500 species of vascular plants and 668 species of vertebrate fauna so far listed (Vazquez et al. 1990; Jardel 1992). The discovery of *Zea diploperennis* Iltis, Doebley, and Guzman, an endemic diploid perennial wild relative of maize (Iltis et al. 1979; Iltis 1980) provided the initial impetus for its preservation and eventu-

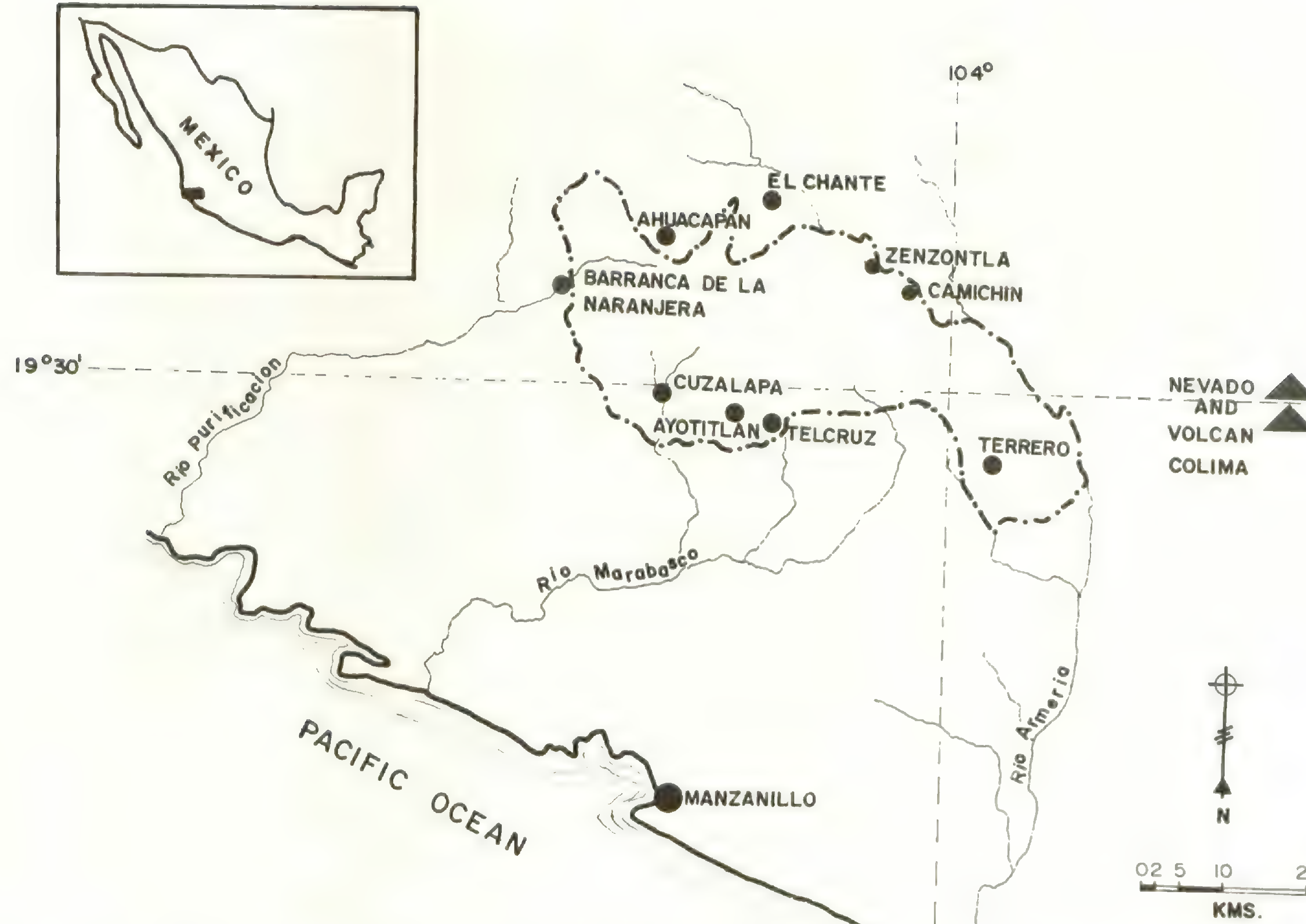

FIG. 1.—Geographic location of the Sierra de Manantlan Biosphere Reserve in western Mexico. Communities where informants were consulted are indicated by small circles.

ally for the federal decree establishing the Sierra de Manantlan as a Mexican Biosphere Reserve (139,000 ha; see Iltis 1980; Jardel 1992) and its eventual inclusion within UNESCO's Man and the Biosphere network of reserves.

For millennia, the forested slopes of these mountains have provided many of the natural resources—agricultural soils, animal forage, and hunted and gathered products—nearby communities depend upon. Second, the forested slopes supply considerable quantities of runoff to three regionally important watersheds, the Ayuquila-Armeria, the Marabasco, and the Purificación, rivers that have been the basis for irrigation-based agriculture since before the arrival of the Spanish (Kelly 1945, 1949; Sauer 1948).

Aside from the obvious economic motives for promoting a conservation and social development program in this mountainous region (Jardel 1992), the rich biological endowment of the Sierra de Manantlan Biosphere Reserve (SMBR) has proven to be exceedingly important for stimulating efforts to prevent local extinction of many of the organisms that occur here and nowhere else.

The objectives of the present study have been defined in the context of aims of the SMBR itself, which seek to integrate social with economic development and conservation to ensure that the local population adopts and/or maintains sustainable practices of natural resource use and thus a sustainable environment. Goals of our ethnobotanical research are to describe existing patterns of plant utilization in and around the SMBR in pursuit of locally adapted and appropriate land use alternatives and to ascertain whether existing exploitation practices in any way threaten present or future natural resource availability. Our research focuses on describing the intensity of utilization of the species recognized as useful by the local inhabitants, and subsequently evaluating it to predict whether these utilization practices might conflict with the conservation objectives of this protected area. Our research also seeks to discern the structure of plant resource knowledge among the local inhabitants. Although our methodology initially sought to corroborate information provided by individual informants, the data obtained thus far suggest that such corroboration is relatively infrequent and variation between informants much more prevalent.

In the following essay we evaluate plant use with respect to (1) the relative importance of plant families according to the abundance of utilized species, (2) the patterns of use with regard to vegetation type, (3) the intensity of use based upon the frequency of report of utilization, and (4) informant idiosyncracy in describing a species' utility.

THE AREA AND ITS PEOPLE

The Sierra de Manantlan, like much of western Mexico, has been inhabited for at least the last 2000 years (Kelly 1945, 1949, 1981). At the time of Spanish contact, the population in the region was widely scattered with only the valley of Autlan supporting a nucleated population large enough to be referred to as a city (Laitner Benz 1992). While the region's population at the time of Spanish contact consisted predominantly of Otomi speakers it also included people who spoke Nahua (Kelly 1945; Harvey 1972). In the Purificación River valley, the population apparently spoke a large variety of languages, though it too had a Nahua overlay.

The northeastern and southern slopes of the Sierra de Manantlan were apparently inhabited principally by Nahua speakers (Sauer 1948; Harvey 1972). Only a few indigenous Nahua speakers remain today, and they reside in the *ejido* of Ayotitlan in the south-central part of the Sierra de Manantlan.

The current population in the Sierra de Manantlan is a mixed lot. While a few of the communities are inhabited by indigenous but Spanish-speaking people (e.g., Ayotitlan, Camichin, Cuzalapa, Tel Cruz), the inhabitants of many of the other communities are descendants of recent immigrants from outside the region. One community in particular, El Terrero, is inhabited by the descendants of immigrants from Michoacan who arrived with the timber boom in the 1940s (Jardel 1992).

For the most part, the inhabitants of the Sierra de Manantlan live under very marginal socioeconomic conditions (see Jardel [1992] for details). While all of the communities studied can be reached by motorized vehicle, many of the roads are impassable during some or all of the rainy season, leaving these communities periodically cut off from surrounding areas except by foot or horse. At least half of these communities lack electricity, and five out of nine lack telephone, regular postal service, or transportation services. While water is carried or piped-in directly from nearby rivers or springs, its potability is seasonal. Illiteracy is relatively high (ranging from 15–40%) in these communities due to the lack of permanence of trained educators and the frequent truancy of students needed to tend the fields or livestock. The Reserve's communities are primarily maize agricultural although the people now see cattle as an increasingly viable economic option; all raise a few chickens and pigs. El Terrero, which has an active timber industry, is the only community which has a nonagricultural economic base.

The Sierra de Manantlan Biosphere Reserve protects a relatively large expanse of Cloud Forest (CF) although it comprises only a very small fraction of the total area of the Reserve (Jardel 1992). Tropical Deciduous Forest (TDF) comprises a very large percentage (25%) of the Reserve's total area; the Reserve is apparently one of the few areas in the Neotropics where relatively undisturbed tracts of this formation have been set aside. The Reserve also protects large expanses of Pine (PF), Oak (OF), and Pine-Oak forests (POF), as well as Fir (*Abies*) (FF) and Tropical Subdeciduous Forest (TSF). The diversity of vegetation types provides habitat to more than 2,500 species of vascular plants (Vazquez et al. 1990; Santana M. unpub. data), including ca. 25 local and many more regional endemic species.

METHODS

The communities under study were initially selected in order to evaluate the local peoples' awareness of the availability of the plant species present in this biosphere reserve. All nine communities have more or less ready access to six vegetation types—CF, OF, POF, TDF, TSF, and Gallery Forest—while only two of the communities have access to Fir Forest. As it turns out this suite of communities also provides a representative sample of the socioeconomic conditions prevailing in the region. Each community was visited periodically over the course of each year so that flowering and/or fruiting herbarium specimens of species that are locally available could be used to facilitate interviewing. Specimens used in interviews were collected in relatively undisturbed vegetation and along paths located within two to three hours walk from the community. Herbarium specimens are collected in sets of five or more; at least two specimens are used in interviews assuring that three to five or more informants saw and commented on all of the species collected during a particular visit to any one community.[1]

Plants were shown to informants in a freshly field-pressed state. Information was elicited about a species' use by asking two questions. The first question is whether the informant recognizes and has a name for the plant, the second is whether the species is used for any purpose. If the informant provides a use for a particular species he/she is again asked whether it might have any additional use. Questioning continues in this way until the informant responds that he/she knows of no other use.

We consulted numerous informants in each community in order to corroborate information provided by individual informants and to permit use of the frequency of informant response as a proxy measure for intensity of use. Individuals who were identified as knowledgeable in informal discussions with community officials and who expressed a willingness to endure our often lengthy interrogations participated as informants. These primary informants have been repeatedly interviewed during the three years this research was underway. Other individuals have participated as well; these persons usually identified themselves as knowledgeable and either offered or agreed to be interviewed. Both male and female informants have been interviewed and we sought to include individuals of all age groups. The vast majority of these individuals are either natives or have spent a considerable part of their life in the community where they now reside.

For the most part the interviews were conducted by persons who are also local residents; half of the interviewers were born and raised in the vicinity of the Sierra de Manantlan. Use of these resident locals (the authors FSM, JCE, and DDL) as interviewers has facilitated understanding of the information elicited from informants principally because many uses appear to be very local and the terminology used to describe such use often appears to be regionally, if not locally, unique.

The information discussed here is based upon an analytical unit that has simplified the management and interpretation of the data obtained. This analytical unit, one report of use, is the single mention of a part of one species for a particular use by one informant (cf. Alcorn 1984). For example, until 1990 *guamuchil* (*Pithecellobium dulce* [Roxb.] Benth.) had been reported as useful by five different informants. One of these informants provides four reports of use: the "seed" (i.e., the aril) is edible, the leaf is medicinal, the trunk makes good firewood, and the wood is useful in house construction. Another informant indicated that the bark is used medicinally and that the seed is edible. A third informant recognized the root as medicinal. The fourth recognized the trunk as being suitable for fence posts and for firewood. The fifth described the bark as medicinal, and like the fourth informant, reported that the trunk is useful for firewood and as fenceposts. In this example the total number of reports of use is 12.

The data was computer-coded and manipulated using a variety of data management and statistical programs. Nonparametric statistical tests (Sign, Chi-

TABLE 1.—Floristic and ethnobotanical representation of the 11 most common families of vascular plants in the Sierra de Manantlan Biosphere Reserve[1]

FLORISTIC INVENTORY[2]		ETHNOBOTANICAL INVENTORY Species[2]		Reports of Use[3]	
Compositae	(291)	Leguminosae	(37)	Leguminosae	(378)
Leguminosae	(213)	Compositae	(20)	Fagaceae	(327)
Gramineae	(193)	Euphorbiaceae	(16)	Verbenaceae	(118)
Orchidaceae	(126)	Solanaceae	(16)	Solanaceae	(118)
Euphorbiaceae	(62)	Fagaceae	(12)	Moraceae	(106)
Solanaceae	(51)	Rubiaceae	(9)	Myrtaceae	(100)
Malvaceae	(48)	Moraceae	(8)	Compositae	(100)
Labiatae	(45)	Gramineae	(8)	Sterculiaceae	(100)
Rubiaceae	(36)	Malvaceae	(7)	Flacourtiaceae	(83)
Scrophulariaceae	(33)	Myrtaceae	(6)	Rosaceae	(71)
Fagaceae	(31)	Labiatae	(6)	Euphorbiaceae	(61)

[1] Species numbers in floristic inventory after Vazquez et al. 1990.
[2] Numbers in parentheses are numbers of species.
[3] Numbers in parentheses are numbers of reports of use for all species.

-square, calculation of Pearson's correlation coefficients, and linear regression analyses) were obtained from these programs or calculated manually (Siegel 1956).

RESULTS

Is the useful flora a representative sample of the area's flora?—One of the questions posed initially was whether use of the flora is in any way related to floristic composition of the study area. Stated another way, is utilization of the flora determined by the relative abundances of certain taxonomic groups? There appear to be two ways of examining this question: first, by comparing the relative numbers of species per family reported by the Reserve's inhabitants with that of the area's flora; second, by comparing the relative importance of each family based upon total number of reports of use and comparing it to the relative floristic importance of each family.

Comparison was made using family rank (Table 1) based upon the number of species present in the flora and the number of species reported as useful by the Reserve's inhabitants. Only two of the 10 most speciose families in the Reserve's flora—the Orchidaceae and Scrophulariaceae—do not provide a relatively large number of useful species (i.e., more than five species). While numerous species from both of these families have been employed in interviews, only three species of the Scrophulariaceae and a single species of orchid have been designated as useful. Comparing how families are ranked in the floristic and ethnobotanical inventories leads us to infer that little difference exists in the order of family importance using these measures. Eight of the 10 families with the largest number of species reported as useful are also among the 10 most speciose families in the Reserve's flora; in fact the order of relative importance of the 11 most speciose families is not significantly different (Sign test; $P < .2$) from that of the Reserve's flora. Plant use in these nine communities of the SMBR thus appears to be related to relative floristic abundance. Comparing relative family order based upon frequency of report of use led to a similar conclusion, i.e., that no significant difference in ranking existed (Sign test; $P < .3$). In this case five of the most speciose families of the Reserve's flora are in the top 10 most commonly reported families in the ethnobotanical inventory and two more are in the 15 most commonly reported (Table 1).

Are all vegetation types subject to equal forms of use?—The specimens utilized in interviews were obtained from different types of vegetation. The aforementioned vegetation types are distinguished in part on physiognomy; for example, CF and TSF are similar in terms of tree diameters, heights, and shrub density, while TDF is quite distinct, with short, small-diameter trees the rule and much higher shrub densities (Rzedowski 1979; Benz unpub. data). Vegetation types are also distinguished in part on floristic, phytogeographic, geographic, and climatic/phenological characteristics. Such differences in forest structure and phenology led us to question whether any one vegetation type might be characterized by a specific pattern of use. This interest stemmed from both a human foraging point of view, i.e., are there more edible products in any one type of vegetation?, or are the products available in one particular vegetation type more diverse than those from other vegetation types?, and from a conservation standpoint, i.e., is timber preferentially exploited from one or more types of vegetation?

The specimens collected for use in interviews were obtained in nearly all 11 types of vegetation present in the Reserve but not all types of vegetation nor all categories of use are equally represented. Comparison of use and vegetation types thus is based upon only six vegetation types and eight of 14 types of use (Table 2).

The null hypothesis is that no difference exists in the number of times a category of use is reported for all the species from each of the different vegetation types, that is, there is no *a priori* reason to expect that any one vegetation type is preferred over the others for any category of use. Acknowledging that a variable number of species were collected from each vegetation type and used in interviews, that these species are for the most part represented in only one vegetation type, and that a variable number of informants were interviewed in each community, we suspect that certain types of vegetation might harbor species of similar habit or life form which, in turn might be subject to similar forms of use and, therefore, subject to characterization. We are willing to admit that similarities and differences of species' uses across vegetation types might be attributed to the species present and their relative abundances in each vegetation type, or that the informants interviewed might have provided biased thematic knowledge; however, for the moment, we focus on vegetation types as the source of this difference or similarity. Statistical comparison indicates that considerable difference exists with respect to the number of reports of use of the species from each of the different vegetation types ($\chi^2=200.5$; 30 df; $p < .001$; Table 2).

Oak Forest appears to be the principal vegetation type for obtaining species whose wood is utilized. Three of the five use categories—firewood, fenceposts,

TABLE 2.—Reports of use arranged according to vegetation type and type of use reported for the plant species by the local population.

TYPE OF USE	TYPE OF VEGETATION						
	OAK FOREST	GALLERY FOREST	CLOUD FOREST	PINE-OAK	TROPICAL DECIDUOUS FOREST	TROPICAL SUB-DECIDUOUS FOREST	Row Total
EDIBLE	82[1] 96.2 -1.6	19 22.2 -.8	103 74.0 4.1	4 20.8 -4.2	53 59.4 -1.0	159 147.5 1.3	420 19.8%
FIREWOOD	95 66.6 4.3	30 15.4 4.1	36 51.3 -2.5	12 14.4 -.7	33 41.1 -1.5	85 102.2 -2.3	291 13.7%
FENCE POSTS	65 43.5 3.9	9 10.0 -.3	23 33.5 -2.1	5 9.4 -1.5	21 26.9 -1.3	67 66.7 .0	190 9.0%
CONSTRUCTION	71 47.0 4.2	1 10.8 -3.2	45 36.1 1.7	13 10.1 1.0	11 29.0 -3.8	64 72.0 -1.2	205 9.7%
FORAGE	19 43.7 -4.5	8 10.1 -.7	45 33.7 2.3	1 9.5 -3.0	37 27.0 2.2	81 67.1 2.2	191 9.0%
INSTRUMENTS	37 34.8 .4	11 8.0 1.1	19 26.8 -1.7	10 7.5 1.0	16 21.5 -1.3	59 53.4 1.0	152 7.2%
MEDICINAL	117 154.1 -4.1	34 35.5 .1	103 118.6 -1.9	60 33.3 5.7	129 95.1 4.5	230 236.3 -.6	673 31.7%
Column Total	486 22.9%	122 5.3%	374 17.6%	105 4.9%	300 14.1%	745 35.1%	2122 100.0%

[1] The numbers in each cell from top to bottom refer to the observed frequency, (number of reports of use), the expected frequency, and the adjusted residual value. Adjusted residuals indicate the magnitude and direction of the deviation of observed from expected standardized across all cells of the table.

and construction—where wood is the forest product of interest show a higher than expected number of reports of use for OF than other types of vegetation (Table 2). This is probably due to frequent report of use of *Quercus magnoliifolia* Née, *Q. gentryi* C.H. Muller, and *Q. elliptica* Née. Reports of species' use where OF appears to provide less than expected number of reports is where forage or medicinal uses are concerned.

Gallery Forest, a type of vegetation whose overstory is dominated by tall trees, appears to be subject to greater frequency of use than expected for firewood (i.e., *Inga eriocarpa* Benth., *Salix humboldtiana* Willd., *Croton draco* Schlecht., and *Xylosma velutinum* [Tulasne] Triana & Planchon) than for other vegetation types except OF. Contrary to expectation, species from Gallery Forest do not appear to be subject to use for construction purposes.

Cloud Forest is one of the most diverse and highly endangered vegetation types in Mexico; its conservation is of high priority for the SMBR. The SMBR's Cloud forest does provide a notable abundance of edible plant products (e.g., *Prunus serotina* Ehrh. ssp. *capulli* [Cav.] McVaugh, *Rubus adenotrichos* Schlecht., *Smilax moranensis* Mart. & Gal., and *Crataegus pubescens* [H.B.K.] Steud.).

Pine-oak Forests cover a large part of the SMBR's area. Species present in POF provide a relatively higher number of reports of medicinal use than species occurring in other vegetation types.

Tropical Deciduous Forest does not appear to provide materials suitable for construction purposes. This is not surprising knowing that the arboreal species characteristic of this type of vegetation rarely exceed 7 m. TDF does, however, provide a relative abundance of species utilized for medicinal purposes (e.g., *Vitex mollis* H.B.K. f. *iltisii* Moldenke, *Anoda cristata* [L.] Schlecht., *Plumbago scandens* L., *Guazuma ulmifolia* Lam.).

The focus of use in certain vegetation types is not totally unanticipated but may contradict the apparent taxonomic focus discussed earlier. In fact, it seems likely that focused use in these vegetation types might in fact be a reflection of relative taxonomic abundances, e.g., Oak Forest, dominated by three to five species of oaks, records uses focused on wood; Tropical Deciduous Forest with its abundance of Leguminosae, Euphorbiaceae, and Anacardiaceae provides a myriad of medicinal species. While floristic composition is undoubtedly a consideration in characterizing focus of use, very likely other factors should be considered in the future to fully understand why, for example, Cloud Forest provides an abundance of edible plant products (from a wide range of families) and Tropical Deciduous Forest is the focus of medicinal plant product extraction.

Are important species subject to overexploitation?—Focusing on the how, where, and what of plant resource use has been an over-riding concern of our research in the SMBR. This is due to the need to detect excessive use of plant species in order to identify which, if any, might require management alternatives to ensure that the species do not become endangered by overuse. Thus we sought a measure of relative importance or intensity of use to detect species whose importance might be adversely affected by human use.

Relative ethnobotanical importance of plant species has been estimated for various reasons by a variety of methods. Prance et al. (1987) derived relative importance values of families by assigning weights (more important versus less important) to general use categories such as edible or construction, and combining these weights with the number of times (i.e., different plant parts) a plant was cited as useful. Johns et al. (1990) calculated consensus values for medicinal species based on the number of informants who employed a given species in the treatment of the same illness and on the species' relative abundance. While not all

TABLE 3.—Twelve species with the greatest number of reports of use in the Sierra de Manantlan Biosphere Reserve's ethnobotanical inventory.

Species	Distribution and Habitat[1]	Reports of Use	Informants Reporting Use	Communities Reporting Use	Types of Use	Parts Used
Guazuma ulmifolia	W,D,TF[1]	96	33	6	6	8
Quercus magnoliifolia	W,N,OF	84	18	3	7	5
Quercus gentryi	L,N,POF	82	25	3	6	6
Vitex mollis	W,C,TF	68	28	7	5	8
Enterolobium cyclocarpum	W,D,TF	67	17	4	9	8
Psidium guineense	W,N,TF	53	16	3	7	5
Byrsonima crassifolia	W,C,?	50	23	5	7	7
Casearia corymbosa	W,D,TF	46	24	5	5	5
Ficus insipida	W,D,TSF	45	24	5	10	7
Inga eriocarpa	W,D,OF	45	20	6	9	7
Quercus elliptica	W,N,OF	43	10	2	6	4
Inga laurina	W,N,TSF	36	12	3	7	4

[1] Distribution and habitat: W = widespread, L = local; D = disturbed habitat, N = natural habitat, C = cultivated/disturbed ground; OF = Oak Forest, POF = Pine-Oak Forest, TF = Tropical Deciduous and Subdeciduous Forests, TSF = Tropical Subdeciduous Forest.

species demonstrating high consensus values in their study were among the most frequently utilized, the majority of widely used species did have high consensus values. In this case consensus and frequency of use appear to be related. Turner (1988: 275–276, 278) calculated an index of cultural significance as a product of weights, each assigned according to the plant's quality of "use" based on the plant's cultural role in terms of its contribution to human survival, combined with an estimate of intensity of use and a scaled value of exclusivity of use. This index is a subjective but systematic attempt to measure relative importance of plant species. Phillips and Gentry (1993a, 1993b) developed an index, overall use value, based on the sum of the number of different uses reported for a species by an informant. This index is based on the number of times each informant saw a species and reported its use, summed over all informants, and divided by the total number of informants. These authors demonstrate that a species will have a high chance of being useful if it is large, a tree, has a high population density, is common, or grows fast (Phillips and Gentry 1993b).

We employ a similar rational in assessing relative importance but separately list as indicators of importance the number of reports of use, the number of different parts utilized and distinct uses given each species, and the number of informants who employ a given species, as well as the number of different communities in which the species is recognized as useful (Table 3). As might be expected, in many cases the species most often cited as useful are the same as those for which the greatest variety of uses are reported; considering all taxa reported as useful, the number of reports and number of uses are correlated ($r^2 = .48$, $p < .001$). Independent of this relationship, however, 12 species of the total 365 (see Table 3, Appendix A) present a significantly higher number of reports of use than the remaining 353, that is, their number of reports is greater than 2 standard deviation units from the mean (see Fig. 2, Appendix A).

Frequency of report of use is probably related to abundance and availability (c.f. Johns et al. 1990; Phillips and Gentry 1993b). Hence it is not totally unexpected that five of these 12 species thrive in disturbed habitats (see Table 3) such as along paths in forests, that two are disturbed ground species that are frequently cultivated, and that the five naturally occurring species are widely distributed in the Oak, Pine-Oak, or Tropical Forests of the SMBR, suggesting that tolerance to human disturbance and/or a wide habitat preferences *might* make certain species predisposed to human utilization (c.f. Bye and Linares 1983).

How consistent are informants in reporting uses of plant species?—Examination of the relative importance of plant species to the population of the SMBR also calls attention to the relatively large number of species that are considered useful by a single informant for a single purpose (Fig. 2). Considering all taxa designated as useful and all categories of use, 21% of these species (78 of 365) are cited as useful by a single informant. The percentage of species reported only once nearly doubles if we consider only those species used medicinally (85 of 221). This general trend has been noted at the level of community as well. In a typical visit to one of the nine communities, 55% of the species (64 of 116) employed in interviews were recognized as useful and 28% percent (18 of 64) of these were identified as useful by only one informant. Thus it would appear that at most 80% of the species cited as useful are subject to use by more than one individual. Neither the cultural or biological basis of this pattern, nor its significance, is currently understood, but we hypothesize that the apparently large proportion of idiosyncratic knowledge (more than 20%) existing among this population may be due either to experimentation or to the waning of traditional indigenous knowledge among the informants of these mestizo communities (see Bernard et al. 1984).

SUMMARY AND CONCLUSIONS

Use of the plant resources in the SMBR appears to be a function of relative taxonomic abundances of the area's flora. Floristically common plant families are represented by a greater number of species listed as useful. This is probably not uncommon in other areas of the world, though it has not, to our knowledge, been reported elsewhere in the ethnobotanical literature.

The forms of use attributed to plant species in different types of vegetation are not uniform in the Sierra de Manantlan. While it might be expected that vegetation types that do contain woody or arboreal species are preferred sites for the collection of firewood or construction materials, the results discussed above suggest that differences exist in the use of species from five vegetation types: reports of use that focus on the wood of species from Oak and Gallery Forests are more numerous than from other vegetation types, Tropical Deciduous Forest and Pine Oak Forest species are more frequently identified as useful for medicinal purposes, and Cloud Forest appears to receive greater attention for its edible plant products than do the other vegetation types. Whether these tendencies

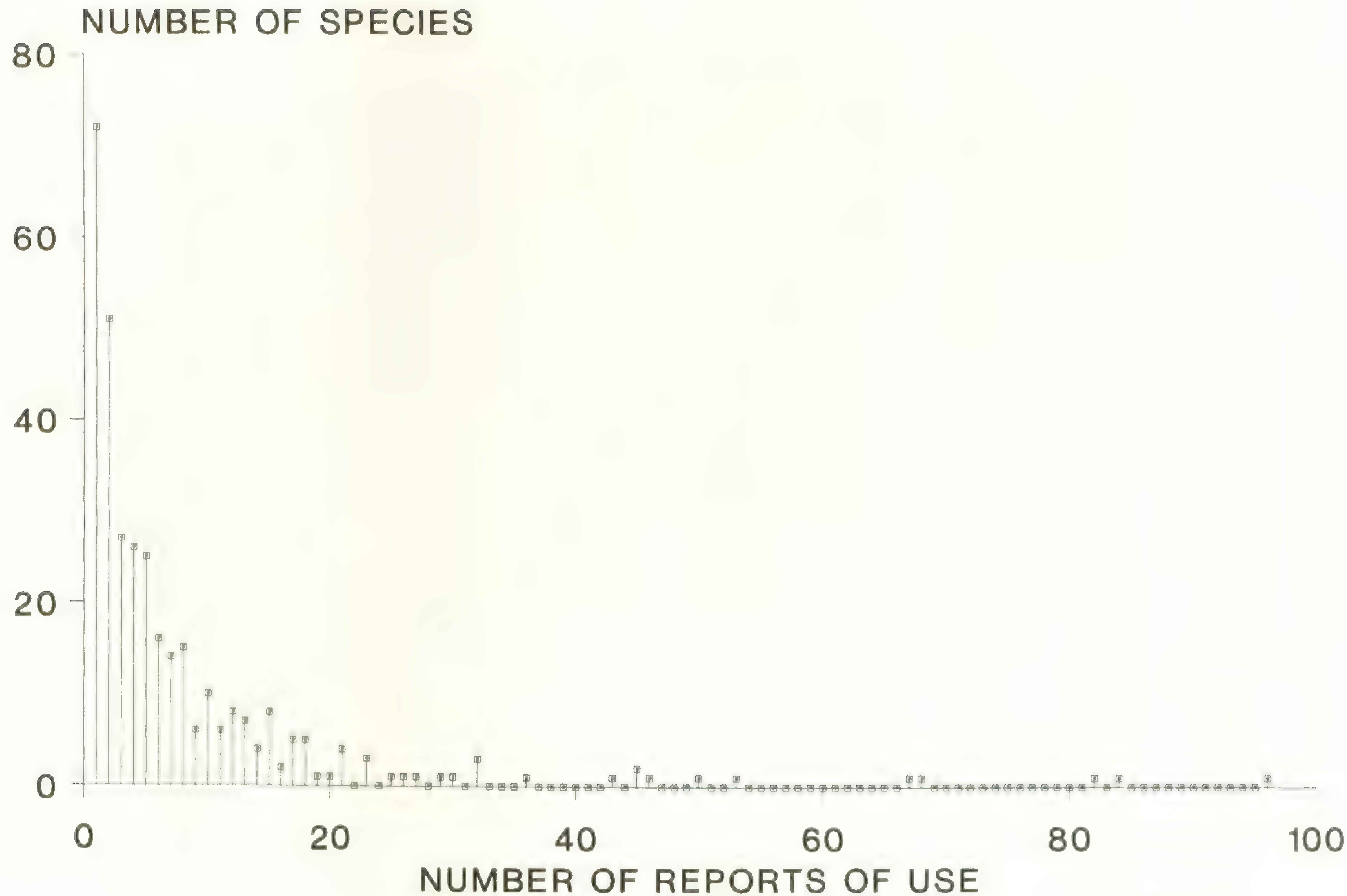

FIG. 2.—Abundance diagram showing the number of reports of use of all useful species (1988–1990). Species exhibiting a significantly ($Z > 2.1$, $P < .05$) large number of reports of use are those numbering more than 36 (see Appendix A). This figure also depicts the relatively large number of species that are utilized for one purpose and by only one informant (Appendix A).

are due to a deliberate use of species found in these vegetation types, to the relative proximities of these vegetation types to habitation areas and the greater familiarity of informants with them, or to other sampling biases have not been tested.

Plants that have significantly more reports of use are species with naturally widespread distributions or species that thrive in disturbed habitats. Humans might more frequently come into contact with such species, which would increase the possibility of experimentation. Once having been found suitable, the species would be included into the local ethnobotanical inventory and knowledge of its suitability widely disseminated. Widespread experimentation might then follow and lead to an even greater number of uses.

While corroboration of a particular species' use by more than one informant was hypothesized at the outset, the seemingly large proportion of species reported as useful by a single informant was an unanticipated result of our research. The large number of informants that we have interviewed could be one source of the seemingly large amount of idiosyncratic knowledge; that is, many informants might be expected to have a proportionately more varied knowledge of the local flora's use than fewer informants. Alternatively, it is possible that the relatively large number of uniquely utilized species is due to identification errors by the informants. We have recorded such instances—where an informant refers to a specimen by a common name frequently applied to another species—but these seem rare and probably would not account for the 20% uniquely utilized species. Our informants appear to prefer to err on the conservative side by admitting not to know a plant or its use instead of incorrectly identifying it. One final consideration is also plausible: that a large proportion of idiosyncratic knowledge is typical (J. Alcorn, personal communication 1993). This possibility is supported by recognizing that each person has individual needs and that such individuality might require that only a small fraction of the total knowledge about a communities surroundings be shared among its inhabitants. These results lead us to suggest that conservation of biological diversity in the SMBR might provide context for continued experimentation and maintenance of traditional uses, hence, to the conservation of traditional empirical knowledge. The manner in which knowledge about use of local plant resources is distributed suggests that programs to modernize these communities that have homogenizing effects on information flow will displace opportunities for experimentation and for the transgenerational transmission of knowledge. Many informants appear to know much about a few species and a little about a large number of species. If we permit such modernization to occur without assuring opportunities to pass along this knowledge, or if we permit these forests and the wealth of species they contain to be destroyed, the rich lore and erudition possessed by these people will surely disappear.

NOTE

[1]Voucher specimens collected during this research are deposited in the herbarium of the Instituto Manantlan de Ecología (ZEA) and the University of Wisconsin-Madison (WIS).

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APPENDIX A

REPORTS	SPECIES	REPORTS	SPECIES
1	*Bunchosia mcvaughii*	1	*Salix microphylla*
1	*Trichilia hirta*	1	*Tinantia longipedunculata*
1	*Arachys hypogaea*	1	*Psacalium peltigerum*
1	*Euphorbia ariensis*	1	*Plumeria rubra*
1	*Hura polyandra*	1	*Acacia angustissima*
1	*Croton wilburi*	1	*Styrax sp.*
1	*Euphorbia indivisa*	1	*Chamaecrista punctulata*
1	*Oxalis hernandezii*	1	*Coursetia mollis*
1	*Penstemon roseus*	1	*Spigelia scabrella*
1	*Pseudobombax ellipticum*	1	*Phoradendron reichenbachianum*
1	*Calophyllum brasiliense*	1	*Rhytidostylis gracilis*
1	*Eucalyptus sp.*	1	*Antigonon flavescens*
1	*Rhus barclayi*	1	*Dalea obreniformis*
1	*Solanum torvum*	1	*Lysiloma tergeminum*
1	*Eryngium nasturtiifolium*	1	*Roripa nasturtium-aquaticum*
1	*Guarea glabra*	1	*Raphanus raphanistrum*
1	*Citrus limon*	1	*Opuntia puberula*
1	*Caesalpinia mexicana*	1	*Randia aculeata*
1	*Cynoglossum pringlei*	1	*Tournefortia mutabilis*
1	*Quercus castanea*	1	*Dyschoriste hirsutissima*
1	*Piper amalago*	1	*Salvia iodantha*
1	*Asclepias angustifolia*	1	*Arceuthobium globosum*
1	*Porophyllum ruderale*	1	*Acacia macilenta*
1	*Heliotropium indicum*	1	*Anoda acerifolia*
1	*Chusquea liebmannii*	1	*Pavonia pleuranthera*
1	*Paspalum clavuliferum*	1	*Malvaviscus arboreus*
1	*Digitaria horizontalis*	1	*Physalis nicandroides*
1	*Rauvolfia canescens*	1	*Hippocratea volubilis*
1	*Tridax procumbens*	1	*Ficus morazaniana*
1	*Salvia sessei*	1	*Sida aggregata*
1	*Baccharis pteronioides*	1	*Senna occidentalis*

REPORTS	SPECIES
1	*Conostegia volcanalis*
1	*Magnolia iltisiana*
1	*Chamissoa altissima*
1	*Crescentia alata*
1	*Talauma mexicana*
1	*Tournefortia densiflora*
1	*Sambucus mexicana*
1	*Iresine celosia*
1	*Buddleia parviflora*
2	*Salix bonplandiana*
2	*Vigna lozanii*
2	*Heimia salicifolia*
2	*Hedyosmum mexicanum*
2	*Piper rosei*
2	*Phoradendron amplifolium*
2	*Dalea versicolor*
2	*Fleischmannia arguta*
2	*Leucocarpus perfoliatus*
2	*Croton draco*
2	*Citrus aurantium*
2	*Martynia annua*
2	*Senna foetidissima*
2	*Hypoxis mexicana*
2	*Trichilia americana*
2	*Bursera grandifolia*
2	*Scoparia dulcis*
2	*Bursera fagaroides*
2	*Acacia riparia*
2	*Bursera bipinnata*
2	*Paullinia tomentosa*
2	*Senna fruticosa*
2	*Picramnia antidesma*
2	*Zanthoxylum arborescens*
2	*Eugenia jambos*
2	*Passiflora filipes*
2	*Lippia umbellata*
2	*Croton fragilis*
2	*Echinopterys eglandulosa*
2	*Nectouxia formosa*
2	*Daucus montanus*
2	*Commelina erecta*
2	*Solanum brachystachys*
2	*Xanthosoma robustum*
2	*Crusea longiflora*
2	*Gnaphalium canescens*
2	*Sapium pedicellatum*
2	*Amaranthus spinosus*
2	*Sonchus oleraceus*
2	*Triumfetta gonophora*
2	*Melochia adenodes*

REPORTS	SPECIES
2	*Chryosophylla nana*
2	*Hamelia xorullensis*
2	*Cestrum lanatum*
2	*Ceiba aesculifolia*
2	*Crataegus pubescens*
2	*Curatella americana*
2	*Cyperus hermaphroditus*
2	*Rhus pachyrrhachis*
2	*Cissampelos pareira*
2	*Eleusine indica*
3	*Iresine interrupta*
3	*Sapium macrocarpum*
3	*Calathea sp.*
3	*Populus guzmanantlensis*
3	*Rhychosia precatoria*
3	*Cayaponia racemosa*
3	*Muntingia calabura*
3	*Cryptostegia grandiflora*
3	*Passiflora podadenia*
3	*Lycopersicon esculentum var. leptophyllum*
3	*Licaria triandra*
3	*Baccharis trinervis*
3	*Citrus aurantifolia*
3	*Jacaratia mexicana*
3	*Aristolochia tequilana*
3	*Xylosma velutinum*
3	*Ixophorus unisetus*
3	*Agonandra racemosa*
3	*Allium glandulosum*
3	*Struthanthus interruptus*
3	*Satureja macrostema*
3	*Senecio sanguisorbae*
3	*Chenopodium graveolens*
3	*Euphorbia heterophylla*
3	*Jatropha mcvaughii*
3	*Cucumis anguria*
3	*Citrullus vulgaris*
4	*Verbesina greenmanii*
4	*Karwinskia humboldtiana*
4	*Crotalaria longirostrata*
4	*Calliandra houstoniana*
4	*Petiveria alliacea*
4	*Nicotiana glauca*
4	*Cissus sicyoides*
4	*Pithecellobium lanceolatum*
4	*Ipomoea bracteata*
4	*Heteropterys laurifolia*
4	*Machaerium salvadorense*
4	*Cnidoscolus autlanensis*

APPENDIX A (continued)

REPORTS	SPECIES	REPORTS	SPECIES
4	*Achyranthes aspera*	6	*Alnus jorullensis*
4	*Wigandia urens*	6	*Acacia cochliacantha*
4	*Calathea soconuscum*	6	*Bursera simaruba*
4	*Acacia farnesiana*	6	*Chamaedorea pochutlensis*
4	*Crataeva palmeri*	6	*Hamelia patens*
4	*Cordia spinescens*	6	*Cladocolea loniceroides*
4	*Ficus cotinifolia*	6	*Cyrtocarpa procera*
4	*Bauhinia divaricata*	7	*Anthurium halmoorei*
4	*Psidium sartorianum*	7	*Xylosma flexuosum*
4	*Caesalpinia pulcherrima*	7	*Maranta arundinacea*
4	*Quercus glaucescens*	7	*Bromelia plumieri*
4	*Calea urticifolia*	7	*Bumelia cartilaginea*
4	*Annona reticulata*	7	*Croton draco*
4	*Govenia superba*	7	*Argemone ochroleuca*
5	*Muhlenbergia speciosa*	7	*Fuchsia fulgens*
5	*Thevetia ovata*	7	*Lippia dulcis*
5	*Paullinia sessiliflora*	7	*Pereskiopsis aquosa*
5	*Senna atomaria*	7	*Amphipterygium adstringens*
5	*Portulaca oleracea*	7	*Lasianthaea ceanothifolia*
5	*Stemmadenia tomentosa*	7	*Tillandsia usneoides*
5	*Parathesis villosa*	7	*Begonia balmisiana*
5	*Dryopteris rosea*	8	*Randia armata*
5	*Rhipidocladum racemiflorum*	8	*Nectandra glabrescens*
5	*Manihot intermedia*	8	*Sida barclayi*
5	*Panicum hirticaule*	8	*Amaranthus hybridus*
5	*Phoebe pachypoda*	8	*Quercus laeta*
5	*Tagetes lucida*	8	*Physalis philadelphica*
5	*Witheringia stramonifolia*	8	*Juglans olanchana*
5	*Randia tetracantha*	8	*Ficus padifolia*
5	*Solanum lanceolatum*	8	*Hyptis albida*
5	*Marrubium vulgare*	8	*Croton ciliato-glandulifera*
5	*Pisonia aculeata*	8	*Riccinus communis*
5	*Sommera grandis*	8	*Verbena carolina*
5	*Cestrum aurantiacum*	8	*Morisonia americana*
5	*Cenchrus ciliaris*	8	*Spondias purpurea*
5	*Oreopanax xalapensis*	8	*Hintonia latiflora*
5	*Sida rhombifolia*	9	*Albizia tomentosa*
5	*Melia azedarach*	9	*Buddleia sessiliflora*
5	*Alvaradoa amorphoides*	9	*Syngonium neglectum*
6	*Clethra hartwegii*	9	*Vernonia capreifolia*
6	*Jaltomata procumbens*	9	*Agave maximiliana*
6	*Vitis berlandieri*	9	*Dahlia coccinea*
6	*Thouinia serrata*	10	*Piper aduncum*
6	*Dendropanax arboreus*	10	*Tithonia tubaeformis*
6	*Parthenium hysterophorus*	10	*Cuphea llavea*
6	*Combretum fruticosum*	10	*Quercus salicifolia*
6	*Pteridium arachnoideum*	10	*Sideroxylon capiri*
6	*Guardiola tulocarpus*	10	*Brosimum alicastrum*

REPORTS	SPECIES	REPORTS	SPECIES
10	*Margaritaria nobilis*	17	*Phytolacca icosandra*
10	*Smilax moranensis*	17	*Quercus peduncularis*
10	*Porophyllum punctatum*	17	*Cecropia obtusifolia*
10	*Salix humboldtiana*	17	*Quercus obtusata*
11	*Quercus rugosa*	17	*Solanum candidum*
11	*Cercocarpus macrophyllus*	18	*Ficus pertusa*
11	*Bixa orellana*	18	*Calliandra laevis*
11	*Pithecellobium acatlense*	18	*Symplocos prionophylla*
11	*Aristolochia taliscana*	18	*Quercus resinosa*
11	*Crotalaria mollicula*	18	*Asclepias curassavica*
12	*Ziziphus mexicana*	19	*Psidium guajava*
12	*Celtis iguanaea*	20	*Lantana camara*
12	*Couepia polyandra*	21	*Casimiroa watsonii*
12	*Coccoloba barbadensis*	21	*Quercus acutifolia*
12	*Coffea arabica*	21	*Eugenia culminicola*
12	*Lysiloma microphyllum*	21	*Ternstroemia lineata*
12	*Celastrus pringlei*	23	*Clethra mexicana*
12	*Acacia macracantha*	23	*Styrax argenteus*
13	*Acacia hindsii*	23	*Guaiacum coulteri*
13	*Comarostaphylis discolor*	25	*Siparuna andina*
13	*Dorstenia drakena*	26	*Ardisia compressa*
13	*Rubus humistratus*	27	*Casearia arguta*
13	*Vitex pyramidata*	29	*Lysiloma acapulcense*
13	*Datura stramonium*	30	*Juglans major*
13	*Rubus adenotrichos*	32	*Solanum americanum*
14	*Solanum madrense*	32	*Prunus serotina*
14	*Lepechinia caulescens*	32	*Acacia pennatula*
14	*Verbesina sphaerocephala*	36	*Inga laurina*
14	*Plumeria obtusa*	43	*Quercus elliptica*
15	*Pithecellobium dulce*	45	*Ficus insipida*
15	*Miconia albicans*	45	*Inga eriocarpa*
15	*Trichospermum mexicanum*	46	*Casearia corymbosa*
15	*Cochlospermum vitifolium*	50	*Byrsonima crassifolia*
15	*Plumbago scandens*	53	*Psidium guineense*
15	*Opuntia fuliginosa*	67	*Enterolobium cyclocarpum*
15	*Annona purpurea*	68	*Vitex mollis*
15	*Astianthus viminalis*	82	*Quercus gentryi*
16	*Ardisia revoluta*	84	*Quercus magnoliifolia*
16	*Anoda cristata*	96	*Guazuma ulmifolia*

BOOK REVIEW

Crops and Man (2nd edition). Jack R. Harlan. Madison, Wisconsin: American Society of Agronomy, Crop Science Society of America, 1992. Pp. xiii, 284. $34.00. ISBN 0–89118–032–X.

It is a pleasure to see this second edition of Harlan's excellent treatise on crops and their influence on human history. It is more than a text book, but it might serve in many courses in economic botany: it is a philosophical understanding of humans' dependence on the Plant Kingdom. As expressed by the foreword written by two outstanding agronomists: "As Dr. Harlan taught us in the first edition . . . and reinforces in this second edition, crops have shaped the evolution of human societies." And as Harlan himself states: "In the second edition, I have tried to bring various features of crop evolution up-to-date, but something becomes obsolete every day and every year. By the time this version is printed, some statements will be out of date and some views may be reversed. . . . There would be little fascination in science if it were static. For better or worse, I offer this version of *Crops and Man*."

The book is divided into 12 chapters which indicate the wide treatment of the story of plants and human affairs: Prologue—the Golden Age; Views on Agricultural Origin; What is a Crop?; What is a Weed?; Classification of Cultivated Plants; Dynamics of Domestication; Space, Time and Variation; the Near East; Indigenous African Agriculture; the Far East; the Americas; Epilogue—Who's in Charge here? There is a bibliography of relevant titles for each chapter and a detailed subject index.

The publication is in easily readable type, and the price is modest and within the range of student ability to purchase if it is used as a text book. With the increasing interdisciplinary approach to the study of plants and man, this well balanced contribution represents a welcome addition to the complex understanding of man's dependence on the vegetation of the world.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138

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CHOICE OF FUEL FOR BAGACO STILLS HELPS MAINTAIN BIOLOGICAL DIVERSITY IN A TRADITIONAL PORTUGUESE AGRICULTURAL SYSTEM

GEORGE F. ESTABROOK
The University of Michigan Herbarium
and The Department of Biology
Ann Arbor, MI 48109-1057 USA

ABSTRACT.—The present vegetation on the shale hills of central interior Portugal is called *mato.* It consists of shrubs mostly in the heath (Ericaceae) and bean (Fabaceae) families. Farmers in this region harvest *mato* and, whenever they plant a crop, bury it in their cultivated plots to make the soil fertile. Farmers cut *mato* at ground level, leaving the woody root crown (caudex) just at ground level. *Mato* plants regrow from these caudices. They are harvested again every four years. In addition, the woody caudex of primarily one species, *Erica arborea,* is occasionally dug up and burned to distill a brandy-like liquid, called *bagaco,* from the mass of grape skins, seeds, and pulp that is left over after the fermented wine is drawn off. Interviewing and observing farmers revealed important uses of many different *mato* species. Sampling *mato* vegetation from areas regenerating from four to 30 years showed that *E. arborea* is competitively dominant and capable of reducing *mato* species diversity. The slow, cool burning qualities of any caudex would be adequate for a still fire, and farmers occasionally do use different species for this. However, the practice of occasionally removing the caudex of the competitive dominant for still fires serves to maintain the variety of useful species in the *mato.* The somewhat unfounded explanation that *E. arborea* caudex is best for still fires results every fall in appropriate and timely activity, and as such may serve better than would a more ecological, long-term explanation for the same practice.

RESUMO.—O mato natural das formaçōes xistosas do centro interior de Portugal é formado por arbustos principalmente das famílias Ericaceae e Fabaceae. Os agricultores daquela regiāo cortam o mato e, sempre que fazem uma nova cultura, enterram-no nas suas hortas para melhorar a fertilidade do solo. Os agricultores cortam o mato rente à superficie da terra, deixando assim as suas raizes lenhosas logo abaixo da superficie. O mato regenera-se a partir dessas raízes e é cortado de novo todos os quatro anos. Contudo, também as raízes lenhosas de *Erica arborea* sāo por vézes arrancadas e queimadas na distilaçāo do bagaço. Foram identificadas várias utilizaçoes importantes de muitas espécies diferentes de mato. A amostragem da vegetaçaō do mato das áreas em regeneraçāo durante quatro, oito, e trinta anos mostrou que a *Erica arborea* é a dominante competitiva e é capaz de reduzir a diversidade das espécies no mato. Embora para um fogo de destilacao sejam adequadas as características de queima lenta e de baixa temperatura de qualquer raiz, a prática existente de arrancar as raízes só da dominante competetiva para queimar serve também para manter no mato a diversidade de especies úteis. A preferência de certa forma arbitrária pela queima da raiz da *E. arborea* em fogo lento proporciona faz cada outono uma lembrança temporal para uma atividade apropriada e desta forma pode servir melhor do que uma de longo têrmo, mais ecológoca.

RÉSUMÉ.—La végétation naturelle du mato des collines de schiste du centre intérieur du Portugal consiste d'arbustes, dont la plupart font partie des familles Ericaceae et Fabaceae. Les agriculteurs de cette région moissonnent le mato et, quand ils sement une nouvelle culture, ils en enterrent de grandes quantités pour engraisser le terrain. Les agriculteurs coupent le mato à quelques centimètres au dessus du sol, en laissant les racines épaisses et ligneuses juste en dessous du sol, desquelles poussent de minuscules racines qui s'enfoncent dans la pierre pour des dizaines de mètres afin de faire monter des éléments nutrifs et de l'eau. Le mato repousse de ses racines épaisses et ligneuses et est moissoné de nouveau tous les quatre ans. Parfois, les racines d'une espèce, *Erica arborea,* sont arrachées et brûlées pour la distillation du bagaco. Des entrevues avec des agriculteurs et des observations des agriculteurs ont révélé de divers usages importants de plusieurs espèces de mato. La végétation mato des locaux de quatre, huit, et trente ans de régénération a démontré que *E. arborea* est le dominateur compétitif et est capable d'abaisser la diversité d'espèces dans la végétation mato. Bien que les racines ligneuses de n'importe quelle espèce de mato pourraient servir à faire un feu de distillation parce qu'elles brûlent lentement et pas trop fort, le fait qu'on n'arrache que les racines du *E. arborea* pour cet usage sert à maintentir la diversité d'espèces utiles du mato.

INTRODUCTION

An important reason to study a traditional agricultural system where it has supported a population for hundreds of years is to try to determine, from an ecological point of view, how various aspects of its technology contribute not only to the productivity but also to the sustainability of the system. Because traditional agricultural technology is usually developed empirically over generations, ecological explanations for some of the very specific, but seemingly arbitrary, practices are not always apparent in the oral tradition of the contemporary population, especially when these practices are more related to long-term sustainability than to short-term productivity. It is remarkable how the persistent empiricism of human beings, struggling to make their living in nature, results in practices that make ecological sense, even though they may be codified in ritual or explained in ways that seem superficial or not compelling ecologically. Indeed, local practitioners may have concepts, equally justifiable but very different from those of academics, of what constitutes a useful explanation. This study of a traditional Portuguese agricultural system provides several examples, one of which is an ecological explanation for what initially seemed an arbitrary but nonetheless very specific fuel choice for the brief annual task of distilling a brandy-like liquid, called *bagaco,* from the mass of grape skins, seeds, and pulp that is left over after wine has been made.

In rural villages in Portugal, grapes are harvested in the fall and made into wine. After the fermented wine has been drained from the fermenting vat and casked, alcohol is distilled from the leftover grape skins and pulp by heating them gently over a cool fire. The distillate, called *bagaco* in some regions, is about 40% ethanol and 60% water, plus traces of higher alcohols and impurities. A little of it is drunk, but traditionally most of it is used as a household chemical for treating minor injuries, sterilizing, and cleaning.

The western and southern foothills of the Serra da Estrela (Fig. 1.), the highest range of mountains in Portugal, are made predominantly of Precambrian shale, with occasional quartzite intrusions. This shale easily erodes, producing very infertile clay soil of resedimented ilites high in iron and with low available water capacity (Azevedo and Ricardo 1973), and also producing very deep, steep-sided valleys that alternate with these quartzite peaks and ridges. Paths over the steep, crumbly rock offer poor footing. There is little or no rain in the summer months when temperatures often exceed 30° C. During the winter, temperatures are near 0° C at dawn, rising to near 15° C during the day. Frequent rains raise impassible torrents in the valley bottoms and erode from the hillsides what little soil may have accumulated during the past year.

Human beings have been culturally and economically active in Portugal for thousands of years. However, low overall population densities before the sixteenth century, abundant nearby land that is more level and fertile, the harshness and infertility of these foothills, and the establishment there of Catholic church parishes not before the fourteenth and fifteenth centuries, together suggest that this area had remained largely unoccupied until the fourteenth or fifteenth centuries. Although a discussion of the biological, social, political, and economic factors that may have motivated people to attempt to inhabit this region in the fourteenth century are beyond the scope of the work reported here, it seems plausible that many of the current practices directly observed in this study are based on techniques that have enabled people to inhabit successfully this harsh and infertile area since the fifteenth century. These techniques, and the self-sufficient village economies they supported, have largely disappeared from Portugal now. Refer to Pearson et al. (1987) for discussions of traditional Portuguese agricultural technology, and of the recent social, political, economic, and technological changes that have contributed to its disappearance.

All the details of the agricultural technology that enabled people to thrive in this marginal environment are beyond the scope of the work presented here, but a brief overview of the techniques used to create and maintain soil fertility is relevant. Cultivation of crops occurs on the steep hillsides in narrow terraces that are constructed of dry stone walls that hold the soil level. In winter, these terraces collect soil and water from above and help control water erosion. In the dry summer they facilitate irrigation by streams of water that trickle from slightly rising caves that have been dug above them about 10 m into the soft shale rock, where the shale is still wet from the rains of the past winter. To create fertility in the infertile clay soil in these terraces, large quantities of organic matter are collected, as brush from the hill tops, and mixed with the soil.

Shrubs, mostly heaths and legumes, make up the scrubby vegetation type called *mato,* which occurs in central-interior Portugal on the tops and upper slopes of shale hills. The *mato* on any given place is cut near ground level every four years. *Mato* is cut from somewhere, two or three times a week, all year long, and removed to the village, where it is spread over the floor of indoor, ground level rooms that house goats. After two to four weeks, this old *mato* is removed and replaced with freshly cut *mato.* After its removal, the old cut *mato* is piled up,

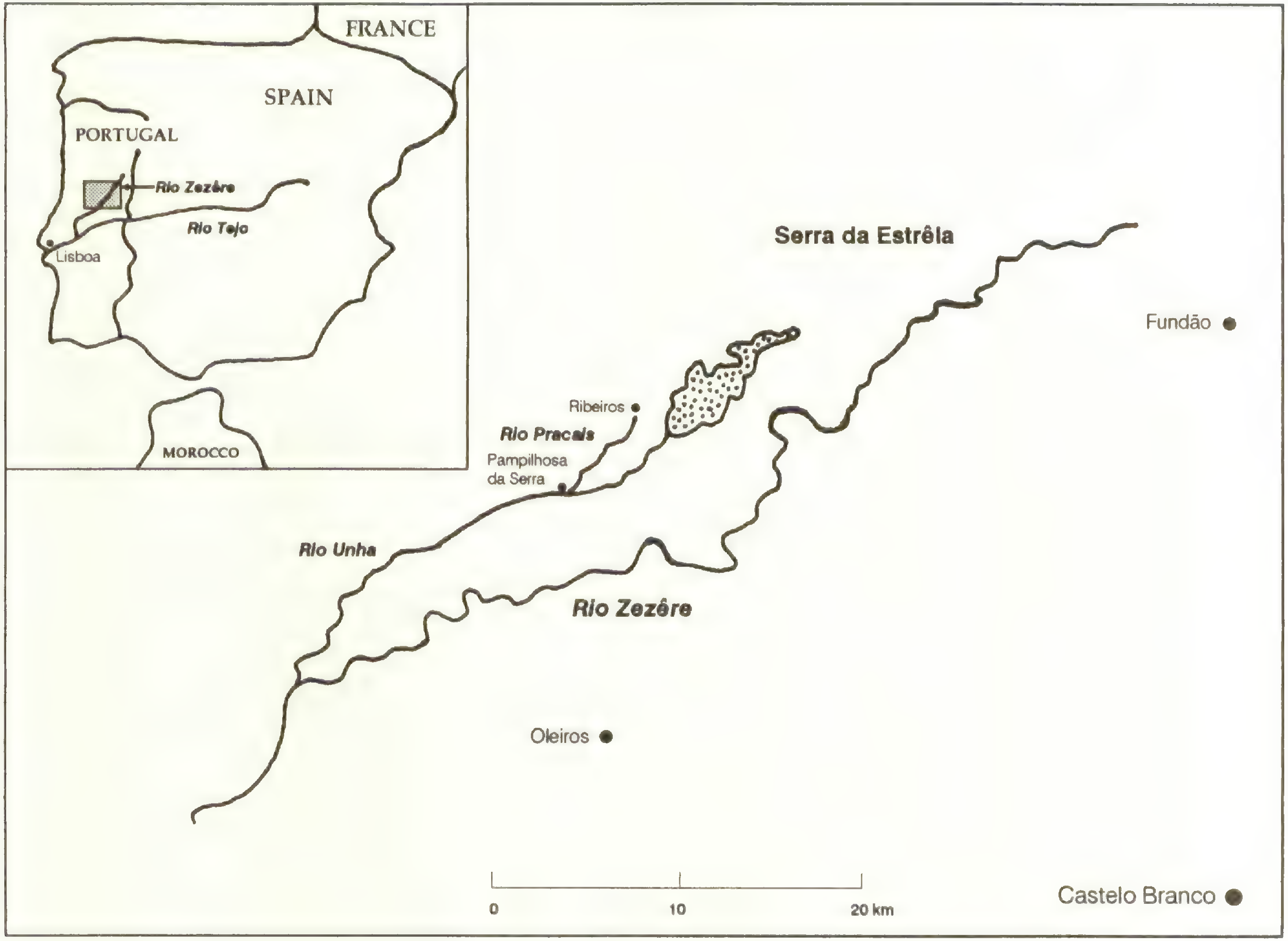

FIG. 1.—Map showing the location of the village of Ribeiros, at the headwaters of the Rio Pracais in the southwest foothills of the Serra da Estrela, Portugal. At the town of Pampilhosa da Serra, The Rio Pracais meets the Rio Unha, a tributary of Rio Zezere in the Rio Tejo drainage. The stippled area is an empoundment. Region of map is approximately the rectangle shown on the inserted outline of Iberia.

TABLE 1.—Principle *mato* species of the region studied.

Scientific name	Common name	Family	Collector Number[1]
Erica arborea L.	*mato negral*	Ericaceae	404
Ulex minor Roth	*tojo branco*	Fabaceae	407
Genista tricanthos Brot.	*tojo negro*	Fabaceae	406
Erica cinerea L.	*urze*	Ericaceae	403
Halimium ocymoidies (Lam.) Wilk. in Wilk & Lange	unknown	Cistaceae	408
Lithodora diffusa (Lag.) I.M.Johnson	unknown	Boraginaceae	401
Caluna vulgaris (L.) Hull	*margarise*	Ericaceae	405
Erica umbellata L.	*negrela*	Ericaceae	402
Chamaespartum tridentatum (L.) P. Gibbs	*carqueja*	Ericaceae	400

[1]All voucher specimens were collected by G. F. Estabrook and are housed at MICH.

and at planting time, buried in the soil of the cultivated terraces. Cut *mato*, enriched by goats, is the source of virtually all soil-borne plant nutrients, and much of the soil's available water capacity.

After a plant is cut, it regenerates from a woody root crown (caudex) just below the ground surface. These caudices ramify into an extensive system of fine roots, which penetrate for meters into the soft shale rock below. Although virtually all *mato* species regenerate in this way, the woody caudex of essentially only one, *Erica arborea*, is dug out and burned to distill *bagaco*. The caudex of *E. arborea* burns cool and slow, thus distilling the *bagaco* with a minimum of impurities and water. Pine *(Pinus pinaster)*, used inside the houses for cooking and warmth, would burn too hot, but any of the woody caudices of the *mato* species would burn cool and slow. Although the caudices of other mato species *are* occasionally used in conjunction with *E. arborea*, farmers clearly prefer *E. arborea* for still fires. Why principally just this one? They stated that it was used by their parents and grandparents, and that it is the best fuel for this task, but they never offered an explicit, functional or ecological explanation for their preference over other "roots."

Most of the principal *mato* species (Table 1) make distinct contributions, which this study will describe, to soil fertility and to other aspects of the local economy. Therefore, the maintenance of the species diversity of the *mato* is an important objective of this agricultural system. This study will also present species abundance data from plots of *mato* regenerating for differing numbers of years and subjected to different harvesting histories. These data show that *Erica arborea*, if not held in check, becomes the dominant species, and thus reduces species richness and diversity in the *mato*. The choice of the regeneration organ (the caudex) of *E. arborea* as a still fuel eliminates the domination of this species. Elimination of dominance maintains the species diversity in the *mato*, which contributes to the sustainability of this self-sufficient village economy. Grime

(1979) discusses in more detail competitive dominance and disturbance-mediated co-existence in stress tolerant plants.

It takes 9–10 ha of regenerating *mato* to supply enough organic matter to create fertility in 1 ha of cultivated terrace. It seems likely that the availability of *mato* may have begun to limit the amount of terrace under cultivation by the beginning of the nineteenth century or earlier. In this situation, all *mato* would have been managed for soil fertility, and thus cut every three or four years. Once the practice of removing a few *Erica arborea* caudices each fall was established, the potential for *E. arborea* to reduce or eliminate other valuable species would no longer be directly observed by the villagers. In the absence of these direct observations, a reason to remove every fall a few *E. arborea* caudices to burn in the brief task of distilling *bagaco* would ensure that the practice happened every year, and thus might serve the local economy better than would a more objectively founded, ecological explanation that did not require a specific action at a specific time.

MATERIALS AND METHODS

The principle area studied is the village group of Ribeiros, located in the Freguesia de Cabril, Concelho de Pampilhosa da Serra, Distrito de Coimbra, Portugal, at about north 40° 06' by west 7° 54'. The village is located near the center of this region of eroded shale foothills, among the branching streamlets (called *ribeiros,* hence the name) at the headwaters of the Rio Pracais, a stream that runs down a deep, steep-sided gully to the Unha river in the Rio Tejo drainage, as shown in Fig. 1. The elevation of the village is 750 m, with the hill tops and ridges rising 100–300 m above the village. Ribeiros is the modern name of the coalescence of three original settlements (Sobralinho, Melho, and Sanguasuga, located about 1 km apart but separated by deep stream gullies), which, judging from church records, was probably established in the late sixteenth century. It continued to grow steadily, and thrived in the nineteenth and first half of the twentieth centuries, reaching a population peak of approximately 300 in 1940, when the first road capable of carrying a motorized vehicle was built into the area to construct an empoundment (Fig. 1) to generate electric power. By the late 1940s, Ribeiros had begun to lose population rapidly, and by 1988 at the conclusion of this study there were some 25 residents, mostly over 60 years old. Refer to Caldas (1981), Serrao (1982), and Brettell (1986) for a discussion of possible reasons for the near universal demise of northern, interior Portuguese villages since the 1940s.

In the 1980s, preindustrial agricultural technology was still practiced, if incompletely, by some of the residents of the villages of the Pracais valley, where I visited briefly in 1980, 1983, and 1984. The steep hillsides surrounding Ribeiros are covered with terraces, some of which may have been originally built over 400 years ago when residents and place names in Ribeiros are first mentioned in church birth records. By the 1980s approximately half of these terraces had been abandoned and about 40% had been planted to apple, fig, and olive within the last decade or so by largely absent owners. The remaining 10% were still in cultivation, mostly in corn, bean, potato, and some rye. In terraces closer to the village, vegetables and herbs are grown. The *mato* is harvested at about one tenth the rate that it was 50 years ago when, according to residents, all terraces were planted with seeds. Because agricultural practices in the village are in decline, much of the *mato* on the surrounding hilltops had not been harvested for varying lengths of time, up to 30 or more years.

I lived in Ribeiros from August until December of 1987. Two married couples among the 21 permanent residents provided me with food and shelter, and introduced and endorsed me to the other residents. This endorsement was essential for any resident to speak freely with me. The residents consisted of eight married couples, no single men, and four to six women who were never married or were widows. Except for the wives of my hosts, the wives of the other six men were essentially not socially accessible to me. Three of the single women would talk readily and accept my help.

During the first two months of my fieldwork, I observed people at work, took samples of soil and vegetation, and with the help of a tape recorder and interpreter, learned the local dialect. During the last three months, I conducted informal interviews on demography, agricultural technology, and economic activities. Typically I spent half of each day talking either repeatedly to the same 13 accessible residents of Ribeiros, or to visitors to the village (nine occasions) or to residents of a nearby village (12 occasions). I talked with people usually as long as they would give me their attention, from a few minutes to often an hour or more. I asked the same things in many different ways on different days of the same people and also of different people. I found that whenever different people talked about the same technical subject, their representations were mutually consistent, never contradictory.

To determine and vouch *mato* species accurately, I collected plants in the *mato* near Ribeiros. These collections were identified at the herbarium of the Estacao Agronomica Nacional (LISE), in Oeiras near Lisboa, and named according to *Nova Flora de Portugal* (Franco 1971, 1984). Voucher specimens were deposited in this herbarium, and at The University of Michigan Herbarium (MICH).

To calculate the diversity and abundance of the species of plants in the *mato* from areas subject to different harvesting regimes, I collected samples of vegetation from four areas (referred to as Areas 1–4) in the *mato*-covered slopes to the north and to the east of Ribeiros. Area 1, located 130 m above, and 1 km from, Ribeiros, has been actively harvested for as long as residents can remember. *Erica arborea* caudex is still taken from here to distill *bagaco*. Area 2 is also still actively harvested, but *E. arborea* caudex has not been taken from it recently. This area is located 150 m above, and about 2 km from, Ribeiros. Areas 3 and 4 contain *mato* vegetation that has never been actively harvested. These areas, located on a nearly level hilltop shoulder, are about 250 m above, and 4 km distant from, Ribeiros. Rye, which grows without irrigation during the cold, wet winter, had been cultivated here but cultivation was abandoned about 30 years ago, largely because of the inconvenient distance of the fields from Ribeiros. *Mato* established spontaneously when this rye plot was abandoned. Area 3 is the eastern part of this shoulder, where above ground *mato* vegetation burned off 8 years ago and has since regenerated. It also contains young pines *(Pinus pinaster)*, all less than 8 years old. This pine does not survive fires but grows readily from seed following fires or other disturbance. Area 4 is the western part that did not burn. Its pines and *mato* are approximately 30 years old.

The residents' description of the history of the vegetation in Areas 3 and 4 is corroborated by the age of the pines growing in these areas. Pines grow a swirl of branches from their trunk every year. For at least the first 20 and often up to 30 or 40 years, one can age pines by counting these swirls. Sometimes a few years' swirls will be universally lost by wind or by a bud worm break out that inhibits the growth of swirls. This can be checked by counting growth rings. I cut down a 7-year-old sapling, whose rings and swirls matched.

In Area 1 and Area 2, *mato* is cut on a four-year cycle and had been regenerating for the past four years. Individual caudices regenerate growth 10–20 cm in circumference during four years. Areas 1 and 2 have only five or six abundant species. At the scale of a meter square, relative species abundance varies little throughout these areas. So, from an arbitrary one square meter plot in each of Area 1 and Area 2, all vegetation was cut at about 3 cm above the ground, the approximate height at which it is cut by residents when harvested for use. Plants were sorted by species into plastic bags, and removed the next day to Coimbra where the contents of each bag were dried and weighed.

In Area 3, some plants have grown to three times the size of those in Area 1 or 2. Relative species abundance was quite variable at the scale of a square meter, but became more uniform for areas two or three times as large. For this reason, an arbitrary plot 2 m × 3 m was selected for harvesting. All vegetation was cut as described above and sorted by species. Because of the large amount of vegetation produced on this 6 m^2 plot, the quantity produced by each species was weighed wet in the field and approximately 0.5 kg was sealed wet in a plastic bag and removed the next day to Coimbra, where it was weighed and dried and reweighed to determine percent dry weight.

No vegetation samples were taken from Area 4, but the kinds, sizes, and relative abundances of these very large plants were recorded.

To determine the potential of each *mato* species to enrich the soil with mineral nutrients, each plant species was analysed for levels of minerals, including nitrogen and phosphorous, at the Laboratorio Agricola Quimica Ribelo da Silva in Lisboa.

RESULTS

An account of the history and technology of agriculture in this region, learned as a result of my interviews, archival research, and field observations, was presented above. The results presented here are of three kinds. First, what residents do with and say about the most common species in the *mato* establishes the conspicuous importance of maintaining the biological diversity of *mato* species. Second, the relative abundances of *mato* species measured from plots with different disturbance histories evidences that *Erica arborea* becomes dominant in plots where it is not periodically reduced. Third, the relative abundance among *mato* species of mineral nutrients essential for crops establishes the inconspicuous importance of maintaining the biological diversity of *mato* species for soil fertilization.

TABLE 2.—Above ground accumulation in three areas of *mato.* Dry weight (gm) of accumulation per m^2 precedes average accumulation per year for each species.

Areas	Area 1		Area 2		Area 3	
Size, age	1 m^2	4 yr	1 m^2	4 yr	6 m^2	8 yr
Species						
Erica arborea	103	26	222	56	1,702	213
Ulex minor	—		347	87	882	110
Genista tricanthos	—		104	26	590	74
Erica cinerea	—		163	41	35	4
Halimium ocymoides	—		12	3	7	1
Lithodora difusa	5	1	—		3	0
Caluna vulgaris	30	8	241	60	63	8
Erica umbellata	256	64	—		—	
Chamaespartum tridentatum	816	204	198	50	—	

Erica arborea is called *mato negral,* which means grey or dark *mato.* Although this study reveals it to be the competitive dominant (Table 2), it is not considered a weed or otherwise undesirable by the village farmers. Its woody caudex is genuinely valued as a fuel, and its foliage is also valued as goat forage and bedding. Like all the harvested *mato,* it is spread over the ground inside the goat houses, where it is enriched by goat urine and excrement before it is finally added to the soil.

Ulex minor is called *tojo branco,* which means white *tojo,* even though it is covered with green leaves and prickers all year long. *Genista tricanthos* is called *tojo negro,* which means black *tojo.* It has green leaves in the winter that fall in the dry season, leaving a dark brown thorn scrub that not even goats will eat. Both *tojos* prick the hands of *mato* harvesters, making harvesting unpleasant and difficult, but these plants are nonetheless harvested, included in goat bedding, and finally buried in the soil. Beyond repeating their preference for *mato negral,* residents did not say why the regeneration organs of *tojo branco* and *tojo negro* are not dug up and burned in stills.

Erica cinerea is called *urze.* It is valued for goat forage, although I rarely saw goats eating it, and highly valued for goat bedding. Except from the thorny *tojos,* there was nothing superficially apparent to set *urze* apart from the other cut *mato* spread on the floor in goat houses.

Halimium ocymoides and *Lithodora difusa* are called *mato* plants by residents, but did not have more specific names that anyone remembered. Neither did residents describe specific uses for them. These species make up a very small percentage of the *mato.*

Caluna vulgaris is called *margarise* by the residents of Ribeiros. This species, one of several known as heather, is common throughout northern Europe as well. In Ribeiros, its floral display in August and September is spectacular. Its prolific nectar production is recognized, and in order to increase the amount of honey

TABLE 3.—Concentration (percent dry weight) of nitrogen (N), and phosphorous (P) in samples of *mato* species from study areas, and in a homogenized sample of old cut *mato* removed from the floor of a room housing goats.

	N	P
Erica arborea	0.86	0.055
Ulex minor	0.64	0.140
Genista tricanthos	1.24	0.101
Erica cinerea	0.64	0.160
Halimium ocymoides	0.59	0.080
Lithodora difusa	0.63	0.096
Caluna vulgaris	0.58	0.098
Erica umbellata	0.90	0.055
Chamaespartum tridentatum	0.48	0.100
Old *mato,* homogenized	1.44	0.377

collected by village bee keepers, *mato* is harvested less frequently during the flowering season of *margarise.*

Erica umbellata is called *negrela,* a diminutive *negral.* Its caudex is not taken for fuel, and it is readily excluded by its more aggressive congener, *E. arborea.* Although *urze* is explicitly recognized, all three *Ericas* are valued as goat bedding.

Chamaespartum tridentatum is called *carqueja* here and over most of northern Portugal. It is highly valued as goat forage. The stems are only slightly lignified, and the goats eat much more of it than of the other *mato* species. Like all harvested *mato,* it becomes part of the goat pen bedding before being added to the soil.

Table 2 presents the total and approximate annual above ground accumulation, in dry weight, of each species at each of Areas 1, 2, and 3. Area 4 was densely dominated by *E. arborea,* which had grown, true to its name, into gnarled trees, 2–3 m high, overtopped with 30-year-old pines.

Table 3 presents concentrations, in percent dry weight, of nitrogen and of phosphorous, in samples of *mato* species collected from the study areas, and in old cut *mato* removed from the floor of a room used to house goats. For both of these plant nutrients, the concentrations vary among the species by a factor of more than 2.5. Nutrient levels are clearly increased in *mato* that has been on the floor where goats are housed.

DISCUSSION

For the last 500 years or more, growth of plants of the *mato* has been essential for the maintenance of soil fertility in the Pracais valley and throughout central interior Portugal. The *mato* species play different and complementary roles to support the lives of the local people. Sugar production, fuel, goat forage, and soil fertility have been mentioned here. Thus, maintaining the species diversity of the *mato* is of genuine, immediate economic value to the residents. Some of their traditional practices can be understood by observing and interviewing the people who employ them. Other dimensions of this understanding are suggested by evidence revealed by the decline or discontinuance of these practices, by experimentation, and by laboratory analysis.

Mato negral is one of the many useful plants of the mato, but its competitive superiority would reduce species diversity if were not somehow controlled. The utility of its caudex (the regeneration organ) as a distilling fuel is the stated reason for digging up caudices every fall, even though the caudex of any *mato* plant would work well in a still fire. Over the past 100 years or more, people may have forgotten that this practice helps maintain *mato* species diversity because, when all the *mato* was being cut and properly managed to maintain both soil fertility and diversity, *mato negral* never had a chance to reveal its dominance. This more ecologically and observationally founded understanding of dominance reduction remains implicit in the traditional preference for *mato negral* caudex as the still fuel. It is much more important to the local economy to practice the appropriate activities at the right time than to explain them objectively as long term ecological phenomena.

The residents of the Pracais valley often do explain their technology in very objective terms and with sound observational bases. Their explanation of irrigation technology and the factors that determine the height, width, and frequency of dry stone retaining walls for cultivated terraces, are two examples. Here, scientific explanations incorporate what people need to do to create and maintain these structures. Thus to participants in this self-sufficient economy, an important part of the utility of an explanation is to help people remember what to do.

Results of this study provide two other examples of local distinctions or explanations that seem to serve primarily to instruct people what to do or value, but that also have compelling scientific explanations of longer term effects. The naming of the three different species of *Erica* that occur in the *mato* provides one example. All three *Ericas* look similar enough to be considered congeners by taxonomists; indeed two of them, the large and small *negral*, are given similar names by residents even though they must be distinguished when it is time to distill *bagaco.* Residents give *urze, Erica cinerea,* separate folk generic status and value it highly as goat bedding, even though they give no compelling reasons. When the cut branches of *urze* are spread on the floor of the goat pen with those of other *mato* species, they cannot be readily distinguished and the goats do not seem to treat them differently. Residents do not know that *urze* branches, in comparison to those of the other *mato* species, have the highest phosphorous concentration. As Table 3 shows, *urze* has more than twice the phosphorous of most other *mato* species (only *Ulex minor* has comparable, but lower, levels), and three times the phosphorous of the other two *Ericas.* Because traditional practice is to use and value this species for goat bedding, which ultimately becomes soil enrichment, soil phosphorous levels are more effectively maintained. The ancient sedimentary ilite minerals in the shale-derived soils of central interior Portugal are especially poor in phosphorous and rich in iron (Azevedo and Ricardo 1973). Iron tends to chelate phosphorus so that it can not be taken up by plants. The release of phosphorous from decaying organic matter occurs at a slow enough rate that it can be taken up immediately by growing crop plants and not lost to the iron in the soil. Thus, organic matter has probably always been an essential source of phosphorous for this agricultural system. It is not surprising that hundreds of years of agricultural tradition in this region has distinguished the plant that is the best organic source of phosphorous from other members of its genus, and valued it as goat bedding, even though as goat bedding per se it has no special value.

The second example of an explanation that seems not to have an observational basis, but that is preferred by villagers because it helps people remember what to do, is provided by the concept of the goats' bed. Like valuing *urze* for goat bedding and removing occasional *Erica arborea* caudices for still fires, the important consequence of spreading *mato* as goat bedding is not immediately apparent, and so an explanation that requires the appropriate activity is created. Residents spent about a quarter of their total economic effort cutting *mato,* hauling *mato,* spreading it out in goat pens to make a "bed" for goats, removing it from goat pens, piling it in heaps, and finally carrying it to cultivated terraces to dig into the soil before a new crop is planted. Although this effort is essential for the maintenance of soil fertility, it was always explained primarily as providing food or a bed for goats. Goats feed as foragers grazing at large during the day, and on weeds and thinnings pulled from the cultivated terraces and given to them, along with occasional rations of grain, when they return to their pens in the evening. Except for *carqueja,* the goats ate very little of the cut *mato,* all of which was spread out below them to make their "bed." Even *tojo negro,* leafless, spiny wands of dense wood that goats won't eat, is included in this "bed." The goats stand up, rarely lying on their thorny bed of sticks and twigs. Why is cutting and carrying *mato* explained as a means of providing food and bedding for goats, when residents are fully aware that their goats eat very little of it and rarely lie on it? Why is it not explained as a means of maintaining soil fertility, the need for which the residents are also fully aware? Spreading *urze, tojo negro,* and the rest of the cut *mato* in goat pens before adding it to the soil raises the ratio of nitrogen to carbon in cut *mato* (Table 3). When this old cut *mato* is buried in soil, the higher N/C ratio provides a microenvironment in which the balance of microbes is shifted towards more effective decay organisms that can decompose *mato* and release its nutrients during one growing season (Griffin 1972). In fact, no residual sticks or twigs were evident in the soil at the time of the corn harvest even though 7–10 metric tons dry weight per hectare of *mato* (mostly sticks and twigs) had been added at the time of corn planting. Effective, rapid decay of the dense woody branches of *Genista tricanthos,* which might otherwise decay more slowly than the fruticose twigs of some other *mato* species, is especially important because this species is highest in nitrogen, substantially higher than other species of *mato* (Table 3). Thus it is important for soil fertility to leave the caudices of the slow growing *tojo negro* in the ground, to include its dense, spiny branches in the harvest of cut *mato,* and especially to spread them out in the goat pens. Chemical analyses and microbial ecology are not evoked by residents to explain why they include inedible thorns in the "food" and "bed" of goats, but the consequences of their traditional agricultural practices are clear. Feeding and bedding goats is an explanation that reminds farmers what to do next, especially when the long term consequences of the activity are important, but not immediately apparent. This more proximal, but apparently less correct explanation, thus may serve a self-sufficient village economy better than would a more ultimate, and apparently more correct, one.

Other authors have discussed aspects of some of the ideas presented here. Brush (1986) documents the maintenance of the biological diversity of surrounding areas by farmers practicing traditional methods. Brush (1992) also discusses the specific case of the persistent, deliberate maintenance within individual fields of high potato cultivar diversity by Andean farmers even following the introduction and acceptance of new potato varieties bred by Green Revolution techniques. He lists some of the reasons why farmers might preserve this diversity: taste, interest, agronomic factors, economic opportunity, and prestige or social status, and observes that not a single ecological reason was given by farmers. Zimmer (1991) also discusses the maintenance within individual fields of high potato cultivar diversity by Andean farmers who have *not* accepted Green Revolution varieties, and describes prestige or social status as the most compelling proximal motive. Although neither author demonstrates, or even hypothesizes, a long term ecological effect of the maintenance of high potato cultivar diversity beneficial to these self-sufficient agricultural economies, attributing proximal prestige to those who maintain diversity would stimulate the practice and produce the ultimate benefit, if it did exist.

There are many examples of the use of specific foods or medicines where the preventative or healing effects are known by practitioners who cannot explain, in scientific physiological or chemical terms, how they work. Kuhnlein (1981), Johns (1981), and Timbrook (1987) provide examples. Even though explanations for these practices may incorporate spiritual or magical concepts, by and large these food and medicinal practices are efficacious and people *do* understand the basic purpose for them, namely to maintain or restore health. These authors do not give examples of less relevant or somewhat artificial reasons, such as the examples of bedding goats or choosing still fuel discussed here, that maintain advantageous practices because they evoke appropriate activity.

Concepts of utilitarian explanations and distinctions have been explicitly discussed by some authors. Alcorn (1981), in discussing Huastec perception of botanical resources, mentions invisible technology that not only enables plant use but also manages the plant resource, but gives no examples. Invisible technology may refer to parts of Huastec explanations with little or no observational basis that function to stimulate timely activity, with long term resource management effects not accounted for by the explanation.

Hays (1982) suggests that distinctions among kinds of organisms made in self-sufficient agricultural economies may result in differential behavioral or attitudinal responses to the organisms distinguished with consequences that are useful or beneficial, even when the benefit cannot be described by those making the distinction. If the distinction is made, then the benefit is enjoyed, not because of the explanation but because of the behavior it elicits. The distinction of the phosphorous rich *urze*, whose name differs from *neqral* and *negrela*, the other two *Ericas*, would seem to be an example of this phenomenon.

The procedural, ritualized, unsubstantiated, or seemingly irrelevant explanations that elicit timely or appropriate behavior in self-sufficient farming communities may describe practices that represent a deeper ecological or natural wisdom. The wisdom of these practices (if not of their explanations) may transcend the short term, production orientation of modern agricultural technology, whose development has been in part motivated by the desire to convert natural resources to cash profits as fast as possible. It is becoming clear that many modern agricultural practices cannot be sustained without decimating the very natural resources on which productivity depends. Studying, recording, and understanding the human ecosystem in the Pracais valley, an ecosystem based on practices that for centuries have sustained agricultural production on poor soils, is especially relevant to the present challenge of developing technology for sustainable agriculture to ensure the future well-being of people. Some aspects of this preindustrial technology were still available through the memory and activities of the aging residents of the Pracais valley. However, some access to the understanding of how things worked, and especially why things worked, is made available to us by studying the present breakdown of their traditional system. For these reasons, studies of preindustrial agricultural systems should be undertaken with any available evidence of how and why these past technologies were successful.

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BOOK REVIEW

Histoire Illustreé du Caoutchouc. Jean-Baptiste Serier, Antionette Diez, and Anne Van Dyk. France: Montpelier Cedex 1 (CIRAD-CP, BP5035, 34032), 1993. $27.00 U.S. (167 French Francs). (No ISBN found)

It is almost impossible to "review" this extraordinary and unusual book because it depicts the story of rubber in 96 pages of illustrations. The 450 pictures record the history of rubber from the dinosaur age and that of early man through the use of the product in pre-conquest Mexican times to the "discovery" by Europeans, the early periods of the tapping of *Hevea* through to the beginnings of commercialisation of Amazonian rubber production to the introduction of *Hevea brasiliensis* to Asia and the establishment of the plantations in the Old World tropics.

The book, extremely novel in its approach, should be useful in teaching economic botany courses and will certainly be of interest to general audiences.

The artist-authors are to be congratulated for making available such an interesting detailed illustrated history of rubber, its uses, and commercial aspects of its development.

Richard Evans Schultes
Director Emeritus
Botanical Museum of Harvard University
Cambridge, Massachusetts

BOOK REVIEW

The Ethnobotany of the Chacobo Indians, Beni, Bolivia. Brian M. Boom. Advances in Economic Botany, Volume 4. New York: New York Botanical Garden. 1987. Pp. 67. $15.00 (paperbound). ISBN 0-89327-312-0.

This book is an important contribution to the ethnobotany of Amazonia, particularly of an area which is relatively underepresented in the literature. Its presentation makes it a useful tool for anthropologists and botanists alike.

This highly concise work provides a brief introduction to the context and objectives of the study. It includes a description of the study area and an ethnographic vignette of the Chacobo. Though largely historical it provides the reader some insight to the relative acculturation of the groups prior to 1983 when the author initiated his investigations. Field methods are described as including two basic approaches. These are the "artifact/interview" approach of anthropologists and the "inventory/interview" technique in which informants are interviewed about names and uses of plants following the active collection of specimens.

The largest section of the book contains an accounting of the 360 species collected within a one-hectare area south of the village of Alto Ivon. The collection is distributed in at least 221 genera and 79 families. Where possible, each entry includes the Latin, Chacobo (with English translation), and Spanish names, local frequency, habit, habitat, geographic range of species, voucher citations and commentary on use. The remainder of the book considers the variable uses of plants in Chacobo culture. Of 305 species utilized, 102 are food plants, 75 gathered wild from the forest. The latter are of interest as they reinforce the author's suggestion that the Chacobo were traditionally hunter-gatherers as opposed to agriculturalists. Fuel plants include 22 species of trees, while species utilized in the context of construction and crafts include 68. Medicinal plants include 174 species, and are tabulated by ailment treated. Only five plants were considered useful due to their toxic properties. The most notable conclusion of Boom's work is the fact that the Chacobo utilize 82% of all species and 95% of all trees, with utilization rather evenly distributed among medicinal, construction, and crafts and food categories.

This book is well written, and contains excellent tables and illustrations and useful appendices on Chacobo names and nonvascular plants from the area. Beyond its obvious scientific value this book notes the significant implications of ethnoecological research in allocation of lands for self-sustaining Indian reserves.

Mark G. Plew
Department of Anthropology
Boise State University
Boise, ID 83725

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TRIBES, STATES, AND THE EXPLOITATION OF BIRDS: SOME COMPARISONS OF BORNEO AND NEW GUINEA

CHRISTOPHER HEALEY
Anthropology
Northern Territory University
Darwin, Australia

ABSTRACT.—Exploitation of birds for trade by tribalists of Borneo and New Guinea are compared. Traditionally, bird products in Borneo passed to overseas markets, but in New Guinea were mainly used locally. Contemporary exploitation is illustrated by case studies of a Punan village in Borneo and a Maring village in Papua New Guinea. The Punan are minimally involved in exploitation and control of birds for markets, these roles having been assumed by outsiders backed by the state. Traditional exploitation of birds persists among the Maring, largely because bird products are unimportant in the national economy.

The comparison indicates alternative consequences of the intrusion of the state for access to and control of biological resources by tribalists. Different forms of incorporation into the state have variable impact on tribalists' ethnobiological systems, including use of resources in exchange. It is therefore appropriate for ethnobiologists to contextualize their studies by reference to contemporary political-economic systems.

RESUMEN.—Se compara en este trabajo la explotación de aves para el comercio por parte de grupos tribales de Borneo y Nueva Guinea. Tradicionalmente, los productos derivados de aves en Borneo pasaban al mercado externo, mientras que en Nueva Guinea eran destinados principalmente al uso local. La explotación contemporánea es ilustrada mediante estudios de caso de una aldea Punan en Borneo y una aldea Maring en Papúa-Nueva Guinea. Los Penan están involucrados en forma mínima en la explotación y control de aves para el mercado, puesto que estas funciones han sido asumidas por personas externas a la comunidad, respaldadas por el estado. La explotación tradicional de aves persiste entre los Maring, debido en buena medida a que los productos de aves no son importantes en la economía nacional.

La comparación indica consecuencias alternativas de la intromisión del estado para el acceso a y control de recursos biológicos por parte de los pueblos tribales. Las diferentes formas de incorporación al estado tienen un impacto variable en los sistemas etnobiológicos de las sociedades tribales, incluyendo el uso de recursos en el intercambio comercial. Es por ello apropiado que los etnobiólogos contextualicen sus estudios en referencia a sistemas político-económicos contemporáneos.

RÉSUMÉ.—Les modes d'exploitation commerciale des oiseaux par les tribues de Bornéo et de Nouvelle Guinée sont comparés. Traditionellement, les produits oiselliers de Bornéo sont destinés aux marchés d'outre-mer, mais en Nouvelle Guinée, ils sont surtout utilisés localement. L'exploitation moderne de ces produits est illustrée à l'aide d'examples tirés d'un village Punan de Bornéo et un village Maring de Papua Nouvelle Guinée. Les Punans s'occupent peu d'exploiter et de controller les oiseaux pour le marché, ce rôle ayant été assumé par des personnes de l'extérieur, appuyées par l'état. L'exploitation traditionelle des oiseaux persiste parmis les Marings, largement parceque les produits oiselliers ne forment pas une partie importante de l'économie nationale.

Les résultats de ces comparaisons indiquent des conséquences variables suivant l'intrusion de l'état conçernant l'accès et le control des resources biologiques par les tribues. Les différents moyens d'incorporation au sein de l'état agissent de façon différente sur les systèmes éthnobiologiques des tribues, y compris l'utilization des resources pour l'échange. Il est donc recommendé aux éthnobiologistes de contextualizer leurs recherches au sein des systèmes politico-économiques contemporains.

INTRODUCTION

An important dimension of ethnobiological studies is the documentation of how biological resources are culturally utilized. Aspects of use include—but by no means exclusively so—processes of cultural appropriation from nature, and of the redistribution of these resources in exchange systems. One very important use to which biological resources have long been put is as objects of trade. It has been by trading local products that many pre-industrial communities linked themselves into a larger economic and socio-political order.

There has been a fruitful convergence of interest of ethnobiologists and human ecologists, particularly in relation to aspects of production and management of biological resources (e.g., Conklin 1957; Ellen 1983). A comparable convergence between ethnobiology and economic anthropology is yet to emerge. This is somewhat surprising, given the common interests of both economic and ecological anthropologists in systems of production and distribution, including indigenous conceptions of the processes. The incorporation of tribal communities into encompassing political-economic systems has clearly had a profound impact upon the nature of systems of production and their sustaining systems of indigenous knowledge.

In this paper I take up some of these issues through a comparison of two adjacent parts of the tribal world, and their different histories as suppliers of forest products, especially birds, to an international market. In particular, I am concerned with how the different trajectories of incorporation into a world-system resulted in different consequences for the continuing involvement of tribal communities in the exploitation and management of wild bird resources.

Ethnobiology embraces a complex of knowledge and practice. It does not, however, constitute a "system" in itself, except as an analytic abstraction. Rather, ethnobiology is composed of elements of diverse aspects of socio-cultural systems, including the ecological, economic, ideological, and cosmological. As such, any ethnobiological study should endeavor to indicate the relation of the particular focus of study to the wider socio-cultural context within which ethnobiological data are embedded.

In this paper I am not concerned with the "content" and internal order of ethnobiological lore—the traditional focus of studies in ethnobiology, whether as knowledge of taxonomies, or practical, medicinal, magical, or ritual properties and uses of organisms. Rather, I focus on how biological resources come to assume a structural role in mediating the impact of the state on tribal, trading populations. Clearly, biological resources become transformed into tradeable commodities through the application of specific ethnobiological knowledge and practice. However, I am concerned here more with the consequences of this transformation than its organization and form.

It is the intention of this paper, then, to develop some comments on how political-economic "world systems" might be conceived as impinging on traditional systems of ethnobiological knowledge and practice. The emphasis is on the socio-cultural procurement practices and systems of redistribution of harvested biological resources. Ultimately, this discussion might lead to a theoretical convergence between anthropological studies of political economy and ethnobiology, as has already occurred in the fields of human ecology and ethnobiology.

For millenia indigenous tribal people have sent the natural productions of their lands afar in trade and tribute. Subsistence economies of tribal communities were, to a greater or lesser extent, geared to the surplus production of commodities that were in high demand by complex, state societies. Many of these goods were of little or no intrinsic value to those who produced them, other than for what useful or luxury items might be obtained in exchange. The range of products of tribal lands in demand by settled societies is legion, but has included the fine furs and pelts of animals, feathers, ivory, aromatic gums, fine woods, perfumes, spices, pigments, narcotics, and a bewildering variety of animal and plant products deemed to have medicinal or magical properties.

In many parts of the globe, relations of mutual dependence rather than open exploitation characterized the political-economic relations between precapitalist trading states and the tribal communities on their peripheries. With the expansion of a capitalist world system, however, the relation of traditional communities to their natural resource base has become radically transformed. Many natural resources have lost their traditional value and been superceded or replaced by industrial manufactures, and, of course, by money. In many instances, those that retain value have become subject to commercial production processes that effectively deny the continuation of traditional forms of association with the resources and their management.

It is conventional to regard the process of the incorporation of indigenous people into the global economy as involving the commoditization of resources—whether natural resources or human labor—which facilitates and encourages their exploitation and sale on an individualistic basis. In this process of commoditization, indigenous people have frequently lost socio-political autonomy and privileged access to resources which formerly characterized subsistence strategies (e.g., Nietschmann 1973).

Two regions where these processes are relatively recent are the great equatorial islands of Borneo and New Guinea. Both islands have long been the source of certain luxury goods, extracted from the forests by tribal communities, that have been important in international trade. In both areas, the influence of Southeast Asian precapitalist states was weak, virtually nonexistent in most of New Guinea west of the Vogelkop (Birdshead) Peninsula. Similarly, effective control by European colonial powers came relatively late.

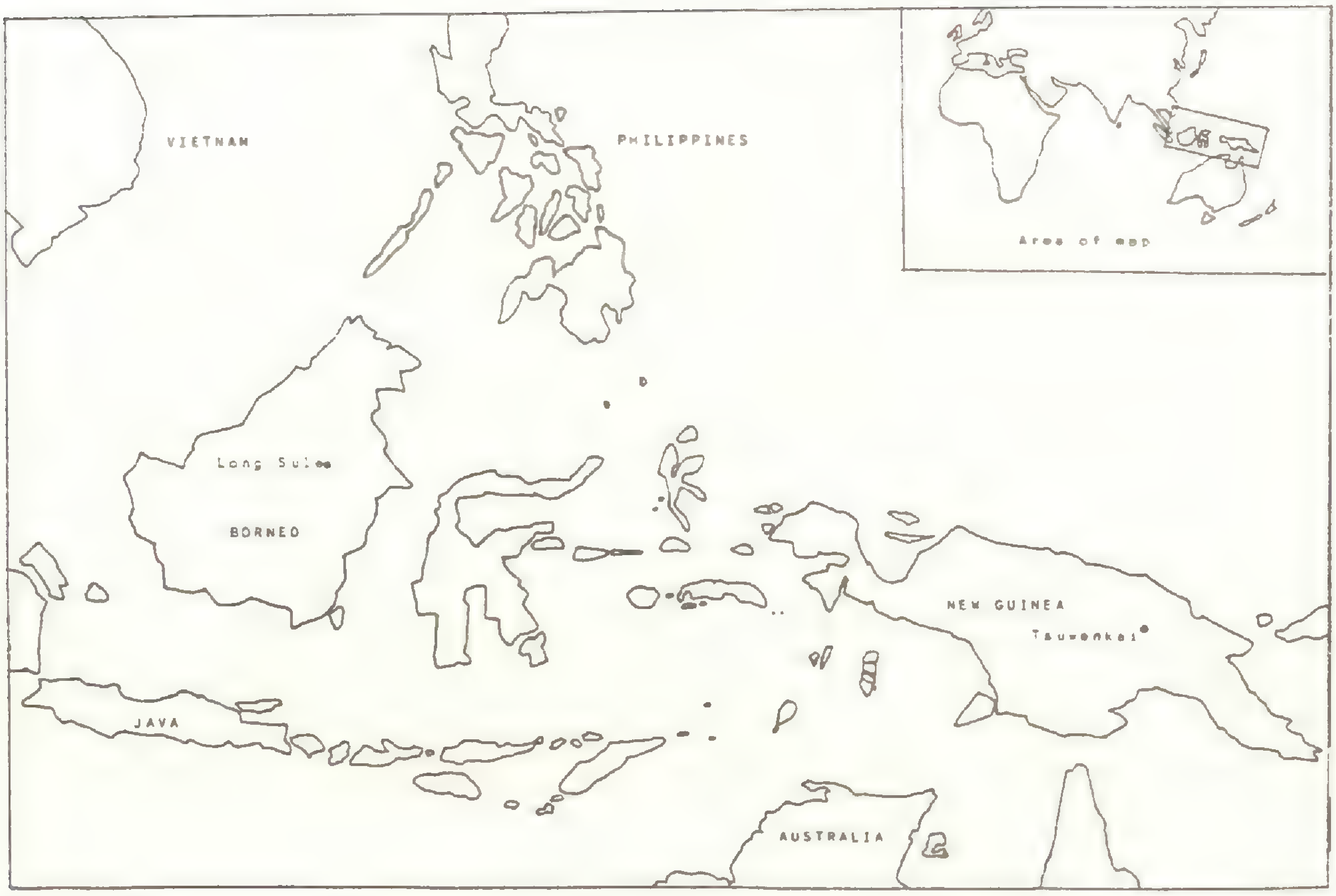

FIGURE 1.—Location of case studies.

This paper, then, examines aspects of traditional exploitation of forest resources in New Guinea and Borneo, and certain recent transformations in the context of colonial and postcolonial developments. The emphasis is on the articulation of the production of jungle goods, especially derived from birds, with systems of exchange, with particular attention to trade. The discussion is based primarily on my own research in New Guinea on the hunting of birds and trade in plumes (e.g., Healey 1980, 1990), and on the literature dealing with forest products in Borneo, but also includes some preliminary comparative remarks on a brief field trip to Indonesian Borneo.

BORNEO AND NEW GUINEA

The large tropical islands of New Guinea and Borneo (Fig. 1) lie either side of the Wallace Line, and exhibit a comparable diversity of flora and fauna (Beehler et al. 1986; Flannery 1990; Medway 1977; Smythies 1981). The richness of biological resources in both islands is paralleled by considerable ecological and cultural diversity that reaches its greatest elaboration in New Guinea.

Forest resources are of material and ideological significance in the indigenous cultures of both islands, and have long been major items in extensive trading networks. The bulk of these goods are luxury items rather than staple foods. Trading networks developed to serve the demands of indigenous tribal groups for access to valuables that were deployed in local economies of competitive display or consumption. In many areas, however, trade networks filtered the products of the far interior to small coastal centers from where they entered the international passage of luxury and exotic goods serving the Far East, the Middle East, and Western Europe.

The traditional societies of both islands can be broadly treated as small-scale tribal formations, mostly egalitarian and decentralized, although some central Borneo societies were stratified. The scale of socio-political units was highly variable, however, from a few score individuals to several thousands.

Subsistence for the most part was based upon shifting cultivation—of dry rice in Borneo and tubers in New Guinea. Hunting and gathering were also important, to the extent that there were specialist forest dwellers in both islands practicing little or no agriculture. Most depended on sago palm for the carbohydrate component of the diet, and were therefore principally confined to lower altitudes.

One major difference between the two islands must be noted: centralized Malay states have been present in Borneo, mostly in coastal regions, since about the fourth century AD. It is through these states that interior tribes were linked to the outside world.

Although there were no truly isolated, self-contained communities in New Guinea prior to the colonial era, contact with the outside world was at most tenuous, sporadic, and confined to the coastal belt in western and north-coastal New Guinea. Indeed, the Sultanate of Tidore in the Moluccas claimed suzerainty over the Western Papuan Isles and much of the Vogelkop Peninsula of what is now Irian Jaya, although its actual economic and political control was probably nominal (de Clercq 1889).

In both islands, exploitation of forest resources served local demands for wild foods, building materials, magical and medicinal items, and valuable items of decoration on ceremonial occasions. Certain forest products were also traded widely. However, in each island, the ecological and social organization of trade was quite different, and this has led to a markedly different impact of the global economy in different areas.

TRADITIONAL TRADE IN FOREST PRODUCTS

The patterns of precolonial trade are quite different in the two islands[1], and this is largely because of their respective connections to larger, international networks of trade.

Borneo was long an important source of jungle produce for international markets, especially in mainland Southeast Asia and China. Principal forest products passed in this trade were edible birds' nests, rattans, aromatic and decorative woods, camphor, gums, rhinoceros horn, "ivory" from the hornbill bird, and bezoar stones. The bulk of these goods were produced by tribal agriculturalists of the interior—the various so-called Dayak tribes—and specialist foragers, the forest nomads such as the Punan. Substantial proportions of these goods were exported to mainland Southeast Asia and China. Most of this export trade was controlled by elites of the various Malay sultanates dotted along the coastal belt at river mouths. Goods flowing in return for forest products were Indian and Indo-Chinese luxury items for consumption by coastal elites, as well as Indian textiles, Indo-Chinese brassware and porcelain, and salt for exchange with interior tribal people (e.g., Brown 1970; Dahlan 1975; Freeman 1970; Healey 1985b; King 1993; Metcalf 1982; Rousseau 1989).

Unequal terms of trade operating between the Malay population of the coastal belt and tribal communities of the interior favored down-river communities that could manipulate the supply of trade goods into the interior by control of river mouths. Coastal states were unstable polities, lacking structurally secure central authority. Their territories were generally poorly defined, and consisted of personal hereditary domains of the nobility interspersed with domains vested in the control of the sultan and his appointed officials.

The decentralized structure of the state, coupled with the revenue-raising powers of domain-holders, was a critical source of instability of sultanates, with fractious noblemen and vassal states occasionally seeking to assert their independence from the sultan and establish themselves as rival, autonomous polities.

Struggles for power within states led to escalating demands for jungle products as a means of raising revenue to underwrite a sumptuous life-style, and to engage armed retainers (effectively pirates) to harrass the settlements and shipping of competitors. As a consequence, interior tribal producers of jungle products were subject to periodic increasing demands for more produce and attempts to undermine their political and economic autonomy (Healey 1985b).

It is important to note that interior tribal people appear to have had an awareness of the basic structure of the larger trade system in which they were embedded. This is indicated by population movements which were sometimes motivated by a desire to escape from disadvantageous trade relations with down-river agents of coastal states, or to gain easier access to other sources of exotic valuables. The ultimate result was the consolidation of structural instability of state systems, and of the mutually interdependent relation between tribes and states, that was historically reflected in the rise and fall of particular dynasties and states in the coastal belt, and in flurries of war, headhunting, and large-scale migrations of tribal people in the interior (Healey 1985b; Rousseau 1989). But ultimately, the position of states and tribal populations in a large system of political-economic relations ramifying out of the Far East and South Asia was crucially dependent upon the capacity of interior tribal groups to exploit forest resources.

An integral aspect of this exploitation was the knowledge base itself. This was continually under potential threat through the tendency of coastal states to incorporate autonomous tribes of shifting cultivators and hunter-gatherers into the state as dependent communities. This process tended to take the form of conversion to Islam and the adoption of sedentary agriculture.

Similar processes continue today, under Indonesian government schemes encouraging re-settlement of communities at selected sites along major rivers. One might suggest that a consequence of such forms of incorporation into the state—premodern and modern—is an attenuation of the forms of attachment to, and exploitation of, forest resources by tribal groups, and an ultimate erosion of the traditional knowledge base upon which that exploitation rests. This is of minor consequence for the modern state, given that the primary sources of revenue in Borneo are oil, natural gas, coal, and timber products in capital-intensive industrial systems. Indeed, the current oil and timber boom in East Kalimantan makes it one of the richest of Indonesia's 26 provinces (Pangestu 1989) although annual incomes of the great bulk of the population are extremely low. But while heavy extractive industry has supplanted the importance of jungle products as a source of state revenue, the collection of jungle produce is still an important source of income for more isolated rural dwellers (Jessup and Peluso 1986).

The structure of trade in New Guinea was traditionally quite different from Borneo. In the precolonial period marine shells penetrated far into the interior, but for the most part, there was not the island-wide pattern of trade that may be discerned in Borneo. Compared to Borneo, the vast majority of trade goods were distributed over comparatively short distances, and the individual links between transactors were typically very short—at least on the mainland—often no more than 20 km at most (Healey 1980, 1990; Hughes 1977). But then, the known social and geographic world in the interior of New Guinea was itself typically very small. Nothing like the extensive journeyings that occurred in Borneo has been reported for mainland New Guinea.

On the mainland a bewildering variety of artifacts, live domestic and wild animals, marine shells, bird plumes, mammal skins, crops, and other material objects, besides magical and ritual substances and knowledge, was passed in both barter and ceremonial exchange. The landscape was criss-crossed with complex, interlocking networks of exchange of material objects, but there were no large-scale, island-wide patterns of trade. Rather, there were a plethora of smaller, interlocking "systems" of trade, each with a rather different catalogue of goods involved.

Unlike Borneo, New Guinea was never directly incorporated as a major supplier of forest products (or other goods) into major maritime trading spheres centered on precapitalist state systems. It is true that parts of western New Guinea were a major source of forest and marine products entering the Southeast Asian trading system, but the direct influence of traders and the agents of the Tidore sultanate seems to have been very limited (Hughes 1977).

Nonetheless, the New Guinea mainland was the principal source of one forest product that excited Southeast Asian merchants and noblemen from early times: Bird of Paradise skins. The principal sources of these were concentrated in the Aru Islands, the Vogelkop, and nearby islands (Healey 1980). It is unlikely that extensive trade networks penetrated far inland prior to colonization. By the time Europeans became interested in the plume trade as a major commercial operation around the turn of the last century, they generally took over all aspects of production, becoming hunters themselves, or supplying local people with guns and ammunition, as well as managing the export of plumes (e.g., Doughty 1975; Gilliard 1969). Traditional patterns of production and supply were therefore only minimally incorporated into the large-scale commercial exploitation of the birds centered upon the European millinery industry.

Nonetheless, bird plumes were probably the only item, other than marine shells, that ever enjoyed a widespread usage in the interior, and which were traded over an extensive area focussed on the central highland valleys of the eastern half of the island (modern Papua New Guinea) (Healey 1980). In essence, trade in plumes in this region converged on a comparatively small central area of densely populated highland valleys that "consume" large volumes of plumes as decorations and valuables, but which lacked direct access to adequate supplies because of extensive deforestation. Goods sent in exchange for plumes varied according to sector, but included marine shells, pigs, stone tools, salt, and various artifacts.

Patterns of trade in such goods of localized provenance as stone tools, salt, and mineral pigments tended to radiate from the source areas, often on intersecting paths. But dominating patterns of trade in many inland regions were often defined by the flow of shells and plumes towards limited central areas of high consumption. In that sense, trade patterns within New Guinea, to the extent that we can reasonably refer to distinctive general orientations, tended to be directed towards an internal "sink," rather than diverging towards overseas consumers, as in Borneo. To a large extent I think this can be attributed to the lack of a long-established demand for the products of New Guinea overseas, and the attendant minimal development of trading networks beyond the region.

But, as in Borneo, trade in New Guinea continued into modern times. While some trade networks suffered substantial decline, especially in island regions (e.g., Harding 1967), others saw considerable growth in terms of the inclusion of new items of value, volumes of goods in circulation, velocities of passage of goods, and geographic scope of trade links (e.g., Healey 1990). Much trade that has persisted into the present remains essentially precapitalist in its organization. Although money is now widely used in trade, it has frequently been incorporated as a valuable rather than as a currency. Thus, the presence of money in trade does not amount to monetization, if the *currency* aspect of money is suppressed (Healey 1985a). Transformations that have occurred in trade systems in New Guinea are not simply the effect of the penetration of a money economy. Indeed, in New Guinea, some exchange systems have shown a capacity to absorb both cash and western commodities leading to an efflorescence of exchange (Gregory 1982; Healey 1990).

One factor that insulated traditional trade from monetization was the fact that inland trade networks were not important in the delivery of specialist forest or other goods to international trade systems. New Guinea forest products were essentially of little commercial value to the outside world, except in small amounts for the curio market, and international trade never depended upon traditional trade for its supply.

With a lack of pre-existing networks and infrastructure, the commercial, village-based exploitation of forest products has never significantly developed in New Guinea, nor has traditional trade in forest products served as a source of government revenue. By contrast, the exploitation of forest products has become a significant source of cash income for villagers and others in Borneo. In short, the history of commercialization of forest products and penetration of a cash economy has been different in the two islands.

CONTEMPORARY EXPLOITATION OF FOREST PRODUCTS

Here I present two brief cases of village-based exploitation of forest resources. This exploitation and its significance for villagers must be considered in its legal context. In Papua New Guinea customary tenure is recognised in national law, together with customary rights of access to forest resources. This contrasts with the situation in Indonesia, where ownership rights to forest land and its products are vested in the national government, which ostensibly regulates trade in such valuable forest products as birds' nests by registering traders and imposing a tax on sales.

Jessup and Peluso (1986) have discussed the ecology of production of forest products in Indonesian East Kalimantan. They conclude that given the legal constraints on ownership of resources imposed by the state, the intrusion of outside collectors, poachers, and smugglers, and the poor regulation of the market by the state, local communities are unable to manage effectively their communally-held forest resources. The high value of birds' nests encourages state control as a source of revenue, and also raiding of nesting caves by outsiders, and has resulted in overharvesting in East Kalimantan (Jessup and Peluso 1986: 524).

The impact of outsiders in the exploitation of minor forest products in Kalimantan is illustrated by the case of the village of Long Sule, which in many respects encapsulates much of the past and contemporary progress of "development" in Indonesian Borneo. The village is located in Kecamatan (subdistrict) Kayan Hilir, Kabupaten (district) Bulungan, on the banks of the Kayan Iut River, a southern tributary of the upper reaches of the Kayan River. Because of the rugged terrain the area has so far escaped the ravages of the timber industry.

Long Sule is a small village of about 300 people. It is one of three small villages clustered together in the middle of a virtually uninhabited stretch of hill-forest. Although it is some five days' walk to the next nearest permanent habitation Long Sule is readily accessible to the outside world, as a small mission-maintained airstrip is adjacent to the village.

Most of residents of Long Sule and its neighboring villages are ethnically Punan Aput, who were formerly forest nomads in the area. Sedentarization of nomads has a long history in Borneo (Sellato 1989) although the Indonesian government has hastened the process in recent decades in an attempt to consolidate control over interior tribalists.

In common with other forest nomads, the Punan Aput maintained, and indeed still do, important trading relations with stratified sedentary neighbors (Hoffman 1986; Sellato 1989), in this case the Kenyah. In particular, the Punan Aput are renowned locally for their fine rattan weaving. At Long Sule the Punan adopted Kenyah rice cultivation technology, as well as other cultural traits, notably certain styles of dress, Hornbill-dance ritual, and various visual art motifs. The village, however, is not self-sufficient in rice, with the granaries exhausted after five or six months. Thereafter villagers depend upon subsidiary garden crops such as bananas, cassava, and taro. Traditional collection of wild sago and other food gathered from the forest, as well as hunting with blow-pipe and spear, and fishing remain important components of the subsistence economy. However, much rice is also purchased from the three local stores in the village. This rice is flown in by light aircraft, and derives from the surplus production of Kenyah agriculturalists elsewhere in Kalimantan. Outsiders as traders are thus an integral element of the village, providing both food and other commodities sold in small stores in the village to help meet Punan subsistence needs, and a source of limited income.

Besides non-Punan (Bugis and Kenyah) store keepers, there are other outsiders resident in the village. These include several Kenyah men engaged in farming and collecting of forest products for the market, a pastor, and a school teacher and their families, and a group of Javanese alluvial gold workers. Long Sule is thus a small multiethnic community. Outsiders are mostly attracted by economic opportunities, and as providers of both goods and income are crucial to the very limited engagement of the Punan in the cash economy.

There are no local cash crops, and the Punan are minimally involved in the collection of birds' nests or aromatic *garu* woods. Both are found locally, though bird nesting caves are several days' walk away. The Punan gain meager supplies of cash primarily through the sale of finely woven rattan bags and other handicrafts to Kenyah and Bugis traders in the village, and by working as casual labor for Javanese gold prospectors.

Despite the proximity of the airstrip, the Punan of Long Sule seldom travel, lacking the cause or financial means to do so. The airstrip is, however, a crucial factor in the current organization of the village, for it enables visits by officials of the government, the mission, and commercial interests such as geologists. It also facilitates the resupply of stores and the import of an impressive array of modern technology: generators, radio and television receivers controlled by store holders, as well as various items owned by Punan families such as a few outboard motors for canoes and children's tricycles. Such possessions are evidence of the capacity of at least some households to amass quite considerable sums of cash despite the lack of local opportunities.

Traditionally, the local Punan did not harvest birds' nests or *garu* wood. Despite their value, and comparative ease of transporting these products to coastal markets, they still do not harvest them, leaving such exploitation entirely to Bugis and Kenyah traders. While Punan knowledge of the forest and skills as blowpipe hunters and gatherers remain an integral aspect of their subsistence utilization of the forest, they appear to have relinquished any possible collective control over, and management of, commercially valuable forest resources other than rattans for weaving.

Arguably, it is the indirect intrusion of the state, which has encouraged and attempted to regulate trade in forest products, that has attracted outsiders to the village as commercial collectors, and inhibited the entry of the Punan into the trade and their potential role as managers of the resources. The scale and extent of the penetration of external commercial interests into this small village far from markets is striking.

The situation in the Papua New Guinea village of Tsuwenkai is quite different. Though comparably isolated, the Kundagai Maring of Tsuwenkai have perhaps had more experience of the wider world. On the other hand, they retain customary control over their own lands, and outsiders—invariably mission personnel—are rarely resident in the village.

Tsuwenkai is located at about 1600 m above sea level on the flanks of the western Bismarck Range in the Jimi Valley, Western Highlands Province. One of over 20 Maring-speaking villages, Tsuwenkai is a community of about 300 people. Self-sufficient horticulture is the mainstay of the local economy. Most households earn modest income from smallholder production of coffee and occasional migrant labor. Money is now regarded as essential to meet demands of bridewealth and other ceremonial exchanges, and to purchase small luxuries and household comforts, but it is not necessary for mere subsistence, as in Long Sule. Investment in items of industrial manufacture beyond simple hand tools, basic kitchen equipment, and small household luxuries like radios and tape recorders is virtually nonexistent.

Kundagai territory in Tsuwenkai includes extensive tracts of high altitude primary forest, harboring several species of birds widely valued in much of the highlands, including various Birds of Paradise. The Kundagai have long been significant producers of plumes for trade towards central highlands consumers. Case history material indicates increasing export of plumes to the central highlands since just before first contact with the colonial administration in the mid-1950s. Until the 1980s little of this trade was directly with central highlanders, but rather over shorter links with trading partners in more nearby communities.

In the two decades after initial contact the rate of trade in plumes increased considerably. This intensification of trade was sustained by an increase in the importation of plumes from more peripheral areas which were then passed on to ultimate consumers, rather than by increasing hunting locally. Local hunting, however, is important in augmenting the supply of plumes, and ensures that the Kundagai are able to export greater volumes of plumes than they import.

Levels of hunting are regulated by a combination of social, technical, and ideological factors:

> (1) individual and collective property rights, by which only members of the local community may hunt plume-bearing birds, and by which individuals may lay claim to exclusive hunting rights at particular sites, such as Bird of Paradise display trees, hunting blinds, fruiting trees, and so on;
>
> (2) explicit conservatory practices, in which hunters refrain from killing all male Birds of Paradise visiting a communal display site, or frequenting a particular tract of forest, and voluntarily limit their hunting of female and immature birds;
>
> (3) beliefs that spirits are angered if hunters kill too much game. Just what amounts to "too much" is, however, equivocal, as the Kundagai also believe that unusual success is a sign of the favor of the spirits. Such beliefs are thus of dubious import in limiting hunting. However, dietary taboos may have some significance. These apply to only some game—mostly mammals prized for their flesh—but make hunting generally less appealing to those subject to taboos. However, the eradication of warfare has resulted in most taboos assumed by warriors falling into abeyance, while Christianization has further eroded traditional taboos.
>
> (4) the restriction of hunting to simple technology and traditional techniques. Keen hunters display a detailed knowledge of the forest, much of it based upon personal experience. Their success in a hunting expedition is frequently limited by technical means of securing prey, rather than in their skills in locating it. The Kundagai own no shotguns, depending mainly on bows and arrows, traps, and improvised weapons.

Although property rights, voluntary restraints, and technological factors limit hunting pressure with beneficial consequences for the conservation of game, it is not necessarily the case that the consequences are intended by the Kundagai.

It is clear that on the basis of their extensive biological lore many Kundagai are conscious of the need to restrain hunting rates. It is another matter, however, to suggest that this appreciation alone, by individuals, is sufficient to have an effect upon levels of hunting by the community at large. Rather, I would suggest that what ultimately limits Kundagai hunting of plume-bearing birds is the cultural ideal of equivalence and egality in exchange. This ideal inhibits the emergence of competetive and incremental exchange, and separates status from prowess in exchange. As such, trade is not a means for the accumulation of material goods or the generation of profit, and individual's participation in trade can be sustained adequately by only modest involvement in hunting.

Should trade become commercialized, however, inherent restraints on hunting pressure would be seriously modified, to the possible detriment of the capacity of the Kundagai to maintain a sustained harvest of plumes. In fact, by the mid-1980s, trade was increasingly monetized, and the traditional scale of customary exchange rates for different goods had given way to vigorous bargaining over price between some traders. Contrary to the situation elsewhere in Papua New Guinea, this did not result in increased hunting of birds as a means of earning money. The reason lies in the fact that central highlanders' demand for plumes from the Kundagai declined dramatically in the 1980s. Plumes have largely been replaced by money and other goods in ceremonial payments, and the occasions for traditional ceremonies requiring plumes as decorations greatly diminished. Central highlands traders no longer come as purchasers of plumes, but as sellers of pigs. Increasingly, they demand cash for pigs in their efforts to accumulate money for bridewealth and other payments. The Kundagai themselves were constrained to acceed to these changing demands in trade in order to maintain their own high demand for pigs for re-deployment in life-crisis prestations.

In essence, the declining demand for plumes in the central highlands and the growing emphasis on cash in exchange are symptomatic of the social and cultural transformations in the central highlands wrought by the intrusion and consolidation of the modern state. The political economy of the modern capitalist state in Papua New Guinea has rendered certain traditional objects, such as bird plumes, redundant to the social order. As such, it has ultimately undermined traditional trade where the objects of trade have no significant commercial value in national and international systems of exchange. This does not mean, of course, that hunting is of no consequence in communities like Tsuwenkai. It is still a means of provisioning local demand for plumes and meat, and as a pleasurable pursuit in itself for the enthusiast.

CONCLUSION

The comparison of the exploitation of biological resources of the forest in Borneo and New Guinea indicate alternative consequences of the intrusion of the state. The incorporation of traditional, subsistence-oriented people as dependent communities within the wider political-economic structures of the modern nation-state does not lead to an inevitable commercialization and overexploitation of forest resources. This is a likely outcome where traditionally exploited forest products continue to have value in wider national or international systems of exchange, or acquire such value. This occurred in Borneo. On the other hand, in at least some parts of New Guinea, the intrusion of the state led to the modification, even collapse of traditional trade and associated systems of production.

This has been to the detriment of some communities, such as the Kundagai, who are now enmeshed in an impoverished position as suppliers of cash to comparatively wealthy pig-providers of the central highlands who no longer desire Kundagai plumes. On the other hand, it has arguably meant that the traditionally exploited biological resource base has enjoyed a measure of protection it might have otherwise lacked.

In both examples of the impact of the state on the relation of subsistence-oriented communities to their forest resources we have seen significant changes in patterns of exploitation. The Punan of Long Sule abandoned a nomadic foraging lifestyle, adopting shifting agriculture and a more-or-less settled residence pattern. This amounts to a radical modification of their traditional relation with the forest though I do not know if this involved any substantial change in their ethnobiological knowledge base.

Similarly, the collapse of the plume trade for the Kundagai has meant that hunting of plume-bearing birds is of little consequence as a specialist activity. In itself, this does not inhibit hunting, but it may well result in a shift in the focus of the hunt, for example, from plumes to meat.

In both cases we can observe changing patterns in the exploitation of biological resources. I suggest that this is liable to have consequences for the ethnobiological knowledge base itself, where that knowledge is significantly shaped by experience. For example, changing patterns of interactions with the environment, as a consequence of the impact of the state, may lead to progressive loss of certain traditional skills, such as hunting, or a selective withering of the traditional knowledge base[2]. So far this does not appear to have occurred among younger generations of the Kundagai. Incorporation into the modern state and a global economy have not yet resulted in a marked erosion of ethnobiological knowledge.

However, a critical implication of the cases reviewed in this paper is that the particular forms taken by incorporation may have differential impact on systems of ethnobiological knowledge. These systems may be cognitively ordered in modified forms. But we should not simply expect an inevitable impoverishment of the traditional ethnobiological systems. What I am therefore suggesting is that it is appropriate for ethnobiologists to contextualize their studies carefully by reference to the political-economic constraints represented by the modern global economy. In this way, the points of conflict and transformation between traditional systems of ethnobiological knowledge and intrusive alternative systems of knowledge may be more readily identified, rather than assumed. At the theoretical level this may lead to further efforts to strike some accommodation and convergence between ethnoscience, human ecology, and political economy within the holistic framework of anthropological discourse.

NOTES

[1]What is meant by "precolonial" varies. Much of Borneo was not strictly colonized, although it fell under nominal control of Dutch and British protectorates from the mid nineteenth century. New Guinea was initially carved up among Dutch, German, and British interests in the late nineteenth century. Australia assumed control of the eastern half of the main island and its archipelagoes until the independence of Papua New Guinea in 1975. The former Dutch possessions in the west became the Indonesian Province of Irian Jaya in 1963.

[2]See Dwyer (1974) for an example of the loss of hunting skills and associated knowledge among younger generations of the Rofaifo of the New Guinea highlands.

ACKNOWLEDGEMENTS

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BOOK REVIEW

The Tasaday Controversy: Assessing the Evidence. Thomas N. Headland (Editor), 1992. Washington: American Anthropological Association Scholarly Series Special Publication no. 28. Pp. 255. $19.95 (paperbound). ISBN 0-913167-51-7.

The charge of "fraud" is one of the most devastating accusations which can be leveled against a scientist. Science as a whole, not just the individual scientist, can be adversely affected by the charge. Critics of science still use the example of the Piltdown skull to discredit the entire scientific community 80 years after this hoax was perpetrated.

This book discusses the controversy about the recently "discovered" Tasaday "Stone Age" people of the island of Mindanao in the Philippines. It gives an evenly balanced presentation, containing articles arguing for the authenticity of the Tasaday, and others maintaining the discovery was a hoax perpetrated by members of the Marcos regime. Arguments on both sides are detailed, well-researched, and compellingly written. These are followed by several more papers by outside researchers attempting to reconstruct the facts objectively from the meager evidence available.

In 1971, the Tasaday were described to the world as a Stone Age people with limited technology. Yet, even from the outset it was clear the Tasaday were no longer pristine. At best, they had already been affected by the people who brought them to the world's attention; at worst, they were a set of local villagers paid to act "primitive." No anthropologist today believes the early press reports of the Tasaday as holdovers living a life unchanged for millenia. The question now is how much of the early reports was accurate and how much was staged or simply exaggerated. The answer is probably somewhere between the two extreme viewpoints.

The only thing certain about the controversy is that not enough is known about the facts. From the beginning of the saga, political and media involvement prevented adequate investigation by trained anthropologists. The entire truth will probably never be known.

The number of books published on the Tasaday now outnumbers the Tasaday themselves. This book is, however, welcome in attempting to help settle the controversy. It is an issue in which we are all involved.

Joseph E. Laferrière
Arnold Arboretum of Harvard University
22 Divinity Ave.
Cambridge MA 02138 USA

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THE DISTRIBUTION AND ETHNOZOOLOGY OF REPTILES OF THE NORTHERN PORTION OF THE EGYPTIAN EASTERN DESERT

STEVEN M. GOODMAN
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, Illinois 60605

JOSEPH J. HOBBS
The Department of Geography
University of Missouri
Columbia, Missouri 65211

ABSTRACT.—In this paper we review the occurrence and distribution of reptiles known from the northern portion of the Egyptian Eastern Desert and the ethnozoology of these animals as viewed by a local Bedouin tribe, the Khushmaan Ma'aza. Particular emphasis is placed on reptile folklore, local names, taxonomy, use as medicine, and natural history as conceived by the Khushmaan; this information is contrasted with Western scientific thought. In most cases these two views are congruent with one another. The major exception is that the Bedouins consider several reptiles venomous which are not known to be so by herpetologists.

RESUMEN.—En este trabajo reseñamos la presencia y distribución de los reptiles conocidos de la porción norte del Desierto Egipcio Oriental, y la etnozoología de estos animales según son vistos por una tribu local de beduinos, los Khushmaan Ma'aza. Ponemos énfasis particular en el folclor, nombres locales, usos como medicina e historia natural de los reptiles, tal y como son concebidos por los Kushmaan; esta información es contrastada con el pensamiento científico occidental. En la mayoría de los casos las dos visiones son reciprocamente congruentes. La principal excepción es el hecho de que los beduinos consideran venenosos a varios reptiles que no son considerados como tales por los herpetólogos.

RÉSUMÉ.—Dans cet article, nous présentons une revue de la répartition géographique des reptiles de la partie septentrionale du désert égyptien oriental, ainsi que l'ethnozoologie de ces espèces d'après la perception d'une tribu locale bédouine, la tribu Khushmaan Ma'aza. Nous discutons les aspects du folklore liés aux reptiles, les noms régionaux, la taxinomie, les utilisations médicinales et l'histoire naturelle à travers la perception Khushmaan. Ces informations sont confrontées aux pensées scientifiques occidentales. Dans la plupart des cas, les deux perspectives ne sont pas opposées. La principale exception consiste dans le fait que les Khushmaan croient que certains reptiles sont venimeux, tandis que les herpétologistes réfutent cette croyance.

INTRODUCTION

By the nature of their unusual locomotion, habits, and life-cycles, snakes and lizards are often the subject of intrigue and a unique folklore. In numerous cases these perceptions exemplify the secretive habits and calamitous mystique of reptiles, including aspects such as disease, poison, death, and the bizarre. Often times the initial basis for these notions and beliefs appears to be some astute knowledge of an animal's habits, rather than the fantastic. Sometimes these natural history observations proceed through a series of cultural permutations that enrich the original information and become the fabric of indigenous environmental knowledge.

Many groups of pastoral nomads of the North African deserts have a rich body of information about the natural world, including the local reptiles. This extensive knowledge reinforces the nearly universal observation by ethnozoologists that various groups of people living in intimate contact with the natural world "know so much" about nature (Berlin 1992). To date only a small fraction of Bedouin ethnozoological knowledge had been researched and published. Other than cursory mention in several works (e.g., Bons 1959), little information on the ethnoherpetology of North African deserts has been published. Corkill (1935a, 1935b) discussed snake stories and snake traps from the Kordofan and Darfur provinces of the Sudan. Marinkelle (1959) reviewed the medicinal and nutritional uses of reptiles and amphibians found in the markets of Tunisia and Libya; he also mentioned some folk stories from the area. The folklore of Sudanese Nilotic people regarding a gecko was discussed by Cottam and Cottam (1923).

In this paper we attempt to narrow the wide gap in the ethnoherpetology of North Africa with the knowledge possessed by the Khushmaan Ma'aza Bedouins of Egypt's Eastern Desert. This presentation opens three subsequent opportunities for analysis herein and in future ethnozoological research. First, by examining Khushmaan nomenclature and perceptions of reptiles it is possible to learn how these people conceptualize some of the living things in their environment (Berlin 1992). This cultural information is important in its own right in filling existing gaps in knowledge about Bedouin peoples, and in allowing for potentially useful cross-cultural comparisons. Second, the environmental context of this cultural information may be quite instructive to Western science, particularly in disclosing the distribution, habitats, and habits of some Egyptian reptiles. Finally, the disparities between Khushmaan and Western scientific knowledge challenge the ethnoscientist with a puzzle: how can a people with such an intimate knowledge of nature be apparently so "wrong" about some major attributes of the animals they know?

THE KHUSHMAAN

The Khushmaan, a clan of the Ma'aza, is comprised of some 250 households in Egypt, of which about half are based in the Eastern Desert between the Qift-Qusseir road to the south and the El Koriamat-Zafarana road to the north (Fig. 1). These Arabic-speaking tribesmen immigrated to Egypt from northwestern Arabia beginning about 200 years ago. They are primarily pastoral nomads, tending camels, sheep, and goats. There is also a hunting and gathering component of

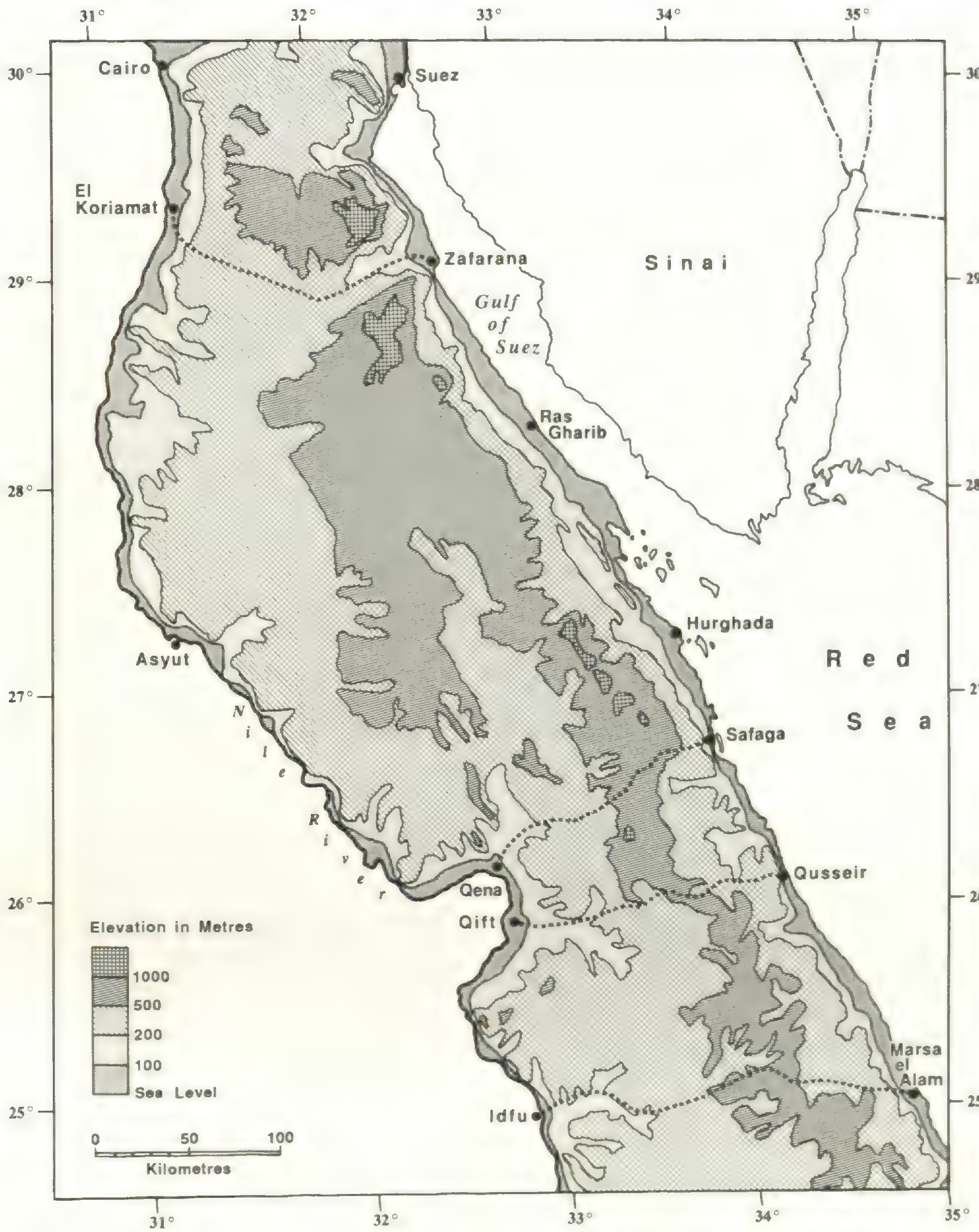

FIG. 1.—Topographical map of the northern portion of the Egyptian Eastern Desert.

their economy. The nomads themselves consume some wild resources, such as the meat of Nubian ibex *(Capra ibex nubiana),* and sell others, including the seeds of *Moringa* trees and foliage of *Artemisia* plants, for cash to market buyers in the Nile Valley (Goodman and Hobbs 1988). The Bedouins also obtain necessary food-stuffs and clothing from sedentary populations (Hobbs 1986, 1989).

The Khushmaan classify all reptiles, with the possible exception of *Uromastyx* (see below) and the little-known marine turtles (which are regarded as fish), in the category ***duud,*** literally "worm." All ***duud*** are believed to be egg-layers. Also in this taxonomic category are spiders, centipedes, ants, ticks, caterpillars, snails, beetles, and all other flightless, nonmammalian animals.

Khushmaan folk medicine for snakebite relies principally on the intervention of a ***hawi*** (feminine, ***hawiyya***), a kind of shaman whose only power is an ability to cure snake, spider, and scorpion bites and stings. Only certain persons can become a ***hawi*** or ***hawiyya.*** When he or she is an infant, the candidate is visited early in the morning on three successive days by a ***hawi*** or ***hawiyya*** who gives them a special drink and bestows his or her powers upon the candidate. The ***hawi*** or ***hawiyya*** does not administer medicine to snakebite victims, but rather breathes upon the bite, sometimes applying spittle to it, and recites special incantations. After five or six days, the patient usually recovers. Notably, the ***hawi*** or ***hawiyya*** is often supplemented by a "first aid" treatment, either cutting off the flesh around the bitten area with a knife; cauterizing the bite with a red-hot nail; or bleeding the bite by an incision, after blood has been brought to the skin surface by the vacuum action of a cup in which a match has been lit. An elderly Khushmaan man claimed that a piece of flesh from the ***rakhaam*** (Egyptian vulture, *Neophron percnopterus*) applied to the bite is sometimes an effective treatment.

THE REPTILES OF THE NORTHERN EGYPTIAN EASTERN DESERT

Several excellent works have been written on the reptiles of Egypt; however, the majority of these deal almost solely with the fauna of the Nile system (e.g., Anderson 1898; Flower 1933). In the past few decades some of the vast desert areas of Egypt have been surveyed zoologically and our knowledge of the local reptiles has increased many times over (e.g., Marx 1968; Capocaccia 1977). One area of the country where little information on the local reptile fauna is available is the Eastern Desert. Herein we restrict our discussion of this region to the northern portion, from the Nile Valley east to the Gulf of Suez and Red Sea, and from the Cairo-Suez Road south to the Idfu-Mersa el Alam Road (Fig. 1). This region is broader than the Khushmaan Ma'aza territory.

Since 1980 we have been working on joint and independent research projects in remote portions of the Egyptian Eastern Desert, and have made observations and collections of the local fauna and flora. In this paper we summarize data on the reptiles of the northern portion of the Egyptian Eastern Desert, combining our own information with previously collected material housed in museums.

To date, 30 reptile species have been recorded in the northern portion of the Egyptian Eastern Desert. These include: Gekkonidae—*Hemidactylus turcicus, Ptyodactylus hasselquistii, Stenodactylus stenodactylus,* and *Tropiocolotes steudneri;* Agamidae—*Agama agama spinosa, Trapelus mutabilis, T. savignyi, Pseudotrapelus sinaita, Uromastyx aegyptius,* and *U. ocellatus;* Lacertidae—*Acanthodactylus boskianus, Mesalina guttulata, M. rubropunctata,* and *Ophisops elegans;* Varanidae—*Varanus griseus;* Scincidae—*Chalcides ocellatus* and *C. sepsoides;* Colubridae—*Coluber florulentus, C. rhodorhachis, C. rogersi, Lytorhynchus diadema, Malpolon moilensis, Psammophis schokari, P. aegyptius,* and *Spalerosophis diadema;* Elapidae—

Walterinnesia aegyptia; and Viperidae—*Cerastes cerastes, C. vipera, Echis pyramidum,* and *E. coloratus.*

METHODS

A considerable portion of the information presented here on the distribution of reptiles in the northern Eastern Desert is unpublished. Distributionally important specimen records for species not included in Figs. 2–10 are mentioned in Appendix 1. For documentary purposes we have cited the museum registration numbers of exceptional specimen records[1].

In order to distinguish the information gathered from the Khushmaan informants from knowledge derived from our own work in the area, we have divided each "species" account into several headings. In most cases the information presented under the heading "Distribution" and always under "Comments" is our own; while that under the balance of headings is strictly from the Khushmaan perspective and should not be viewed in the light of Western scientific thought. Any exceptions to this are explicitly noted.

The systematic order and English common names generally follow Marx (1968) for reptiles, with the exception of the Agamidae which is after Moody (1980), and Täckholm (1974) for plants. The Khushmaan names for plants and their scientific counterparts are based on collections made by JJH in the Eastern Desert and deposited in the Herbarium of the National Research Center, Cairo, where they were kindly identified by Dr. Loutfy Boulos. The system used to transliterate Khushmaan Arabic words is based on Hobbs (1989). The coordinates of Egyptian localities mentioned in the text are presented in Table 1.

THE REPTILES

Family Gekkonidae
brays; gecko

Distribution.—Four species of geckos are known to inhabit the northern half of the Egyptian Eastern Desert: *Hemidactylus turcicus* (Turkish gecko), *Ptyodactylus hasselquistii* (fan-footed gecko), *Stenodactylus stenodactylus* (elegant gecko), and *Tropiocolotes steudneri* (Steudner's gecko) (Fig. 2; Appendix 1). *Ptyodactylus* is the most widely distributed gecko in the Eastern Desert.

Bedouin taxonomy.—No distinction seems to be made by the Khushmaan among different types of geckos.

Folklore.—The ***brays*** is poisonous and people die from contact with it. The venom is in the spittle ***(riig)*** and is contracted from it via the animal's tongue and not by bite. The poison may be spread by the ***brays*** visiting camps at night and crawling over food utensils or water-carrying vessels. After coming in contact with contaminated objects, the victim generally becomes extremely ill for about a week and then recovers. During that time the victim has no thirst, and may vomit after consuming liquids.

TABLE 1.—Gazetteer of Egyptian localities mentioned in the text.

Locality	Governorate	N. (°)	Lat. (′)	E. (°)	Long. (′)
Aın Sukhna	Suez	29	35	32	20
Beni Hassan	Minya	27	54	30	51
El Koriamat	Giza	29	18	31	13
Gebel Abul Hassan	Red Sea	26	57	33	21
Gebel Galala el Qibyla	Red Sea	ca.28	50	32	30
Gebel Gharib	Red Sea	28	07	32	54
Gebel Moqattam	Cairo	30	02	31	17
Gebel Qattar	Red Sea	27	05	33	22
Gebel Shayib el Banat	Red Sea	26	59	33	29
Gebel Suez	Suez	29	55	32	20
Hurghada	Red Sea	27	14	33	50
Idfu	Aswan	24	58	32	52
Ismailiya	Ismailiya	30	35	32	16
Katamiya Observatory	Red Sea	29	56	31	49
Mersa el Alam	Red Sea	25	04	34	54
Qift	Qena	26	00	32	49
Qusseir	Red Sea	26	06	34	17
Ras Gharib	Red Sea	28	21	33	06
Ras Zafarana	Red Sea	29	07	32	39
Suez	Suez	29	58	32	33
Umm Diisi	Red Sea	27	03	33	15
Wadi Abu Haadh	Red Sea	28	18	32	48
Wadi at-Tarfa	Red Sea	ca.28	25	30	50
Wadi al-Maniih	Red Sea	25	33	33	37
Wadi al-Radda	Red Sea	27	08	33	20
Wadi Araba	Red Sea	ca.29	07	32	39
Wadi Arkas	Red Sea	28	43	32	01
Wadi Askar	Red Sea	29	01	32	04
Wadi el Asyuti	Asyut	27	10	31	16
Wadi el Nasuri	Suez	30	10	31	29
Wadi Gindali	Suez	29	55	31	40
Wadi Hof	Cairo	29	53	31	18
Wadi Iseili	Suez	30	04	31	55
Wadi Qena	Red Sea	ca.26	12	32	44
Wadi Umm Haadh	Red Sea	26	20	33	23
Wadi Umm Tinaydhab	Red Sea	27	03	33	13
Wadi Umm Yasar	Red Sea	27	03	33	11
Zafarana	Red Sea	29	07	32	39

Bedouin natural history.—**Brays** are known to eat ***jaru,*** the fruits of ***lasaf*** *(Capparis cartilaginea).* The snake ***as-sill al-argat*** (*Coluber* sp., see below) is a recognized predator of geckos.

Comments.—No species of gecko is venomous. Similar beliefs on the dangerous nature of geckos are held by people residing in the Egyptian and Sudanese Nile

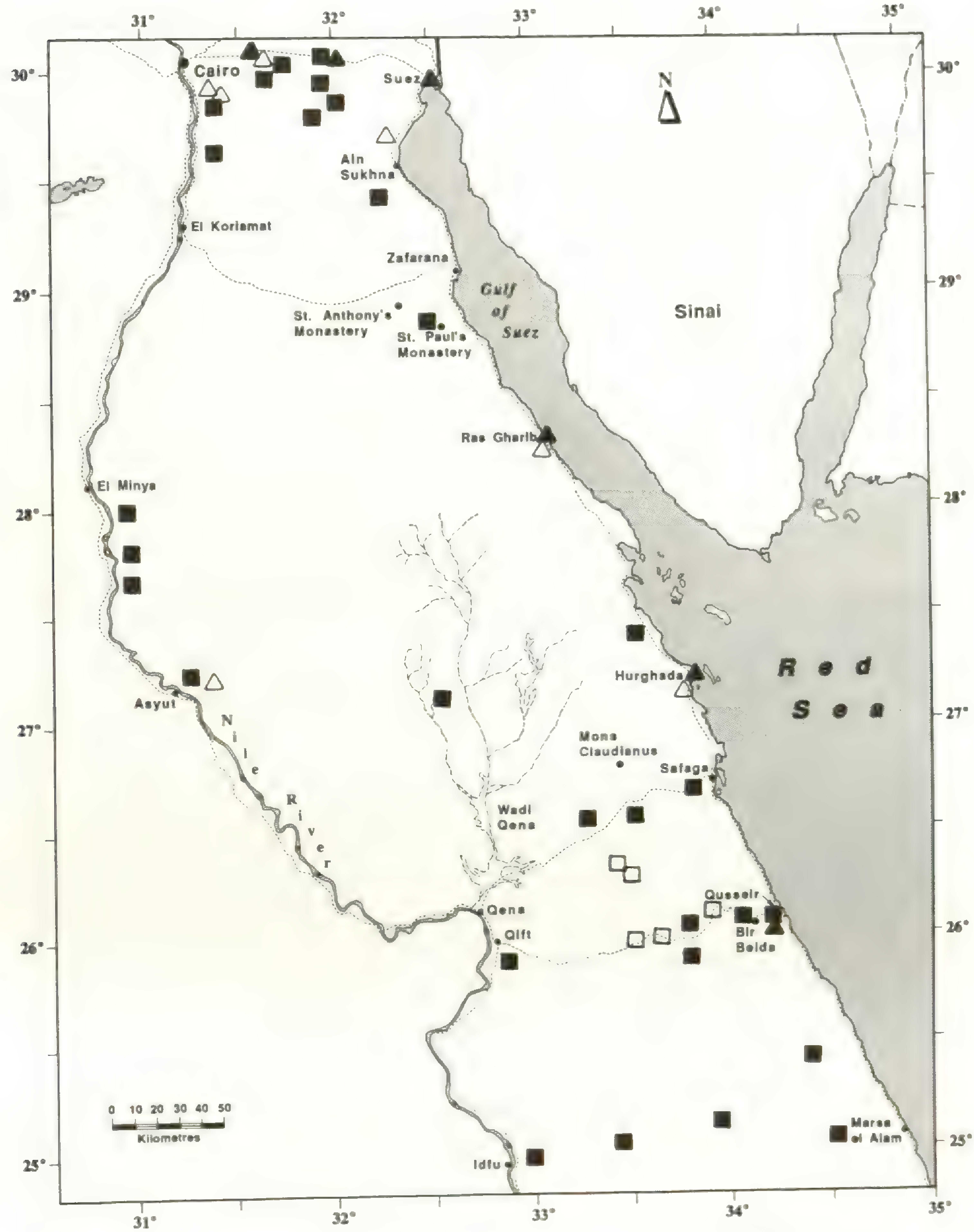

FIG. 2.—The distribution of **brays** in the northern portion of the Egyptian Eastern Desert. Records include *Ptyodactylus hasselquistii* specimens (closed squares) and observations (open squares), *Hemidactylus turcicus* specimens (closed triangles), and *Tropiocolotes steudneri* specimens (open triangles).

Valley (Cottam and Cottam 1923; personal observations). It is plausible that geckos occasionally consume ***jaru*** fruits.

Family Agamidae
Abu sayha; *Agama agama spinosa;* Gray's agama

Distribution.—This species occurs in both the granitic and limestone mountainous regions of the Eastern Desert (Fig. 3). It occurs at high elevations, e.g., the summit of Gebel Shayib el Banat (2,187 m. above sea level).

Bedouin etymology and taxonomy.—The word ***sayha,*** from which the name of this lizard was derived, means blue in Arabic. The term ***abu sayha*** is generally used for male *Agama agama spinosa* while the females are often put in the generic agamid category ***hibayna*** (see next entry).

Bedouin natural history.—This animal prefers rocky slopes. In the autumn (not in summer) the male ***abu sayha*** has red forelegs, like pants; the female is similar but lacks the prominent head spines. Six or seven eggs, very soft (the consistency of the skin on a person's forefinger) are deposited in rocky clefts. It consumes the fruits of *Capparis* sp. and ants (Tregenza 1955). This lizard hibernates during the winter and, in this state, cannot move if picked up.

hibayna; Agamidae lizards

Distribution.—***Hibayna*** is the Khushmaan designation for several species of agamid This term lizards inhabiting the northern portion of the Eastern Desert (Fig. 4). This term generally denotes *Pseudotrapelus sinaita* (syn. *Agama sinaita*), the Sinai agama, but it is also used for *Trapelus mutabilis* (syn. *Agama pallida* and *A. mutabilis),* the changeable agama; potentially *Trapelus savignyi* (syn. *Agama savignyi),* Savigny's agama; and often female *Agama a. spinosa,* also known as ***abu sayha.*** *T. savignyi* is known only from the northern edge of the Eastern Desert (Appendix 1). In summary, any agamid other than male *A. a. spinosa* is classified by the Khushmaan as ***hibayna.***

Bedouin natural history.—***Hibayna*** are known to eat **lasaf** fruits. They prefer rocky slopes or wadis with mixed sand and boulders. An important predator on these lizards is the snake ***as-sill al-argat*** (*Coluber* sp., see below).

dhabb; *Uromastyx* spp.

Distribution.—*Uromastyx aegyptius* (syn. *U. spinipes*) (Egyptian dabb lizard) and *U. ocellatus* (eyed dabb lizard) inhabit the northern portion of the Eastern Desert and are known by the Khushmaan as ***dhabb.*** *U. aegyptius* is locally common from the Cairo-Suez road south to Wadi Qena (Fig. 5). It lives in dispersed colonies, generally in sandy or gravelly areas with sparse vegetation. *U. ocellatus* occupies the southern half of the Eastern Desert; most records are from south of the mountainous granitic area west of Hurghada (Fig. 5). This species lives solitarily

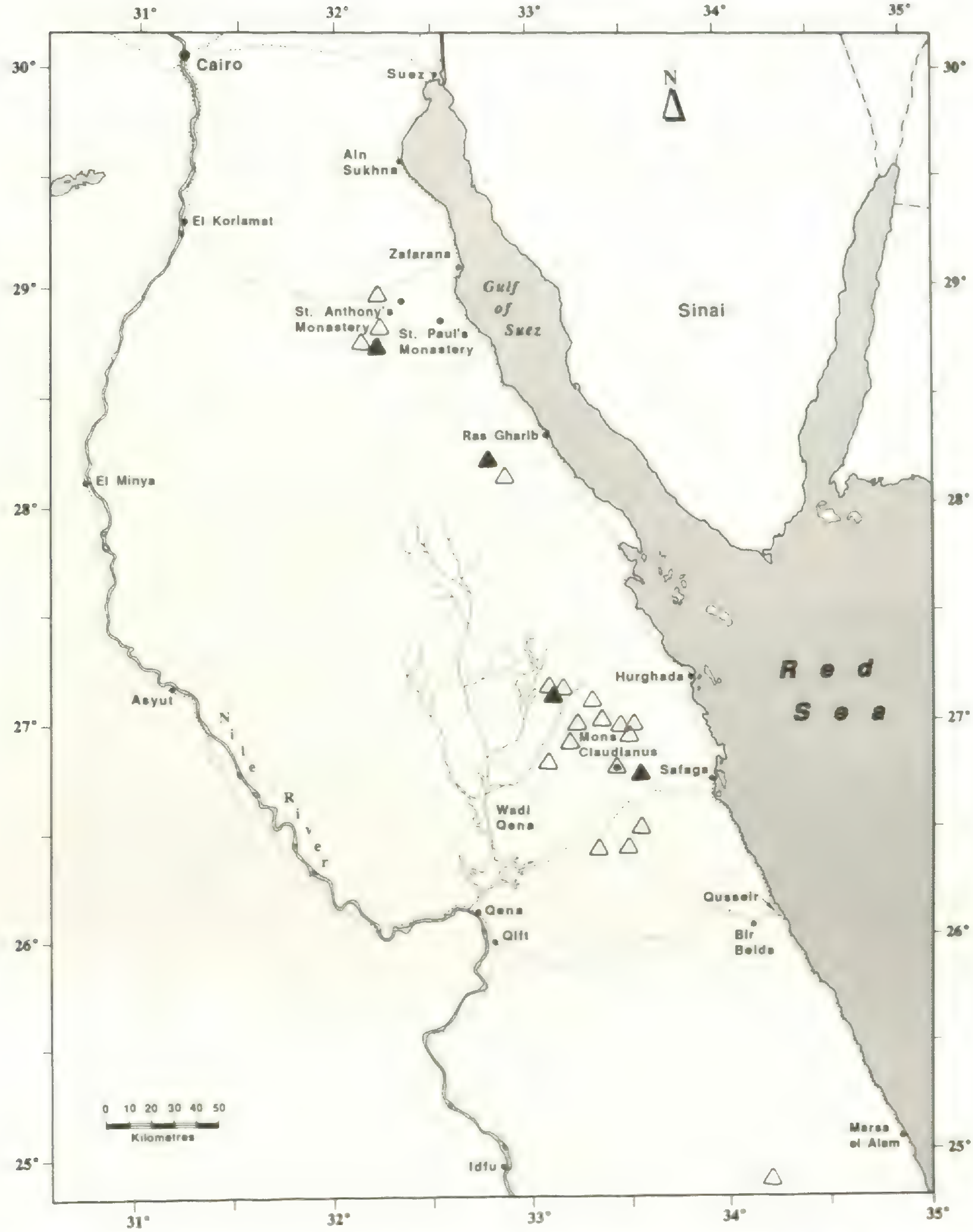

FIG. 3.—The distribution of ***abu sayha*** in the northern portion of the Egyptian Eastern Desert. Records include *Agama agama spinosa* specimens (closed triangles) and observations (open triangles).

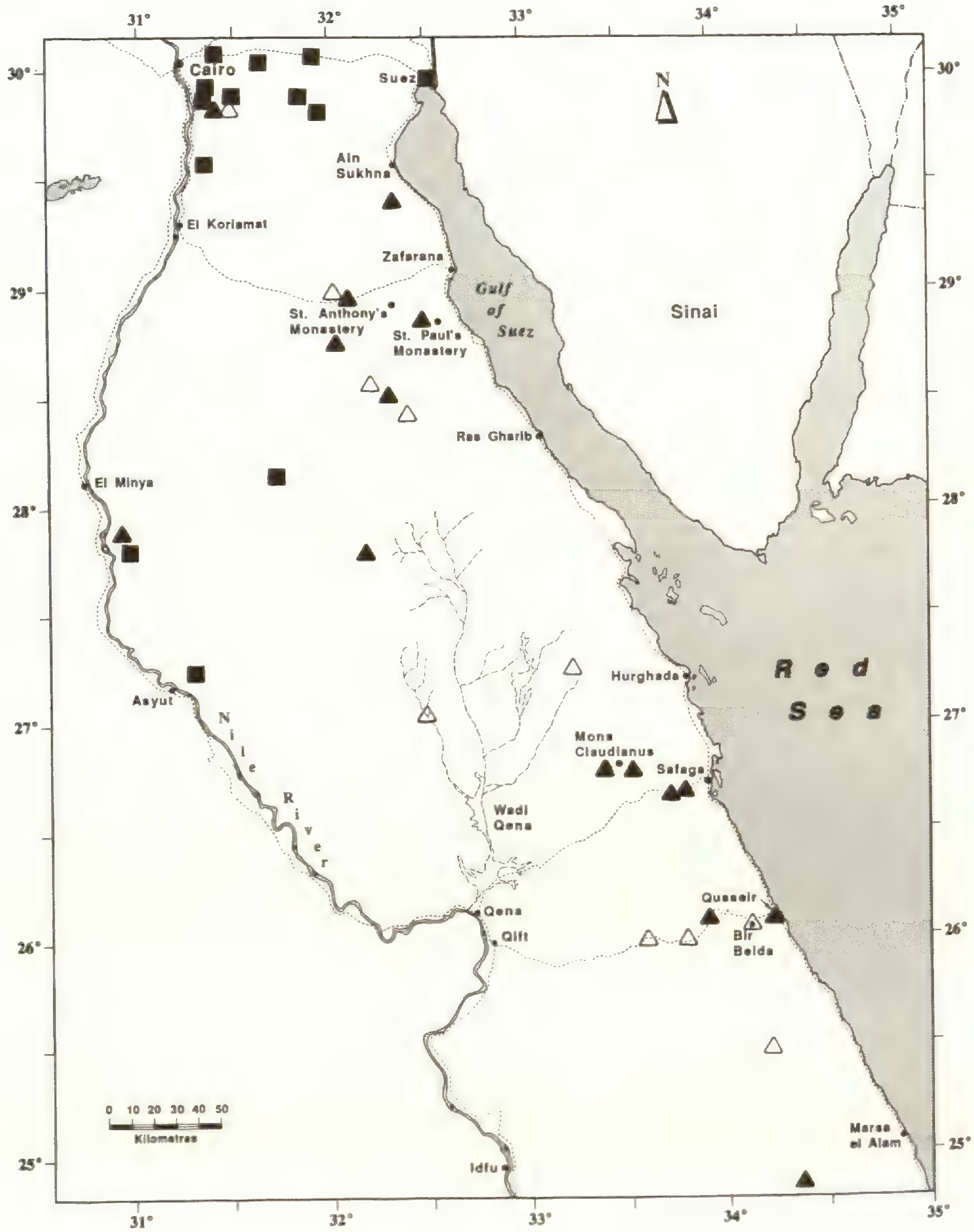

FIG. 4.—The distribution of ***hibayna*** in the northern portion of the Egyptian Eastern Desert. Records include *Trapelus mutabilis* specimens (closed squares) and *Pseudotrapelus sinaita* specimens (closed triangles) and observations (open triangles).

in rocky or mountainous habitat with relatively dense vegetation. Marx (1968) reported a third species, *U. acanthinurus* (Bell's dabb lizard), from the area; the specimen this record was based on has been examined (FMNH 164664), and it is a young *U. aegyptius.* A specimen obtained at Ismailiya (MHNP 1974.328) is referable to *U. acanthinurus;* however, some of the collecting details are not clear and this specimen should not be used as evidence for the occurrence of this species in the Eastern Desert.

Bedouin taxonomy.—No linguistic distinction is made by the Khushmaan between *U. aegyptius* and *U. ocellatus,* although they recognize two types of ***dhabb:*** the large one *(U. aegyptius)* occurring in the habitat of gravel plains such as Wadi Qena and Wadi Araba, and the smaller one (*U. ocellatus)* in the mountainous regions typified by such locales as Gebel Qattar, Gebel Abul Hassan, Wadi Umm Yasar, and Umm Diisi. Some Khushmaan feel the ***dhabb*** belongs to the class known as ***hayawaan,*** the true ruminating animals, because it eats only plants. Others, however, point out that the ***dhabb*** is an egg-layer, unlike the other animals of the ***hayawaan*** category. The Khushmaan find significance in the resemblance between the hands of people or ***bani adam*** and the ***dhabb.***

Folklore.—Some Khushmaan have eaten the flesh of this lizard, but this is ***haraam*** (forbidden). When the flesh of the ***dhabb*** is placed in a fire, it twitches and shakes. Once a Khushmaan threw a rock at a ***dhabb,*** hitting it on the head. The lizard put its hands to its head, like a person with a headache. The ***dhabb*** is much respected for saving the Prophet's life. The Prophet Muhammad was fleeing from a person who wanted to kill him. After the Prophet entered a cave, a ***dhabb*** emerged and with his spine-covered tail erased the Prophet's tracks in the sand, throwing off the pursuer.

Bedouin natural history.—The small ***dhabb*** is particularly fond of eating the flowers and seed pods of ***markh*** *(Leptadenia pyrotechnica)* and ***sayaal*** *(Acacia raddiana).* It also consumes ***kibaath*** *(Launea spinosa),* ***'awshiz*** *(Lycium shawii),* ***hurbith*** *(Lotononis platycarpa),* ***himaadh*** *(Rumex vesicarius),* and ***dharagrag*** *(Trigonella stellata).* The Khushmaan explain that the resemblance of the ***dhabb***'s tail to the ***dhanaba dhabb*** plant *(Blepharis ciliaris)* accounts for the plant's name, which means "tail of the ***dhabb***." The plant ***yahmiim dhabbaani*** *(Trichodesma africana),* "the ***dhabb's yahmiim*** plant," is named for the small ***dhabb***'s fondness of eating it.

The Khushmaan note that only four animals are active and feed at the hottest part of the day: the ***dhabb, dhabi*** (gazelle, *Gazella dorcas*), ***badan*** (ibex), and ***bill*** (camel). The ***dhabb*** goes into its hole in winter and does not surface for 40 days; there it eats its own dung to stay alive. The small ***dhabb*** lives under rocks, not in tunnels like its larger counterpart. Predators include ***abul-husayn*** (fox, *Vulpes* spp.), ***ihdayii*** and ***'ugaab*** (assorted hawks and eagles), and ***sagr*** (falcons). The Khushmaan have observed that if you give chase to a ***dhabb*** and beat the animal to its hole, it will "surrender" and allow you to pick it up.

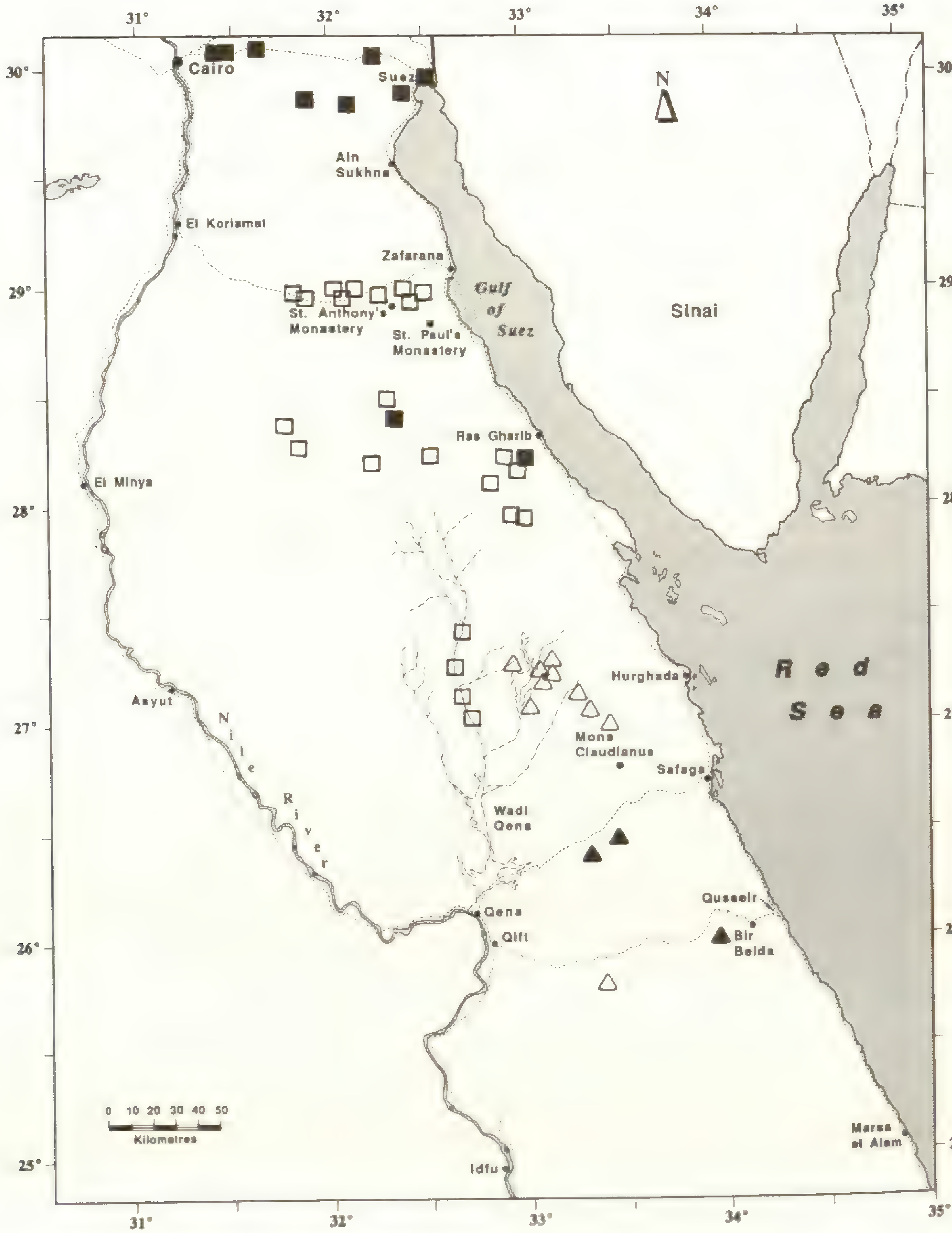

FIG. 5.—The distribution of ***dhabb*** in the northern portion of the Egyptian Eastern Desert. Records of *Uromastyx aegyptius* include specimens (closed squares) and observations (open squares) and *U. ocellatus* specimens (closed triangles) and observations (open triangles).

Family Lacertidae
arabuuna; lizard

Distribution.—Four species of lacertid lizards are known from the Khushmaan territory and all are collectively known as ***arabuuna***. These include: *Acanthodactylus boskianus*, Bosc's lizard; *Mesalina guttulata* (syn. *Eremias guttulata*), small-spotted lizard; *Mesalina rubropunctata* (syn. *Eremias rubropunctata*), red-spotted lizard; and *Ophisops elegans*, Ménétries lizard (Fig. 6; Appendix 1).

Bedouin taxonomy.—The Khushmaan do not differentiate by name among any of the lacertid lizards living within their territory.

Folklore.—***Arabuuna*** are respected by the Khushmaan and are not to be harmed. "If a little boy tries to catch it . . . an old man says to him, no, don't kill the lizards, my son; they hold the keys to paradise." The ***erebona*** [= ***arabuuna***] drinks not like ***bani adam*** and most animals, but with its tongue like a dog (Tregenza 1955).

Bedouin natural history.—These lizards tend to live in sandy wadi bottoms with sparse or essentially no vegetation. Known predators include the ***as-sill al-argat*** snake (*Coluber* sp., see below), the ***raahu*** (white stork, *Ciconia ciconia*), and the ***ghuraab*** (brown-necked raven, *Corvus ruficollis*).

Family Varanidae
warran or ***waral;*** *Varanus griseus;* desert monitor

Distribution.—This species is rare and widely dispersed throughout the northern portion of the Eastern Desert (Fig. 7).

Folklore.—The ***warran*** is considered venomous. A Khushmaan informant related how the efficacy against snake bite of a plant called ***muliih*** *(Reaumuria hirtella)* was discovered. Long ago, a man saw a battle between the poisonous ***aaf*** snake (probably a cobra) and the ***warran.*** The monitor when fatigued and bitten ran periodically to a ***muliih*** bush and rubbed itself in it, returning repeatedly to do battle with the ***aaf.*** The man watching the fight uprooted the plant. The ***warran*** found the plant missing and could not "recharge," and was quickly dispatched by the snake.

Bedouin natural history.—The ***warran*** is a voracious snake killer and uses its whip-like tail to dispatch prey. It sleeps under trees and does not dig a burrow. When the sun is high and there is no shade, the ***warran*** seeks shelter in rodent burrows and other holes, where there may be a ***hanash*** (*Cerastes cerastes*, see below).

Comments.—The desert monitor is not venomous. The exceptionally strong and agile tail is used as a whip to stun and sometimes kill prey. The fine, sharp teeth readily cut through flesh. This species is known to excavate burrows (Vernet 1977).

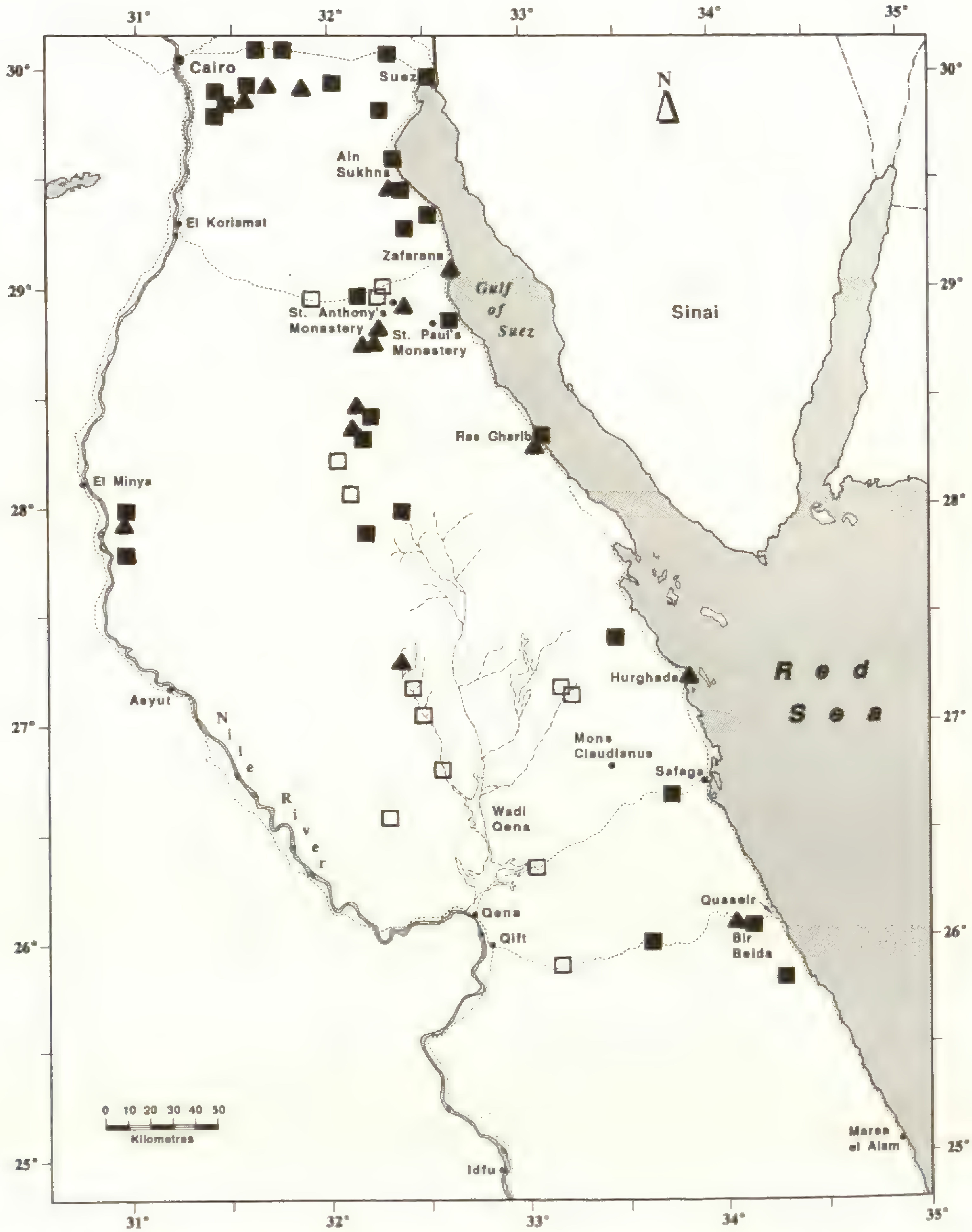

FIG. 6.—The distribution of ***arabuuna*** in the northern portion of the Egyptian Eastern Desert. Records of *Acanthodactylus boskianus* include specimens (closed squares) and observations (open squares) and *Mesalina guttulata* specimens (closed triangles).

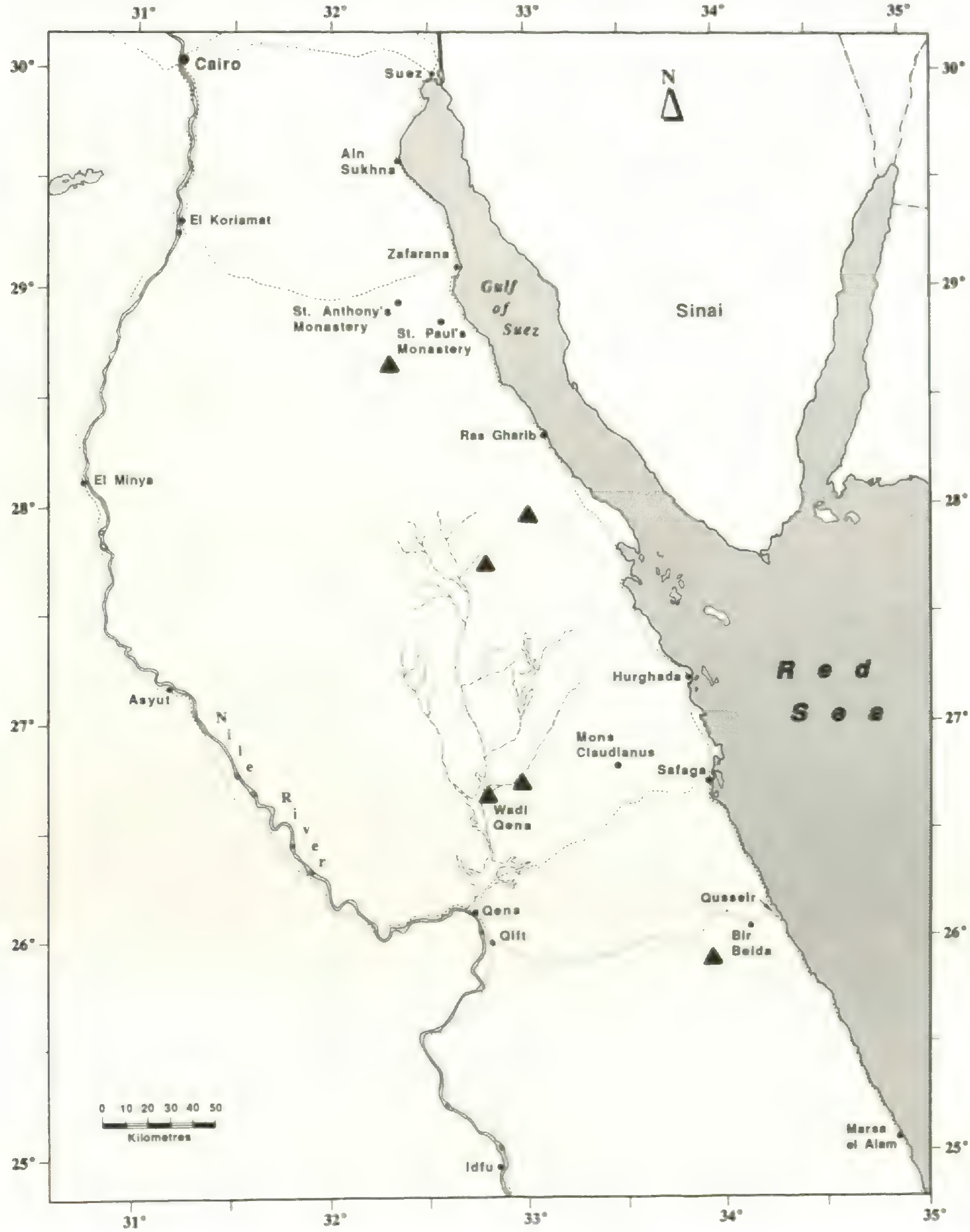

FIG. 7.—The distribution of *warran* in the northern portion of the Egyptian Eastern Desert based on sight observations of *Varanus griseus* (closed triangles).

Family Scincidae
mallaja; *Chalcides* spp.; skinks

Distribution.—Two species of scincids are known from the northern portion of the Eastern Desert: *Chalcides ocellatus* (eyed skink) and *C. sepsoides* (Audouin's sand skink) (Appendix 1). Some records from the area may be of accidental introductions by people; skinks regularly turn up in supplies and are occasionally carted between localities, perhaps most often from the Nile Valley to the Eastern Desert. For example, a specimen of *C. ocellatus* found by JJH in camp supplies in Wadi Umm Tinaydhab almost certainly was carried from Wadi al-Radda.

Bedouin taxonomy.—No apparent distinction is made by the Khushmaan between these two species. Only *C. ocellatus* was captured in the company of our Bedouin informants. Another lizard, called ***lukaaz,*** described as similar to the ***mallaja*** and never observed by us, may well be *C. sepsoides.*

Folklore.—The ***mallaja*** is venomous and responsible for the death of many people, particularly the aged. The virulent spittle (***riig***) is passed via the tongue instead of fangs, in a similar fashion to the ***brays.*** If a person is "bitten" and then goes into sunlight, they will die immediately; even in the shade the chance of succumbing to the poison is great.

Bedouin natural history.—The Khushmaan consider the ***mallaja*** to be a rare animal in their territory. Many middle-aged Bedouin have never seen this animal. It is known to bury itself in ***guff,*** the accumulated needle-like leaves of the ***yasar*** tree *(Moringa peregrina),* or in sand. These skinks have the ability to disappear into and move quickly through sand.

Comments.—No skink is known to be poisonous.

Family Colubridae
as-sill al-argat or ***sill abraq;*** *Coluber* spp.

Distribution.—All of our records of this genus from the Khushmaan territory are of *C. rhodorhachis,* Jan's desert racer (Fig. 8). However, specimens and records of *C. florulentus* (flowered snake) and *C. rogersi* (Roger's snake) are known from the northern portion of the Eastern Desert (Appendix 1; Anderson 1898; Flower 1933; Marx 1968).

Bedouin taxonomy.—This snake is classified as a type of ***aaf*** (probably a cobra). Only *C. rhodorhachis* was found by us in the company of our Bedouin companions. Another snake, called ***dhaawi,*** about 50 cm long, black and white, and with a body shape like ***as-sill al-argat,*** may well be one or both of the other *Coluber* spp. known from the region.

Folklore.—The ***as-sill al-argat*** is thought to be venomous. No deaths are known, but some bite-victims get sick. An infusion or poultice of the plant ***muliih*** is good treatment for the bite of this snake.

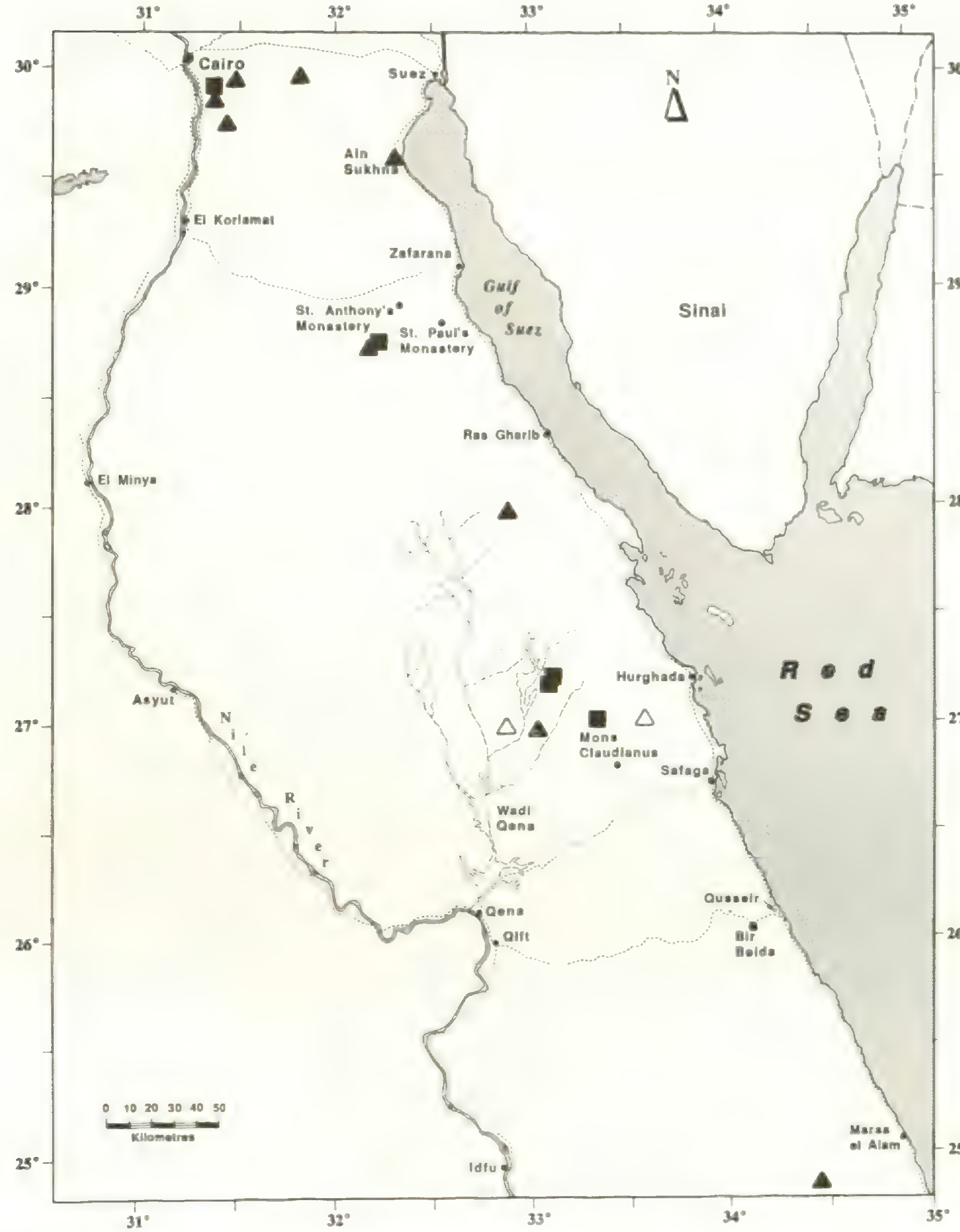

FIG. 8.—The distribution of ***as-sill al-argat*** and ***hidhif*** in the northern portion of the Egyptian Eastern Desert. Records include specimens and photographs of *Coluber rhodorhachis* (closed squares), and specimens of *Echis coloratus* (closed triangles) and observations (open triangles).

Bedouin natural history.—The ***as-sill al-argat*** is rare in the area. The snake's locomotion is different from the ***hanash*** (viper) in that it is not a side-winder but rather leaves an "S-shaped" track. The ***as-sill al-argat*** eats ***brays, arabuuna,*** small ***hibayna,*** and small ***abu shawk*** rodents *(Acomys cahirinus).*

Comments.—No *Coluber* spp. is known to have fangs or to be poisonous.

sill; *Psammophis* spp.

Distribution.—The systematic status of *Psammophis* in the area is unresolved. Marx (1958) described the species *P. aegyptius* (Saharan sand snake) from the Egyptian Western Desert and distinguished it from *P. schokari* (Schokari sand snake) by differences in coloration and scale counts. Since Marx's paper the status of *P. aegyptius* has varied from a subspecies of *P. schokari* to full species status (e.g., Kramer and Schnurrenberger 1963; Marx 1968; Welch 1982). There are areas within Egypt where *P. aegyptius* and *P. schokari* are sympatric (Goodman et al. 1985), and both have been collected in the Egyptian Eastern Desert (Fig. 9).

Bedouin natural history.—The ***sill*** is often found under bushes such as ***gurdhy*** (*Ochradenus baccutus*), ***natash*** *(Crotalaria aegyptiaca),* and ***markh*** where they lie in wait for small birds attracted to the vegetation. They are known to take several types of birds including ***kalb is-hayl*** (bee-eater, *Merops apiaster*), ***fisaysi*** (warblers, Family Sylviidae), and ***slaygaw*** (wheatears, *Oenanthe* spp.). This snake is aggressive and when handled will readily bite people, but is not venomous. It hibernates in winter.

Family Elapidae
aaf; cobra?

Identification and distribution.—We have not been able to capture or view any snakes referred to as the ***aaf*** in the company of our Bedouin informants. The identification of this animal with a single species of snake is problematical, in part because of the variation in the Bedouin's descriptions of its appearence. It is reported by some Khushmaan as being a very long venomous snake, with a hood, and green to beige coloration. It is common in the ***riif*** (Nile Valley), but not in the desert. A very black ***aaf*** was once observed by a Bedouin in Wadi al-Maniih. Another Khushmaan description of the ***aaf*** is that it moves in a straight line like the ***sill,*** and is whitish grey with white spots (Tregenza 1958).

The only elapid known from the Eastern Desert is the rare *Walterinnesia aegyptia* (Inne's cobra), which occurs in the northern portion of the area (Appendix 1). It is completely black and the record from Wadi al-Maniih may well be of this species. Two other cobras, *Naja naje* (Egyptian cobra) and *N. mossambica* [= *N. nigricollis*] (spitting cobra) are found in the Nile Valley, but to our knowledge have not been documented in the Eastern Desert very far from the valley. One Khushmaan mentioned that the ***aaf*** lives in the middle elevations (300–600 m above sea-level) of the basement-complex mountains, such as Gebel Qattar.

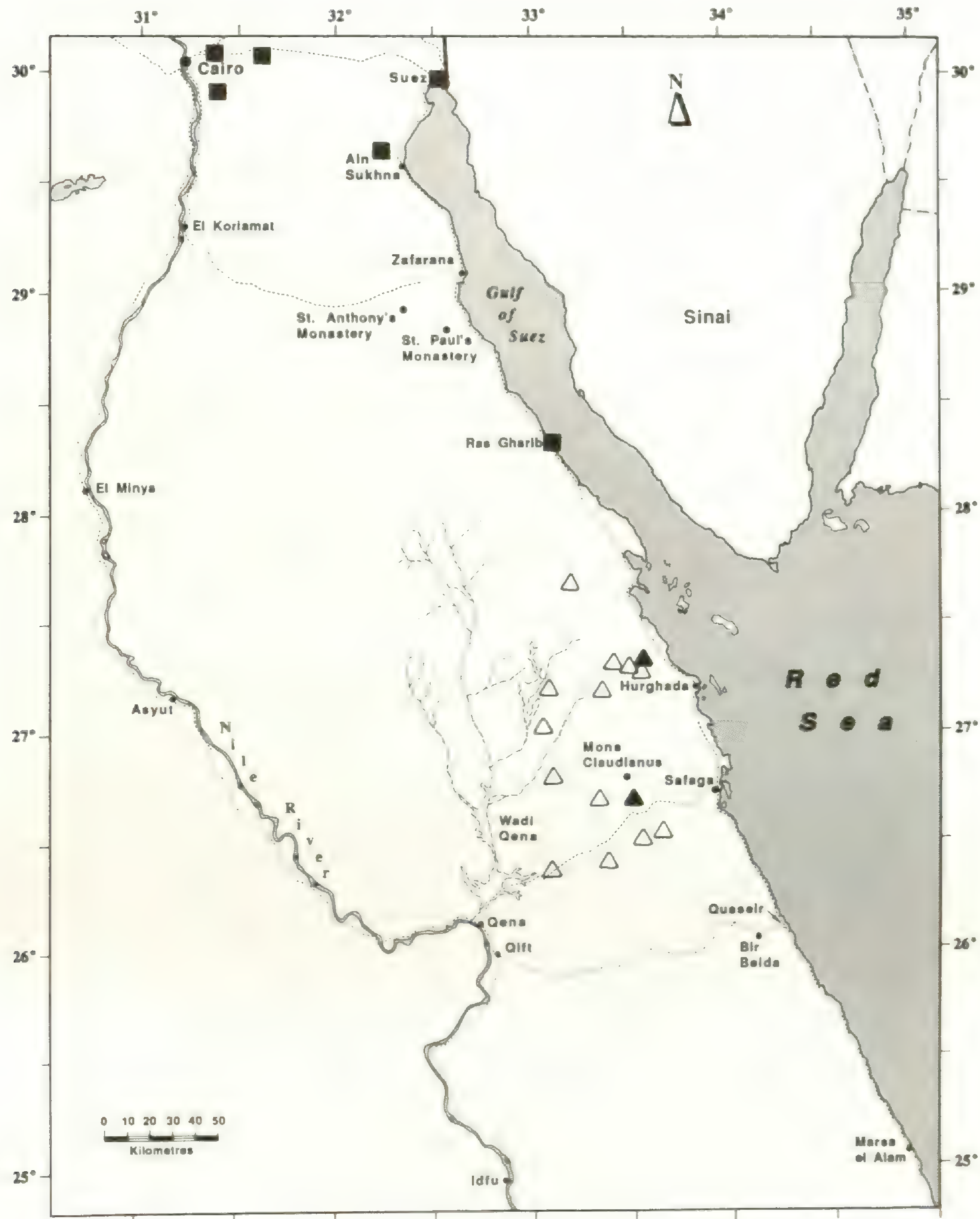

FIG. 9.—The distribution of ***sill*** in the northern portion of the Egyptian Eastern Desert. Records include specimens of *Psammophis schokari* (closed squares) and *P. aegyptius* (closed triangles) and observations of *Psammophis* spp. (open triangles)

Folklore.—In a battle between the ***warran*** and the ***aaf,*** people first learned about the medicinal qualities of a plant called ***muliih*** (see discussion of ***warran).***

Family Viperidae
hanash; *Cerastes cerastes;* greater horned viper

Distribution.—This species is widely distributed throughout the region (Fig. 10). It tends to occur in sandy wadi bottoms with sparse vegetation. A drainage west of Wadi Qena with a particularly high concentration of ***hanash*** was named by the Bedouins ***"Umm Duud,"*** "the mother of crawling creatures."

Folklore.—The ***hanash*** is the only animal which the Khushmaan invariably kill when they encounter it. The virulent venom of the ***hanash*** poses a serious threat to these desert nomads, particularly children. ***Hanash*** are generally killed by direct blows. If the animal is hidden in a large bush such as ***gurdhy,*** the vegetation is set ablaze. Dispatched vipers are often buried in the ground, so that if a person or domestic animal steps on the bones they will not be envenomated. The animal's entire body is regarded as toxic. Thus, for example, if an ant has been feeding on the carcass of a viper and then crawls on your food or utensils, you may be indirectly poisoned.

Bedouin natural history.—The Khushmaan report that ***hanash*** come in different color phases and with or without horns. All ***hanash*** are side-winders. Some Bedouins believe that vipers with horns ***(abu guruun,*** the "father of horns") are always males. It is reported that the ratio of hornless:horned ***hanash*** is about 6:1 or 7:1. For example, of seven vipers killed near Gebel Gharib in one week, only one had horns, and of six infant vipers found in one spot, only one possessed horns.

There is some disagreement as to whether the fox eats this snake; some informants stated that fox do not consume vipers, while others said they readily do so. Fresh remains of a viper were found in a fox cache in Wadi Umm Haadh. Dogs ***(kalb)*** apparently eat ***hanash*** with no ill effects. The ***warran*** hunts the ***hanash*** by swishing its tail in rodent burrows and other holes where the snake resides. When it finds a sleeping viper, the ***warran*** strikes the snake with its whip-like tail, causing the snake to raise the front portion of the body. The ***warran*** then bites the snake's head off; it always defeats the ***hanash.***

Vipers regularly take ***slaygaw*** and ***fisaysi.*** They often hunt for these birds from the ground below or from middle branches of ***markh*** bushes. When ***slaygaw*** (particularly the mourning wheatear, *Oenanthe lugens)* spot a viper they hover over it and give a distinctive alarm call. Wheatears performing this action are occasionally taken by the snake. In several cases Bedouin were tipped off about the presence of a ***hanash*** by the behavior of a ***slaygaw.*** This snake is also known to eat ***abu sayha*** (Tregenza 1958).

Vipers are more common in summer than at other times of the year, and become more so after rain, when vegetation cover and rodent populations increase. They are regularly found under ***yasar*** and ***markh,*** the latter particularly in the summer. It is thought that during the winter, when vipers are in holes or

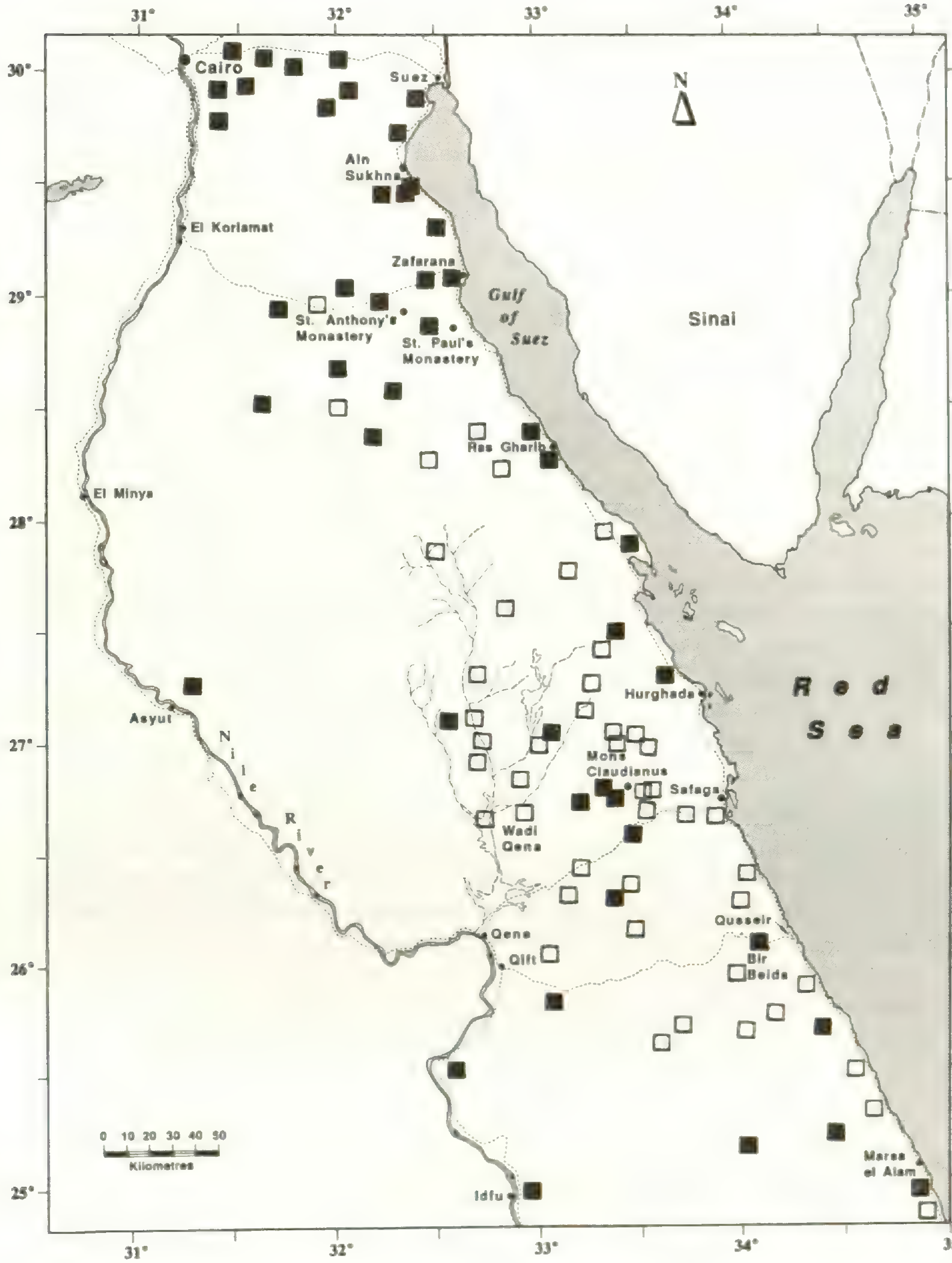

FIG. 10.—The distribution of ***hanash*** in the northern portion of the Egyptian Eastern Desert. Records of *Cerastes cerastes* include specimens (closed squares) and observations (open squares).

burrows, they eat sand to survive. ***Hanash*** never drink water. They can often be found in and under ***mashta*** *(Cleome droserifolia);* a plant known to repel other pests such as ticks. One informant mentioned they had once found eight viper eggs in loose wadi-bottom sand, buried less than one inch below the surface. Infant ***hanash,*** like the adults, make a characteristic ***manaam al-hanash*** or viper-sleeping place in the sand. This is a subtle but sure clue to the Bedouins of the viper's presence below the surface.

Hanash *bite*.—There are many vivid accounts of Khushmaan being bitten by this snake, the venom of which is not always fatal. At one discussion of this topic, the Khushmaan recalled 13 or 14 people who were bitten by vipers but survived. Children and elderly persons often succumb to the venom. Most deaths occur three or more days after the bite; often the person appears to be recovering and then dies. In other cases the victim expires almost immediately. There are several cases of people being bitten on different occasions and surviving each instance. Numerous camels have died after being bitten by this snake on the nose or mouth.

There is disagreement about some of the treatments for ***hanash*** bite. A few Khushmaan believe the application of a poultice of garlic to the bite is useful; more commonly a poultice of the plant ***muliih*** is applied to bites on both people and domestic animals. Treatment by a ***hawi*** or ***hawiyya*** is always desirable.

sayda; *Cerastes vipera;* lesser horned viper

Distribution.—*Cerastes vipera* is a rare snake in the northern portion of the Eastern Desert and is apparently confined to sandy wadis and dunes (Appendix 1; also see Anderson 1898; Flower 1933). We did not meet with this species during our travels in the region. Bedouin informed us the ***sayda*** is found in sandy areas of Wadi at-Tarfa, Wadi Arkas, and Wadi Abu Haadh.

Bedouin description.—This snake is described as a small venomous viper, 100–130 mm long, with a blackish tail and a slim white to greyish body. It buries itself in the sand. We were unable to observe a ***sayda*** in the company of our Khushmaan companions, but the above characteristics are diagnostic of *Cerastes vipera*.

Medicine.—There is some variation in the type of snake used in the Khushmaan medicinal concoction to make one "strong" and to treat backache. One informant mentioned it is the ***sayda,*** not ***hidhif*** (*Echis coloratus,* see next species), that is skinned, the body dried between flat stones, crushed to a powder, mixed with a small amount of milk, and drunk. (Also see Tregenza [1958] for a detailed description of the preparation and use of this medicine.)

hidhif; *Echis coloratus;* Burton's carpet viper

Distribution.—*Echis coloratus* lives in rocky areas throughout the northern portion of the Eastern Desert (Fig. 8). Another species, *Echis pyramidum* (syn. *E. carinatus*), the saw-scaled viper, has been collected on the edge of the region (Appendix 1).

Bedouin natural history.—The ***hidhif*** favors rocky areas and is often found between cracks in stones. It occurs at high altitudes, including the summit of Gebel Shayib el Banat (2,187 m above sea-level).

Hidhif** bite.*—The venom of this snake is extremely virulent and equal to that of the ***hanash. The complete animal (skin, meat, and spittle) is regarded as poisonous. Some people are apparently immune to the snake's venom; a ***hidhif*** bit one Khushmaan and he survived, although the finger affected became deformed.

Medicine.—A dried ***hidhif,*** crushed, mixed with milk, and drunk makes one strong and able to walk great distances. A similar concoction, minus the head, is used to relieve backaches.

DISCUSSION

The Khushmaan Ma'aza Bedouins of Egypt's Eastern Desert categorize nearly all reptiles as ***duud,*** literally "worms" but meaning essentially "crawling, non-ruminating, unclean animals." This single category incorporates what are two distinct categories in most cultures, as related by Brown (1984): "snake," including featherless, furless, elongated creatures usually lacking appendages, and "wug," small creatures other than those pertaining to "bird," "fish," and "snake" categories. In this respect, Khushmaan folk taxonomy differs from the classification scheme present in the modern standard Arabic of urban cultures in the Middle East, which differentiates "snake" and "wug" and awards each virtually the same degree of salience (Landau 1959; Brown 1984). It is also notable that while most peoples who combine these categories inhabit high latitudes where reptiles are scarce or inconspicuous (Brown 1984), the Khushmaan live in an environment where reptiles are varied, numerous, and even conspicuous.

Khushmaan classification of most reptiles as ***duud*** verifies Berlin's principle that ethnobiological taxonomy is based primarily on affinities which people have observed among the taxa themselves, independent of cultural significance of these taxa (Berlin 1992). There is an extremely wide range of Khushmaan cultural attributes to reptiles, and these have clearly challenged the Bedouin themselves with some important questions about their own hierarchical scheme of the natural world. Some reptiles are to be respected for their contributions to humankind: the *Uromastyx* lizard saved the Prophet Muhammad's life; the lacertid lizards hold the "keys to paradise;" and the desert monitor revealed the medicinal efficacy of a plant. Other reptiles are demonized and like the vipers are to be destroyed on sight or like the geckos to be avoided altogether. The cultural status of *Uromastyx* is so peculiar that individual Bedouins disagree on whether it deserves a special "betwixt and between" category outside of the ***duud.*** It is believed to ruminate and to have anatomical and behavioral likenesses to humans. Some Bedouins therefore regard it as "clean" and edible, while others emphasize that it is too humanlike to kill. Such variations in ethnobiological information are common within cultures, often varying with the gender and age of the informants (Berlin 1992); however, no particular pattern in these differences is apparent with the Khushmaan. There is consensus on the vipers: they are toxic, unclean, and not to be consumed. Yet here again culture has created exception to its own apparent rule: prepared properly for eating, some vipers are highly effective analgesics and stimulants.

Khushmaan reptile taxonomy has a high degree of correspondence with Western scientific classification, particularly at the generic level. As has been observed in most folk classification schemes, taxa of subgeneric rank have a lower degree of correspondence with Western scientific taxonomy (Berlin 1992). There is remarkable overlap in Khushmaan and Western scientific knowledge of many of the dietary and other behaviors of desert reptiles. More striking contrasts exist between Western scientific and Khushmaan knowledge about the toxicity of these animals. The Bedouins regard as venomous several species which are not known to be by western herpetologists, notably the geckos, skinks, desert monitor, and some colubrid snakes. They recognize the saliva of these creatures as highly dangerous, and capable of inflicting sickness or death on people even by minimal contact with eating utensils. In most cases, they regard as poisonous the entire body of the creature, not merely its head, venom, or saliva.

Khushmaan ethnoherpetology thus presents its Western counterpart with opportunities and puzzles. On the one hand, as the Bedouin natural history notes in this paper reveal, the nomads have much to teach others about the distribution, habitats, habits, and life-cycles of desert wildlife. Other Khushmaan observations are more challenging. We trust the knowledge and insight of the Bedouin who, unlike us, can detect a viper hidden beneath the sand. Can we also rely on their observation that vipers eat sand, and that the animal's entire body is quite deadly? From the Bedouin point of view, it is clear that we have not spent enough time observing the animal to know that it eats sand, but why can not we see the viper buried in the sand and why do not we know that all of the animal is poisonous? Future partnerships in the field will reveal more about our cultures and the natural worlds we perceive.

NOTE

[1]The following acronyms have been used: BMNH = British Museum (Natural History), London; CAS = California Academy of Sciences, San Francisco; FMNH = Field Museum of Natural History, Chicago; MHNP = Muséum National d'Histoire Naturelle, Paris; UMMZ = University of Michigan Museum of Zoology, Ann Arbor; and USNM = United States National Museum, Washington, D.C.

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APPENDIX 1.

Specimen records of some rare or uncommon reptiles in the northern Egyptian Eastern Desert (includes some species mentioned in main text).

Family Gekkonidae

Stenodactylus stenodactylus—Wadi Hof (BMNH 1910.6.3.4); 29 km east of Cairo along Cairo-Suez Road (FMNH 82821); road to Katamiya Observatory (FMNH 152637); and Ras Gharib (BMNH 97.10.28.22).

Family Agamidae

Trapelus savignyi—37 km south of halfway point along Cairo-Suez Road (FMNH 152887).

Family Lacertidae

Mesalina rubropunctata—Ain Sukhna (FMNH 75566); and Ras Gharib (FMNH 78700).

Ophisops elegans—Wadi Araba, near Ras Zafarana (FMNH 152664-65).

Family Scincidae

Chalcides ocellatus—100 km east of Cairo along Cairo-Suez Road (FMNH 72228); branch of Wadi Iseili, 24 km east Katamiya Observatory (FMNH 152716); 48 km west of Suez (FMNH 78993); Ain Sukhna (FMNH 75555); Gebel Qattar (UMMZ 177842); and Wadi el Asyuti (FMNH 152720).

Chalcides sepsoides—Wadi Gindali (FMNH 152642); 48 km west of Suez (FMNH 78976–78); and Ain Sukhna (FMNH 75556).

Family Colubridae

Coluber florulentus—Suez (USNM 130593); and "Eastern Desert" (USNM 136426).

Coluber rogersi—17 km east of Cairo, near Suez Road (FMNH 75290); and Wadi el Nasuri (FMNH 69262).

Lytorhynchus diadema—Gebel Galala el Qibyla, mouth of Wadi Askar (UMMZ 183173).

Malpolon moilensis—17 km east of Cairo, near Suez Road (FMNH 75284).

Spalerosophis diadema—Wadi Iseili, 24 km east of Katamiya Observatory (FMNH 153050).

Family Elapidae

Walterinnesia aegyptia—Gebel Suez, near Suez (FMNH 68810); Wadi el Nasuri (FMNH 72025, 72321); and about 36 km east of Cairo (FMNH 69240).

Family Viperidae

Cerastes vipera—branch of Wadi Iseili, 36 km east of Katamiya Observatory (FMNH 142976); and Beni Hassan (BMNH 97.10.28.636).

Echis carinatus—Gebel Moqattam (BMNH 11.1.3; USNM 37339; CAS 38722).

J. Ethnobiol. 14(1):101–105 Summer 1994

NEWS AND COMMENTS

COMMENTS, RESPONSES, OPINIONS, and notes on **COURSES AND DEGREES IN ETHNOBIOLOGY** and **REQUESTS FOR INFORMATION** may be submitted to the News and Comments editor in addition to items for the sections included below. Because the Journal is published only twice a year, dated items must be received at least six months in advance of the event.

PROJECTS AND PROGRAMS

The **Centre for Nutrition and the Environment of Indigenous Peoples (CINE)** recently opened its new offices and laboratories on the Macdonald Campus of McGill University in Ste-Anne-de-Bellevue, Quebec. Established as an independent and permanent research and education center for Indigenous Peoples, CINE addresses concerns about the integrity of traditional food systems. The staff of CINE is focusing initially on Northern Canada, but looks to develop links and cooperative programs internationally.

CINE represents a novel partnership in which Indigenous Peoples and academically-trained scientists work together in a university setting. Its policies, research, and educational activities are determined by a Governing Board composed of representatives of the Assembly of First Nations, Council for Yukon Indians, Dene Nation, Inuit Circumpolar Conference, Inuit Tapirisat of Canada, and the Metis Nation of the Northwest Territories. The director of the Centre is Harriet V. Kuhnlein and the associate director is Timothy Johns. Graduate students can become associated with the Centre by registering in an affiliated degree program at McGill University. For further information contact the director or associate director at CINE, McGill University, Macdonald Campus, 21,111 Lakeshore, Ste.-Anne-de-Bellevue QC, Canada, H9X 3V9; telephone 1.514.398-7544; fax 1.514.398-1020; E-mail address CYNE@MUSICA.MCGILL.CA.

Participants in the **Ethnobotany Task of the Conservation Commission of the Northern Territory,** Australia are focusing on promoting traditional Aboriginal plant use through a variety of programs and publications. Based on ethnobotanical surveys carried out with speakers of Djambarrpuyngu, Emi/Batjamal, Alawa, Mudburra, Mangarrayi, Ngarinyman, and many other languages, they have developed plant walks in the Darwin Botanic Garden, posters, and popular booklets. A booklet on Mudburra ethnobotany, for example, contains descriptions of 99 species of useful plants, many of which are illustrated to facilitate identification in the field. The booklets, inspired by the wish of Aboriginal elders to record their traditional knowledge, are designed and produced to stimulate younger Aboriginal people to learn about traditional culture in their contemporary school curriculum. In addition, attractive full-color posters for the general public have been produced on themes such as Bush Medicine, Bush Timber, and Bush Pandanus.

The ethnobotanical information from various Aboriginal groups has been consolidated in a comprehensive publication, *Traditional Aboriginal Medicines in the Northern Territory of Australia.* This 650-page book details the local uses of 167 medicinal plants as well as some animals and minerals that have been documented over the course of the eight-year project. For more information, write to Ethnobotany Task, Conservation Commission of the Northern Territory, P.O. Box 496, Palmerston, N.T. 0831, Australia; telephone 61.89.894513; fax 61.89.323849 or 61.89.894510.

The **Foundation for Revitalisation of Local Health Traditions (FRLHT)** is a nongovernmental organization whose main objective is to bring about a revival of India's medical heritage. The FRHLT has begun a medicinal plants conservation project in Kerala, Karnataka, and Tamil Nadu, three states in southern India. A network—called INMEDGERN (Indian Medicinal Plants Genetic Resources Network)—will coordinate activities in over thirty Medicinal Plant Conservation Areas for *in-situ* conservation as well as some 15 *ex-situ* conservation areas to be established over the next three years in cooperation with Forest Departments and environmental and health NGOs. These areas will protect a large number of plant species—including endemics and threatened medicinal plants—in all major forest and vegetation types of the region, from thorny scrub to rain forests. In addition, the conservation sites will be used to demonstrate methods for sustainable production and use of medicinal plants in classical and folk systems of Indian medicine. For additional information, contact FRLHT, 50, 2nd Stage, 3rd Main, MSH Layout, Anand Nagar, Bangalore—560 024, India; Telephone 91.80.3336909; Fax 91.80.3334167.

CONFERENCES AND SEMINARS

The **IV International Congress of Ethnobiology (ICE)** will be held in India under the auspices of the International Society of Ethnobiology. The focal theme of this congress is "Ethnobiology in Human Welfare." It will be held from November 17–21, 1994, in the historic city of Lucknow, 500 km east of Delhi, northern India, at the National Botanical Research Institute (NBRI) and Central Drug Research Institute (CDRI). The ICE programme will include plenary sessions, symposia, contributed papers, and poster sessions. The official language will be English, although posters in other languages will be accepted. Registration fees are US$100 for international delegates, US$60 for students and delegates from developing countries, and Rs. 800 for participants from India. Fees for accompanying persons are 25% less. A number of postcongress field trips and sightseeing tours are being planned. For the latest circular and any additional information, contact: Dr. S.K. Jain, Chair, Organising Committee Fourth ICE, National Botanical Research Institute, Lucknow, India 226001; telephone 91.522.236431; telex 0535-2315; fax 91.522.244330 or 243111.

JOURNALS AND OTHER MEDIA

The **Regional Network for the Chemistry of Natural Products in Southeast Asia** publishes a newsletter twice a year. The latest issue (volume 17, number 1; January–June 1993) contains country reports on activities carried out in the member nations, research reports and general news on scientific exchanges, lecture series, and conferences. The Network, which started operations in 1975, is a regional grouping of 11 countries. Its main purpose is to strengthen research and training capabilities of national faculties and institutions through regional programs such as training courses, workshops, seminars, and exchange of personnel and information, and to promote regional cooperation in the advancement of sciences. It receives financial support from UNESCO's regular budget and through funds-in-trust which are largely contributed by the government of Japan. For more information, contact: Mr. Fumin Zhang, Programme Specialist, Unesco Regional Office for Science and Technology for Southeast Asia, Jalan M.H. Thamrin 14, Tromolpos 1273/JKT, Jakarta 10012, INDONESIA; telephone 62.21.3141308; fax 62.21.3150382.

The **Botany 2000—Asia Newsletter** is published 4 times a year by the UNESCO Regional Office of Science and Technology for South and Central Asia. The latest issue (volume 2, number 4; December 1993) contains news on workshops, training courses, databases, projects, and forthcoming meetings as well as reports on unauthorized collection and export of medicinal plants from the region. The editor requests one to two page articles and reports of seminars and meetings of general relevance to botany and ethnobotany in Asia. Apart from producing the newsletter, the UNESCO Botany 2000—Asia program sponsors occasional workshops on the taxonomy, ethnobotany, and chemistry of various plant families as well as training courses in herbarium techniques and curation. For more information, contact: Marius van Alphen, editor, UNESCO/ROSTSCA, 8 Poorvi Marg, Vasant Vihar, New Delhi 110057, INDIA; telephone 91.11.677310, 676308, 676285 or 676588; fax 91.11.6873351.

BOOK REVIEWERS NEEDED

The following titles have been received for review in the *Journal of Ethnobiology* and are still awaiting reviewers:

The Ethnobotany of Southern Balochistan, Pakistan, with Particular Reference to Medicinal Plants. Steven M. Goodman and Abdul Ghafoor. Fieldiana: Botany: New Series, No. 31, 1992. Pp.v, 84. (paperbound). ISSN 0015-0746.

Aboriginal Health and History: Power and Prejudice in Remote Australia. Ernest Hunter. New York: Cambridge University Press. 1993. Pp. 318. ($59.95) (hardcover). ISBN 0-521-41629-9.

The Cultural Relations of Classification: An Analysis of Nuaulu Animal Catagories From Central Seram. Roy Ellen. Cambridge University Press: Cambridge Studies in Social and Cultural Anthropology, 1993. Pp. 315. ($64.95) (hardcover). ISBN 0-521-43114-X

Domestication of Plants in the Old World (Second Edition). Daniel Zohary and Maria Hopf. Clarendon Press: Oxford Science Publications, 1993. Pp. 278. ($35.00) (hardcover). ISBN 0-19-854795-1

Edible Wild Plants of Sub-Saharan Africa. Charles R. Peters, Eileen M. O'Brien, Robert B. Drummond. Kew, Richmond, Surrey: Royal Botanic Gardens. 1992. Pp. 239. (15 £) (softcover). ISBN 0 947643 51 6.

Foraging and Farming in the Eastern Woodlands. Edited by C. Margaret Scarry. University Press of Florida, 1993. Pp. 366. ($49.95) (hardcover) ISBN 0-8130-1235-X

The Iron Age Community of Osteria dell'Osa. A Study of Socio-political Development in Central Tyrrhenian Italy. Anna Maria Bietti Sestieri. Cambridge, U.K.: Cambridge University Press, 1992. Pp. xii, 271. ISBN 0-521-32628-1.

Life Cycles. Reflections of an Evolutionary Biologist. John Tyler Bonner. Princeton, New Jersey: Princeton University Press, 1993. Pp. 209. $19.95 (hardcover). ISBN 0-691-03319-6.

Native American Cultural Resource Studies at Yucca Mountain, Nevada. Richard W. Stoffle, David B. Halmo, John E. Olmsted and Michael J. Evans. Ann Arbor: Institute for Social Research, The University of Michigan. 1990. Pp. xxiv, 232. (paperbound). ISBN 0-87944-328-6.

The Nature of Shamanism: Substance and Function of a Religious Metaphor. Michael Ripinsky-Naxon. State University of New York Press, 1993. Pp. 289. ($57.50) (hardcover). ISBN 0-7914-1385-3

Phytolith Systematics: Emerging Issues. George Rapp, Jr., and Susan C. Mulholland (Editors). New York: Plenum Press, 1992. Pp 350. $49.50 (hardcover). ISBN 0-036-44208-6.

Polynesian Herbal Medicine. W. Arthur Whistler. Lawai, Kauai, Hawaii: National Tropical Botanical Garden. 1992. Pp. x, 238. ISBN 0-915809-16-8.

Primate Behavior: Information, Social Knowledge, and the Evolution of Culture. Duane Quiatt and Vernon Reynolds. Cambridge University Press: Cambridge Studies in Biological Anthropology, 1993. Pp. 322. (hardcover) ISBN 0-521-35255-X

Progress in Old World Palaeoethnobotany. A retrospective view on the occasion of 20 years of the International Work Group for Palaeoethnobotany. Willem van Zeist, Krystyna Wasylikowa and Karl-Ernst Behre (Editors). Rotterdam, Netherlands and Brookfield, Vermont: A.A. Belkema, 1991. Pp. ix, 350. $60.00 (hardcover). ISBN 90-6191-881-2.

Smallholders, Householders. Robert McC. Netting. Stanford, California: Stanford University Press, 1993. Pp. xxi, 389. $49.50 (hardcover), $16.95 (paperback). ISBN 0-8047-2061-4 (hardcover), 0-8047-2102-5 (paperback).

Soils in Archaeology: Landscape Evolution and Human Occupation. Editied by Vance T. Holliday. Smithsonian Institution Press, 1992. Pp. 254. ($39.95) (hardcover) ISBN 1-56098-111-3

Weaving the Threads of Life: The *Khita* Gyn-Eco-Logical Healing Cult Among the Yaka. Rene Devisch. Chicago: The University of Chicago Press, 1993. Pp. 323. ($19.95) (paperbound). ISBN 0-226-14326-7

If you would like to review any of these books and would be able to have your review completed within four months after receiving the book, please write to:

Nancy J. Turner
Book Review Editor for the *Journal of Ethnobiology*
Environmental Studies Program, P.O. Box 1700
University of Victoria
Victoria, British Columbia
CANADA V8W 2Y2
phone: (604) 721-6124; FAX (604) 721-7212; e-mail: njturner@sol.uvic.ca

BOOK REVIEWS

Ayahuasca Visions: The Religious Iconography of a Peruvian Shaman. Luis Eduardo Luna and Pablo Amaringo. Berkeley, California: North Atlantic Books. 1991. Pp. 160. $60.00 (clothbound). ISBN 1–55643–064–7.

Amazon Healer: The Life and Times of an Urban Shaman. Marlene Dobkin de Ríos. Bridport, United Kingdom: Prism Press (2 South Street, Bridport, Dorset, DT6 3NQ England). 1992. Pp. 180. $10.95 U.S.; 7.95 pounds sterling (paperback). ISBN 1–85327–076–8.

Guiado Pela Lua: Xamanismo e Uso Ritual da Ayahuasca no Culto do Santo Daime. Edward MacRae. São Paolo, Brazil: Editora Brasiliense (Av. Marquês de São Vicente 1771, São Paolo 01139, Brasil). 1992. Pp. 163. (price not given; text in Portuguese) (paperback). ISBN 85–11–07035–4.

In keeping with the recent upsurge in lay and scientific interest in shamanic inebriants in general, and in the pan-Amazonian entheogenic potion *ayahuasca* in particular, we have here three recent books on the subject of contemporary, quasi-traditional, mestizo use of *ayahuasca,* mainly in an urban setting. Although there has been a modern resurgence in use of ancient entheogens like *péyotl* (*Lophophora williamsii* [Lem.] Coulter) and *teonanácatl* (psilocybian mushrooms, especially *Psilocybe* species), *ayahuasca* had found its niche in the modern world long before its "rediscovery" by the entheogenic subculture. Mestizo *ayahuasqueros,* having abandoned their jungle homes for city life, have continued to practice shamanic healing in urban areas of Peru and Colombia, even as their Indian relatives continued, in ever decreasing measure, to commune with *Sacha Runa* (the "jungle man") and other "plant spirits," in ever-diminishing islands of primary rainforest throughout Amazonia. This urban shamanic use of *ayahuasca* is the subject of *Ayahuasca Visions* and *Amazon Healer,* whereas the Portuguese *Guiado Pela Lua* (*Guided by the Moon: Shamanism and Ritual Use of Ayahuasca in the Santo Daime Cult*) focuses on the syncretistic Christian church of *Santo Daime,* which has adopted *ayahuasca* as the Eucharist. Both the religious and urban shamanic use of the Amazonian ambrosia continue to expand internationally, far beyond their South American homes.

Ayahuasca Visions is a large-format art book, with 49 full-color, 19.7x26.4 cm plates of tempera paintings by Peruvian shaman/artist Pablo Amaringo, a bilingual Quechua speaker born in Peruvian Amazonia of parents with Cocama, Lamista (or Lama) and Piro Indian blood (all three traditional *ayahuasca*-using groups). After a general introduction to the subject of Amazonian shamanism and *ayahuasca* by Luna, there follows Luna's biography of Amaringo, in which we learn how he first sampled the potion at age 10, and became a *vegetalista* or plant-using healer in the late 1960s. Much of this interesting biography consists of Amaringo's own words, and we also learn how he became a painter, and how Luna "discovered" his art in 1985. Besides detailed landscape paintings, Amaringo had painted a couple of his *ayahuasca* visions; indeed, he says he learned to paint from *ayahuasca*. On questioning Amaringo with regard to plants and other elements depicted in his visions, Luna realized that he had uncovered an entirely novel means of recording ethnobiological information. Over the next several years, there flourished a rich collaboration between Amaringo and Luna (Luna is a Colombian anthropologist, currently a lecturer at the Swedish School of Economics in Helsinki, Finland), with Luna providing art materials and funding to enable Amaringo to paint some 100 different *Ayahuasca Visions,* from which 49 were selected for reproduction in the book.

Following an introductory comment on the visions and their most common motifs, and the musical score and lyrics of a typical *ayahuasca* melody or *icaro,* there are reproduced 48 of the visions (number 49 appears on the cover) in vibrant, phantasmagoric color. Each vision is accompanied by 1–2 pages of text written by Amaringo himself, explaining the vision, its mythological background, and identifying the individual plants and animals present. Amaringo's text is accompanied by extensive analytical notes written by Luna with more detailed and specific scientific information, especially of an ethnobotanical nature. Here there is a plethora of new ethnological and ethnobotanical data, demonstrating incontrovertibly the validity and utility of this novel means of ethnographic documentation. Luna has also helped establish Amaringo in the Latin American art market by promoting and selling his original art works, and aided him in founding an art school in the Peruvian Amazon, the Usko-Ayar Amazonian School of Painting, presently with some 600 students! Luna has also promoted the work of the more talented of Amaringo's students through lectures, shows and an annual calendar, and there is evidence that this vibrant artistic movement has rekindled interest in traditional medicine and culture among the younger generation of Amazonian artists. Luna and Amaringo are to be commended for this superb example of the integration of shamanism and science; veritably the art of ethnobotany in full flower! Besides being a lavish visual feast, *Ayahuasca Visions* is a rich source of scientific information, and features the largest bibliography on *ayahuasca* yet assembled, and a useful 5-page (5 columns *per* page) index, including scientific and vernacular names for the organisms depicted in the visions. The book is well bound and printed on good quality paper: a good value in light of the 49 color plates and density of information these and the accompanying analytical notes represent.

Marlene Dobkin de Rios' new book on *ayahuasca* (a companion to her well-known 1972 *Visionary Vine: Hallucinogenic Healing in in the Peruvian Amazon,* republished in 1984 (Dobkin de Rios 1972) is a biography of her father-in-law, the Peruvian *ayahuasquero* Don Hildebrando Ríos, who hails from the same part of the Amazonian basin as Pablo Amaringo. Born in 1917 near the Amazonian urban center of Pucallpa, Peru, Don Hilde lives and practices in this polyglot city, located in traditional territory of the Shipibo and Cashiva Indians. Dobkin de Ríos characterizes urban *vegetalistas* and/or *ayahuasqueros* like Don Hilde as the mestizo descendants of the tribal shaman/healer known throughout Amazonia's many indigenous groups. After centuries of proselytizing, first by the Jesuits (from 1630–1768), who preached the Gospel in 39 Indian languages, then by the Franciscans, and more recently by various Protestant groups such as the Instituto Lingüistico de Verano, and after the urbanization favored by the rubber boom and the subsequent petrol boom, little of indigenous Amazonian culture has remained untouched. Dobkin de Ríos here gives special attention to Septrionism, a branch of esoteric Christian mysticism/spiritualism which has especially influenced Don Hilde, and which she and her husband experienced at first hand, as initiates to the Septrionic Mystical Order in Lima. Dobkin de Ríos also studied 95 members of Don Hilde's patient cohort, characterizing the group as 83% practising Christians with 17% Evangelical Protestants among them, and gives short case histories of 21 patients to illustrate the sort of care they solicit from their *doctorcito.* The author documents two "particularly impressive cases" in which "it was clear that a healing had taken place," and in a curious introductory chapter, attempts to explain or justify traditional healing by the "transducer effect," a haphazard look at scientific concepts like hypnosis, endogenous analgesics and immune stimulation—this is the least successful part of the book and might better have been left out.

An important chapter, "The Plant Pharmacopoeia" suffers from insufficient ethnobotanical information. The author discusses "hallucinogenic [sic] plant use" by Don Hilde, mentioning *chiricsanango* without giving its botanical identification (*Brunfelsia grandiflora* D. Don subsp. *schultesii* Plowman—should one dig a bit, it can be found in Table II that the "probable botanical name" of this plant is *B. grandiflora*). Whereas *chacruna* is identified in the text as *Psychotria viridis* Ruíz et Pavón; one has again to dig into the tables to discover that the *toé* additive to *ayahuasca* is a *Brugmansia* species. A number of the 32 organisms (including insects) cited in Table I (Don Hilde's pharmacopoeia) are not identified scientifically at all, and the data on 11 plants mentioned in Table II is sketchy, the author stating "botanical identification is not available for the plants in this list but may conform to identifications by Plowman. . . ." In a field study involving a considerable number of ethnomedicinal plants, this is simply not acceptable. Why was the botanical identification not available? Why did the author fail to collect and deposit voucher specimens of all of the medicinal plants she mentions? This would not be up to standards in ethnobiological journals such as the *Journal of Ethnobiology* (Anon. 1990), and any ethnobiologists would do well to adhere to scientific journal standards in book publications as well. There is no chemical/pharmacological information given regarding the entheogenic plants used by Don Hilde, also a significant omission. After a chapter in which some of Don Hilde's conversations with the author are recorded intact, the book concludes with a chapter on the "*vidente* phenomenon" or clairvoyance, an attempt by Dobkin de Ríos to frame the proper line of inquiry for field work of this type. A short glossary precedes a small but useful bibliography, and the book suffers from the lack of an index.

Edward MacRae's second book *Guiado Pela Lua* fills an important gap in the literature on the Amazonian *ayahuasca* complex—the history and sociology of the Brazilian cult of *Santo Daime*, a contemporary Christian cult grounded in Amazonian shamanism, in which the use of *ayahuasca* as sacrament is fundamental. Apart from a paper in Spanish on one (primarily urban) Brazilian branch of this cult (Henman 1986), and two short papers on branches of the cult in Acre (Lowy 1987; Prance 1970), no scientific papers have been published on this important contemporary syncretistic religion, and it is to be hoped that MacRae's Portuguese book will be translated into English and Spanish. Three introductory chapters discuss the relationship between entheogenic drugs (here we find the neologism *entheogens* used in print in Portuguese) and shamanism; the key role of *ayahuasca* and other "plant teachers" in Amazonian shamanism; and Amazonian mestizo concepts of disease as these relate to healing with *ayahuasca*. A detailed historical study of the *Santo Daime* cults commences with a brief biography of Raimundo Irineu Serra, or Mestre Irineu as he was known to his disciples, generally regarded to be the founder of the religion (MacRae's book appeared on the centenary of the birth of Serra, who died in 1971). Serra was introduced to *ayahuasca* late in the 1920s, and by 1931 was leading public *ayahuasca* masses under the auspices of his Centro de Iluminação Cristã Luz Universal (CICLU). Mestre Irineu's doctrine was based on eclectic Christianity, with *Daime* (or *ayahuasca;* from invocations like "Daime luz, força, amor . . ." "grant me light, strength, love . . .") as the solar, masculine element, and the lunar, feminine aspect personified as Nossa Senhora da Conceição or Rainha da Floresta.

From Mestre Irineu's CICLU cult in the state of Acre in the Brazilian Amazon, also called Alto Santo, there derived several branches, especially the group of Sebastião Mota de Melo or Padrinho Sebastião, who set up a related cult in Acre called Colonia 5000. When Padrinho Sebastião's group incorporated marijuana (*Cannabis* spp.) into the ritual, the federal police raided Colonia 5000 in 1981, leading to illegalization of *ayahuasca* in Brazil in 1985. By this time, Padrinho Sebastião had set up another commune called Céu do Mapiá near Río Purús, and in 1982 the first urban branch of the *Daime* cult was established in Rio de Janeiro, the Chamou-se Centro Ecléctico Fluente Luz Universal Sebastião Mota de Melo (CEFLUSME). An independent *ayahuasca* church, the Centro Espírita Beneficente União do Vegetal (UDV), started in Acre in 1961, had meanwhile become Brazil's largest *ayahuasca* church, which became centered in Brazilia to attend to the needs of its predominantly urban flock. The relatively wealthy and politically-powerful UDV petitioned the government to overturn the ban on the sacrament, which was accordingly done in 1987, after a government commission had studied the cult and determined it to be genuine and sincere. Another attempt (with right-wing political motivation) in 1988 to illegalize *ayahuasca* also failed, after a second high-level government commission again gave the cult a clean bill of heath, and recommended permanent exemption of *ayahuasca* from Brazilian controlled substances laws. The church continues to grow in strength in Brazil, and the various *Daime* groups have many millions of members. Impressive quantities of the sacramental potion are prepared from *Banisteriopsis caapi* (Spruce ex Griseb.) Morton and *Psychotria viridis* Ruíz et Pavón cultivated in Brazilian Amazonia. Recently there have been attempts to establish *Daime* church groups outside of South America, where it has already spread far beyond its original range (Liwszyc et al. 1992). In the United States such attempts were unsuccessful, as the U.S. government seized samples of the sacramental potion on attempts to import it into the country. In

Europe the church has fared better, and there has even been door-to-door proselytizing for *Daime* in Spain and other countries!

MacRae's book is a fascinating look at the history and inner workings of a growing, large-scale, syncretistic, Christian religion based on ingestion of a true, and not symbolic, sacrament, of an entheogenic potion of which the Christian Eucharist is but a placebo, a pallid symbol. It is hoped that there will be further study of this important phenomenon, and that this valuable book will not remain accessible only to the Portuguese-speaking world. Luna and Amaringo's pioneering *Ayahuasca Visions* will hopefully inaugurate a new era in documentation of ethnographic data, botanical and otherwise, and is a splendid example of the manifold creative possibilities for such work. While Dobkin de Rios' *Amazon Healer* contains much of interest, the scientific deficiencies in the presentation detract considerably from what could have been a useful and valuable book. The addition of an index and further botanical and chemical legwork would go a long way toward improving this book.

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

Before the Wilderness. Environmental Management by Native Californians. Thomas C. Blackburn and Kat Anderson (editors). Menlo Park, California: Ballena Press, 1993. $31.50 (hardcover); $ 23.50 (softcover). Pp. 476. ISBN 0–87919–127–9 (hardcover), 0–87919–126–0 (softcover).

This book will be welcomed by ecologists, historians, archaeologists and ethnologists, environmentalists, and Aboriginal peoples interested in traditional ecological knowledge and the complex interactions between people and their environment. It provides an ethnobiological perspective to traditional land and resource management systems and strategies among California Aboriginal groups.

Before the Wilderness is comprised of a series of 13 papers by different authors addressing a spectrum of specific "case studies" within this general topic. These are prefaced by an introductory chapter by the editors, setting the stage and discussing the papers in context. They are concluded with a retrospective essay by Henry T. Lewis, one of the leading researchers in traditional land management systems of Indigenous peoples, notably the use of habitat burning. Several of the papers have been previously published in various journals. The initial paper, by Bean and Lawton on proto-agriculture and agriculture, and the following one, by Henry Lewis on patterns of Indian burning in California, were originally published in 1973, and are regarded by the editors as the inspiration for or the precursor to almost all subsequent research on the topic. Nearly half of the essays were first presented at the Seventh Annual California Indian Conference in October, 1991, in a symposium on past and present resource management practices by Native Californians.

A popular perception of the North American landscape at the time of the arrival of Europeans has been as a "wilderness,"—in the words of Longfellow, a "forest primeval"—with vast areas unaltered by humans. To be sure, it was recognized that Aboriginal peoples carried on their lives and activities on the land, as hunter-gatherer-fishers and small scale agriculturalists. However, these activities were seen to be limited in time and scale, and for the most part, the land and its ecosystems were considered largely as "natural." This view is refuted by researchers such as Ford, in presenting prehistoric plant production in North America as a continuum, where activities of tending, tilling, sowing and transplanting are classified as "incipient agriculture" with their own impacts on the plants and their habitats (Ford, 1985:2). This book supports, and in some senses elaborates on, Ford's model, presenting a wide array of evidence to indicate a spectrum of human-caused modifications to the environment, with specific reference to Native California societies. Aboriginal Peoples not only lived on and used the land and its resources, they influenced and changed their environment in major ways. In fact, the editors of this book contend, large areas of the environment were carefully managed and "domesticated" by First Nations peoples.

Most of the papers in *Before the Wilderness* focus on the technologies developed to manage and maintain important plant resources used for food, medicines and construction materials. These include essays on: vegetation burning by the Chumash (Timbrook, Johnson and Earle); Native Californians as cultivators (Anderson); cultivation and harvesting of roots by Pomo basket makers (Peri and Patterson); contemporary basket weavers and the environment; managing oaks for acorns (McCarthy); use of pine nuts (Farris); and use of juniper for bow staves in west central Nevada (Wilke). Other chapters address topics that have received even less attention previously. For example, King analyzes fuel use, with careful consideration of the quantities and qualities of wood needed for cooking and heating. Swezey and Heizer discuss management of the salmonid fisheries, emphasizing the role of ritual systems in maintaining this important resource. Shipek describes the complex social, political and ceremonial aspects of influencing and controlling populations of various mammals among the Kumeyaay. Strategies for water management and flood and erosion control in dryland agriculture are examined by Lawton et al. and Shipek. The papers are well written, and most are supplemented with excellent photographs, diagrams, tables and maps.

This book represents a "first" in literature pertaining to traditional land management systems. The editors note that it represents only a beginning, but it does provide a nucleus for subsequent work. "Like other scholarly compendia of its kind, *Before the Wilderness* should be viewed less as an integrated overview of a mature field of investigation than as a prolegomenon to future research, and one moreover that raises as many questions as it answers . . ." (p. 21). The editors express the hope that this book with help to foster further interdisciplinary research aimed at increasing our understanding of traditional environmental management strategies. If only there were collections of this calibre documenting traditional land and resource management practices for other regions of North America!

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Nancy J. Turner
Book Review Editor
Environmental Studies Program
University of Victoria
Victoria, British Columbia V8W 2Y2

BOOK REVIEW

Altrove 1: Società Italiana per lo Studio degli Stati de Coscienza. Claudio Barberi, Antonio Bianchi, Gilberto Camilla, Francesco Festi, Marco Margnelli, Bruno Pochettino, Giorgio Samorini, Eds. Nautilus, Casella Postale 1311, 10100 Torino, Italy, 1993. Pp. 152. Lire 15,000 (paperback). No ISBN or copyright. [Note: Address of SISSC: c/o Museo Civico di Rovereto, Via Calcinari 18, 38068 Rovereto, Italy (Lire 40,000 to receive only the newsletter and "other informative material," Lire 50,000 for individual membership; Lire 100,000 for group membership).]

This first yearbook of the Italian Society for the Study of the States of Consciousness, which also publishes a 16–20 page tri-annual periodical newsletter entitled *Bolletino D'Informazione,* marks a considerable advance both quantitative and qualitative for the two-year-old group. Instead of a garden-variety newsletter, we have here a nicely-printed, well-illustrated paperback book with a sewn binding. Each article is graced by a different Huichol face-paint design in the margin, and abstracts, notes and bibliographic citations likewise appear as marginalia. There are also numerous black-and-white illustrations, some of them full-page, and in general the design and production is clean and professional.

There are 13 articles by different authors, preceded by introductory descriptions of the publishing company Nautilus, and the Society, responsible for production and content of the yearbook respectively. Four of the authors are members of the scientific and editorial committee behind the publication—G. Camilla, F. Festi, M. Margnelli and G. Samorini—the remainder are members of the Society. Camilla leads off with an introductory essay entitled "For a Science of States of Consciousness," followed by Samorini's paper on the "Utilization of Hallucinogens for Religious Purposes," using the African Bwiti cult, based on sacramental ingestion of the roots of *Tabernanthe iboga* Baillon as an example (Samorini 1993). A brief note on the Tassili frescoes of Africa (Samorini 1992) is followed by Camilla's article on the "Universality of Psychedelic Experience." Pierangelo Garzia then presents a short interview with Albert Hofmann "The LSD Man," after which Peter Gorman discusses "Shamanism among the Matses." This interesting article describes the preparation of entheogenic *nu-nu* snuff from tobacco leaves and ashes of inner bark of *macambo,* a species of *Theobroma*. Gorman describes the effects and use of the snuff to provoke visions of game animals as an aid to hunting. He also describes preparation and effects of another visionary drug used as an aid in hunting, and called simply *sapo*—here not identified, but known to be the venom of the frog *Phyllomedusa bicolor,* which is mixed with salvia and rubbed into a small burn on the arm (Amato 1992). Giorgio Spertini then presents a study comparing "Anorexia and Mysticism," followed by Mario Polia's detailed article on "Use of the Mescalinic Cactus *Trichocereus Pachanoi* in Traditional Andean Medicine" (Polia and Bianchi 1991). Margnelli's piece on "Virtual Reality and Self-Consciousness" is followed by Luis Eduardo Luna's article on use of *ayahuasca* to aid "Therapeutic Imagination in Amazonian Shamanism" (Luna and Amaringo 1991). There is a brief unsigned piece on the biochemistry of *ayahuasca* (Ott 1994), which unfortunately perpetuates the persistent error that harmaline is the major alkaloid of the source plant *Banisteriopsis caapi* (Spr. ex Griseb.) Morton and of the potions themselves. In reality, harmaline is a secondary alkaloid of *Banisteriopsis* species, present only in trace quantities in *ayahuasca* potions, while harmine is the most important active principle (Ott 1993, 1994). There follows Festi's concluding article on "A Panorama of Hallucinogenic Fungi," ending with an "Essential Bibliography" to the subject, as well as an Italian bibliography (Festi 1985). Inexplicably, this volume concludes with two separate tables of Italian "psychotropic" and "hallucinogenic" fungi (which, unfortunately, do not quite agree), together with a table of the "Chemical Pharmacology of Adventitious or Cultivated Italian Plants."

An unfortunate error in this volume is the presentation by Camilla of a photograph of the 13th century French Plaincourault fresco, said in the caption to represent "clearly identifiable" *Amanita muscaria* (L. ex Fr.) Persoon ex Gray as the Tree of Knowledge of *Genesis.* In reality, this conventional representation from Romanesque and early Gothic art, of which there are hundreds of examples, shows a stylized Italian pine tree, distorted by repeated copying from classical prototypes into a shape somewhat suggestive of a mushroom. Indeed, art historians call this sort of representation a *Pilzbaum* or "mushroom tree," but its resemblance to a mushroom is fortuitous (Wasson 1968). The presence of branches, the coloration, and the clump-like growth indicate to anyone with first-hand experience with *A. muscaria* in the field, that this is *not* an *Amanita* motif. The popular book *The Sacred Mushroom and the Cross* (Allegro 1970), a fanciful linguistic speculation inspired by R. Gordon Wasson's pioneering book *Soma: Divine Mushroom of Immortality* (Wasson 1968), is the modern source of this gross misinterpretation of a well-known medieval art motif. Equally dubious is Camilla's identification of *A. muscaria* in bunches of grapes being presented to Persephone by Dionysos in a fourth century B.C. terra cotta tablet—unless in Italy this mushroom grows on grapevines, replete with naturally-rendered grape leaves!

While the great bulk of the material in *Altrove 1* deals with psychotropic plants, three articles treat general themes about consciousness, as befits a publication by a society for the study of "States of Consciousness." The articles are of an introductory nature, clearly written for the layperson, and consequently feature less detail and fewer bibliographic citations than would be expected in a journal for a professional society. On the other hand, the authors are well-known experts in their particular fields, and there are here some tidbits of new information of interest to the specialist, too. All in all, this is a solid publication by the Italian group, setting a good example for the rest of the world to follow, of the conception and presentation of wide-ranging information on altered states of consciousness, of interest to the layperson and specialist alike. While the United States has traditionally been, and remains, a hotbed of research in these subjects, we have no equivalent publication of the quality and scope of *Altrove*, which might hopefully serve as a model and stimulus on this side of the Atlantic!

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

Handbook of Edible Weeds. James A. Duke. Boca Raton, FL: CRC Press Inc., 1992. Pp. v, 246. $24.95 (hardcover). ISBN 0-8493-4225-2.

It can be a difficult job to represent the 1000 plus consumable species in the United States with a sample of 100 edible plants, even if you are using a rather broad definition of "weed." Dr. Duke has met this challenge admirably even if he included a few that he himself would have rather excluded (e.g., *Stellaria media*). Some readers might be surprised to find that such trees and shrubs as *Acer, Asimina, Carpinus, Castanea* and *Diospyros* are considered weeds. Nonetheless, their weediness is attested to by their presence in the Weed Science Society of America's "Composite List of Weeds" (which unfortunately lacks a complete citation and inclusion in the bibliography) or, in a few cases, the author's field experience.

The "introductory harangue" (Duke 1992:6) enlightens the readers on several matters. The most important are the perspectives "Jim" employed to put together this volume. One should consider that about 10% of the world's flowering plants are weeds. More than half of the 18 worst world weeds are included in the book. This point is of interest to ethnobiologists given that the general definition used is that a weed is "a plant growing where it is not wanted"—a pandora's box for plant-human relationships. Rather than getting rid of weeds, one could exploit this renewable resource to increase available human food, to produce renewable biomass fuel, to provide primary material for extraction of chemical substances of medicinal and industrial importance, and to slow down global warming by fixing more carbon dioxide. The rapid evolution of herbicide resistance coupled with Nature's abhorrence of an ecological vacuum suggest that the complete elimination of weeds is not possible. So, "If you can't beat them, eat them!" (Duke 1992:3).

The main text consists of 100 genera of flowering plants with selected species discussed under each genus and with one species per genus illustrated. The presentation is alphabetical by the generic name. The format incorporates the scientific binomial followed by the family and common names. The brief text includes the plant description, its distribution in the United States and notes on its utility. The descriptive section is brief with the diagnostic characteristics of the habit, leaves, flowers and fruits listed. The distributional data mention the habitats, the flowering and fruiting periods as well as the general biogeography by listing the limiting northwestern, northeastern, southwestern and southeastern states and the United States Department of Agriculture's Plant Hardiness Zones.

The most chewy part of the book is found in the utility section. Most of the data are derived from US references as well as the author's personal foraging experience in the field or during his jogging lunch hour. Fragments of human experiences with the described species or related taxa in other parts of the world are presented. Many of the 100 utility sections devote more lines to non-edible uses, especially medicinal, in addition to the details of the palatable vegetable and fruits.

Appropriate caution is given to such possible dangers as deadly misidentifications, nitrate toxicity, oxalic acid composition and the ingestion of *Giardia* and amoebas when eating untreated aquatic plants. The compact two-page arrangement with the illustration facing the text allows convenient reference to each entry. Apparently due to the limited space and in the interest of smoother reading, the bibliographic citations are very uneven and in some cases absent or incomplete. This situation makes it pleasant to read without getting bogged down but is frustrating when trying to use it as a guide to the literature on the diverse aspects of edible plants that are delightfully presented.

The text is full of interesting comments of a personal and general nature. Under *Castanea* we learn about Mr. Brooks who instilled the interest in foraging in the author. We also know he does not like spinach and uses it to rate his preferences for other plants (such as comparing *Portulaca,* one of the most important greens eaten in Mexico, to "slimy spinach"). His observations have lead him to propose certain hypotheses for future investigation such as "blacks and southerners . . . prefer potherbs of the cabbage family, while northerners tend to prefer potherbs of the spinach family" perhaps explaining Dr. Duke's dislike of spinach. Another is that squirrels know which nuts of *Carya* are sweeter by the split pattern of the husks. The exploitation of animal caches of fruits and roots is an interesting component of human foraging behavior for various edible species. The author's episode with the strong tasting *Yucca* buds might have been more pleasant if he had removed the stamens and pistils as is done with the popularly consumed flower buds of *Agave* and *Yucca* in Mexico. As an example of the relevance of eating weeds to an environmentalism philosophy developed in the introduction, we learn that adding endoperoxide-containing herbs such as *Artemisia annua* and *Chenopodium ambrosioides* to beans not only reduces certain personal annoyance but also could promote greater consumption of vegetarian protein in place of animal protein thus altering the global warming trend to which ruminant animals contribute through their release of methane and carbon dioxide.

The bibliography of edible plants is limited to some of the more standard references, of which only a part are cited directly in the text (and so marked with an asterisk). Some entries are incomplete (e.g., Baird and Lane 1947) while others are absent (e.g., BCW on page 82, Gail on page 193, SN [Science News ?] on page 44, and WSSA [Weed Science Society of America]). The remainder of the book presents a useful listing of the illustrations, and an index to scientific and common plant names as well as a general index.

This delightful book is a fine prologue to common edible plants that surround North Americans but whose gustatory benefits may go unrecognized and under exploited. The concise text is an introduction to history, biology and values of little appreciated plants for those wishing to know more based upon practical and scientific literature as well as personal experience.

Robert Bye
Jardín Botánico
Instituto de Biología
Universidad Nacional Autónoma de México
04510 México, DF
MEXICO

BOOK REVIEW

The Palaeoethnobotany of Franchthi Cave. Julie M. Hansen. Excavations at Franchthi Cave, Greece, Fascicle 7, Bloomington, Indiana: Indiana University Press. 1991. Pp. 278. $75.00 (paperbound) ISBN 0-253-31979-X.

This book is the seventh fascicle in a series of final reports on the excavations of Franchthi Cave, Greece. The history of the cave spans a period of nearly 25,000 years and the book provides important insights regarding the prehistory of the general Mediterranean region. A major research problem of the Franchthi excavations pertains to early agricultural origins in the Aegean Basin. The excavations sought to describe domestication in the record and carefully analyze the associated stratigraphic contexts. The report, based on the author's 1980 dissertation, is an extremely important work as it details nearly 100,000 botanical specimens. As such it represents the largest fully reported collection of its type yet reported in the Old World.

The introductory chapters summarize the site and its environmental context as well as the methodology used. A water sieve technique from which light and heavy fraction remains are recovered (see Diament 1979) floated 100% of four trenches within the cave. Biostratigraphic zonation was based on the number and/or the variety of plant remains represented. Chapter 3 provides a detailed description of the plant remains including quantity and zonal distribution, measurements, description, habit and habitat and discussion of historically known uses. Of particular utility are nutritional data presented for most seeds and fruits. The chapter contains excellent illustrations of carbonized remains and maps of their present regional distributions. Chapters 4 through 10 describe the seven zones identified at Franchthi. The remains from each zone are placed within cultural and chronological context. The distribution of remains within each trench is the basis for interpreting the botanical assemblages of each zone. Discussion includes possible environmental changes, human-plant interactions, seasonality, the availability of nutritional resources and occupational intensities.

Zone I dates to the late Pleistocene between 30,000 and 17,000 B.P. (all dates reported as uncalibrated radiocarbon dates B.P.). The zone is characterized by a predominance of Boraginaceae nutlets which are believed to have accumulated slowly over long periods of time and not to represent intentional human activity. Associated faunal remains suggest a cold, dry, steppic environ. Following a hiatus seen in all trenches between 17,000 and 13,000, Zone II dates to c. 10,500 B.P. with warmer and wetter conditions indicated by increased arboreal species such as almond, pistachio and pear. These species, along with the replacement of steppe ass by red deer and wild cattle, suggest a parkland-woodland environment. Zone III dates between 9,500 and 9,000 B.P.; the transition from Paleolithic to lower Mesolithic. A woodland environment is suggested by abundant evidence of pistachio, almond, pear and oats with the common presence of lentils, wild barley and a variety of legumes throughout the zone. Animal resources are broadened to include coastal, marsh and inland species. The botanical evidence suggests spring, summer and autumn occupations of the cave.

Though no radiocarbon dates exist for Zone IV, the zone includes the Lower and part of the Upper Mesolithic habitation at Franchthi Cave. A relative paucity of botanical remains is notable in context with an increase in fish bones, particularly tuna. Botanical evidence suggests spring through autumn use and a shift from long-term use of the cave to a pattern of short term visits. Zone V extends from 9,000 to 8,000 B.P. and corresponds to the latter part of the Upper and Final Mesolithic. This zone contains little evidence of plant remains which the author interprets as possibly representing lesser occupational use of the cave. Zone VI dates between 8,000 and 7,000 B.P. and represents the earliest Neolithic sequence at Franchthi Cave. The occupation is characterized by the appearance of domesticated species of barley, wheat and lentils and the disappearance of wild varieties of oats, barley and lentils within a relatively dry open woodland environment. Zone 7 dates between 7,000 and 5200 B.P. spanning the Middle through the Final Neolithic. The zone is characterized by a marked increase in the domesticates, in particular emmer wheat, barley and lentils as well as the first appearance of einkorn wheat and the reappearance of several wild species, including pistachio and almond.

The final two chapters summarize the botanical remains from Franchthi and of the Eastern Mediterranean region. Chapter 11 provides a useful discussion of the variable presence of botanical remains within the cultural chronology while Chapter 12 attempts to review the palaeoethnobotany of the Eastern Mediterranean providing discussion of distribution of botanical remains, time depth and theories of agricultural origins in the Near East. Both are well crafted summaries providing a broad and useful context for the Franchthi report. The modest conclusion of the report is that the data from Franchthi strongly support the hypothesis of diffusion from the Near East. The remaining section of the book includes four appendices detailing the remains from each trench and an excellent series of plates.

This is a very good volume. It is clear and well written and nicely illustrated. The volume contains an impressive data set which will prove extremely useful for palaeoethnobotanists and archaeologists. One shortcoming is the rather limited conclusion regarding the human-plant interactions at Franchthi Cave. The data suggest a highly variable set of strategies which in all likelihood provide more general insights regarding domestication and agriculture than are offered in the volume.

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Mark G. Plew
Department of Anthropology
Boise State University
Boise, ID 83725

BOOK REVIEW

Kava: The Pacific Drug. Vincent Lebot, Mark Merlin and Lamont Lindstrom. New Haven and London: Yale University Press, 1992 (Richard E. Schultes and Robert F. Raffauf, Eds., Psychoactive Plants of the World). Pp. 255. $45.00 (clothbound). ISBN 0-300-05213-8.

At last, we have here a comprehensive, multi-disciplinary book on the South Pacific inebriating potion *kava*, prepared from roots of *Piper methysticum* Forst. f.! Although the pioneering German psychopharmacognosist Louis Lewin published a monograph on *kava* a century ago (Lewin 1886) and devoted a chapter to the drug in his classic *Phantastica* (Lewin 1924), in which he categorized it under *Hypnotica* or "sleep agents," *kava* has until now escaped a full-dress, modern treatment. The last multi-disciplinary review of *kava* was part of a symposium volume published in 1967, presenting eight papers on *kava* ethnobotany, chemistry and pharmacology (Efron et al. 1967). In the seven chapters and six appendices of *Kava: The Pacific Drug,* the authors systematically review the botany, chemistry, pharmacology, ethnobotany, anthropology and economics of the South Pacific inebriant. In their discussion of the botany of *P. methysticum,* the authors dissect the origin of this cultivar in the wild species *Piper wichmannii* DC., probably from the Vanuatu archipelago. This treatment incorporates considerable field and laboratory research by the first author, who published an important recent monograph on the subject (Lebot and Lévesque 1989) as well as a related chapter in a recent anthology (Lebot 1991). In their chapter on *kava* chemistry, the authors describe the properties of the *kava* potions, and the history of chemical study of the source plant. Structures and pharmacological properties of the active *kava* lactones are given, as well as information on other secondary constituents. A discussion of *kava* chemotypes (differing with respect to relative concentrations of the various active lactones), backed by an appendix, provides much of the evidence for the origin and distribution scheme aforementioned. The authors show convincingly that clones of *P. methysticum* (seen here as a cultivar conspecific with *P. wichmannii,* the only other species of *Piper* to contain the psychoactive lactones), have been selected for psychoactive properties. This ongoing process is contributing to the steady expansion of *kava* use throughout the South Pacific, which is now spilling over into worldwide use of the drug in western herbal medicine. This and other evidence leads the authors to take issue with Brunton's recent characterization of *kava* as *The Abandoned Narcotic* (Brunton 1989; reviewed in *Journal of Ethnobiology* 12[2]:271–272, 1992).

In the ethnobotanical chapter, cultivation of *kava* is detailed, as is the ethnotaxonomy in various island cultures. Different methods of preparation of the potion are discussed, and there is a review of ethnomedicinal use of *kava* in New Guinea, Vanuatu, Fiji, Polynesia and Pohnpei, with an accompanying table. These data complement ethnomedicinal information from Tonga, Samoa, The Cook Islands and Hawai'i in W. A. Whistler's recent *Polynesian Herbal Medicine* (Whistler 1992). "The Cultural Significance and Social Uses of Kava" are the subjects of the next chapter, which analyzes charming myths of the plant's origin, and details the social and sexual context of its use in various island societies. *Kava* as entheogen is briefly described—divinatory/shamanic use, such as by Hawai'ian *kahunas.* Five "kavettes" or vignettes describing contemporary use of the drug in Vanuatu, Papua New Guinea, Samoa and Pohnpei round out the anthropological chapter. These include urban use in *kava* bars in Pohnpei and Vanuatu, as documented by Merlin and Lindstrom.

A detailed chapter covers "Kava as a Cash Crop" in Vanuatu, Fiji and Tonga, and includes eleven econometric tables (of 16 tables in the book). *Kava* as crop in Vanuatu is compared with other cash crops cacao, cardamom, coffee, copra, black pepper, garlic, ginger and vanilla. While intermediate with respect to income *per* hectare/year; *kava* led the list with regard to income *per* workday. Trade and revenues from Vanuatu *kava* crops are also detailed, showing *kava* a distant third behind copra and cacao. Fijian production is also analyzed; documenting annual earnings for farmers of over $18 million from 2200 hectares planted to *kava.* The *kava* export market is briefly treated, and the growing use of the drug in western medicine is described. The final chapter "Kava: A World Drug?" deals with the purported emergence of *kava* as a "drug of abuse" among Australian Aborigines, and charts a rosy future for *The Pacific Drug.* The six appendices detail geographical distribution of *kava* use; *kava* names in New Guinea and Vanuatu; morphotypes of *P. wichmannii* and *P. methysticum* by island; *kava* chemotypes and geographical distribution of cultivars in Vanuatu. A solid, complete bibliography of 368 references is followed by a useful 9-page index.

Yale University Press is to be commended for the attractive and utilitarian production, and for launching the much-needed series on *Psychoactive Plants of the World,* of which this volume is the second contribution (the first being Johannes Wilbert's 1987 *Tobacco and Shamanism in South America*). The Yale Press is to be chastised also, for failing to use recycled paper to print this book. Despite the multiple authors, the style is even and uniform, readable and not pedantic. Apart from the useful maps and nine botanical illustrations (anonymous, except for Sydney Parkinson's first botanical drawing made in 1769), the book contains a treasure of historical and contemporary black-and-white photographs of the preparation (such as by a Samoan *taupou* or ceremonial virgin) and ceremonial use of *kava* in Samoa and Fiji—showing, for example, a pith-helmeted British colonial administrator drinking *kava* in Fiji *ca.* 1880. Included also are a wealth of contemporary photographs of *kava* cultivation and preparation, both in traditional settings and in Wilson's Sakau Bar in Kolonia, Pohnpei. Ancient *kava* grinding stones and typical drinking bowls (and their modern Waikiki cocktail-bar derivative) are likewise illustrated, and we even see Pope John Paul II grimmacing as he quaffs *kava* from a coconut shell in the company of the Fijian Prime Minister, during a state visit in 1986! This book is essential for ethnobiologists interested in psychoactive drugs, and fills a conspicuous gap in the literature. It will be a welcome addition to libraries of specialists with an interest in South Pacific ethnomedicine, history and anthropology.

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

Aromatic Plants and Essential Constituents. Zhu Liangfeng, Li Younghua, Li Baoling, Lu Biyao, Xia Nianhe. Chinese Academy of Sciences: South China Institute of Botany. Hai Feng Publishing Company, Chinese National Node for APINMAP, 1993. (Price and ISBN not found).

This beautifully published survey of aromatic plants, their botany and chemistry, can be recommended to the teachers and researchers in aromatic constituents in plants. It is authoritative and exhibits much personal research into these economically very important plants.

As the foreword states: "China is well known for her natural aromatic resource and is becoming more and more important in international essential oil market." It is one of the main popular exports of China in recent years.

This monograph comprises information, often difficult elsewhere to procure—of more than 270 species and subspecies in a number of important families from the point of view of essential oils. The book has four sections arranged according to the utility of the aromatic species: 1) Fragrances and Flavours; 2) Medicinals; 3) Flowers and fruits; Other uses.

The interest is apparent in the following several aspects involved: 1) state of scientific research; 2) the first publication of the use of a number of indigenous aromatic plants; 3) and the value of these kinds of information to modern commercial and industrial entities.

As is well recognised, China is well supplied with aromatic plants which have long been employed in folk-medicine and household use. There is a valuable chapter on advances in techniques of analytic methods for studying essential oil composition.

This is the first of two volumes relating to aromatic plants and their constituents; the second is promised.

There can be no doubt that this scientifically critical volume will be a valuable addition to the modern, technical bibliography of this fast-developing field of ethnobotany as well as a rich contribution to our knowledge of the chemistry of many well-known and numerous poorly known aromatic plants employed in China and elsewhere. It is highly recommended to teachers and researchers in the fields of economic botany and ethnobotany.

Richard Evans Schultes
Director Emeritus
Botanical Museum of Harvard University

BOOK REVIEW

Ethnobotany of the Waimiri Atroari Indians of Brazil. William Milliken, Robert P. Miller, Sharon R. Pollard, and Elisa V. Wandelli. Kew, UK: Royal Botanic Gardens. 1993. (£15.00) (softcover). Pp. 146. ISBN 0-947643-50-8.

The Waimiri Atroari are a Carib-speaking indigenous group located about 200 km NW of Manaus, Brazil, on black-water tributaries of the Rio Negro. This study was conducted as part of a program of compensation for the loss of a sizeable portion of their reserve to a hydroelectric project. Two approaches to ethnobotanical research were employed: the traditional qualitative approach and the recently developed quantitative approach. The quantitative portion of the study duplicates the methods utilized by Balee (1986, 1987) with the Ka'apor and Tembe of Brazil and Boom (1987, 1990) with the Chacobo of Bolivia and the Panare of Venezuela. Those studies found that 77, 61, 79, and 49 percent, respectively, of *terra firme* trees (dbh greater than or equal to 10 cm) were attributed useful properties (not counting firewood or game animal food species). A similar study conducted by Pinedo-Vasquez et al. (1991) in a *ribereno* (acculturated, mixed blood) community in northeast Peru found that 60 percent of forest trees were used.

The book begins with a concise history of relations between the Waimiri Atroari and settlers, the military, government officials, a military road-building team, and a mineral development company. This account provides a very useful context for understanding the conditions and implications of the study. It suggests the extreme processes of acculturation and deculturation which the group is likely to have been undergoing. These processes are likely to have caused the loss of a significant portion of the Waimiri Atoari's forest utilization and management knowledge. This book also outlines the mechanisms whereby the group's forest resource base has been reduced over the past 200 years. An understanding of these mechanisms is essential for the future management and protection of the Waimiri Atroari Reserve.

The Waimiri Atroari defense of their territorial integrity has resulted in a number of brutal military reprisals. Their original 1971 reserve was dismantled after ten years in order to make way for tin mining. The ecologically and economically disastrous Balbina hydroelectric project inundated a portion of the reserve. Grenades, machine guns, and bombings are reported to have been employed against the group during the construction of the highway linking Manaus with Roraima State. The group's population dropped from about 3000 in 1968 to about 330 in the mid-1980s.

The 24-page section describing aspects of Waimiri Atroari plant use includes chapters on cultigens and on plants used for hunting, craft, adornment, transport, medicine, fuel, ritual, commerce, and miscellaneous. This is followed by a 56-page section, organized by plant family, which gives the scientific and common names of the trees and lianas found in the one hectare study plot, and of a few shrubs and herbaceous plants. The uses of these plants by the Waimiri Atroari and other South American groups are given. Extensive references are provided.

The final section reports the results of the quantitative study. Two hundred tree species and 14 liana or strangler species were recorded. One hundred and seventy five, or 81%, were said to be useful. The inclusion of species which provide indirect benefit by attracting game animals and of firewood species would raise the percentage of useful species in the plot to 92%.

Twenty-two well-reproduced color photographs are included which illustrate the forest, river, village, and cattle pasture environments as well as several plant uses. Appendixes provide information on Waimiri Atroari use categories, scientific and Waimiri Atroari names for forest animals, a list of medicinal plants arranged according to application, and an index of botanical names.

The authors conclude that "The Waimiri Atroari are heavily dependent upon the *terra firme* forest for every aspect of their physical, cultural and spiritual lives. In order to retain an adequate supply of the plants which they need (many of which are present in very low densities on account of the diversity of the flora), and of the animals which they hunt, extensive tracts of forest are clearly required" (p. 119). They point out the well-established incompatibility of Amazonian *terra firme* forest with cattle ranching and advise against the ranching project which has been operating on the reserve since 1983. The authors emphasize the importance for the cultural survival of the Waimiri Atroari of maintaining the integrity of the current reserve boundaries against continued interest in exploiting the minerals which lie beneath the forest.

This well written and well organized book makes an excellent contribution to the study of Amazonian ethnobotany. It provides ethnobotanical and historical material of great interest for understanding the contemporary relationship between indigenous Brazilians and their botanical environment. It makes a strong and well informed statement with regard to the importance of maintaining access to large tracts of forest for the Waimiri Atroari and other lowland Amazonian indigenous groups.

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Bret Blosser
Department of Anthropology
Tulane University
New Orleans, LA 70118

BOOK REVIEW

Funghetti. Silvio Pagani [pseudonym]. Nautilus, Casella Postale 1311, 10100 Torino, Italy, 1993. Pp. 36. Lire 4,000 (stapled academic wrap with separate 2-color dust jacket). No ISBN or copyright.

The pseudonymous work of a leading Italian ethnopharmacognosist and founding member of the Italian Society for the Study of the States of Consciousness (see *Altrove 1* review), this inexpensive little booklet on psilocybine-containing mushrooms is the first Italian contribution to a *genre* of drug literature which commenced with L. Enos' *A Key to the American Psilocybin Mushroom* (Enos 1970). From this crude beginning in the U.S., the "field guide" to psilocybian mushrooms was perfected through various iterations (Ghouled 1972; Haard and Haard 1975; Norland 1976; Menser 1977; Ott 1976), leading to quite elegant books on the subject (Ott and Bigwood 1978; Stamets 1978). Outside of the U.S., there has been comparatively little such publishing activity, an exception being an English field guide from 1977 (Cooper 1977), and recently there have been German contributions to the *genre*, notably the multi-disciplinary *ZauberPilze* (Rippchen 1993) and the scientific *Narrenschwämme* (Gartz 1993), both recently reviewed in this journal.

Funghetti briefly surveys the pre-Columbian history of *teonanácatl*, as the Aztecs called the sacred mushrooms, which R. Gordon Wasson rediscovered in 1955, leading to Albert Hofmann's isolation of psilocybine and psilocine in 1958. The treatise then focuses on *Psilocybe semilanceata* (Fr. ex Secr.) Kumm., the most common psilocybian mushroom in Italy and the world. Somewhat detailed information regarding dosage and effects of this diminutive mushroom is presented. The author then comments on the legal situation in Europe, where some mushroom pickers have run afoul of the law, since psilocybine is an illicit drug. Field identification of psilocybian fungi is discussed, and there are three good color photographs of the common species *P. semilanceata*, suitable for identification (a low-resolution line drawing of this species is more decorative than of use in aid of identification; the booklet also features a frontispiece drawing of a "mushroom head" from the Mixtec *Lienzo de Zacatepec*). The danger of mushroom poisoning from faulty identification is mentioned, as is the possibility of negative reactions to psilocybine. The author discusses appropriate use of the fungal pharmacotheon, to minimize this possibility. The booklet concludes with a discussion of the potential value of entheogenic mushrooms to contemporary society, with a commentary on the Holy Inquisition of the Dark Ages, and the contemporary "Pharmacratic Inquisition" of drug prohibition, which has resulted in wild mushrooms being considered to be dangerous narcotics.

Despite its brevity and diminutive size, *Funghetti* is an informative and inexpensive treatise for the layperson on *Psilocybe semilanceata*, Europe's most common psilocybian mushroom. The Italian mycophile will find therein information on identification and use of this mushroom, its effects and dangers, all placed in ancient historical and modern sociological context. This is a worthy modern contribution to the *genre* of psilocybian mushroom field guides, and a valuable addition to the Italian drug literature.

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

New Directions in the Study of Plants and People: Research Contributions from the Institute of Economic Botany. G. T. Prance and M. J. Balick (Eds). Advances in Economic Botany 8. New York: The New York Botanical Garden. 1990. Pp. vii; 278. $55.00 (paper). ISBN 0-89327-347-3.

This highly readable volume is designed to show the depth and breadth of the research activities of the Institute of Economic Botany of the New York Botanical Garden. While admirably profiling the IEB, it presents numerous articles of significance in the fields of economic botany, ethnobotany, human ecology and population biology of economic plants. The articles are well illustrated and there are indices of common and scientific names of the species mentioned, but no general index, a minor inconvenience. Fourteen of the 17 articles are focused on the Neotropics. The other three are more globally focused surveys of piscicides, *Paullinia* (a medicinal and stimulant genus) and poisonous Anacardiaceae.

There are two economic botany reviews, one of a species, the other of a genus. Mori and Prance provide an extremely useful review of the Brazil nut, highlighting its long history of use by humans and identifying key references that are hard to find. Prance provides a review of the genus *Caryocar,* many species of which are important fruits and nuts in tropical America with potential to become "new" crops.

Salick and Lundberg study the effect of change on an Amuesha community's agriculture and developing interactions with the modern Peruvian economy. The diversity of agricultural practices and genetic resources are shown to be the result of numerous personal and community decisions, some of which are seldom adequately examined. For example, the difficulty of storing seed in a humid tropical environment can explain the planting of maize in what would normally be the off-season. Newly formed families and the stability of more established ones can also account for considerable variation in plot size and plot species diversity.

Padoch and de Jong trace the history of a Peruvian community during this century and identify the effects of the various forest product booms on it. The tribal origins of many members of the community are identified with the numerous moves made by the community in search of new sources of the forest products that had demand at various times.

Peters and Hammond study the population biology of three Amazonian fruit species, all of which occur at relatively high densities in apparently unmanaged forest. The sustainable harvest of forest products is currently suggested as a way of developing the humid tropics without destroying the forest. The viability of this development option depends first of all on the population biology of the forest species. The authors examine the demographic structure of the populations and discover that all three species show strong recruitment even though they are also subject to significant harvest pressures. They also examine spacial distribution, reproductive phenology and individual tree yield. With this information they can estimate population yield and relate this to market value. The three species studied are found to be good candidates for sustainable harvest. This excellent study is a model for examining any species that is recommended for harvest from the forest.

May examines the recent history of the *babassu* (*Orbignya phalerata,* Palmae) market in the face of technological change in northeastern Brazil. This type of study is essential if one desires to market forest products. May poses and answers several important questions: why is *babassu* (or any other forest product) in decline today? How does the market structure encourage or discourage harvesting and marketing? How is technological change affecting the harvesting, marketing, and processing of this product?

Strudwick provides an interesting look at an apparently new forest management practice to sustainably harvest hearts of the *assai* (*Euterpe oleracea,* Palmae) in the Amazon River estuary. Unfortunately he does not provide the exact location nor the name of the company (probably at their request), so it will be impossible to accompany this promising practice in the future without the author on hand. This, in fact, is one of the difficulties faced by many ethnobotanical researchers as we attempt to protect our consultant's privacy or see that they receive an equitable return on the information provided.

Williams provides an excellent summary of the late pre-contact and early post-contact literature that bears on the botany practiced by the Nahuatl speakers, the Aztecs and related peoples, of southern Mexico. As with many other aspects of the high Neotropical civilizations, Nahuatl botany appears to have been more advanced at contact than European botany. This important article identifies many of the sources necessary to study Nahuatl ethnohistory and botany and may help shed light on the Nahuatl pharmacopeia and the domestication of numerous Mesoamerican crops.

As with the earlier volumes in the Advances in Economic Botany series, this is well worth the rather steep price for a paperback. Fortunately, future volumes are more accessibly priced. The book is highly recommended for students and professionals in economic botany, ethnobotany, population biology, human ecology, and the sustainable development of the humid tropics.

Charles R. Clement
Instituto Nacional de
Pesquisas da Amazônia
Cx. Postal 478
69011 Manaus, AM, Brasil

BOOK REVIEW

50 Jahre LSD-Erfahrung: Eine Jubiläumsschrift. Christian Rätsch, Ed. [Der Grüne Zweig 159]. Nachtschatten Verlag, Ritterquai 2–4, CH-4502 Solothrun, Switzerland and W. Pieper's Medienexperimente, Alte Schmiede, D-6941 Löhrbach, Germany, 1993. Pp. 126. DM 20 (perfect-bound paperback). ISBN 3-925817-59-X.

German ethnologist Christian Rätsch, a musician and graphic artist best known for his fieldwork among the Lacandón Indians of Chiapas, México (Rätsch 1985), decided to mark the 50th anniversary of Albert Hofmann's 1943 discovery of the entheogenic effects of LSD by publishing both musical and literary pæans to the fabled wonder drug, with the covers of both graced by his own paintings. The musical tribute is a compact disk (SL CD 00556) entitled *Hommage à Albert—50 Jahre LSD-Erfahrung [Tribute to Albert—50 Years of LSD Experience]* by Rätsch's 5-member group, *Acid Test.* There are five compositions with Sanskrit titles, and the box features a photograph of Albert Hofmann in a dance pose holding a *ling chih* mushroom, *Ganoderma lucidum* (Fr.) Karst., and photographs of Aztec entheogen god Xochipilli and the morning glory *Ipomoea violacea* L., which contains LSD-like alkaloids. Rätsch's book bears the same title, *50 Years of LSD Experience*, and is dedicated to Albert Hofmann, "in memory of the events and sequelae of 19 April 1943." Rätsch had already edited a *Festschrift* for Hofmann (Rätsch 1989).

After an introductory *Hymn to LSD* by Norbert J. Mayer, Rätsch presents a 15-part treatise on "LSD Culture," backed by 123 footnote references. After expressing his "Cultural/Anthropological Viewpoint," the author puts LSD in historical perspective by examining "The Sacrament: Dew of the Tree of Knowledge," including speculations on the symbology of contemporary LSD visions. "LSD Spirituality" traces the mystical modalities of entheogenic experience, after which various chapters explore "LSD and Creativity"—in literature, graphic arts, underground "comix," psychedelic music, lightshows, and dream theater. A chapter associates the "Mysteries of the Grateful Dead" (sixties-revival concerts by the "acid-rock" band Grateful Dead) with the ancient Grecian Eleusinian Mysteries, which seems a specious juxtaposition to me—I would say the ancient Athenian drama festivals involving frenzies of group inebriation by wines fortified with visionary drugs (Ruck 1982) offer a more apt parallel to the contemporary rock concert. Some notes on "The New Psychiatry: LSD Shamans" follow, and there is a curious error in this section—Rätsch speaks of "the Sandoz/Basel-produced Lysergol® (pure LSD) . . ." whereas *Delysid®* was the Sandoz trade-name for pharmaceutical LSD-tartrate, while lysergol is a simple clavine alkaloid from *ololiuhqui* seeds (*Turbina corymbosa* [L.] Raf.) and ergot of *Elymus* species (Ott 1993). A brief "Insight" rounds out this section of the book, with the author concluding that the influence of LSD and kindred drugs on our culture has been so important that: "Our contemporary world is unthinkable without LSD!"

The second part of the book is entitled "LSD Voices," and consists of short quotations from 50 individuals, the sources of which are identified in another 50 footnotes. Tibetan Lama Yeshe comments, for example, that "LSD is the wisdom of the West," and there are also remarks from Alan Watts and Aldous Huxley, religious philosophers well-known for their experiments with LSD-type drugs. There are also several quotes from scientists and psychiatrists who have experimented with LSD, like the late Walter Pahnke, Ralph Metzner, Stanislav Grof, and Albert Hofmann himself, who comments that his "problem child" LSD could become a "wonder child," were it to come to be used as an aid to meditation and as a catalyst to mystical totality experiences (Hofmann 1980). Rätsch also presents quotations from artists who have found in LSD a source of inspiration. There are remarks from Cary Grant, whose use of LSD in psychiatric treatment in the fifties became a *cause célèbre* (Hoge 1977) and from Anaïs Nin, for whom LSD was a wellspring of art. The reader encounters the words of Ernst Jünger, famous German writer and "psychonaut" (Jünger himself coined the term), as well as remarks on LSD by popular musicians Jerry García of the Grateful Dead, David Crosby of The Byrds and Canadian folk-singer Leonard Cohen.

The book concludes with the "LSD Library," a series of four bibliographies, commencing with a short annotated bibliography to LSD, followed by a 160-source bibliography in two parts: scientific and literary. Finally, there is an "LSD Discography" listing 5 publications on psychedelic music and 209 compact disks and LP records of music influenced by LSD, listed in alphabetical order by group—from Acid to The Zombies. Gracing the cleanly-designed and well-produced book are black-and-white photographs of Sandoz *Delysid®* and Spofa *Lysergamid®* ampules (LSD-tartrate), and a half-dozen photographs of "blotters" (stamp-like squares of blotter paper on which LSD has been spotted), decorated variously with a portrait of Hofmann ("Father of LSD"), disembodied eyes, mandala-like symbols, an octopus and Mickey Mouse as sorcerer's apprentice.

Rätsch deserves praise for producing this pair of handsome and passionate pæans to LSD, the entheogenic drug of the modern shaman, and to its discoverer Albert Hofmann. Turning the analytical eye of the anthropologist inward to 20th century western culture, Rätsch's book explores the impact of LSD-like drugs on our society, on our religion, art and medicine. This, however, is no detached, exsanguinated, scientific analysis, for Rätsch is clearly an avid exponent of "acid" rock and "psychedelic" art, as evidenced by his cover art and the music of his group *Acid Test,* which is an example of the phenomenon his book examines. *50 Years of LSD Experience* is a art-historical study of the ethnopharmacognosy of LSD and allied shamanic inebriants in contemporary European and American society, which stands as a fitting tribute to one of the most significant scientific discoveries of the twentieth century.

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

ZauberPilze. Ronald Rippchen, Ed. (Der Grüne Zweig No. 155). "A Joint Venture" of Nachtschatten Verlag (Ritterquai 2–4, CH-4502 Solothurn, Switzerland) and Medienexperimente (Alte Schmiede, D-69488 Löhrbach, Germany), 1993. Pp. 231. DM 30 (paperback). ISBN 3-925817-55-7.

ZauberPilze ("Magic Mushrooms") is an anthology of 26 papers on entheogenic mushrooms, half of which are reprints or translations into German. The translations include Lewis Carroll's section of *Alice's Adventures in Wonderland* describing the caterpillar and the mushroom, and Valentina P. Wasson's classic article "I ate the sacred mushroom," describing the first psychonautic experiment with psilocybian mushrooms outside of a traditional ritual context (Wasson 1957). There is also a chapter on entheogenic mushrooms by LSD and psilocybine discoverer Albert Hofmann.

There are three scientific papers by German chemist Jochen Gartz, describing a "new" psilocybian species from Europe, *Inocybe aeruginascens* Babos, outdoor cultivation of *Psilocybe cyanescens* Wakefield on wood-chip piles, and the accumulation by mushrooms of environmental pollutants. In addition to this scientific nucleus, there are six unsigned scientific chapters on botany and chemistry of psychoactive mushrooms, descriptions (with illustrations) of seven species, details on cultivation of psilocybian mushrooms and notes on dosage and ingestion of same. There is also a brief note on history of entheogenic mushrooms by German anthropologist Christian Rätsch.

The book is divided into eight sections. The introductory part has the papers by Hofmann and Rätsch, and a pair of short essays by the pseudonymous editor Ronald "Rumpelstilz" Rippchen (who seems to be daring us to guess his name; but here he will remain pseudonymous!). There follow two scientific sections with the papers by Gartz and several anonymous essays with botanical, chemical and horticultural data. A brief question-and-answer section is followed by 22 pages of illustrations of mushroom motifs, mostly quite ugly cartoon-like posters and signs, and a few comic strips. The next section deals with psychonautic experiments with entheogenic mushrooms by Valentina P. Wasson, Ann Shulgin (Shulgin and Shulgin 1991), María Sabina and Timothy Leary. The penultimate section contains the translation of Terence McKenna's paper on entheogenic mushroom motifs in literature (McKenna 1990), a review of mushrooms in science-fiction films, and a discussion of German law regarding entheogenic mushrooms. The final section consists of a solitary paper by Martin Hanslmeier, by far the longest and most detailed in the book. This is the reprint of a paper from the new entheogen journal *Integration: Journal for Mind-Moving Plants and Culture* (Haseneier 1992), unfortunately lacking the references from the original. This discussion of "the archetypal dimension" of entheogenic mushrooms is a serious piece of scholarship, accompanied by 16 black-and-white reproductions of the author's water-color paintings of psilocybian mushrooms (with 3 others scattered throughout the book). Unfortunately, the exceedingly bad, low-resolution printing renders these muddy and poor facsimiles of the originals, which I have seen, and which are superb. At least the inside covers of **ZauberPilze** are graced by fair color reproductions of two of these (*Psilocybe semilanceata* [Fr. ex Secr.] Kumm. and *Psilocybe cyanescens* Wakef.), which, however, only serves to underscore the awful quality of the black-and-white counterparts.

While this book gathers together reprints of several interesting and significant papers on entheogenic mushrooms, it suffers from poor design and production. Although good quality paper is used, this is not recycled as it should be, and printing appears to have been done using 300 dot-*per*-inch output from a low-resolution laser printer, not suitable for subsequent reproduction. Worse still, the 22 pages of illustrations in the middle of the book (with a couple of exceptions) had better been left in the obscurity they deserve and from which they were unfortunately dredged up. In combination with another dozen or so cartoon-like mushroom drawings scattered throughout the book, these *kitsch* graphic elements unfortunately give the book a sleazy, frivolous look not in keeping with the serious content of the papers. This is unfair to the authors, some of whom, like the late V. P. Wasson, had no say in the matter. The cover illustration by Kat Harrison evokes a similar circus-like atmosphere, and could give the impression that this is a comic book. It would have been far better to have used on the covers Martin Hanslmeier's lovely and botanically-accurate water-color paintings which appear on the inside covers. The ugly illustrations and low-resolution typography conspire with a weak design to create a hideous *pastiche* or hodgepodge. I realize this book was the joint production of two publishing houses and at least 16 authors—all the more reason to have hired a competent designer to give a smooth and consistent look to the book. To add insult to injury, in place of a much-needed index or bibliography, we have a final, ninth "section" on "Infospores and Sources" which is in reality eight pages of advertisements, which are at least graphically consistent with the book—yet another *pastiche* of diverse designs and typography! As a writer and publisher it pains me to say that publishers who can't be bothered to hire a graphic designer, and who scrimp so as to produce a book with the crass graphic quality of a Xerox copy, are inviting the reading public to photocopy the book rather than pay for it!

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

Lista Anotada de las Plantas Medicinales de Uso Actual en el Estado de Quintana Roo, México. Ma. T. Pulido Salas and L. Serralta Peraza. Centro de Investigaciones de Quintana Roo, Apartado Postal 424, 77000 Chetumal, Quintana Roo, México. [TEL.: (983) 21666 or 20115; FAX: (983) 20447] 1993. Pp. 105. No price given (paperback). ISBN 968-6780-08-4.

The state inventories of medicinal plants in Mexico are increasing as local institutions recognize the importance of establishing the scientific basis of their floristic, ecological, and health care programs. The most recent publication focuses on the state of Quintana Roo of the Yucatan peninsula on the southern border of Mexico. Previous listings for Veracruz, Yucatan, Durango and Sonora have relied heavily on general bibliographies on medicinal plants. In contrast, Pulido and Serralta base 370 of their 373 plants on primary sources from the state.

The flowering plants dominate the medicinal vascular flora with 366 species while ferns account for seven. The information is based upon herbarium and bibliographic records as well as interviews with users and growers of vegetal remedies, *curanderos,* and members of Asociación de Médicos Tradicionales de Quintana Roo. Of the 18 references in the bibliography, 13 are based upon studies in Quintana Roo or from the Yucatan peninsula.

The main text (written in Spanish) consists of plant listings divided into ferns, dicots and monocots. Under each division, the plants are arranged alphabetically by family, genus and species. Each taxonomic entry has the following fields: scientific name, common name, medicinal use, bibliographic reference, locality where it is used in the state, and herbarium specimen. It is curious that 13 plants do not have common names registered in Quintana Roo; no explanation is given. Herbarium specimens are deposited in the state herbarium (CIQRO), the regional herbarium (CICY) or the National Herbarium (MEXU).

It is difficult to estimate the percentage of native medicinal plants of the state's flora (about 2300 native species, 70% of which are found in the rest of the peninsula) because no distinction is made among the native, introduced and cultivated taxa. The only plant illustrations are the six untitled color photographs on the cover. One state map, a list of synonyms and an index to common names adds to the utility of this welcomed contribution of the inventory of medicinal plants of Mexico.

Robert Bye and Edelmira Linares
Jardín Botánico
Instituto de Biología
Universidad Nacional Autónoma de México
04510 México, DF
MEXICO

BOOK REVIEW

Plants of the Gods: Their Sacred, Healing and Hallucinogenic Powers. Richard Evans Schultes and Albert Hofmann [reprint of 1979 edition]. Rochester, Vermont: Healing Arts Press, 1992. Pp. 192. U.S.$19.95 (paperback). ISBN 0-89281-406-3.

We have here a facsimile reproduction of Richard Evans Schultes and Albert Hofmann's classic 1979 "coffee-table" book on entheogens, *Plants of the Gods* (Schultes and Hofmann 1979) with the only alteration being a new cover and front matter, along with a new subtitle, *Their Sacred, Healing and Hallucinogenic Powers* (the dedication to Heinrich Klüver has also been removed). The text and numerous color and black-and-white photographs and illustrations have been well printed in Italy on excellent paper, and bound with a durable, sew-and-glue binding. It is indeed fortunate that this facsimile has appeared, as the original edition, published nearly simultaneously with Hofmann's memoirs (Hofmann 1980) and R. Gordon Wasson's *The Wondrous Mushroom* (Wasson 1980), was remaindered together with these two books shortly after release, owing to internal problems with the publisher, McGraw-Hill. This cut short the shelf-life of a truly excellent book, which now enjoys a new lease on life. The original edition was patterned after a lovely twin book, *Medicines from the Earth* (Thomson 1978).

Introductory sections on the botany, chemistry and geography of entheogenic plants are followed by a "Plant Lexicon" with single-column entries (some double-sized) for 91 species, each with a color illustration (mainly superb color drawings, but 15 with excellent color photographs), botanical name and family, geographic range, and a paragraph of text giving mainly botanical information, but with some phytochemical and ethnobotanical data as well. A 14-page table lists the same 91 species in alphabetical order by common names (in the lexicon, they are listed in alphabetical order based on Latin names), with sections giving scientific names, history and ethnography, context and purpose of use, manner of preparation, and phytochemistry and pharmacology for each species. Short chapters on "Fourteen Major Hallucinogenic Plants" make up the bulk of the book. These chapters are: 1) "Mainstay of the Heavens" (*Amanita muscaria* [L. ex Fr.] Persoon ex Gray); 2) "The Hexing Herbs" (*Atropa, Hyoscyamus, Mandragora* species); 3) "The Nectar of Delight" (*Cannabis* species); 4) "St. Anthony's Fire" (*Claviceps purpurea* [Fr.] Tulasne); 5) "Holy Flower of the North Star" (*Datura* species); 6) "Guide to the Ancestors" (*Tabernanthe iboga* Baillon); 7) "Beans of the Hekula Spirit" (*Anadenanthera* species); 8) "Vine of the Soul" (*Banisteriopsis* species); 9) "Trees of the Evil Eagle" (*Brugmansia* species); 10) "The Tracks of the Little Deer" (*Lophophora williamsii* [Lem.] Coulter); 11) "Little Flowers of the Gods" (*Psilocybe* and other species of psilocybian mushrooms); 12) "Cactus of the Four Winds" (*Trichocereus pachanoi* Brit. et Rose); 13) "Vines of the Serpent" (*Ipomoea violacea* L. and *Turbina corymbosa* [L.] Raf.); and 14) "Semen of the Sun" (*Virola* species). These chapters, superbly illustrated with black-and-white photographs and botanical illustrations of the respective plants, also feature maps showing distribution of traditional use, and superb photographs of use and preparation of these drugs, together with woodcuts and manuscript illustrations of entheogen-inspired art, pictures of shamans, deities, and drug paraphernalia,—a veritable artistic treasure-trove. The accompanying text of each chapter details the history and ethnobotany of each category of sacred inebriant, and each chapter has a brief sidebar on the chemistry and pharmacology of the active principles. A 4-page chapter on chemistry is also illustrative—it depicts colored ball-and-stick molecular models of 8 important hallucinogenic compounds and of 2 neurotransmitters for comparison purposes. Unfortunately, a glaring error in the original book (the transposition of the figure legends for *iso*-LSD and lysergic acid hydroxy-ethylamide on page 175) has not been corrected here. The last chapter on the "Uses of Hallucinogens in Medicine" presents a dozen colorful drawings made by psychiatric patients treated with LSD, and is followed by an epilogue, the author's salute to four pioneering predecessors in the study of shamanic inebriants—Ernst Freiherrn von Bibra, Mordecai Cubitt Cooke, Karl Hartwich and Louis Lewin. A 79-source "Further Reading" list is followed by credits to the numerous photographs and a detailed four-and-a-half-page index.

Withal, the quality is commensurate with that of the original $34.95 clothbound edition, and Healing Arts Press is to be commended for somehow producing this superb facsimile of the original, lavishly-illustrated book, 13 inflationary years later, for the incredibly low price of $19.95, the only palpable difference between the two editions being the hard and soft cover. In an era in which the average scientific book in natural sciences, many of which lack illustrations or decent design and typography, is priced at $79.00 (Anon. 1994), this ranks as one of the best book bargains to be found. While *Plants of the Gods* is clearly directed toward the layperson, it contains many nuggets of ethnobotanical data of compelling interest to the specialist, which are not to be found in any other publication by either author. It isn't often that we get a second chance to purchase an important book, and this is a chance no ethnobiologist interested in shamanic inebriants can afford to pass up!

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

Les Plantes des Dieux: Les Plantes Hallucinogènes, Botanique et Etnologie. Richard Evans Schultes and Albert Hofmann [anonymous translation of 1979 American original; *préface* by Jean-Pierre Galland]. Paris: Les Éditions du Lézard, 9 Passage Dagorno, 75020 Paris, France, 1993. Pp. 192. 195 French Francs (paperback). ISBN 2-9507264-2-9.

While the French marketplace has long been refractory to publications on the ethnopharmacognosy of shamanic inebriants, a new company, Les Éditions du Lézard, has recently tested the waters, apparently with commercial success. In its first year of operation, this company published a translation and an original title on marijuana or *Cannabis* (Éditions 1993; Herer 1993), and the firm brought out two large-format, elegantly colorful books on this subject. Jean-Pierre Galland's *Fumée Clandestine: Il Était une Fois le Cannabis* (Galland 1993) was followed closely by this French translation of Richard Evans Schultes and Albert Hofmann's 1979 popular book *Plants of the Gods: Origins of Hallucinogenic Use* (Schultes and Hofmann 1979—reviewed separately). There are only three alterations from the American original: a different subtitle, a one-page *préface* by Jean-Pierre Galland *in lieu* of the original unsigned preface; and the use of a larger typeface for the index and photographic credits, resulting in the regrettable excision of the single-page "Further Reading" bibliography. It would have been far better to have retained this vital section, using the smaller typeface of the original index and photographic credits, to leave sufficient space.

Furthermore, for some reason (and in contrast to the typographically-elegant *Fumé Clandestine*) the publisher chose to use low-resolution (300 dot *per* inch) laser printer output for the French text (like the original, using a classic, serif face for the main body text, with the figure legends, table and "Plant Lexicon" set in a *sans* serif typeface). Besides compromising the elegant graphic design, this clunky, muddy type contrasts poorly with the excellent reproduction of color and black-and-white photographs and illustrations, the quality of which, like the paper on which they are printed, is commensurate with that of the original. Another typographic problem is the use of clumsily hand-drawn Greek characters (α, ß, Δ) in the text; is the French marketplace lacking in garden-variety font packages? Also, there are far too many misprints. The Table of Contents, for example, has 5 misspellings, and a cursory examination of just the scientific names of 91 plants in the 14-page table immediately disclosed 21 misspellings, while the same quick look at plant names in the lexicon disclosed 9 mistakes in the 91 entries. Of course, Latin botanical names trip up even the most thorough proofreader, but these numbers indicate far too little attention was paid to the accuracy of the text. It might also be said that this translation suffers from a too-close correspondence with the original—a glaring error in the figure legends for the ball-and-stick chemical models on page 175 of the original is perpetuated in the translation (the transposition of the figure legends for *iso*-LSD and lysergic acid hydroxyethylamide).

On the bright side, however, this is a handsome and well-made book, lavishly and beautifully illustrated, at what I consider to be a bargain price (less than $40 U.S. for a book printed on good paper with 127 color illustrations, and a durable, sewn binding). On the other hand, the contemporaneous, typographically-superior, American softcover facsimile edition sells for about half as much, but perhaps this was made from the original plates, and of course that edition entailed no expense for translation. Moreover, *Plants of the Gods*, as is well known, is an excellent introduction to the subject by two pioneering experts in the ethnobotany and chemistry of entheogenic plants (Hofmann 1964; Schultes and Hofmann 1980; Schultes and Raffauf 1990), well worthy of translation. The cover features a lovely reproduction of a Huichol yarn painting also appearing on page 63, and has an elegant design which does justice to the quality of the contents. The translation is faithful and accurate, 'though I am not qualified to comment on its literary quality. In conclusion, apart from the typographic problems aforementioned, we have here a lavish production of one of the best introductory, popular books on the subject of shamanic inebriants by two leading experts. Éditions du Lézard is to be commended for making this excellent book available to French readers in a style appropriate to the original and at a fair, indeed, a bargain price.

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Jonathan Ott
Natural Products Co.
Apartado Postal 274
Xalapa, Veracruz, México

BOOK REVIEW

Rivers of Change: Essays on Early Agriculture in Eastern North America. Bruce D. Smith. Washington and London: Smithsonian Institution Press. 1992. Pp. xiv, 320. $49.95 (cloth). ISBN 1-56098-162-8.

In this important but rather overlong book, Smith presents compelling argument, data, and documentation that eastern North America was a major center of plant domestication before the advent of maize and other Mesoamerican crops. Although this is the book's central focus, along the way Smith deals with the transition from hunting and gathering life ways to a dawning dependence on food production and other topics. Several plant taxa are discussed in the context of early pre-maize agriculture. Four of them, *Chenopodium, Iva, Cucurbita,* and *Helianthus,* played major roles and they receive a great deal of attention.

The book is organized into four unequal sections: I. Rivers of Change; II. An Independent Center of Plant Domestication; III. Premaize Farming Economies in Eastern North America; and IV. Synthesis. Except for Chapter 4 wherein C. Wesley Cowan and Michael P. Hoffman are co-authors, Smith has authored all 12 essays (terminology of the book's title); actually each is simply a chapter. Four of these have been previously published, one in this journal. When *Rivers of Change* was published, it was noted that two additional chapters "also will appear" in other works. Thus, only five chapters—approximately one-third of the book—were written exclusively for *Rivers of Change*. Many students of early agriculture in the eastern U.S.A. will likely have all or most of this previously published material in their files.

Most of Section III seemed less interesting in content and less interestingly written than earlier and later sections. There are at least two reasons for this: (1) Although I have followed this literature in only the most casual manner, I found I was familiar with much of this previously published material, and (2) Sections I, II, and IV, most of which was written with this volume in mind, is freer of style, without the editorial limitations and other requirements of the various other publication outlets. And, into the bargain, these sections compare and contrast the various theories that have been advanced regarding early agriculture in eastern North America from a historical perspective and taking into account data and interpretations now available as a result of recent archaeological excavations, the latest findings in evolution and genetics and the application of new technologies, e.g., the scanning electron microscope.

There are 33 black and white illustrations and 72 line drawings, most of which I found quite ordinary (striking exceptions: Figure 2.1 Diagramatic representation of the six interlocking segments of the Floodplain Weed Theory of plant domestication in eastern North America, figures 4.9-12 which are photographs of gourds, and the several figures of scanning electron micrographs). There are no color plates, not even of the four plant taxa discussed in detail, contributing to a book deficient in aesthetic visual appeal.

A couple of minor points: There is a difference in spelling in what appears to be the same archaeological site in figures 3.1, 11.1, and 12.1 (is it Hayes or Haynes?). I must express disappointment with the index, which is admirably complete for plant taxa and without any entries at all for other categories, e.g., archaeological site names, names of investigators and hypotheses or theories mentioned in the text, diminishing its value for reference work.

I recommend this book as background reading to those with a general interest in this topic and as essential reading to those conducting research in this and related areas. The summary and analyses of earlier treatises of pre-maize agriculture in eastern U.S.A. are outstanding. Smith's treatment is provocative, comprehensive, and timely.

Willard Van Asdall, Past Editor
Journal of Ethnobiology
4479 N. Summer Set Loop
Tucson, AZ 85715, U.S.A.

BOOK REVIEW

Persephone's Quest: Entheogens and the Origins of Religion. R. Gordon Wasson, Stella Kramrisch, Jonathan Ott & Carl A. P. Ruck. New Haven and London: Yale University Press, 1986. Pp. 257, paper. Price: $14.00. ISBN: 0-300-05266-9.

The word "entheogen," literally "god generated within," is defined as a psychoactive drug capable of producing awe-inspiring visions and emotions. This book contains a series of essays discussing the purported role various enthogenic plants and fungi have played in religious rituals of Eurasia and Mesoamerica.

Only the first chapter, by R. Gordon Wasson, is previously unpublished. It reads more like a rambling, folksy autobiography than a serious piece of scientific research. It concerns the author's ethnomycological experiences in Mesoamerica and South Asia. Wasson's amateur status is betrayed by such statements as "mushrooms are a lower order of plant life," and "*Amanita muscaria* . . . carries no name today in English" (fly agaric?). He surveys the purported use of fly agaric in several parts of the world. He then postulates that use of this mushroom represented the first religion of the human race. This is quite a tenuous conclusion to draw from controversial evidence. Even Wasson's identifications of this fungus as the organism involved are not universally accepted.

I believe the book's major shortcoming, beyond a tendency toward inductive reasoning and unsubstantiated speculation, is a narrow view of religion. Anthropologists have devoted considerable debate to defining and characterizing religion, but Wasson et al. prefer to accept common Western assumptions, even when discussing non-Western cultures. Their view is that religion necessarily involves adoration of mystical and powerful phenomena. They thus overlook a great portion of the human religious experience. They discuss ancient Sanskrit texts as if these represent the first dawning of human consciousness. Religion has a much longer history, albeit largely unwritten. They are discussing not the origins of religion, but rather one particular manifestation of it.

The book does contain a useful and fascinating discussion of the use of psychoactive substances in human rituals in many parts of the world. It is definitely worth reading, even if some of the basic assumptions are unscientific.

Joseph E. Laferrière
Arnold Arboretum of Harvard University
22 Divinity Ave.
Cambridge MA 02138 USA

BOOK REVIEW

Wild Seasons: Gathering and Cooking Wild Plants of the Great Plains. Kay Young. Lincoln and London: University of Nebraska Press. 1993. $15.00 (paper); $40.00 (cloth). Pp. xxiv, 318. ISBN 0-8032-4906-3 (alkaline paper); 0-8032-9904-4 (paperback).

Quite simply, in this wonderful book (and quite literally it is filled with wonder); author Kay Young and illustrator Marc E. Marcuson approach perfection. The nearly 250 recipes it includes have been tested by the author and other cooks of long experience. If I had not been already convinced that the author "knew her onions," this quote from her discussion of wild black raspberries would have persuaded me: "Plants growing along streams or in other areas where they can draw enough moisture produce plump, juicy fruit and are one of nature's most outstanding treats." (p. 163).

I was impressed with the glossary of botanical terms, glossary of cooking terms, the appendix on canning, freezing, and drying, and the three indexes of plants, of recipes by plant, and of recipes by food category. These carefully prepared features contribute to easy use of the book.

Readers are guided and encouraged to develop environmental and ecological sensitivity to wild plant resources. The Introduction ends with "Guidelines for the Safe and Sustainable Use of Edible Wild Plants." These ten points could and should serve as a model for the development of environmental awareness anywhere and everywhere.

Throughout the book the author offers accurate information about each species or group of related species discussed, such as a description of the plant, its distribution and habitat, edible parts, seasons to collect, and any cautions of which the collector should be aware. Kay Young also offers interesting and useful anecdotal material about how, when, and where she acquired additional information and recipes. I especially liked reading about the annual Poke Sallet Festival in Harlan County, Kentucky.

What more can I say? Beg, borrow, or preferably buy Kay Young's *Wild Seasons.* As in the Shaker hymn, *Simple Gifts,* while reading it you will find yourself "in the valley of love and delight."

Willard Van Asdall, Past Editor
Journal of Ethnobiology
4479 N. Summer Set Loop
Tucson, AZ 85715, U.S.A.

NOTICE TO AUTHORS

The *Journal of Ethnobiology* has published "Guidelines for Authors" in Volume 10, Number 2 (Winter 1990). Many authors will be able to prepare their manuscripts by consulting recent issues of the *Journal*. If you need a copy of the "Guidelines for Authors" please consult the issue of the *Journal* in which it was first published or write to the Editor requesting a copy.

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We welcome suggestions on books to review or actual reviews from readership of the *Journal*. Please send suggestions, comments, or reviews to one of the *Journal*'s book review editors (see inside front cover).

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CONTENTS

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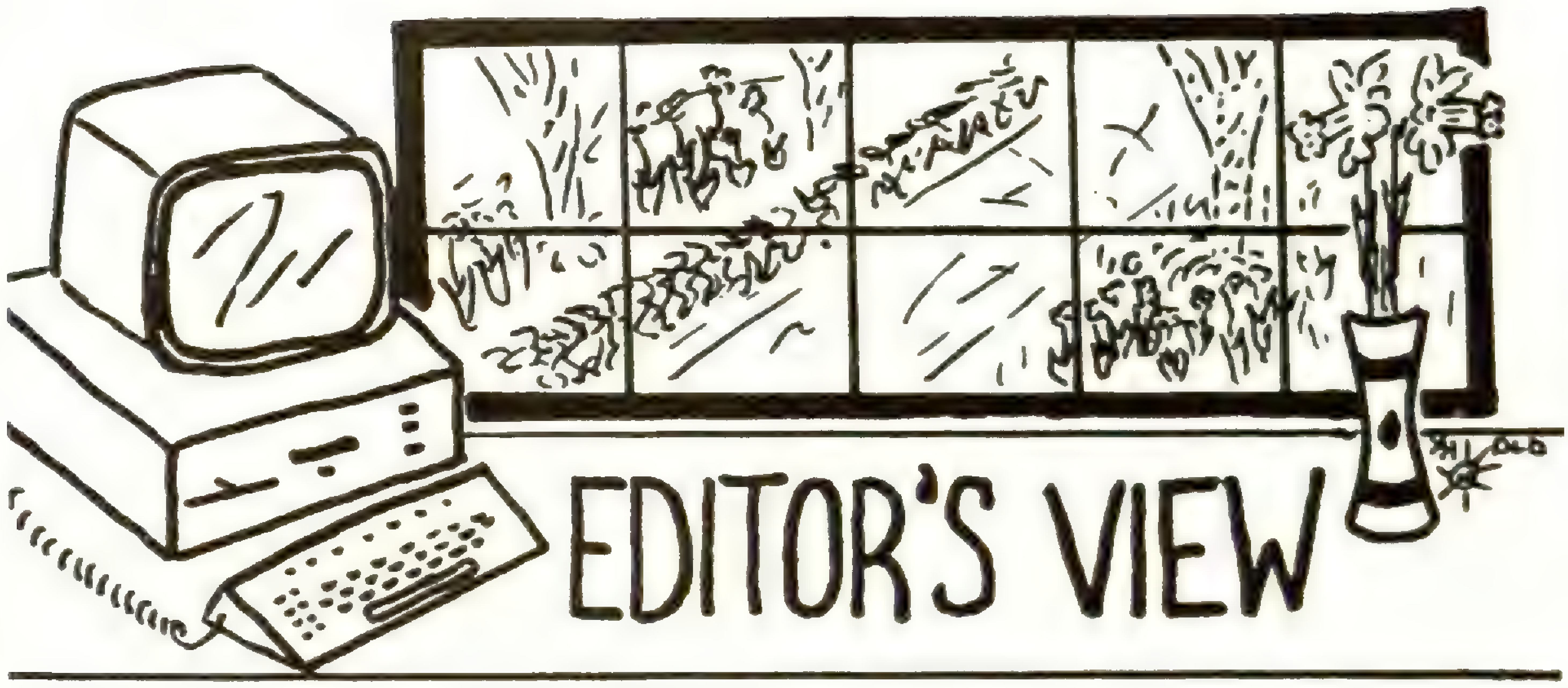
CONTENTS



Some thoughts on **dietary reconstruction**. Last winter I conducted a seminar at MU on reconstructing diet and nutrition through the archaeological record. Understanding what people ate at various times in prehistory is fundamental for understanding how past populations survived and prospered—how healthy people were, the nature and stability of a population's adaptation to the environment, and whether agricultural surpluses were produced to support complex social and political organizations. The students and I read a large number of studies purporting to reconstruct diet. We attempted to assess how, and to what extent, this goal could be achieved using the remains of plants and animals preserved at archaeological sites, and dietary indicators in the human skeleton. For me, it was essential to consider these issues before I attempted, with other members of the Jama Valley Project (Ecuador), to test competing models of agricultural evolution and cultural change using the floral, faunal, skeletal, and site settlement data from our research.

What did the students and I learn? In essence, we found few of the studies we read convincing because few presented *multiple lines of evidence* to support their reconstructions of diet and nutrition. In other words, many studies focused on a single source of data—usually isotopes, skeletal stress indicators, botanical macroremains, or faunal remains—with other indicators of diet and health either not considered at all, or used without critical evaluation and real integration. Essential aspects of diet were often ignored, as in paleoethnobotanical studies that didn't consider animal protein sources. Also, the inherent weaknesses in each type of dietary data—differential preservation and recovery in the case of plant remains, to continue this example—often resulted in single indicators not being robust enough to carry a reconstruction.

I think there is a need to open debate among ethnobiologists on how multiple lines of evidence can be brought to bear on dietary reconstruction—how a true interdisciplinary synthesis can be achieved. One approach I hope to explore in the coming year is developing a framework for evaluating data sets against one another that is based on knowledge of the strengths and weaknesses of the data, and that frames successive hypotheses for testing. Although we are often introspective and critical of our own data, there is remarkably little communication among practitioners focusing on different types of biological data. Lack of familiarity can lead to skepticism of new approaches or mis-use of data, and continuing misconceptions will eventually hinder research in the area of diet and nutrition. Changes in the way research is conducted are needed: researchers really do need to think things through together. Elizabeth Wing, in a commentary that ends *Paleonutrition. The Diet and Health of Prehistoric Americans* (K. Sobolik, editor, 1994, p. 316), puts it well:

> Great progress in paleonutrition has been achieved in the past three decades, but for it to progress along the same trajectory, the close cooperation of interdisciplinary team efforts must be fostered.

I look forward to your comments on these issues.

News and Comments editor Gary Martin reports receiving few news items from our readers. Announcements of meetings, classes, and workshops (and reports on activities at meetings), new organizations and projects, publications, sources of funding, and requests for information or assistance are all welcome. Our publication schedule limits announcements of meetings or other events to those where you can give 6 months or more notice. I would like to see many more short reports on events members have attended, and more use of the "Opinions" section, where you can bring up issues for discussion. Information on electronic networks that readers have found useful would be a good contribution, as would tips on accessing the "grey" literature. Gary and I would also be interested in ideas on how to make this section more useful to readers. Students, for example—what would you like to see added? Send contributions/suggestions for **News and Comments** by mail or fax to Gary Martin (see back cover for details).

DMP

J. Ethnobiol. 14(2):141–160 Winter 1994

THE WELLS OF SPANISH FLORIDA: USING TAPHONOMY TO IDENTIFY SITE HISTORY

ELIZABETH J. REITZ
Museum of Natural History
University of Georgia
Athens, GA 30602-1882

ABSTRACT.—Wells from Spanish Florida provide a wealth of information about subsistence in the colony. Archaeologists working with materials from the Spanish colony argue that these wells were filled quickly. It is possible, however, that they were filled slowly. Wells left open after being abandoned, like natural pitfall traps, should accumulate the remains of animals such as rodents, snakes, and frogs, which become entrapped in such features. Wells filled quickly once abandoned should contain few of these animals. While two Spanish wells have been found that did function as natural traps, most of the wells of St. Augustine and Santa Elena do not appear to have been open and unused long enough to serve as natural traps.

RESUMEN.—Los pozos de La Florida española son una rica fuente de información acerca de la subsistencia en la colonia. Los arqueólogos que han trabajado con los materiales de la colonia española aseveran que estos pozos fueron llenados rapidamente. Es posible, sin embargo, que se hayan llenado lentamente. Los pozos que permanecieron abiertos después de ser abandonados, como las trampas naturales, debieron acumular los restos de animales tales como roedores, víboras y ranas que son atrapados en esos sitios. Los pozos que se llenaron rapidamente despues de ser abandonados debieran contener pocos de estos animales. Si bien se han encontrado dos pozos españoles que sí funcionaron como trampas naturales, la mayoría de los pozos de San Augustín y Santa Elena no parecen haber permanecido abiertos y sin uso por suficiente tiempo para servir como trampas naturales.

RÉSUMÉ.—Les puits de la Florida offrent une abondance de renseignements concernant la subsistance au temps de la colonie. Les archaéologues traitant du matériel archaéologique de la colonie espagnole maintiennent que ces puits se sont remplis rapidement. Toutes fois, il est possible qu'ils se soient remplis lentement. Les puits, ayant été abandonnés ouverts et formant des trappes naturelles, devraient accumuler des restes d'animaux, tels que rongeurs, serpents, et grenouilles qui se trouvent piégés dans ces trappes. Les puits qui se remplissent rapidement une fois abandonnés devraient contenir peu de ces animaux. Deux puits provenant de La Florida espagnole ont, en effect, joué le rôle de trappes naturelles. Mais la plus part des puits de St Augustine et Santa Elena ne semblent pas être demeurés ouverts et inutilisés assez longtemps pour avoir servi de trappes naturelles.

INTRODUCTION

Wells from Spanish Florida provide a wealth of information about subsistence and other aspects of human/animal interactions in the colony (Reitz 1991, 1992;

Reitz and Cumbaa 1983; Reitz and Scarry 1985). Archaeologists working in St. Augustine argue that wells associated with the First Spanish Period, A.D. 1565–1763, were filled relatively quickly with trash once they no longer were used for water (Deagan 1983:57). If that was the case, the contents of wells represent short-lived behavior and provide tightly focused, closed-context, glimpses into the life of a household at a specific point in time. Such closed-context deposits are useful in discussions of the colonies' economic and social networks. It is possible, however, that abandoned wells filled slowly. In that case their contents would be representative of no particular household or moment in time, and less valuable as sources of information about social and economic interactions. It is important, therefore, to determine which wells represent closed-contexts and which ones do not. This same dilemma confronts archaeologists working in other locations and time periods.

Observations of natural and artifical pitfall traps suggest this problem can be resolved using faunal remains since, from the perspective of a mouse, wells are hazards similar to bell-shaped pits or other features dug by humans. Wells filled quickly would be expected to have few characteristics in common with pitfall traps while wells left open would have many of the same faunal remains as natural pits. Testing this hypothesis is best accomplished where the historical events associated with each pit (well) are known; however, once it is established that faunal assemblages from traps do have a characteristic signature, such patterns may distinguish rapidly filled pits from pits filled slowly at sites whose histories are not known.

Open wells, like natural traps, may contain large numbers of animals such as insectivores, small rodents, snakes, frogs, and toads. Such animals accumulate in what are essentially deep holes, as long as these were too deep or steep-sided for escape (Whyte 1988). Wells filled quickly might have few of these animals since there would be a shorter period of time for them to become trapped and easier access through the accumulating debris to the surface and escape. Presumably a large number of entrapped animals would preclude use of a well for drinking water, providing a motive to either clean the well or dig a new one.

Using the identity of vertebrates found in well-fill, two patterns are seen. Some wells in Spanish Florida apparently were natural traps and probably filled slowly. Most of the wells of St. Augustine and Santa Elena do not contain quantities of animals considered likely members of a natural trap death-assemblage and were probably filled quickly when they no longer were used for water. Two wells identified as natural traps were both associated with unique moments in the history of the colony.

SPANISH FLORIDA HISTORY

Spanish Florida was founded in 1565 by Pedro Menéndez de Avilés, marking the beginning of the First Spanish Period. Originally Spain claimed all of North America south of Newfoundland and west of the Atlantic Ocean indefinitely (Gannon 1967:1); however, the actual occupation was a strip along the Atlantic coast between Santa Elena and St. Augustine and westward to Apalachee Province (Fig. 1). Menéndez founded two towns, St. Augustine and Santa Elena.

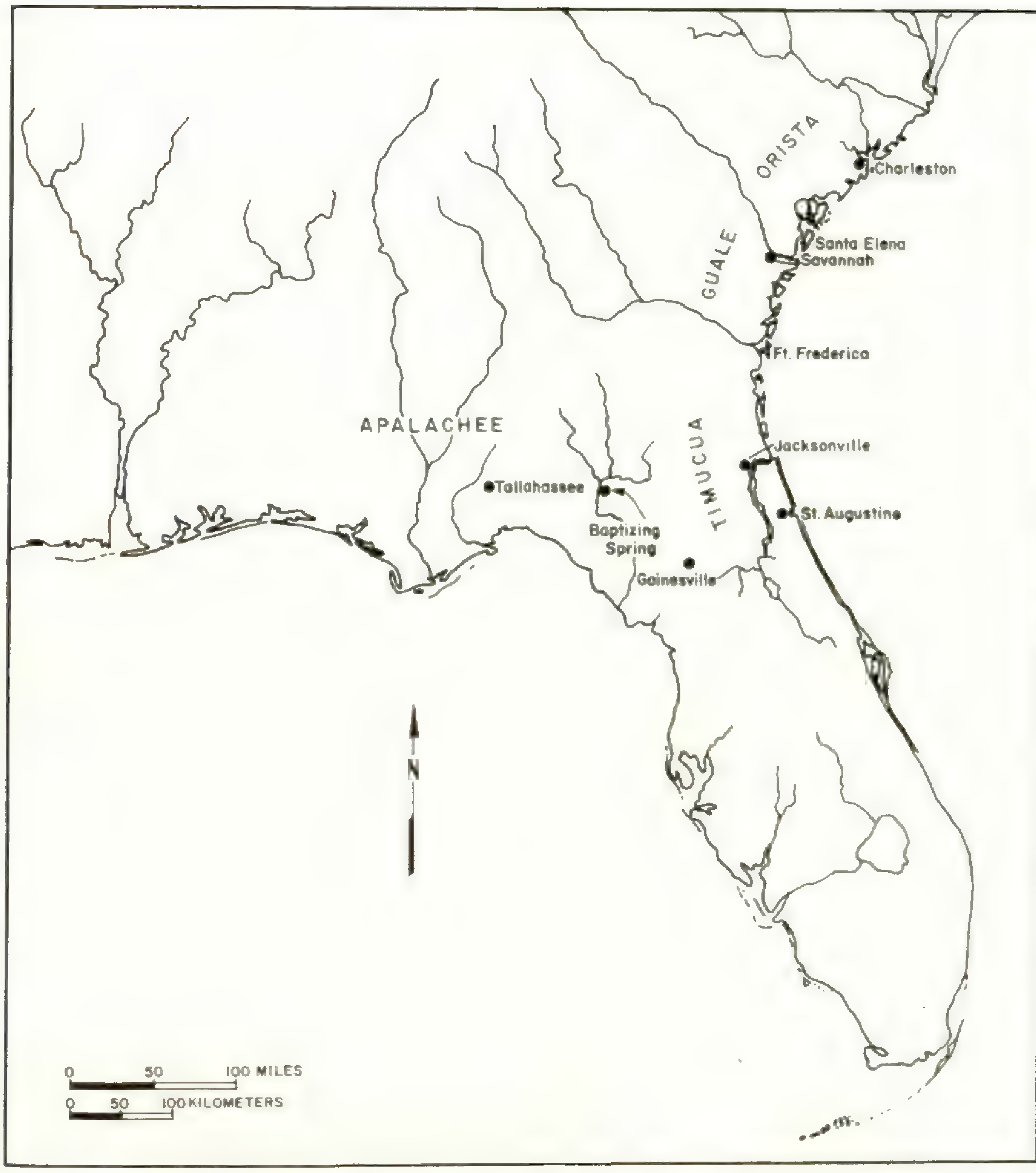


FIG. 1.—Map showing location of St. Augustine, Santa Elena, and Charleston.

Santa Elena was established a few months after St. Augustine and was the capital of Spanish Florida until 1587, when it was abandoned and St. Augustine became the capital of the province. Throughout the sixteenth century natural disasters and attacks by a variety of human foes contributed to the unreliabiity of imported staples, munitions, and other supplies. In 1570 an official subsidy was established to remedy the problem, but it did not do so (Lyon 1977; Sluiter 1985). Disease also hampered efforts to develop an export economy. If the official correspondence is to be believed, sixteenth-century St. Augustinians had very little to eat and subsisted on scum and vermin (Bushnell 1981:11; Conner 1925:99).

In the seventeenth century Floridians continued to experience disease, natural disasters, and war. Epidemics of yellow fever or typhus, smallpox, and measles devastated Europeans, Africans, and native Floridians (Bushnell 1978; 1981:13). Buccaneers attacked the mission chain along the Atlantic coast as well as outposts in the interior of peninsular Florida (Bushnell 1978, 1981:12; Hann 1986:175). Wars throughout the century between Spain, France, and England made Caribbean waters generally unsafe for external trade (Bushnell 1981:12); the subsidy was often many years overdue. For this reason many indigenous local sources of food continued to be used by all Floridians.

The eighteenth century was also a time of turmoil for Spanish Florida (TePaske 1964). British raids destroyed outlying missions and cattle ranches by 1704, and St. Augustine was beseiged in 1728 and 1740. These raids reflected the gradual advance of English settlements down the Atlantic seaboard. Charleston, South Carolina, was founded in 1670 and Savannah, Georgia, in 1733. In spite of hostilities, trade with British colonies was routine (Harman 1969). As in the previous centuries, reports of hardship were frequent. For example, after the subsidy ship was captured in 1712, Governor Don Francisco de Córcoles y Martínez reported townspeople ate dogs, cats, and horses (Córcoles y Martínez 1712; TePaske 1964:83).

The First Spanish Period ended in 1763 when Spain ceded what remained of Spanish Florida to England. Virtually the entire European, African, and missionized Indian populations evacuated the colony from 1763 to 1783, during what is known as the British Period (Dunkel 1958). The Second Spanish Period began when Spain regained peninsular Florida in 1783 and ended when Spain ceded the territory to the United States of America in 1821.

MATERIALS AND METHODS

This analysis is facilitated by the large amount of faunal data available from Spanish Florida. As an indication of the sample size involved, 2,602 vertebrate individuals were estimated in a total sample of 106,570 bone fragments from First Spanish Period St. Augustine and Santa Elena contexts (Reitz 1992; Reitz and Cumbaa 1983; Reitz and Scarry 1985). In brief, the faunal evidence for Spanish Florida indicates extensive use of estuarine resources, some use of wild terrestrial resources including but not limited to white-tailed deer, and little use of domestic animals until the eighteenth century. Species lists for each of the sites discussed here are available elsewhere (Reitz 1990, 1991, 1992; Reitz and Cumbaa 1983; Reitz and Scarry 1985; Wood and Reitz 1986). The faunal remains from Spanish Florida have all been identified using either the comparative skeletal collections at the Florida Museum of Natural History or the University of Georgia Museum of Natural History. The reader is referred to Deagan (1983:54–61) for an extensive discussion of field logistics and nomenclature.

The sites and methods used in identification and analysis of the collections are described in detail elsewhere (Reitz 1990, 1991, 1992; Reitz and Cumbaa 1983; Reitz and Scarry 1985; Wood and Reitz 1986). For purposes of the following presentation, however, it is important to note that faunal remains recovered from both general zone deposits and features were studied from all Spanish Florida sites. Most of the 200 taxa identified in wells were also present in zone deposits. The only exceptions are single bones identified as great egret (*Casmerodius albus*), ruddy duck (*Oxyura jamaicensis*), broad-winged hawk (*Buteo platypterus*), and largemouth bass (*Micropterus salmoides*); as well as two fish bones identified as grunt (Haemulidae), all of which were found only in wells.

COMMENSAL TAXA IN SPANISH FLORIDA

To determine whether the wells of Spanish Florida filled quickly or slowly, those animals that are considered characteristic of natural pitfall traps must be defined. The animals likely to be victims of natural traps were classified as commensal taxa during analysis of Spanish Florida faunal assemblages. Commensal taxa are those animals found frequently in association with human residences, perhaps through no active intention of humans (Reitz and Scarry 1985:42). Moles, mice, rats, voles, lizards, frogs, and toads are considered commensal animals. These small animals might in turn attract owls, snakes, and other predators. A special category of commensal fauna are pets and working animals. Pets, including dogs and cats, and working animals, such as mules, horses, and oxen, might be present at sites and incorporated into the archaeological record by accident or through burial not associated with consumption. Large working animals are unlikely to fall into wells by accident, but dogs and cats might do so.

While the classification of certain taxa as commensal has had functional utility over the course of the Spanish Florida project, classification of species as commensal rather than as food sources has never been taken for granted. Most of the "commensal" animals might also be consumed either routinely or at least occasionally (Stahl 1982; Szuter 1988). Individual animals of taxa that generally were consumed, such as opossums or raccoons, might also become entrapped, but these animals have not been classified as commensal. Determining which species are included in faunal assemblages through subsistence and other cultural behaviors is important because Spaniards at various times claimed that the poverty of the colony forced them to eat vermin. It is not clear what a Spaniard might consider vermin because a wide range of species that may have been unfamiliar to Europeans were consumed frequently in Spanish Florida. Any or all of these might have been considered disgusting, inedible vermin by homesick Spaniards either as a group or individually. Our normal (ethnocentric) categories of what might be commensal are irrelevant because Spaniards clearly claimed to consume undesirable foods, some of which might have been ordinarily commensal to the town and its surroundings.

Identifying which animals were "vermin" and testing the accuracy of the commensal classification are among the goals of zooarchaeological research for Spanish Florida. Is there a group of animals common in Spanish deposits that were not consumed, and if so, which of the 200 vertebrate taxa found in First Spanish Period collections might have been truly commensal rather than food items wrongly classified as commensal during analysis? Did Spaniards really face famines during which they ate vermin, and if they did, what did they think of as vermin? These are not minor questions since commensal taxa as defined here have comprised 5% of the St. Augustine sixteenth-century vertebrate individuals (MNI=1,126), 5% of the Santa Elena vertebrate individuals (MNI=558), 4% of the seventeenth-century vertebrate individuals (MNI=166), and 5% of the eighteenth-century vertebrate individuals (MNI=722), although their dietary contribution, if any, must have been small (Reitz 1992; Reitz and Cumbaa 1983:175; Reitz and Scarry 1985:66).

Traditionally zooarchaeologists examine characteristics such as articulated joints, butchering and other modifications to bones resulting from exposure, digestion, or both, skeletal completeness, bone breakage, and context to separate the depositional origin of different species. Unfortunately, none of the standard techniques used to distinguish between food and nonfood animals have consistently delineated food from nonfood uses of either vertebrates or invertebrates in Spanish Florida. This suggests that the categories "commensal" and "noncommensal" do not clearly distinguish between "food" and "nonfood" animals in Spanish Florida. This issue is too complex to be addressed here other than to note that commensal taxa are ubiquitous in First Spanish Period collections and that their status in the colonial diet is unclear. Further research is needed to resolve the question of whether the animals classified as "commensal" here were consumed frequently, occasionally, or not at all.

However, as is often the case, data collected for one purpose may be useful for another. Site formation processes have been part of the research design at St. Augustine since the 1970s (Deagan 1983:14), but zooarchaeology has contributed little in this area largely because of the difficulty of distinguishing between food and nonfood refuse. However, there seems to be a characteristic accumulation of commensal taxa that indicates when a well was left open for enough time to serve as a natural trap. Wells filled quickly lack these characteristics. Accumulations of taxa classified as commensal for purposes of this study (Table 1) will be used as markers for natural traps without addressing the question of whether the species were eaten, although the assumption is made that they were not, at least in these contexts.

NATURAL TRAPS

The literature on natural traps is voluminous (e.g., Gibbons and Semlitsch 1981; Guilday et al. 1969; Hirschfeld 1968; Hudson and Solf 1959; Semken and Falk 1991; White et al. 1984) and will be briefly summarized here only to demonstrate that Spanish Florida wells meet many of the physical characteristics of natural traps and that the types of fauna found in traps with small openings can be anticipated with a good degree of accuracy. The point does not need to be belabored because most archaeologists are familiar with the success of 1 × 1 m squares in capturing small animals. Pitfall traps of various designs are also a common biological approach to capturing small animals in the field.

In experimental work designed to replicate site formation processes at archaeological sites, Whyte (1988) found that small vertebrates tend to be caught in deep, steep-sided pit features that remain uncovered while slowly filling with debris. Whyte's baited traps were designed to replicate common archaeological features and were 75 cm in diameter at the surface and 75 cm deep. These pits attracted newts, narrow-mouthed toads, treefrogs, pickerel frogs, leopard frogs, green frogs, bullfrogs, stinkpots, painted turtles, yellow-bellied turtles, snapping turtles, queen snakes, a black kingsnake, a wood duck, opossum, shrews, house mice, white-footed mice, pine voles, muskrats, and rabbits. The species captured and their relative proportions in each pit varied with season, weather, surrounding vegetation, bait, and pit characteristics. When all data from all seasons and all pit types are combined, amphibians comprised 29% of the 267 vertebrate individ-

TABLE 1.—Taxa found in wells and considered potentially commensal for purposes of this study.

Scientific Name	Common Name
Scalopus aquaticus	Eastern mole
UID Rodent	
Cricetidae/Muridae	New and Old World mice and rats
Sigmodon hispidus	Hispid cotton rat
Microtus pinetorum	Pine vole
Rattus spp.	Old World rat
Rattus norvegicus	Norway rat
Rattus rattus	Roof rat
Canis familiaris	Dog
Felis domesticus	Cat
UID Snake	
Colubridae	Non-poisonous snakes
Viperidae	Pit vipers
Crotalus/Sistrurus spp.	Rattlesnake
Rana/Bufo spp.	Anura; Frog/Toad
Rana spp.	Frog
Bufo spp.	Toad
Bufo terrestris	Southern toad

uals, turtles 36%, snakes and birds 1%, and mammals 34% (Whyte 1988:40). Mice were able to escape from some pits (Whyte 1988:57), a situation also reported by Hudson and Solf (1959) for insectivores. Whyte reports that entrapped animals are more likely to be found in the lower levels of natural traps (Whyte 1988:80, 82). A further observation made by Whyte (1988:139) is that entrapped animals are more abundant in experimental pits surrounded by vegetation or debris, a fact that might be used as an indication of site abandonment.

With the exception of the opossums, muskrat, turtles, duck, and rabbits, all of the animals captured in Whyte's pits would be classified as commensal taxa in Spanish Florida archaeofaunal collections. Turtles are a particular surprise since the possibility that turtles might be commensal had been considered and rejected for Spanish Florida collections. However, Whyte notes that 79 of the 95 entrapped turtles were young, newly hatched individuals rather than adults (Whyte 1988:45). Many of the other animals captured were also young, including both snakes and the wood duck. Gibbons and Semlitsch (1981) also found that adults of some species may not be captured in pitfall traps.

A similar interpretation was made by Armitage and West (1985) in a study of materials from a late medieval garden well of the Greyfriars in London. They found that 92% of the commensal small mammals and amphibians in this well were either juveniles or subadults (Armitage and West 1985:123). While not using this as evidence that the well was abandoned but open, they did interpret these animals as evidence of garden fauna associated with nearby orchards rather than subsistence items. They also observed that a high percentage of the garden fauna were young individuals, probably exploring new territory but too inexperienced to be wary of hazards such as wells. Some may have been tossed into the abandoned well as a quick way of disposing of dead animals. Shrews, rodents, dogs, cats, and amphibians contributed 37% of the bone fragments reported from the Greyfriars well.

Carnivores and large herbivores are rarely part of a natural trap fauna when the opening is small, although a study by White and colleagues (White et al. 1984) of two caves formed in a lava field in Idaho provides a good example of a situation in which carnivores can become entrapped. Both caves contained a high incidence of rodents, rabbits, and carnivores, suggesting that the carnivores were attracted by the small rodents and rabbits that fell into the caves, and themselves became entrapped once they jumped through the cave entrances. This study also found that young animals, and very old adults, were the individuals most likely to become entrapped.

DESCRIPTION OF DATA FROM TWO WELLS/NATURAL TRAPS

Examining the Spanish Florida well data might be facilitated by looking first at materials from wells that probably were natural traps, from Lesesne Plantation and 70 Nassau Street, Charleston. While neither of these wells is from St. Augustine or Santa Elena, they do fall within the original sixteenth-century boundaries of Spanish Florida. Characteristics of these wells and their faunal assemblages are presented in Table 2. An important characteristic of wells is that when the well is filled with water, debris accumulates at the bottom of the well in an anaerobic zone, and preservation is therefore enhanced. Hence noting the relationship of commensal taxa to the well bottom and the current water table is important for reconstructing the taphonomic history of the deposit.

One of the "natural trap" wells is from the Lesesne Plantation, just north of Charleston, South Carolina (Wood and Reitz 1986; Zierden et al. 1986). The Lesesne Plantation well was brick-lined and about a meter in diameter at the surface (Zierden et al. 1986:4–44). The well was built in 1800 and abandoned in 1860, although materials probably accumulated during the midnineteenth century. Standing water was found at 2.6 m (Level 28), although the well was dug to culturally sterile soil at 3.3 m. The well was excavated in 20 cm increments from Levels 1–9 and in 10 cm levels from Levels 10–28. Level 29 was the bottom 30 cm of the well. Levels 1–18 contained materials associated with the slump of the plowzone; Levels 19–27 accumulated during the period of abandonment; and Levels 28–29 contained items probably lost while the well was still active. Level 29 was full of organic debris, including what was probably the water bucket. The studied materials were recovered using a 1/4-inch meshed screen.

While the location of the Lesesne well was rural, the second "natural trap" well is urban, from Charleston, South Carolina (Reitz 1990; Table 2). This brick-lined well was found at 70 Nassau Street, the home of a free African-American household. Although the well may have been dug in the 1840s, its contents appear to date to the early twentieth century. The well was enclosed by a house sometime after that, but it remained open, with water perhaps accessed via a pipe. It was excavated as a single unit, and hence there are no levels. The well was 10 ft deep,

TABLE 2.—Description of wells.

Site[1]	Feature	Century	Taxa[2]	NISP	Weight, gm	MNI	Screen	Comments
Natural Traps								
Lesesne	106	19th	13	1071	80.07	52	1/4"	to sterile
70 Nassau	1	19th/20th	8	2215	913.72	48	1/4"	to sterile
Sixteenth-century First Spanish Period, St. Augustine								
SA 26-1	21	16th	30	4295	1128.80	75	1/4"	to sterile
SA 26-1	62	16th	29	1232	1419.97	75	1/4"	to water level
SA 34-1	1977	16th	5	34	262.50	5	1/4"	to sterile; incomplete
SA 34-1	24	16th	19	470	500.10	38	1/4"	to sterile
SA 34-1	26	16th	19	1036	506.74	30	1/4",ss	to sterile
SA 34-2	44	16th	13	291	127.03	14	1/4"	not completely excavated
SA 36-4	5	16th	21	1387	1183.52	72	1/4"	to sterile
SA 36-4	16	16th	8	586	1296.10	9	1/8"	to sterile
FOY	9	16th	18	881	43.69	32	1/16"	to sterile
Sixteenth-century First Spanish Period, Santa Elena								
Sta. Elena	146	16th	24	2506	840.69	40	1/8"	to sterile
Sta. Elena	172	16th	25	1640	544.25	32	1/8"	to sterile
Sta. Elena	217	16th	2	21	17.45	2	1/8"	to sterile
Seventeenth-century First Spanish Period								
SA 34-2	47	17th	12	1559	1320.95	21	1/4"	not completely excavated
Eighteenth-century First Spanish Period								
SA 7-6	14	18th	12	1149	2771.20	22	1/4"	to sterile
SA 34-2	Area 13/17	18th	11	136	161.43	11	1/4"	not completely excavated
SA 36-4	11/12/13	18th	20	1480	1715.95	41	1/4"	to sterile
Later St. Augustine Wells								
SA 34-2	26	British	10	200	871.85	10	1/4"	not completely excavated
SA 34-2	41	2nd Span.	14	1210	2547.59	22	1/4"	to sterile

[1] St. Augustine sites are designed by the prefix "SA". FOY refers to the Fountain of Youth Park site.

[2] Number of taxa for which MNI was estimated.

with water encountered in the lower 3 ft.[1] The last 0.5 ft was dark fill above sterile sand. Only faunal materials from this dark fill at the bottom of the well were studied. The materials were recovered using 1/4-inch meshed screen.

Tables 3 and 4 show the Number of Identified Specimens (NISP) and Minimum Numbers of Individuals (MNI) for the Lesesne and 70 Nassau Street wells. The animals in both wells are overwhelmingly commensal taxa. An exception was made to the general classificatory rule for commensal taxa in the case of rabbits identified in the Lesesne well. Normally rabbits (*Sylvilagus* spp.) are not classified as commensal animals, however, the skeletons in these wells were very complete. High degrees of skeletal completeness indicate minimal postmortem disturbance, suggesting these individuals were commensal. In the Lesesne well 98% of the NISP and 94% of the MNI were commensal taxa. In the 70 Nassau Street well 95% of the NISP and 88% of the MNI were commensal taxa. The general lack of bones from animals that would normally have been consumed, such as cattle and chickens, indicates that food remains rarely were thrown, fell, dragged, or pushed into these wells. Since the 70 Nassau Street well was excavated as a single unit, we cannot examine the levels in which these commensal taxa were recovered. However, in the Lesesne well all but two of the commensal bones were recovered from Levels 20 through 23, the levels just above the water line (Table 5).

Both of these deposits clearly appear to be natural traps, with some additional refuse included in the case of the 70 Nassau Street well. It should be noted that the high incidence of adult rats in the 70 Nassau Street well lead Philip Armitage (personal communication, 1991) to suggest that this well was not a natural trap. He reasoned that because the well was under a house when these rodents became part of the well contents, they must have entered the well through their own initiative. Perhaps an aggressive rat poison campaign encouraged adult rats to seek water in the well regardless of the hazard of being trapped.

It is also important to note that a 1/4-inch mesh was used to recover materials from both deposits. In the presentation that follows, some of the well deposits were also seived through 1/4-inch mesh, which one might expect to bias against recovery of small animal remains. These two cases indicate that if a deposit did serve as a natural trap, use of 1/4-inch mesh will not necessarily disguise that function. Presumably if a smaller-meshed screen had been used, the numbers of commensal taxa would have increased to an even higher percentage of the total sample in both the Lesesne and 70 Nassau Street wells.

THE WELLS OF ST. AUGUSTINE

Wells are common in St. Augustine (Deagan 1981; 1983:57, 111). They were constructed by digging a large well construction pit into which a stack of wooden barrels was placed to form a well roughly a meter in diameter (Fig. 2). A typical well included a stack of one or two barrels extending about 4 m below ground level and 2 m below the water table. Wells are routinely found 12 to 15 m from the street edge toward the back of each lot (Deagan 1983:247). Frequently a number of well construction pits, wells, and false starts are located within a few meters of each other, sometimes overlapping one another. When archaeologists excavate a

TABLE 3.—Commensal taxa in wells, NISP.

Site[1]	Feature	NISP	NISP for Commensal Taxa							% Commensal
			Mole	Rabbits[2]	Rodents	Dogs	Cats	Snakes	Anura	Taxa
Natural Traps										
Lesesne	106	1071		75	206	3		255	509	97.9
70 Nassau	1	2215			1755	55	292			94.9
Sixteenth-century First Spanish Period, St. Augustine										
SA 26-1	21	4295		4	2	2			2	0.1
SA 26-1	62	1232			1		1			0.2
SA 34-1	24	470							2	0.4
SA 34-1	26	1036		3	1				21	2.1
SA 36-4	5	1387		13						
SA 36-4	16	586		1			1			0.2
FOY	9	881			2			2	80	9.5
Sixteenth-century First Spanish Period, Santa Elena										
Sta. Elena	146	2506		1	1				3	0.2
Sta. Elena	172	1640	1		63			109	32	12.5
Sta. Elena	217	21								
Eighteenth-century First Spanish Period										
SA 7-6	14	1149				20				1.7
SA 36-4	11/12/13	1480	1	1			1			0.1
Later St. Augustine Wells										
SA 34-2	41	1210						2		0.2

[1] St. Augustine sites are designed by the prefix "SA". FOY refers to the Fountain of Youth Park site.

[2] Rabbits are not included in the commensal calculations for Spanish deposits but are included in the table so that their numbers can be compared to those in the Lesesne well.

TABLE 4.—Commensal taxa in wells, MNI.

			MNI for Commensal Taxa							% Commensal
Site[1]	Feature	MNI	Mole	Rabbits[2]	Rodents	Dogs	Cats	Snakes	Anura	Taxa
Natural Traps										
Lesesne	106	52		5	11	1		4	28	94.2
70 Nassau	1	48			33	2	7			87.5
Sixteenth-century First Spanish Period, St. Augustine										
SA 26–1	21	75		1	2	1			1	5.3
SA 26–1	62	75			1		1			2.7
SA 34–1	24	38							1	2.6
SA 34–1	26	30		2	1				2	10.0
SA 36–4	5	72		3						
SA 36–4	16	9		1			1			11.1
FOY	9	32			1			1	12	43.8
Sixteenth-century First Spanish Period, Santa Elena										
Sta. Elena	146	40		1	1				1	5.0
Sta. Elena	172	32	1		2			2	1	18.8
Sta. Elena	217	2								
Eighteenth-century First Spanish Period										
SA 7–6	14	22				1				4.5
SA 36–4	11/12/13	41	1	1			1			4.9
Later St. Augustine Wells										
SA 34–2	41	22						1		4.5

[1] St. Augustine sites are designed by the prefix "SA". FOY refers to the Fountain of Youth Park site.

[2] Rabbits are not included in the commensal calculations for Spanish deposits but are included in the table so that their numbers can be compared to those in the Lesesne well.

TABLE 5.—Location of commensal taxa in Natural Trap (Lesesne) and Spanish wells, by Level.

	UID Small Mammal	Eastern mole	Rabbit	Rodents	Cat/Dog	Snakes	Anura
Lesesne, Feature 106							
Level 3				1			
Level 8							1
Level 20							4
Level 21			2				5
Level 22	11		60	3		72	29
Level 23	90		13	102	3	183	471
SA 7-6, Feature 14							
Level 1					9		
Level 3					6		
Level 6					4		
Level 9					1		
SA 26-1, Feature 21							
Level 2					2		
Level 3			1				
Level 4			1				1
Level 6			1				
Level 9				1			
Level 12			1				
Level 13							1
Level 16				1			
SA 26-1, Feature 62							
Level 1					1		
Level 2				1			
SA 34-1, Feature 24							
Level 3							2
SA 34-1, Feature 26							
Level 1							5
Level 3				1			3
Level 4							1
Level 6			1				1
Level 7			1				1
Level 10			1				10
SA 34-2, Feature 41							
Level 5						1	
Level 11						1	
SA 36-4, Feature 5							
Level 4			3				
Level 7			2				
Level 8			1				
Level 9			7				
SA 36-4, Feature 11/12/13							
Level 1			1				
Level 4					1		
Level 7		1					

TABLE 5.—Location of commensal taxa in Natural Trap (Lesesne) and Spanish wells, by Level. (continued)

	UID Small Mammal	Eastern mole	Rabbit	Rodents	Cat/Dog	Snakes	Anura
SA 36-4, Feature 16							
Level 4			1				
Level 6					1		
FOY, Feature 9							
Level 6				2		1	
Level 9							17
Level 11							1
Level 12							56
Level 13							6
Level 15						1	
Santa Elena, Feature 146							
Level A							1
Level B							1
Level C			1				
Level D							1
Level F				1			
Santa Elena, Feature 172							
Level A						1	
Level C							1
Level D				4			
Level E				7			7
Level F				52		108	5
Level G		1					19

well into sterile soil below the water table, large quantities of organic materials can be recovered. Organic debris includes such things as shoes, oranges, and other plant remains. Over 15,000 vertebrate bones have been recovered from the wells of St. Augustine (Table 2). It is likely that when wells were contaminated or found to be too shallow it was easier to dig another one than to clean the old one, or make it deeper, because ground water is so close to the surface in St. Augustine. The earliest well was constructed in the fall of 1565 when Pedro Menéndez de Avilés first established the colony at what is known as the Fountain of Youth Park site (FOY), but the tradition of constructing barrel wells continued into the Second Spanish Period (Table 2).

A total of 15 St. Augustine wells were considered in this study (Table 2). Thirteen of these wells were filled during the First Spanish Period. Nine of the First Spanish Period wells were filled during the sixteenth century, one in the seventeenth century, and three in the eighteenth century. Use of well points permitted excavation of many of these wells below water level into the culturally sterile zone below the well. In several cases conditions did not permit excavation of a well to sterile. One well (SA 26–1, Feature 62) was excavated just to water level, and only a few levels were excavated for four other wells. The actual

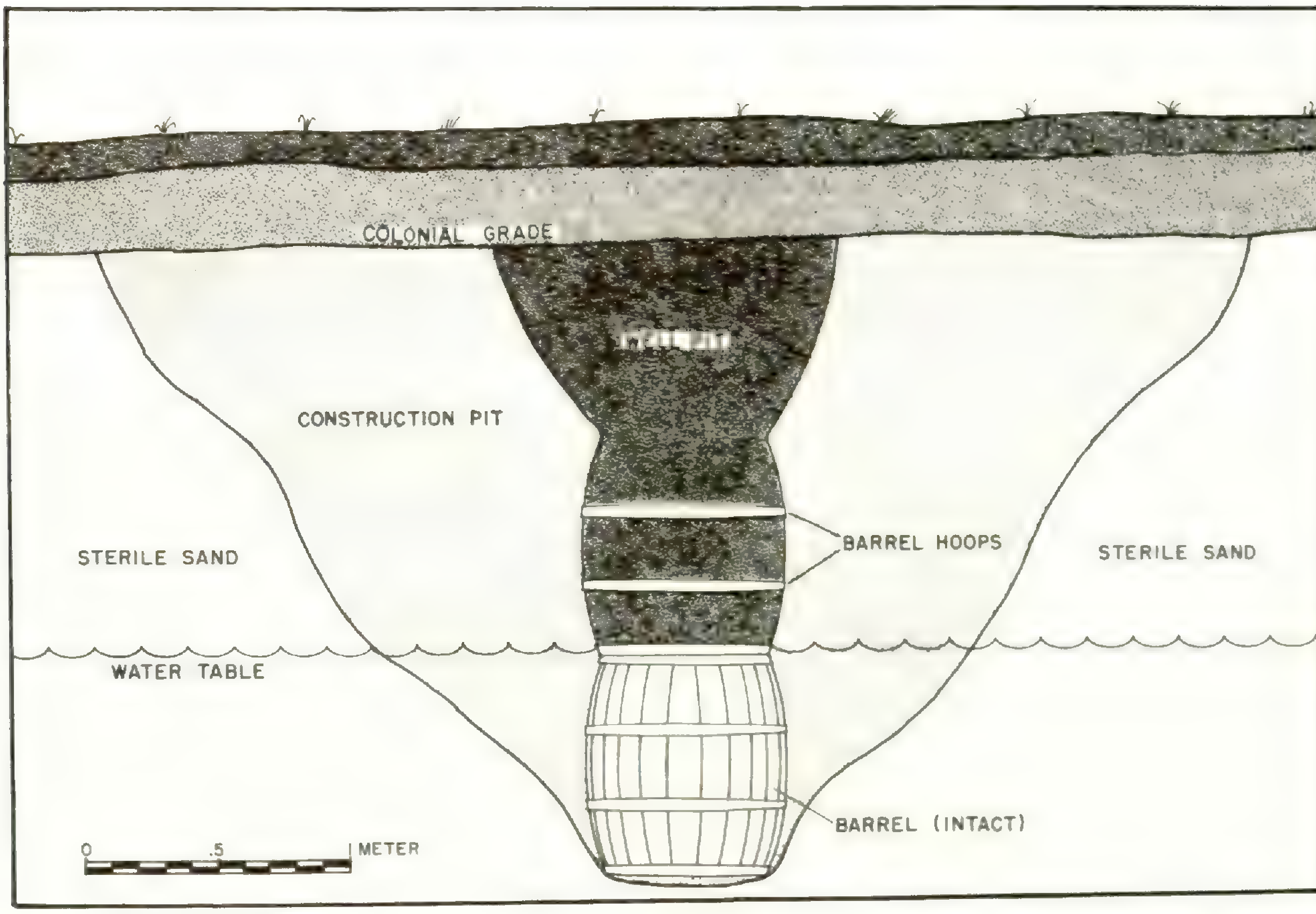


FIG. 2.—Schematic profile of a Spanish well (from Reitz and Scarry 1985:50).

number of levels in the wells varies, reflecting the fact that the initial point at which each well was observed was variable. Wells have been first encountered between 1.9 m and 2.7 m below datum and when excavated to sterile have ended between 3.6 m and 4.6 m below datum. Contents of wells have been variously excavated in 5 cm, 10 cm, or 15 cm increments over the 14 years it took to assemble this data base. Recovery techniques also varied. Although at least a 1/4-inch mesh was always used to recover the materials, finer meshes were used occasionally. In one case (SA 34–1, Feature 26), soil samples were examined in addition to the 1/4-inch fraction. Finer-meshed screens were used to recover samples from Feature 16 at SA 36–4 (1/8-inch) and the Fountain of Youth Park well (1/16-inch).

The St. Augustine wells contrast sharply with the two American wells described above. In all but one case (FOY), commensal taxa comprised less than 3% of the NISP in the St. Augustine wells (Table 3). The percentage of MNI is more variable, but commensal individuals contributed 11% or less of the estimated individuals in all but one case (FOY; Table 4). The exception in both cases, the Fountain of Youth Park well, is the oldest St. Augustine well at the oldest Spanish site (Reitz 1991). This well will be discussed in more detail below. While the use of a 1/4-inch meshed screen is a possible source of bias in this interpretation, it should be remembered that this screen size did not obscure the "natural trap" function of the Lesesne and 70 Nassau Street wells. Unlike these two American wells, and with the exception of the Fountain of Youth Park site well, the commensal taxa from the St. Augustine wells are evenly distributed throughout the strata (Table 5). This suggests that most of the St. Augustine wells were not left open sufficiently long for commensal taxa to accumulate in them. Instead, these wells almost certainly were filled quickly, before commensal taxa had an opportunity to accumulate.

The Fountain of Youth Park well, however, is clearly a different case. Commensal taxa comprise 10% of the bones (Table 3) and 44% of the individuals (Table 4) in this well. Further evidence that this well was a natural trap for at least some period of time is found in the observation that commensal taxa are not evenly distributed in all levels (Table 5). Levels 9 through 15 contain 96% of the commensal taxa recovered from the well. This probably reflects the history of the site. The Fountain of Youth Park site was originally an Indian village. It was occupied by Pedro Menéndez's colonists when they first made landfall in September, 1565 (Reitz 1991). It was abandoned in April, 1566, when Indian hostilities forced Menéndez to find a more defensible position. The well was built during the brief Spanish occupation and the village was not reoccupied by Spaniards for some time thereafter. The well, therefore, was abandoned rather than filled as was the case at the other St. Augustine sites. The contents probably represent natural filling activities between the time the Spaniards left and the Native Americans returned to their village. Once the village was reoccupied, the well was filled relatively quickly with materials that appear to be food refuse.

SANTA ELENA WELLS

There is another case of a well which probably represents a natural trap. This is from St. Augustine's sister town, Santa Elena. Santa Elena yielded three wells associated with the San Felipe fortification (Table 2; South 1984, 1985). Fort San Felipe was constructed in 1570 and a *casa fuerte* built in 1572, but both were abandoned in 1576 when Santa Elena was sacked and burned by Indians hostile to the Spanish colony. The town itself was abandoned briefly after this attack. When Santa Elena was reoccupied by Spaniards, a new fort, San Marcos, was constructed.

All three barrel wells were built inside Fort San Felipe and used during a six-year period. Well contents were recovered using a 1/8-inch meshed screen (Table 2). Feature 146 barely extended into the water table. Apparently this well was not dug deeply enough to fill sufficiently with water and so the well was probably almost immediately abandoned, the barrels salvaged, and the hole filled with oyster shell and other debris characteristic of subsistence (South 1985:35). Feature 172 was the primary well in the fort and was probably in use when Fort San Felipe was abandoned in 1576. Levels F and G were associated with the 1576 burn of San Felipe; charcoal and burned daub from the fire were found in Level G. The water table was encountered at 36 cm above sea level. Feature 217 was excavated to the bottom of the well at 60 cm below sea level, and the water table was encountered at 45 cm above sea level. This well contained limited faunal material but no sign of intentional abandonment was seen.

Vertebrate remains suggest that Feature 146 was filled with trash relatively quickly and that Feature 172 served as a natural trap. Less than 1% of the NISP and 5% of the MNI for Feature 146 were commensal taxa, but commensal taxa comprised 13% of the NISP and 19% of the MNI in Feature 172 (Tables 3 and 4).

While the few commensal taxa in Feature 142 appear evenly distributed throughout the feature, those in Feature 172 appear to cluster in the lower levels of the well, in fact, just above the burned daub associated with the destruction of Fort San Felipe (Table 5). Feature 172 was probably still in use when the fort was abandoned in 1576. The well functioned as a natural trap while the village and fort were empty of Europeans. It was later filled with rubbish when colonists returned to the town. Feature 146 was filled shortly after it was constructed.

DISCUSSION

It appears that the wells of Spanish Florida seldom were left open once they no longer provided clean water. Only two of the 18 Spanish Florida wells examined contained high percentages of commensal taxa clustered in the lower levels of the feature. The only St. Augustine well that remained unfilled long enough to serve as a natural trap is a well (the Fountain of Youth Park site) used for a very short period of time and then abandoned. Even this well was eventually filled with cultural debris, but only after collecting at least 14 commensal individuals in the lowest levels. The Santa Elena well that probably served as a natural trap did so during a period when the European population was absent from the town.

Recovery techniques, as is so often the case in zooarchaeology, may be a source of error in these interpretations. However, in this study the function of wells as natural traps was not hidden by the use of larger-meshed screen. Only two of the four wells identified as probable traps were excavated using fine-mesh screen to recover materials. While the use of 1/4-inch screen undoubtedly resulted in a reduction of bones from small commensal animals, evidence of entrapment in the two American examples was not obscured by use of the larger meshed screen. Additionally, soil samples or material recovered using fine-meshed screens were examined for three wells and did not yield high quantities of commensal taxa. While screen meshes smaller than 1/4-inch should be used routinely when recovering faunal materials, larger screen does not necessarily eliminate the possibility of identifying wells or other features that functioned as natural traps.

One alternative explanation for the lack of commensal taxa in most wells is that unfilled wells were not accessible to commensal fauna even when no longer in use. For example, the area around most wells may have been kept so clear of vegetation that commensal taxa did not have access to the wells due to lack of protective cover. Interestingly, both Spanish wells identified here as natural traps (FOY, Santa Elena Feature 172) probably functioned as such during periods when Europeans, and possibly Native Americans, were absent from the sites and ground cover may have been more dense. Presumably the Fountain of Youth Park site and Fort San Felipe became over-grown with weedy vegetation during these periods. However, vegetation on the Atlantic coastal plain grows rapidly in all seasons, so it seems unlikely that even house lots with heavy human and domestic animal use would lack adequate protection for rodents, snakes, frogs, and toads, unless the household was extremely diligent at weeding.

A second alternative explanation for the lack of commensal taxa in Spanish wells is that abandoned wells may have been capped so that domestic animals and children could not fall in. Given that Spanish wells were relatively shallow, it is difficult to imagine why an abandoned well would be capped rather than filled. More likely these attractive nuisances were rapidly filled by the household as soon as they no longer served as a source of water. In fact, some may have been abandoned because entrapped animals contaminated the water rather than the other way around.

CONCLUSION

This review suggests that site formation processes revealed by faunal data can be of use in outlining the history of a site, giving us another view of taphonomic processes. While a well at St. Augustine and one at Santa Elena may have functioned as natural traps during periods of abandonment, most Spanish wells studied lack the faunal characteristics of natural traps. It appears that if commensal taxa contribute over 9% of NISP and 40% of MNI in a feature, it may have been a natural trap during at least part of the site's history. Further evidence that a well was a natural trap for at least some period of time is found in the accumulation of commensal taxa in the lower levels of the feature. The most characteristic trap victims are rodents, snakes, amphibians, and young individuals of larger taxa such as turtles and cats. Based on the low percentages of commensal taxa, especially in the lower levels, most of the wells of Spanish Florida were probably intentionally filled with trash over a relatively short period of time. Identifying similar layers of commensal taxa may aid in distinguishing brief periods of abandonment at other types of archaeological sites.

NOTE

[1]English measurements are used at historic sites with English colonial histories, such as Charleston.

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PALM ETHNOECOLOGY IN THE SARIPIQUI REGION OF COSTA RICA

ELAINE JOYAL
Department of Botany
Arizona State University
Tempe, AZ 85287-1601

ABSTRACT.—Palms are an important natural resource in the lowland tropical rainforest in the Saripiqui region of Costa Rica. An ethnoecological study of palms therefore was conducted at La Selva Biological Station and nearby Puerto Viejo during July 1990. The study consisted of interviews with local residents knowledgeable of the palm flora and a survey of palm populations occurring on primary forest alluvium, the soil type most often occupied by local inhabitants.

Seventeen of 30 native palm species were identified as economically useful; nine species have not previously been reported as used in this region. Major uses cited were for *palmito* (edible palm heart), thatch, and wood. The single most important palm species was *Iriartea deltoidea,* which has the best (native) *palmito* and is also a source of wood for construction. *Welfia georgii* was considered the most important source of thatch by all informants. It was the only palm which has been "actively" managed and, along with *Euterpe macrospadix* and *Iriartea deltoidea,* was believed to be over-harvested.

Sixteen of 30 native species were present in transects through primary forest alluvium; 10 were reported as useful. The subcanopy species *Welfia georgii* was the most abundant palm in transects overall (36.1% of stems). Understory clonal species such as *Asterogyne martiana* and *Geonoma congesta* had proportionally greater numbers of the larger size-class individuals. Information on harvesting techniques and levels were combined with data from population transects to estimate resource capacity. *Welfia georgii* leaves appear to be the limiting resource in thatch roof construction.

RESUMEN.—Las palmas son un recurso natural importante en el bosque tropical lluvioso de zona baja en la región de Saripiqui en Costa Rica. Por ello se realizó un estudio etnoecológico de las palmas en la Estación Biológica de La Selva y el pueblo vecino de Puerto Viejo en julio de 1990. El estudio consistió en entrevistas con residentes locales que conocen la flora de palmas, y un reconocimiento de las poblaciones de palmas en el bosque primario sobre aluvión, el tipo de suelo ocupado más frecuentemente por los habitantes locales.

Diecisiete de las treinta especies nativas fueron identificadas como plantas economicamente útiles; nueve de ellas no han sido reportadas previamente como especies usadas en esta región. Los principales usos citados fueron como palmito (corazón comestible), para techado y como madera. La especie más importante de todas fue *Iriartea deltoidea,* que tiene el mejor palmito (local) y es también fuente de madera para construcción. *Welfia georgii* fue considerada por todos los informantes como la palma más importante para techar. Fue la única palma que ha sido manejada "activamente", y junto con *Euterpe macrospadix* y *Iriartea deltoidea* se consideró que ha sido sobre-explotada.

Dieciseis de las treinta especies nativas estuvieron presentes en transectos a través del bosque primario sobre aluvión; diez de ellas fueron reportadas como plantas útiles. La especie del subdosel *Welfia georgii* fue la palma más abundante en los transectos en total (36.1% de los tallos). Las especies clonales del sotobosque como *Asterogyne martiana* y *Geonoma congesta* tuvieron números proporcionalmente mayores de individuos de la clase de talla superior. Se combinó la información sobre técnicas y niveles de recolección con los datos de los transectos de poblaciones para estimar la capacidad de los recursos. Las hojas de *Welfia georgii* parecen ser el recurso limitante en la construcción de techos de palma.

RÉSUMÉ.—Les palmiers représentent une ressource naturelle importante de la forêt tropicale basse de la région Saripiqui (Costa Rica). Une étude ethnoécologique des palmiers a été effectuée à la station biologique de La Selva et à Puerto Viejo, ville voisinante, en Juillet 1990. Cette étude a consistée d'entrevues avec des habitants locaux bien informés sur la flore, ainsi que d'un examen des populations de palmiers poussant sur alluvions de forêt primaire, où habitent le plus souvent les habitants locaux.

Dix-sept des trentes espèces indigènes ont été identifiées comme étant utiles; l'utilization de neuf espèces n'avait pas été reportée auparavant dans cette région. Les emplois principaux cités consistent en *palmito* (le coeur de palmier comestible), en chaume, et en bois. L'espèce de palmier la plus importante est *Iriartea deltoidea,* qui produit le meilleur *palmito* indigène et apporte également une source de bois pour la construction. *Welfia georgii* a été désignée à l'unanimité comme étant la source de chaume de choix. De fait, c'est le seul palmier à subir un control actif, et le seul, avec *Euterpe macrospadix* et *Iriartea deltoidea* à être trop récolté, selon les informateurs.

Seize des trentes espèces indigènes ont été retrouvées dans les quadrants effectués à travers la forêt primaire alluviale; dix ont été identifiées comme étant utiles. L'espèce sous-canopy *Welfia georgii* est le palmier le plus abondant dans tous les quadrants (36.1% de toutes les tiges récoltées). Les espèces clonales de sous-bois, telles que *Asterogyne martiana* et *Geonoma congesta* présentent une proportion plus élevée d'individus de grande taille. Des renseignements sur les techniques et niveaux de récolte sont alliés aux données provenant de l'étude des quadrants, à fin de pouvoir estimer la capacité des ressources. Les feuilles de *Welfia georgii* semblent être la ressource limitative pour la construction des toits de chaume.

INTRODUCTION

Ethnobiologists generally agree that indigenous people have a keen understanding of the natural world around them and that they have developed effective management (e.g., sustainable yield) for important wild plant resources (e.g., Anderson 1991; Posey et al. 1984). Although an increasing number of studies quantify the value of wild plant resources or indigenous knowledge about them (e.g., Prance et al. 1987), few *quantitatively* evaluate traditional resource management (e.g., Anderson 1991). An important first step to understanding the impact of harvesting on wild-collected plant species is to study their population size-class structure (Pinard and Putz 1992). The results presented here are from a pilot study that combined ethnographic and ecological methods to investigate the relationship between use and population structure in native palms, an important natural resource throughout much of the tropics.

La Selva Biological Station, located in the lowland tropical rainforest of the Saripiqui region of Costa Rica, has one of the most diverse palm floras in the world (Chazdon 1985). The area has been largely undisturbed since the 1950s. La Selva was established as a biological preserve in the 1960s, but present palm distribution may reflect prepreserve activity (Deborah Clark, personal communication, 1991). Thirty indigenous and two exotic palm species, *Bactris gasipaes* H.B.K. and *Cocos nucifera* L., have been reported from La Selva (unpublished checklist, 1989, in possession of the author and the station director). Only the two introduced and eight of the native species have been documented as economically useful in the region (Murphy 1983). An ethnographic survey was therefore conducted at La Selva to improve documentation of local knowledge of native palms. Information gathered included which species were known and what informants knew about the use, management, and natural history (distribution, abundance, and so on) of each. Standard ecological methods were used to establish baseline population data for palm species growing in primary alluvial forest, the forest type most often occupied by local residents.

METHODS

Ethnography—Interviews were conducted at La Selva Biological Station and in the nearby town of Puerto Viejo during July 1990. Hector Gonzalez, director of La Selva's community education program, arranged interviews with local residents. Orlando Vargas, the station naturalist, was interviewed first. His knowledge is a combination of local information and what he has learned from assisting field station biologists. During the interview we walked through the reserve; the route (Sendero Oriental and Camino Circular Lejano) included most local palm species and all those with prior recorded use. Vargas identified palms by both local and scientific names, and provided information on distinguishing characters, local uses, natural history, abundance, distribution, and management and conservation practices. Species were identified using available palm keys (Chazdon and Marquis 1985; Moore and Chazdon 1985). Identifications were verified by field station biologists David and Deborah Clark and by comparison with vouchers deposited in La Selva's herbarium. Subsequent interviews were conducted at each informant's home or work place. Vargas assisted in translation during all but one interview. Using local name(s) and palm morphological and ecological descriptions to identify the palms being discussed, informants were asked which palms they knew, and what they knew about their use, management, and natural history.

Palm population surveys.—Eight 2 × 50 m (100 m^2) transects were established at 100 m intervals along the Camino Experimental Sur (CES). The CES runs through primary forest overlaying alluvial terraces comprised of the soil type most often occupied by local residents (Bette Loiselle, personal communication, 1990). The forest has been undisturbed, except for scientific study, for more than 25 years. A general habitat description for each transect was recorded. All size-class individuals of all palm species were counted in one half (50 m^2) of each transect. In the second half of the transect, only subcanopy species were counted in order to increase sample size for large species. Voucher specimens were not collected. Instead, species were identified as described above. For each palm present I noted species, size-class, crown height, reproductive status, and numbers of stems and green leaves. The size-classes were seedling, juvenile, immature, and adult (after Vandermeer 1983). Seedlings have no more than two leaflets per leaf. Juveniles are trunkless individuals with intermediate to mature leaf morphology. Immature palms resemble adults in leaf morphology but have short trunks and are sexually nonreproductive. Adults have mature leaf morphology, tall trunks, and fresh or old inflorescences present.

RESULTS

Ethnography.—Five male, lifetime residents of the Saripiqui region were interviewed. All except one are employed as workmen or guards at La Selva Biological Station. Informants recognized between 11 and 19 palms each. They identified a total of 18 of the 30 native species by common name, cited them as used, or both. The two introduced species included by Murphy (1983) were not discussed during these interviews. Table 1 summarizes local name(s) and reported use(s) of the palms discussed (for full species accounts see Joyal 1990).

Thirteen palms had one common name, two had two local names, and three had three names. There were two designations at the generic level, *biscoylillo* for *Bactris* spp. and *palmilla* for *Geonoma* (Table 1). The names *cola de gallo* and *pacaya* were applied to different species than those reported by Murphy (1983) by the informants in this study. Murphy identified *Asterogyne martiana* as *cola de gallo* whereas my informants called it *suita*. She did not identify any plant as *suita* nor did she note any uses for *Calyptrogyne sarapiquensis*, a palm identified as *cola de gallo* in this study. Robin Chazdon (personal communication, 1994) says that local knowledgeable people have always applied *suita* to *A. martiana* whereas *cola de gallo* refers either to *Calyptrogyne saripiquensis* or *Geonoma* species. This is in agreement with the present survey. Murphy identified *pacaya* as an undescribed *Chamaedorea* sp. while Vargas and I identified it as *Prestoea decurrens. Chamaedorea tepejilote* Liebm. is called *pacaya* in Guatemala, where it has been domesticated primarily for its edible male inflorescence, and secondarily for its *palmito* (Castillo Mont et al. 1994). Robin Chazdon (personal communication, 1994) reports that *pacaya* has always referred to *Chamaedorea* species in the Saripiqui region and that the inflorescence buds are roasted and eaten. She could not recall a common name for *P. decurrens* nor could she remember its flowers being eaten. It appears, therefore, that Vargas and I may have misidentified this palm. Clarification will have to await further field work. There was only one instance in which the same common name was used by the same informant for two species: *chonta* for *Socratea exorrhiza* and *Iriartea deltoidea*.

Major palm uses reported were leaves for thatch, trunks for wood, and edible palm heart *(palmito)* (Table 1). Murphy (1983) reported three species that were used exclusively for fiber, one species each that had edible fruit or *palmito*, and three that were used for a combination of fiber, fruit, or *palmito*. She listed only one species, *Chamaedorea* sp., as useful that was not reported during the course of my interviews. This is a species of doubtful identity, as discussed above. A total of

TABLE 1.—Palm species with reported use in the Saripiqui region of Costa Rica. Observations are based on original field work and Murphy (1983). * indicates introduced species, not covered in 1990 interviews. Informants are identified by their initials.

Species	Local name(s)	Use(s)
Asterogyne martiana H. A. Wendl. ex Burret	*suita* (FM, GM, EP, OV); *cola de gallo* (HM)	thatch (FM, GM, HM, EP, OV); edible fruit (FM); ornamental (FM)
Astrocaryum alatum Loomis	*coquito* (FM, GM, HM, EP, OV)	fruit for wildlife (FM, HM, EP, OV); thatch (HM, EP); wood (GM)
A. standleyanum Bailey (*A. confertum* H. A. Wendl. ex Burret)	*pejibaye del monte* (IA, GM, EP)	*palmito* (IA, GM, EP, OV); wood (EP)
**Bactris gasipaes* H.B.K.	*pejibaye* (HM)	edible fruit (HM)
Bactris porschiana Burret	*biscoyol* (IA, FM, GM, EP, OV)	wood (IA, FM, GM, EP, OV); *palmito* (OV); edible fruit (OV)
Bactris sp.	*pejibayito* (IA)	—
Bactris spp.	*biscoyolillo* (OV)	wood (OV); *palmito* (OV)
Calyptrogyne saripiquensis H. A. Wendl. ex Burret	*cola de gallo* (IA, FM, GM, EP, OV)	thatch (IA, FM, GM, EP, OV); edible fruit (OV); ornamental (FM)
Chamaedorea sp.	*pacaya* (HM)	*palmito* (HM)
**Cocos nucifera* L.	*coco, pipa* (HM)	medicinal fruit (HM)
Cryosophila albida Bartlett	*escobon* (all)	thatch (all); fruit for wildlife (GM)
Desmoncus costaricensis (Kuntze) Burret	*batamba* (IA, EP, OV)	lance/prod (IA, EP, OV)
Euterpe macrospadix Oersted	*palmito de mantequilla* (IA, FM, GM, OV)	*palmito* (IA, FM, GM, OV); ornamental (FM)
Geonoma congesta H. A. Wendl. ex Spruce	*caña de danta* (all)	thatch (all); lance (FM, EP, OV); wood (FM, GM, OV)
Geonoma cuneata H. A. Wendl.	not known	thatch (OV)
Geonoma interrupta (Ruiz & Pavón) C. Martius	*surtuba* (IA, GM)	*palmito* (IA, GM)
Geonoma spp.	*palmilla* (OV)	—
Iriartea deltoidea Ruíz & Pavón (*I. gigantea* H. A. Wendl. ex Burret)	*palmito dulce* (IA, FM, GM, EP, OV); *chonta* (IA, EP, OV); *palmilera* (IA, GM, HM, EP)	*palmito* (all); wood (all)

TABLE 1.—Palm species with reported use in the Saripiqui region of Costa Rica. Observations are based on original field work and Murphy (1983). * indicates introduced species, not covered in 1990 interviews. Informants are identified by their initials. (continued)

Species	Local name(s)	Use(s)
Prestoea decurrens (H. A. Wendl.) H. Moore	*pacaya* (FM, GM, EP, OV); *pacayita* (IA); *pacaya de danta* (IA)	*palmito* (FM, GM, EP, OV); ornamental (FM); edible flower bud (IA)
Reinhardtia cf. *simplex* (H. A. Wendl.) Burret	not known	ornamental (OV)
Socratea exorrhiza (C. Martius) H. A. Wendl. (*S. durissima* (Oersted) H. A. Wendl.)	*palmito amargo* (all); *maquenque* (IA, FM, HM); *chonta* (GM)	*palmito* (IA, FM, GM, EP); wood (IA, FM, EP, OV); edible fruit (HM, OV); medicinal palmito (GM)
Welfia georgii H. A. Wendl. ex Burret	*corozo* (all)	thatch (all); wood (GM, EP, OV); *palmito* (GM, HM, EP)

17 of the 30 native palm species were reported as used in the study presented here, with 12 cited by four or all five informants. Several species were used interchangeably while a few were preferred for specific uses. For example, nine native species can be used for palmito but *Euterpe macrospadix* is considered the best flavored. Its small size makes it relatively unpopular, however, and the larger *palmito* of *Iriartea deltoidea* was the most commonly used until recently (the introduced *Bactris gasipaes* is replacing it). The large leaves of *Welfia georgii* are preferred for covering flat sections of roofs whereas the small leaves of *Asterogyne martiana* and *Geonoma congesta* are used to finish the peaks. Some uses have disappeared entirely or were more common in the past. For example, *Geonoma congesta* stems were frequently used as lances for hunting tapir (*caña de danta,* tapir's cane) in the past. This use is now restricted to the most remote jungle areas, hunting lances having been largely replaced by rifles.

Harvest practices for several species were discussed. Three of the five subcanopy palms, *Euterpe macrospadix, Iriartea deltoidea,* and *Welfia georgii,* were reported to be over-harvested for *palmito,* thatch, or wood. In contrast, *Cryosophila albida* is valued for its beauty and some farmers are reluctant to allow harvesting of leaves for broom-making. *I. deltoidea* was considered to be the single most important palm, being a major source of *palmito* and an important source of wood. *W. georgii,* cited by all five informants as the most important palm for thatch, is the only native palm that is or has been "actively" managed. Active management is defined here as activities consciously done to enhance plant populations for economic exploitation. For example, when clearing forest for pasture, *W. georgii* palms are left standing and only five leaves per palm are cut for thatch. The palms do not grow as tall in open pasture and they produce larger leaves at a faster rate. Whereas it takes about 500 forest-grown *W. georgii* leaves to thatch a roof, only 300-350 pasture-grown leaves are needed. Lunar cycles play a critical role in harvesting palm fiber. *Welfia georgii* leaves not collected during *la luna menguante* (the first few days of the waning moon) will be "wet" or destroyed by insects within a few years, whereas a roof made from properly-harvested leaves may last 25 years (a 10–50 year range was given by informants). Special harvesting practices were used for *Cryosophila albida* and *Geonoma congesta* for reasons of safety. The first has sharp spines on the trunk and the latter leaves sharp, persistent stumps after cutting.

Informants provided information about palm natural history and conservation issues 24 times. Habitat was given for several species: virgin forest for *Bactris* sp., *Pholidostachys pulchra,* and *Reinhardtia* cf. *simplex;* secondary forest for *Prestoea decurrens;* higher elevation forests for *Geonoma interrupta.* In addition, informants noted that *Prestoea decurrens* grows near rivers, *Astrocaryum alatum* and *Calyptrogyne saripiquensis* in swamps, and *A. standleyanum* and *Pholidostachys pulchra* are restricted to hilltops. Discussion of abundance and distribution of palm species was limited by time constraints. Three species *(Euterpe macrospadix, Prestoea decurrens* and *Welfia georgii)* were cited as common, five *(Bactris wendlandiana, Bactris* sp., *Geonoma interrupta, G. longevaginata, Reinhardtia* cf. *simplex)* as uncommon, and six *(Astrocaryum alatum, A. standleyanum, E. macrospadix, Iriartea deltoidea, Socratea exorrhiza,* and *W. georgii)* as decreasing in numbers. Some *Geonoma* species, recognized as the folk genus *caña de danta,* were characterized as rare.

Palm population surveys. —A total of 489 individual palms (296 seedlings, 91 juveniles, 45 immature, and 56 adults) were present in eight transects established through primary forest on alluvium. Sixteen palm species, approximately half of the species known from La Selva, were encountered. *Welfia georgii* was the single most abundant species, accounting for 36.1% of all individuals. The six most frequent species, which accounted for 92.0% of individuals present *(Asterogyne martiana, Geonoma congesta, G. cuneata, Prestoea decurrens, Socratea exorrhiza, Welfia georgii)* (Fig. 1), were all reported as economically important (Table 1). Four additional useful palm species *(Bactris porschiana, Calyptrogyne saripiquensis, Cryosophila albida, Geonoma interrupta)* that were present but infrequent (< 1% presence) in the transects brought the total number of useful species in the transects to ten and the percentage to 94.9% of all palm stems. Size-class distribution for the four most frequent species (> 20 individuals) are presented in Fig. 2. Plot size for subcanopy species was twice as large as those for understory species and numbers were therefore halved to give an accurate proportion for *W. georgii* and *Socratea exorrhiza.* Three of the five economically-important subcanopy species, *Astrocaryum standleyanum, Euterpe macrospadix,* and *Iriartea deltoidea,* are restricted to habitats other than alluvium (Hartshorn and Poveda 1983; Chazdon 1985; Deborah Clark, personal communication, 1990) and thus did not occur in the transects.

Combined ethnographic and palm population survey data—Although sufficient time was not available during the course of this survey to determine annual stem and leaf productivity, it was possible to estimate resource capacity from the data collected. *Welfia georgii* and *Socratea exorrhiza,* both important sources of wood, had an average standing crop of 137.5 and 25 useable stems per hectare, respec-

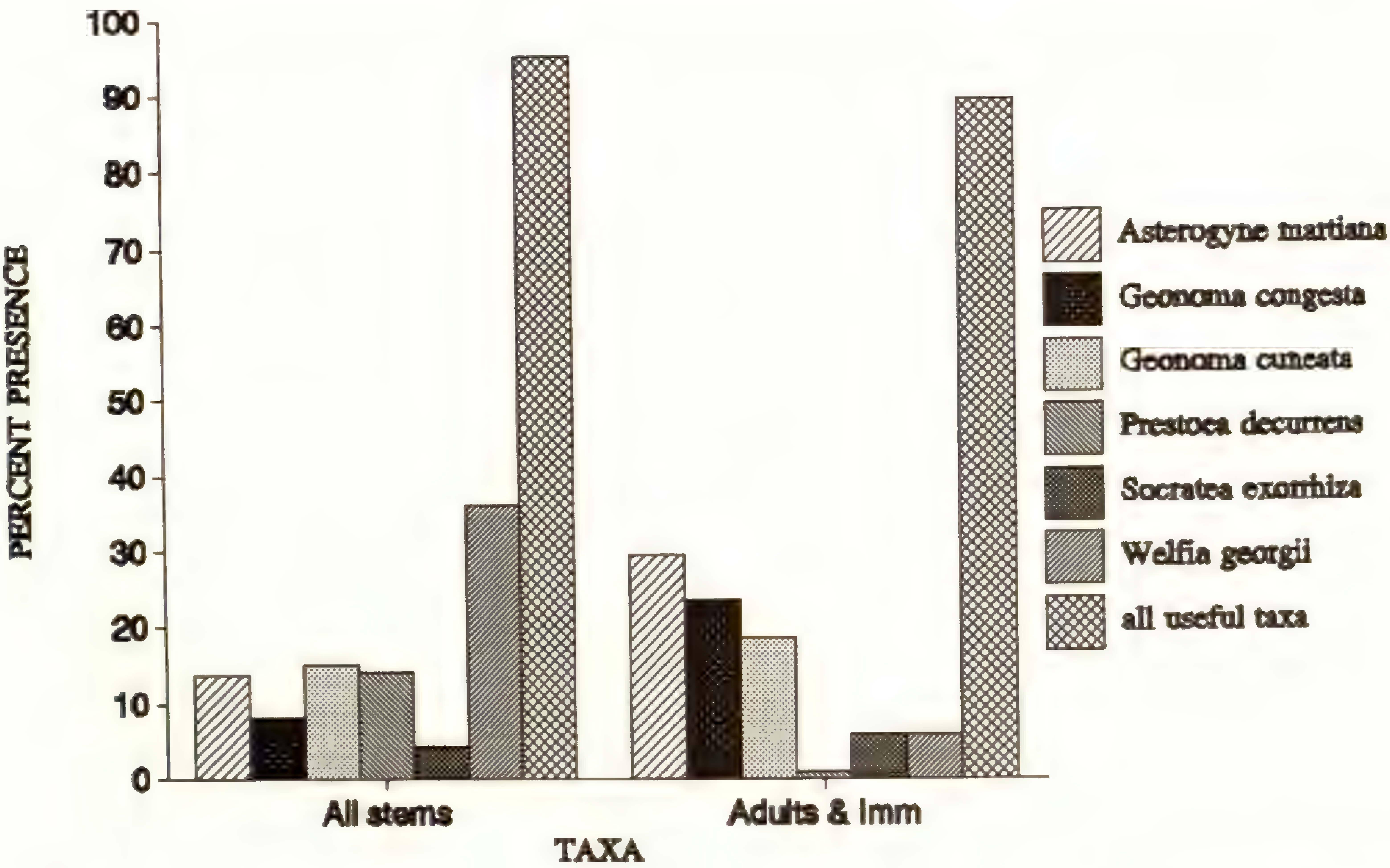

FIG. 1.—Palm species with > 3% presence in transects through primary forest alluvium and percentage of stems represented by adult and immature stems. All six species shown have economic value. Ten species were represented by < 1% presence: *Bactris porschiana**, 0.29%; *B. wendlandiana* Burret, 0.57%; *Bactris* sp. 0.86%; *Calyptrogyne saripiquensis**, 0.57%; *Chamaedorea warscewiczii*, 0.29%; *Cryosophila albida**, 1.15%; *Geonoma interrupta**, 0.86%; *G. oxycarpa* Martius, 0.29%; *Pholidostachys pulchra* H. A. Wendl. ex Hemsl., 2.59%; and *Synecanthus warscewiczianus* H. A. Wendl., 0.57% (* indicates species with reported economic use). The category "all useful taxa" is the sum of all palm species reported as economically useful.

tively (Fig. 2). Both adult and immature stems are considered useable. *Geonoma congesta* is a clonal species that is used occasionally for wood. There was an average of 600 clones per hectare and 8.4 utilizable stems per clone, or a standing crop of 5,040 stems per hectare (Fig. 2). Given that the average stem height was 3.4 m, a total of 17,136 m of stem are available per hectare.

The average standing crop of leaves for the three common thatch palms (adult and immature only) occurring in the alluvial transects, *Welfia georgii*, *Asterogyne martiana*, and *Geonoma congesta*, was calculated at 11.5, 14.7, and 65.9 leaves per palm, respectively. *W. georgii* leaves are employed for the large, flat areas of thatched roofs. An average forested hectare contains 137.5 harvestable *W. georgii* palms (Fig. 2) for a total of 1,581 useable leaves per hectare (Joyal 1990). Given that 500 forest-grown *W. georgii* leaves are needed to thatch one roof, 43 palms are required if the entire leaf standing crop is removed. (550 lvs/roof ÷ 11.5 lvs/palm = 43.5 palms/roof). Thus 3.2 roofs could be thatched per hectare if all leaves are cut. Only five leaves per palm are cut if the trees are to be maintained, that is if traditional management is practiced. In this case 100 palms are needed per roof, and the number of roofs that can be thatched from each hectare drops to 1.4. If the

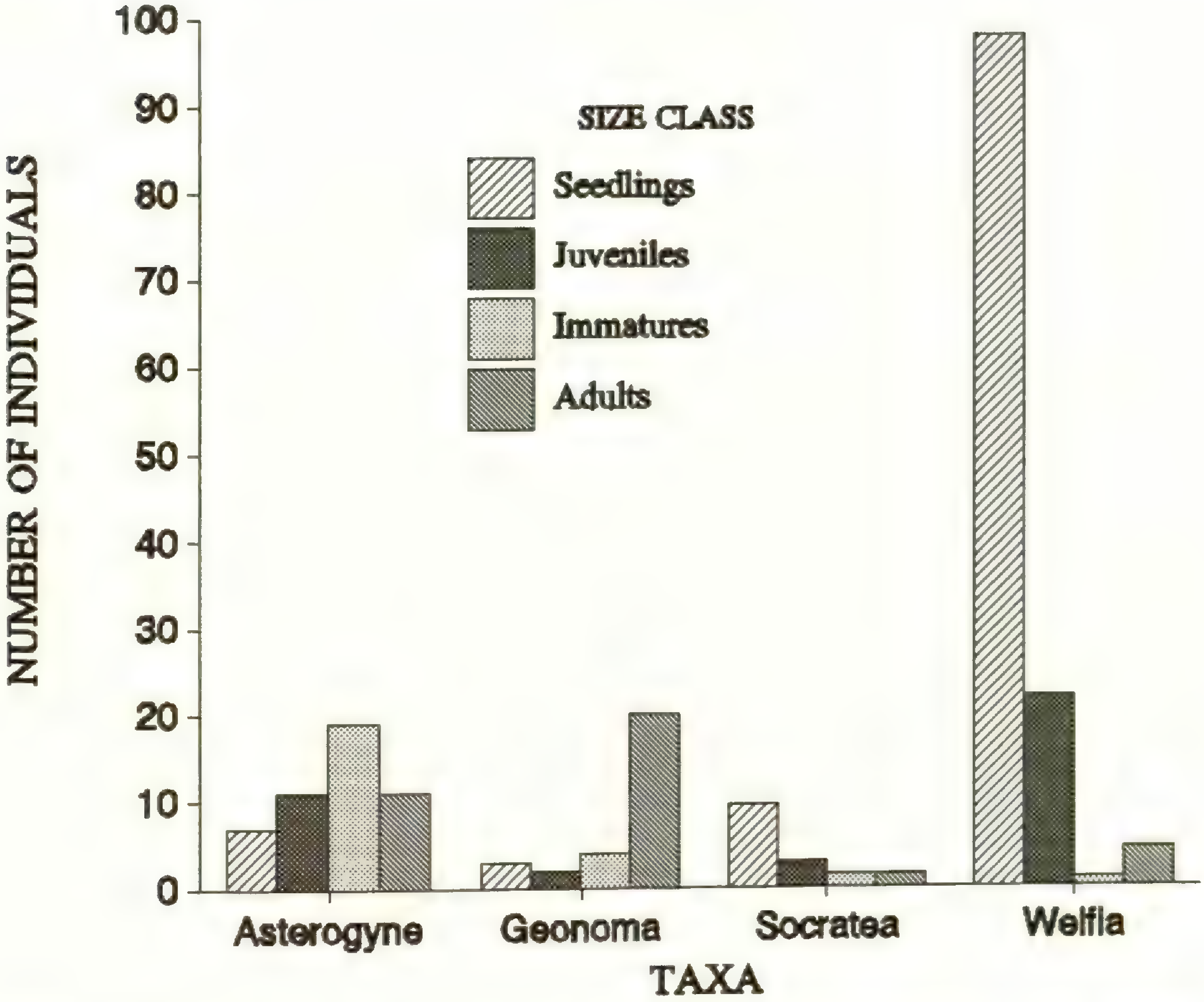

FIG. 2.—Size-class distribution for four economically important palm species at La Selva Biological Station, Costa Rica.

larger leaves of pasture-grown *W. georgii* are used, only 300–350 leaves, or 60–70 palms (5 lvs/palm/harvest), are needed to thatch a roof. Orlando Vargas (personal communication, 1990) thought that forest-grown *W. georgii* produces about one leaf per palm per year; he felt that annual leaf production for pasture-grown *W. georgii* was higher (no estimate is available). Using a production rate of 1 leaf per palm per year, one forested hectare will produce enough *W. georgii* leaves to thatch a new roof every 3.6 years. The small leaves of *Asterogyne martiana* and *Geonoma congesta* are used solely for finishing roof peaks. The amount needed per roof was not reported. However, the standing crop of these palms was calculated as 225 stems and 600 clones, or 3,308 and 39,540 leaves, per hectare, respectively. *Welfia georgii* leaves, while much larger, are less abundant (1,581 versus 42,848 combined *A. martiana* and *G. congesta* leaves) and, given their low numbers per hectare and high demand, are likely to be the limiting resource in thatched roof construction.

DISCUSSION AND CONCLUSIONS

Results obtained from the present study indicate that all palm species that are common at La Selva are economically useful (Hartshorn and Poveda 1983; Chazdon 1985; Deborah Clark, personal communication, 1990; Joyal 1990). Only three small understory species *(Bactris longiseta, Chamaedorea exorrhiza, Pholidostachys pulchra)* that were cited as frequent in distribution in previous studies have no documented use.

Determining the size-class structure of relatively undisturbed populations is an important first step toward assessing the status of harvested populations. For example, the size-class distributions for *Welfia georgii* and *Socratea exorrhiza* at La Selva (Fig. 2) are characteristic of long-lived individuals reproducing from seed. There are many seedlings and the number of individuals present in each subsequent life stage is progressively smaller (Sarukhán 1978). *Geonoma congesta* exhibits a size-class distribution typical of clonal species, i.e., there are many older individuals with relatively few seedlings and juveniles present (DeSteven 1986). The size-class distribution of *Asterogyne martiana* is not easily explained by either of the preceding patterns. The establishment of large cohorts of individuals at irregular intervals in years of abundant flower production followed by high seed set, dispersal, and establishment, can produce a size-class distribution other than those typically exhibited by woody species. This "episodic recruitment" (Harper 1977) is a possible explanation for the observed pattern in *Asterogyne martiana.* This baseline data can now be used for comparisons with harvested populations. For example, if the economically-important size-classes (adult and immature) of *W. georgii* populations outside the preserve were found to be greatly reduced, it would suggest over-harvest. However, if the seedling or juvenile size-classes were significantly decreased, an alternative explanation should be sought (e.g., biological phenomena or other changes in land-use management).

How might harvesting affect the abundance of economically important plant species? Some species increase and others decrease in abundance, depending upon what part is harvested, harvesting pressure, and the individual species' response to stress (Harper 1977). The use of a plant resource can be destructive to the entire plant or require only the limited harvest of a plant part. Destructive uses of palms include harvesting of stems for wood, edible *palmitos,* and whole plants as ornamentals. These uses have immediate demographic consequences to a palm population. Palm parts harvested nondestructively include leaves for thatch, edible flower buds and fruit (some fruit are also used medicinally), and seeds for growing palms as ornamentals. While more subtle, these practices can have long-term impacts on a palm population (Mendoza et al. 1987). Present harvesting practices for wood, *palmito* and thatch are creating conservation concerns for three subcanopy palm species *(Euterpe macrospadix, Iriartea deltoidea, Welfia georgii)* among some local residents (Joyal 1990).

Welfia georgii, a slow-growing subcanopy species (Chazdon 1985), is among the most economically important palms in this region. It is reported as uncommon through much of its range but is locally abundant in the La Selva area (Vandermeer 1983). Use of *Welfia georgii* is primarily nondestructive (leaves for thatch) but it is also harvested destructively (for wood and *palmito*). It is the only palm reported as "actively" managed. In the past complete harvest occured only when *W. georgii* was cleared for conversion of forest to pasture. Many people now harvest the entire standing crop of leaves, which is reported to kill the palm because it only produces one leaf per year (Orlando Vargas, personal communication, 1990). Traditional cultures often have practices which serve to regulate the harvest of important wild-collected resources. For example, in Sonora, Mexico, only the emerging leaves from large-leaved juvenile palms (*Sabal uresana* Trelease) are used for weaving. A leaf is not harvested until its petiole is visible, and its' specific use (for hats, baskets, or mats) depends upon the developmental stage of the fibers. Harvest is restricted to the time of the full moon during the summer monsoon season. As a result of these practices, individuals rarely have more than one leaf harvested per year, an important consideration when harvesting from young, slow-growing palms that produce an average of three leaves each per year (unpublished field notes, 1990–1994, in possession of the author).

The absence of appreciable "active" palm management, except for *W. georgii*, the single most useful species, has several possible explanations. It may be that more species were previously managed but that the traditional knowledge associated with them has been lost and the practices abandoned ("cultural erosion"). Alternatively, the need for active management may be recent if it can be assumed that active management becomes necessary only when a resource is both important and limited. For example, the *palmitos* of both *Euterpe macrospadix* and *Iriartea deltoidea* are destructively harvested as the *comida tipica* (traditional food) of Costa Rican holy days (Joyal 1990). Both were cited as overharvested but neither was reported as managed in any way. Did active management for these species exist in the past in Costa Rica? Or is a rapidly expanding human population that is changing from a subsistence to a market economy placing a greater demand on the *palmito* resource? Fortunately, the increased popularity of the domesticated *Bactris gasipaes* as a new source of *palmito* for local and export markets is reducing pressure on native *palmito* species. Like the native palms of the Saripiqui, many of our wild plant resources are dwindling under the pressure of increasing world populations. By documenting traditional ecological knowledge and resource management for wild plant resources now, we hopefully can manage them better in the future.

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AFRICA'S BAOBAB TREE: WHY MONKEY NAMES?

JOHN RASHFORD
Department of Sociology and Anthropology
College of Charleston
Charleston, SC 29424

ABSTRACT.—*Monkey bread* and *monkey tamarind* are two of the common names that appear in published accounts of Africa's well-known baobab tree (*Adansonia digitata* L.). These *monkey* names are generally assumed to be derived from the simple fact that monkeys eat the baobab's fruit. Although this literal interpretation seems obvious, it is neither the only one, nor is it necessarily the correct one. In the Caribbean, the use of monkey in the compound common names for the baobab and other plants implies imitation. The name monkey tamarind, for example, indicates that the baobab is like the tamarind tree (*Tamarindus indica* L.). It mimics the tamarind just as a monkey does a human. This is consistent with what we find in other parts of the world where the baobab is also identified as a kind of tamarind, though without the name monkey.

RESUMEN.—*Pan de mono* y *tamarindo de mono* son dos de los nombres comunes que aparecen en las publicaciones acerca del conocido árbol africano llamado baobab (*Adansonia digitata* L.). Generalmente se da por sentado que estos nombres de *mono* se derivan del simple hecho que los monos comen el fruto del baobab. Si bien esta interpretación literal parece obvia, no es la única ni es necesariamente la correcta. En el Caribe, el uso de mono en los nombres compuestos del baobab y de otras plantas implica la imitación. El nombre tamarindo de mono, por ejemplo, indica que el baobab es como el árbol de tamarindo (*Tamarindus indica* L.). Simula al tamarindo tanto como el mono remeda a un humano. Esto es consistente con lo que encontramos en otras partes del mundo donde al baobab también se le identifica como un tipo de tamarindo, aunque sin el nombre de mono.

RÉSUMÉ.—*Monkey bread* et *monkey tamarind* sont deux des noms les plus communs qui apparaissent dans les publications sur l'arbre d'Afrique bien connu, le baobab (*Adansonia digitata* L.). Ces noms de *monkey* sont généralement prétendus être dérivés du simple fait que le singe mange le fruit du baobab. Bien que cette interprétation littérale semble évidente, ce n'est ni la seule, ni nécessairement la plus acceptable. Aux Caraïbes l'utilisation du *monkey* comme nom courant composé pour le baobab et d'autres plantes implique la notion d'imitation. Le nom *monkey tamarind,* par exemple, indique que le baobab est en quelque sorte similaire à l'arbre de tamarind (*Tamarindus indica* L.); il imiterait ou mimiquerait tel un singe un humain. C'est en accord avec ce que nous trouvons dans d'autres parties du monde oú, bien que le nom *monkey* ne soit pas utilisé, le baobab est également identifié comme une espèce de tamarind.

INTRODUCTION

Why does Africa's baobab tree have monkey names? While it is generally assumed that the baobab (*Adansonia digitata* L.) is called *monkey bread* and *monkey tamarind* because monkeys eat its fruit, there is an alternative—and more plausible—explanation.[1] In the Caribbean, there is a far richer meaning to the use of the word *monkey* in the compound common names for the baobab and other plants, and for other things as well. Put simply, we learn that the thing whose specific name is monkey bears a resemblance—often a "ridiculous" resemblance—to the thing identified in the second half of the compound common name. The baobab is called monkey tamarind in the Caribbean not because monkeys eat the fruit, but because the fruit is very similar in taste to that of the true tamarind (*Tamarindus indica* L.). This explanation offers an entirely different perspective on the meaning of the baobab's monkey names.

The African baobab is the most prominent member of the small, well defined tropical genus *Adansonia,* of which there are an additional seven species in Madagascar and one in Australia (Wickens 1982). It is one of the continent's most unusual trees, readily distinguished by its huge bulging trunk, which seems strangely disproportionate to the tree's moderate height and thick, rapidly tapering branches (Fig. 1–3). The baobab's size testifies to its remarkable ability to store water, making it ideally suited to the dry open or wooded savannas of tropical Africa (Owen 1974). Because of human dispersal, the tree now grows worldwide. It is especially common in the more intensively managed areas of the human environment including roadsides, public grounds, religious places, nurseries, parks, home gardens, and botanic gardens (Vaid 1978; Wickens 1982; Rashford 1987, 1991) (Fig 4, 5).

THE COMMON-SENSE EXPLANATION FOR THE NAME MONKEY BREAD

While monkey bread is one of the baobab's most frequently reported common names, appearing in many dictionaries, only a few authors have offered an explanation for its origin and meaning.[2] These authors favor the explanation that seems self-evident: the tree is called monkey bread because monkeys eat its fruit. In some cases this is stated explicitly. Owen (1974:90–91), for example, reports that "The name . . . is related to the habit of monkeys, particularly baboons, relishing the fruit which they either pluck from the tree or pick up from the ground." Dellatola (1983:27) states, "The baobab fruit, commonly known as monkey bread, is a favorite food of baboons, hence the name." Robyns (1980:68) takes a similar position by noting, "monkeys are very fond of the capsules, hence the English vernacular name, Monkey Bread Tree."

The association between the baobab's common names and primate fruit consumption is implicit in other sources. In *The Random House Dictionary* (1968:862), for example, monkey bread is defined as "the gourd-like fruit of the baobab, eaten by monkeys," and the name for "the tree itself." *Funk and Wagnalls New "Standard" Dictionary* (1958:1602) provides a similar definition. Monkey bread refers to "the baobab tree, or its fruits" and the fruit "is eaten by man as well as by monkeys."

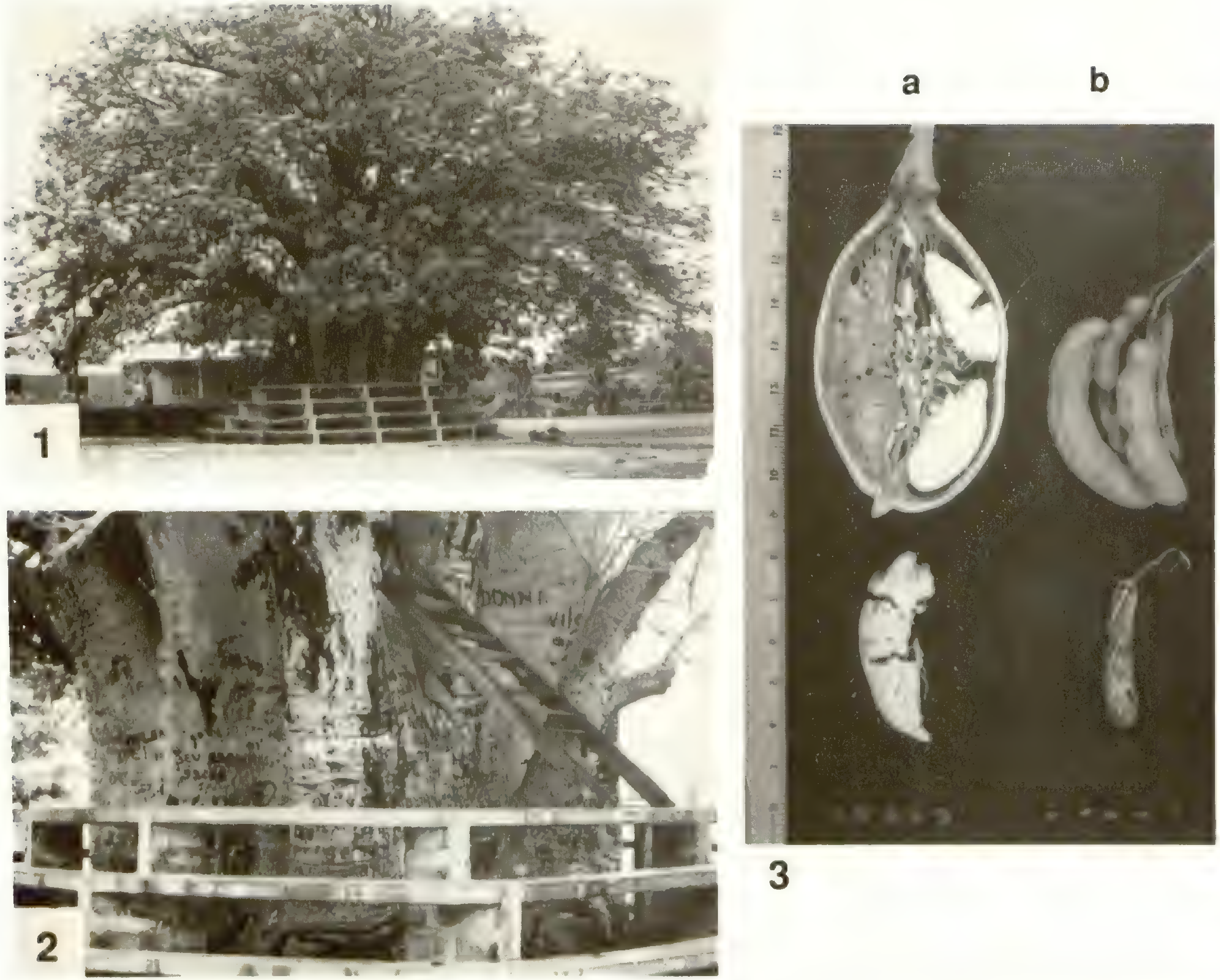

FIG. 1, 2.—Baobab at the Convent of Mercy Academy (Alpha) Girls School in Kingston, Jamaica; FIG. 3.—A comparison of the fruits of the baobab (a) and tamarind (b).

FIG. 4.—A live baobab stump not far from Parham, Antigua.

FIG. 5.—Two fallen trees on the grounds of the University of Florida's Research and Education Center in Homestead, FL.

According to Porteous (1928:235), "the fruit, large, oval, and resembling a cucumber, is a great favorite with monkeys, the tree being sometimes called Ape's-bread Tree [and] Monkey's Bread."

Published accounts implicitly or explicitly link monkey foraging to the plant's common name. Yet, this explanation may not be the only one, nor is it necessarily the correct one. The alternative—and more plausible—explanation this paper offers for the baobab's monkey names is discussed in relationship to the name monkey tamarind which occurs in the Caribbean.

MONKEY TAMARIND—A CARIBBEAN NAME

I have been mapping the Caribbean distribution of the baobab over the past seven years to learn something about its history and cultural significance in the region. In Jamaica, there are five trees in Kingston, the island's capital, and there are reliable reports of three more in the parish of St. Elizabeth. Published accounts (Macfadyen 1850; Rock 1861) suggest that the tree was more plentiful in the past, but it is generally agreed that it was never common. One of the oldest and most impressive of the trees in Kingston grows at the Convent of Mercy Academy, also known as Alpha Girls School. Measured at 7.6 cm from the ground, it is 2.26 m in circumference. In 1986 Sister Mill Delores said the tree was already "as big as it is now" when she came to Jamaica from Malta in 1913 to teach at Alpha, and that at that time it was also called monkey tamarind tree. In 1970 Alex Hawkes visited this tree and wrote about it in his widely-read newspaper column in the Jamaica *Daily Gleaner.* He described it as "an absolutely magnificent huge tree" noting that it "is known by the students fondly as monkey tamarind." Hawkes says this was his first encounter with this name, which is still in use among the students today. In 1977 in the first edition of *Hibiscus*, the Alpha Academy newspaper, a student, Vanessa Soarez, wrote an article titled "Monkey Tamarind Tree" (1977) in which she offered a description of the tree and her impressions of its significance to "every Alpha girl."

The name "monkey tamarind" seems to be of Caribbean origin. It has been reported in Jamaica, the Bahamas (Ives 1880:84), and Dominica (Gerth Van Wijk 1971:25). Monkey tamarind is not among the common names frequently mentioned in the literature, however. In fact most authors who have written about this species in Jamaica only cite the names baobab, Ethiopian sour gourd, or monkey bread (Edwards 1794:195; Lunan 1814:46; Macfadyen 1850:89; Morris 1884:19; Harris 1912:160; Adams 1972:479). Unlike the name monkey bread, monkey tamarind does not appear in any of the standard English dictionaries.

One of the earliest references to the name monkey tamarind is Baillon (1876–1892), cited by Gerth Van Wijk (1971:4). Another reference is Rock (1861:347), whose discussion of the baobab suggests this name came to his attention from a Caribbean source. The inference is based on the fact that he regarded the baobab as "indigenous to Africa and the West Indies," noting that although it was not common in Jamaica, "the pulp and rind or shell of the fruit are employed medicinally," and that "the nuts are occasionally exposed for sale in the markets at Kingston and elsewhere" (Rock 1861:349).

Another interesting reference to the name monkey tamarind that also associates it with Jamaica is Ives (1880). Ives describes a tree in the Bahamas that he identified as Jamaican tamarind and noted that it was "sometimes" called monkey tamarind. Although Ives did not offer a scientific name, the vernacular names and description he used (Ives 1880:83–85) identify the tree as a baobab—probably introduced to the Bahamas from Jamaica as suggested by the name Jamaican tamarind.

THE MEANING OF MONKEY NAMES IN THE CARIBBEAN

In Jamaican culture, the true meaning of monkey in the many compound common names for plants and other things is clearly recognized by Cassidy (1971:382) in his discussion of *Morinda citrifolia* L. This is a small exotic tree from tropical Asia and the Pacific, now extensively naturalized in the wet, coastal areas of Jamaica, especially in the northeastern parishes of Portland and St. Mary (Morton 1992). In the Virgin Islands, *Morinda citrifolia* L. is called painkiller and monkey apple (Valls 1981:82). According to Cassidy (1971:382), it is known in Jamaica as bluuda, duck apple, hog berry, pig's apple, and monkey berry. In the eastern part of the parish of Portland where I did field research, the tree is commonly called hog apple although it is occasionally identified as jumbie chocho, and less frequently as duppy chocho. In explaining the name monkey berry, Cassidy (1971:382) points out that "monkey does not refer to actual animals eating the fruit . . . but suggests . . . that this is something like the proper plant but not really good—it imitates it in a ridiculous way as a monkey [does] a man (compare *monkey fiddle* and other monkey names)." I have followed Cassidy's interpretation and found that in Jamaica this principle seems to hold true for all plants with monkey names. In addition to monkey berry and monkey fiddle (*Pedilanthus tithymaloides* (L.) Poit.), this includes monkey breadfruit (*Artocarpus atilis* (S. Parkinson) Fosberg), monkey comb (*Pithecoctenium echinatum* Jacq.) and monkey apple (*Clusia flava* Jacq.).[3]

In Jamaica, the notion that the word monkey implies imitation holds true not only for plants, but for other things as well. For example, grated coconut boiled in sugar (to the point where it almost begins to burn) becomes hard when it cools, making it difficult to chew. This candy is called monkey iron—something imitating or resembling true iron. The same principle is implied when the word monkey is used to describe a person's behavior, appearance, or facial expressions. To say someone has a monkey face is to say that, like a monkey, he or she is ugly. To make monkey faces is to make ugly faces—faces like those of monkeys—that are meant to poke fun, ridicule, insult, or humor. Cassidy and LePage (1967:304) report that Monkey Jesus is a name used in Kingston to describe an ugly person. A clear example of the association of monkey with imitation—what Jamaicans call "follow fashion"—is evident in Jamaican proverbs that point to the potential for disaster in mimicking or "aping" others (Anderson and Cundall 1972:867):

> Follow-fashion break monkey neck
> Monkey follow-fashion cut him throat
> Follow-fashion mek monkey lose him tail.

The use of monkey names to imply imitation or resemblance seems to hold true not only for Jamaica but for the Caribbean in general. According to Cassidy (1971:277), for example, the use of the expression "monkey face, for a grimace, has survived in Jamaica and Barbados though apparently obsolete elsewhere." It is possible that the survival of this expression is more widespread than Cassidy suggests, for it has also been reported for the Virgin Islands (Valls 1981:82).

There are monkey names for plants in other parts of the Caribbean where the meaning implied seems to be the same as in Jamaica. In the Virgin Islands, for example, Valls (1981:82) says the vine *Mimosa unguis-cati* L. is called cat-law, cat's claw, cat's paw, and monkey earring. Monkey earring is obviously a reference to the rounded shape of the pea pod which bears a "ridiculous resemblance" to true earrings. In Barbados the small herbaceous plant *Ruellia tuberosa* L. is called monkey gun (Robertson and Gooding 1970:230). In Jamaica it is known as duppy pop gun.[4] In both cases the plant receives its specific epithet from its explosive fruit—it imitates or resembles a real gun in the sound it produces. Similarly, mushrooms are called monkey umbrellas in Barbados and duppy umbrellas in Jamaica—they mimic real umbrellas (Robertson and Gooding 1970:230).

Another good example of monkey names for plants is the sandbox tree, *Hura crepitans* L., which grows up to 3.7 m in height with a relatively dense, spreading crown. This impressive tree of the Caribbean and other parts of tropical America is also known as Jumbie dinner bell and monkey dinner bell, and Valls (1981:82) reports the name monkey pistol for the Virgin Islands. Like the monkey gun (*Ruellia tuberosa* L.), the sandbox tree disperses its seeds by means of an explosive pod, hence the dinner bell names and the name monkey pistol. Rampini's (1873:157–158) incidental account of his experience with a sandbox tree while traveling in Jamaica suggests that the association between the exploding pod and a pistol shot was recognized in the nineteenth century:

> As we [Rampini and his coachman] were driving along the sea-shore, just before entering the bustling little town of Black River, we met one of the old-fashioned "kittereens," a vehicle once universal in Jamaica, and still known, we believe, in some outlandish districts in Cornwall . . .
>
> As we were wondering at this old-world turn-out, the nut of a sand-bag tree, expanded with the heat, burst with a loud explosion.
>
> 'Warra!' cried Bob, nearly jumping from his driving box, 'what for debbil shoot pistol to kill poor nigger so?'

Storer (1958:35) resorts to the common-sense approach of seeking a literal interpretation in his effort to explain the origin of the sandbox's other monkey name—monkey dinner bell tree. "Poultry," he writes, "(and where they occur, presumably monkeys) rush eagerly to find the seeds. On the continent, this action of the pod is the reason for the tree's name of Monkey Dinner Bell." A similar explanation is offered in the *Funk and Wagnalls New "Standard" Dictionary* (1958: 1602): the tree is called monkey dinner bell because "the loud noise made by the bursting of the capsule when ripe is understood by the monkeys as a signal that a fresh supply of food is ready."

An early attempt at an explanation was presented by Reverend J. Scholes in 1885 (Abrahams and Szwed 1983:157): "Whether the noisy habit alluded to, arouses and calls the monkey to dinner, in the shape of the many button-like seeds scattered on the ground, or whether the noise is only a general summons to Master Monkey to attend to his corporal wants is a question for the learned to decide." Neither Scholes's or any of the other explanations offered above adequately explain the origin of monkey names in the Caribbean and elsewhere. It is equally possible—even much more likely—that the idea of a dinner bell refers to the noise made by the exploding fruit, and by the many seeds and other parts of the fruits that fall through the dense foliage of this very tall tree. In this context, monkey as the generic term simply means imitative of, or bearing some resemblance to the real thing—a noisy dinner-bell.

THE BAOBAB AS A KIND OF TAMARIND

Thus, the name monkey tamarind tells us that the baobab is a kind of tamarind, but what is the tamarind and how is the baobab related to it? The real tamarind, *Tamarindus indica* L., is a large, evergreen, leguminous tree of Africa—some say India—that is now widespread throughout the tropics. Because it is usually a common tree in the human environment, the tamarind serves as a point of reference for identifying other plants that are also given the name tamarind. The majority of these are, like the tamarind, leguminous shrubs and trees that have leaves, flowers, or fruits that resemble the true tamarind. The baobab is one very noticeable exception since it bears no resemblance to the true tamarind in leaves, flowers, fruits, or physiognomy. What the baobab shares with the true tamarind is that its fruit is similar in taste.

The baobab has many uses and the fruit is one of the most valuable parts of the tree. The value of the fruit is evident when we consider that the most frequently cited English common names—baobab,[5] Ethiopian sour gourd, sour gourd tree, cream of tartar tree, and monkey bread—are all in reference to the fruit. The names Ethiopian sour gourd, sour gourd tree, and cream of tartar tree indicate that one of the most important qualities of the fruit is its edible acidic pulp. Palmer and Pitman (1961:231) note that the pulp "[w]hen dry. . . . becomes powdery, and mixed with water makes a refreshing drink. It is this powder which has given the names 'cream-of-tartar tree' and 'lemonade tree' to the baobab."

In Africa, India, and the Caribbean, not only do the tamarind and baobab grow sympatrically, they have also been reported as growing together (Fig. 6–7) with their branches intertwined (Lely 1925:9; Dalziel 1937:112; Owen 1970:24). Both trees produce indehiscent fruits that ripen in the winter and early spring. These fruits contain hard, dry seeds surrounded by an edible acidic pulp, and the pulp of the tamarind, like that of the baobab, is also used to make a refreshing drink.

The similar use of baobab and tamarind fruits is evident in many common names for the baobab that include the term tamarind. Varmah and Vaid (1978:461) report that in Allahabad, India, the baobab is known as *Vilaiti imli*—exotic tamarind. In some cases these generic terms seem to be related to a particular place. We have already seen references to the baobab as Jamaican Tamarind. Rock (1861:347) reports the name African tamarind, and in St. Croix, the baobab is known as Guinea tamarind.[6] In India, one of the tree's many names is *khurasani imli*—*khurasani* tamarind. According to Burton-Page (1969:332), "The epithet *Khurasani* is fanciful, for the tree is unknown in Khurasan; it seems to be no more than an elegant word meaning 'foreign,' as in *American cloth, Russian salad*." Specific terms can also be related to individuals as in India where the baobab also is called *Gorak imli*—Gorak's tamarind—after Goraksanatha, whom Burton-Page (1969:332) described as "the patron saint of an order of yogis." The meaning of the name monkey tamarind is consistent with the above. The specific term *monkey* tells us that the baobab fruit imitates the taste of the real tamarind. *Monkey* serves

FIG. 6.—Tamarind seedlings at the root of the baobab at Alpha Girls School in Kingston; FIG. 7.—Tamarind and baobab growing side by side in St. Croix.

as only one of many specific terms that distinguishes various plants, particularly trees, as being kinds of tamarinds.

SUMMARY

Though it seems self-evident that the baobab's two monkey names refer to monkeys eating the fruit, I think that this is either not true, or if it is true, it is only partially so. The meaning of monkey tamarind in the Caribbean context suggests that monkey names imply imitation. In the case of the baobab, monkey tamarind refers not to monkeys eating the fruit, but to the simple fact that the fruit is similar in taste to tamarind.

It is not so easy to explain the name monkey bread, however. In what way can the baobab's fruit be said to imitate "real" bread? There are three possible answers. It could be argued that the white or creamy acidic pulp resembles bread. The name also could indicate that the baobab fruit has the same significance to monkeys as bread does to humans—it is their "staff of life." In the final analysis, it might well be that the name monkey bread does derive from primate consumption of the fruit, and that it is unrelated to the use of monkey as a generic term in the name monkey tamarind. I believe, however, that the use of *monkey* as a generic term in the name monkey bread is similar in construction and meaning to what has already been said about the name monkey tamarind. In fact, an examination of the meaning of monkey in the English language generally suggests that it is widely used in ways that are consistent with the argument made in this paper.

NOTES

[1]In actuality, the two monkey names of the baobab—monkey bread and monkey tamarind—have been presented in a variety of ways: monkey bread, monkeybread, monkey-bread, monkey bread tree, monkey's bread, monkey's bread tree, monkeys-bread, monkeys bread tree, monkey bread nut, monkey bread fruit, monkey bread-fruit, monkey bread-fruit tree, monkey tamarind, and monkey tamarind tree.

[2]The dictionaries consulted are: The Oxford English Dictionary (1961, 1989), Clarendon Press, Oxford. Webster's Third New International Dictionary of the English Language (1981), G. & C. Merriam Co., Springfield, MA. Funk and Wagnalls New "Standard" Dictionary of the English Language (1958), Funk and Wagnalls Company, New York. New Riverside University Dictionary (1984), The Riverside Publishing Company, Chicago, IL. The Universal Dictionary of the English Language (1961), Routledge and Kegan Paul, Ltd. The Random House Dictionary of the English Language (1968), Random House, New York. The American Heritage Dictionary of the English Language (1971), American Heritage Publishing Co., New York.

[3]There is one clear case where the common name *monkey comb* does have a literal meaning. In his review of this manuscript, Bradley Bennett wrote: "In Ecuador, *Apeiba aspera* Aublet is called *peine de mono* (Monkey's comb). Wooly monkeys and capuchin monkeys use the spiny fruit capsule to brush their coat."

[4]*Duppy* is the Jamaican name for spirits, especially spirits of the dead. *Jumbie* has the same meaning and occurs in Jamaica and in other Caribbean Islands. In general, plants with duppy or jumbie names (of which there are many) are regarded as inedible or poisonous, while plants with monkey names are regarded as unusual in some way, but may still be eaten.

[5]Wickens (1982:174) says "In 1952, the Venetian herbalist and physician Prospero Alpino wrote that the fruit was known in those markets under the name *bu hobab,* which gave rise to the common European name *baobab* . . . Thus, it would appear that *bu hobab* was a local name invented by the Cairo merchants for a fruit (and tree) which they did not know in the wild."

[6]In St. Croix the baobab is also known as Guinea almond. This is probably because the baobab seeds which are eaten in St. Croix and Jamaica taste like the seeds of the tropical almond *(Terminalia catappa).*

ACKNOWLEDGEMENTS

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BOOK REVIEW

Chumash Healing: Changing Health and Medical Practices in an American Indian Society. Phillip L. Walker and Travis Hudson. Foreword by Jan Timbrook. Banning, California: Malki Museum Press, 1993. Pp. xvi; 161. $12.95 (softcover). ISBN 0-939046-33-4 (hardcover), 0-939046-34-x (softcover).

The book at hand is of interest to ethnobiologists largely because of the medicinal uses of plants and animals, described in Chapter VII, "Treatment of Specific Disorders" (pp. 81–102). However, the whole book is well worth attention. It presents a comprehensive view of what we currently know of Chumash medicine.

The book is rather unusual, among works of its kind, for its commendable attention to changes in postcontact times. The Chumash were among the most severely impacted by introduced diseases; they almost died out. A crumb of consolation lay in the Spanish/Mexican folk remedies they acquired during the mission days. Later, they have become sharers—alas, marginal sharers only—in the benefits of modern medicine.

Phillip Walker's work on epidemics, demography, and physical changes among the Chumash is well known. In this book he has combined it with the ethnographic researches of Travis Hudson and John Peabody Harrington. Harrington's vast unpublished treasure trove of ethnographic findings has shed much light on the Chumash in recent years. Until his tragic and untimely death, Hudson worked assiduously with these notes. It was left to Walker to bring the results to light, combined with his own dynamic picture.

The amount of material that we have is surprising, but no doubt represents only a small fraction of Chumash medical lore. At least five named classes of medical practitioners are described; this is very possibly not an exhaustive list. The ethnobotany is extensive, but surely there was much more.

The strength of the book lies in its archaeological, demographic, and historical materials. Contemporary Chumash ways are not well covered. The authors have drawn on published sources and some surviving oral tradition. Some comparative material is provided, but not very much. There is a need for a systematic investigation of, for example, Mexican and Southwestern parallels in herbal lore and curing practice. Judging from the evidence, modern Chumash practice is very heavily influenced by Mexican and Hispanic-American medical lore. This does not make it less worthy of attention; no detailed research on *any* group's folk medicine has come to us from the Santa Barbara-Ventura area. We need basic documentation comparable to what Bea Roeder has given us in *Chicano Folk Medicine from Los Angeles, California* (Berkeley: University of California, 1988). But that is a task for another book.

E. N. Anderson
Department of Anthropology
University of California
Riverside, CA 92521

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WET'SUWET'EN ETHNOBOTANY: TRADITIONAL PLANT USES

LESLIE M. JOHNSON GOTTESFELD
Anthropology Department
13-15 HM Tory Bldg.
University of Alberta
Edmonton, Alberta, Canada
T6G 2H4

ABSTRACT.—The Wet'suwet'en are an Athapaskan-speaking people of northwestern British Columbia who occupy the transition zone between the sub-boreal spruce forests of the central interior and the cedar-hemlock forests of the Pacific Coast. Wet'suwet'en plant use reflects their transitional location and the diverse plant communities available in their territories. Plant uses show similarities to neighboring peoples. Plants are used by Wet'suwet'en people for herbal medicines, foods, and material culture. The names and uses of 59 species of vascular plants and three nonvascular taxa are documented in this study. Plant uses reported here reflect Wet'suwet'en practices of the twentieth century and have been verified by living elders.

Important medicines include: *Oplopanax horridum, Abies lasiocarpa, Picea engelmannii* x *glauca, Cornus stolonifera, Sorbus scopulina, Lonicera involucrata, Nuphar polysepalum,* and *Veratrum viride.* Food plants include *Heracleum lanatum, Sedum divergens, Dryopteris expansa, Pinus contorta, Tsuga heterophylla, Vaccinium membranaceum, Vaccinium caespitosum, Arctostaphylos uva-ursi, Cornus canadensis, Viburnum edule,* and *Vaccinium oxycoccus.* Plants used in technology and material culture include *Acer glabrum* var. *douglasii, Pinus contorta, Betula papyrifera, Salix* spp., *Thuja plicata, Alnus* spp., and *Picea engelmannii* x *glauca.*

RESUMEN.—Los Wet'suwet'en son un pueblo de habla athapaskana del noroeste de Columbia Británica, en el Canadá, que ocupa la zona de transición entre los bosques sub-boreales de *Picea* del interior central y los bosques de *Thuja plicata* y *Tsuga heterophylla* de la costa del Pacífico. La utilización de plantas por parte de los Wet'suwet'en refleja su ubicación transicional y la diversidad de comunidades vegetales disponibles en sus territorios. Los usos de las plantas muestran similitudes con los grupos vecinos. Los Wet'suwet'en emplean plantas como remedio, alimento y cultura material. En este estudio se documentan los nombres y usos de 59 especies de plantas vasculares y de tres taxa no vasculares. Los usos aquí reportados reflejan prácticas vigentes de los Wet'suwet'en en el siglo veinte y han sido verificados por los ancianos actuales.

Las medicinas importantes incluyen a: *Oplopanax horridum, Abies lasiocarpa, Picea engelmannii* x *glauca, Cornus stolonifera, Sorbus scopulina, Lonicera involucrata, Nuphar polysepalum,* y *Veratrum viride.* Las plantas alimenticias incluyen a *Heracleum lanatum, Sedum divergens, Dryopteris expansa, Pinus contorta, Tsuga heterophylla, Vaccinium membranaceum, Vaccinium caespitosum, Arctostaphylos uva-ursi, Cornus canadensis, Viburnum edule,* y *Vaccinium oxycoccus.* Las plantas empleadas en la tecnologá y la cultura material incluyen a *Acer glabrum* var. *douglasii, Pinus* *contorta, Betula papyrifera, Salix* spp., *Thuja plicata, Alnus* spp., y *Picea engelmannii* x *glauca*.

RÉSUMÉ.—Les Wet'suwet'en sont un peuple autochtone parlant la langue athapascane du nord ouest de la Colombie Britanique qui occupent une zone de transition entre les forêts de sapins de l'interieur et les forêts de cèdres de la côte pacifique. L'utilisation des plantes par les Wet'suwet'en reflète leur occupation de cette zone de transition et les diverses communautés de plantes présentes dans ce territoire. Leur utilisation des plantes montre des similarités avec celle qu'en font leurs voisins. Les plantes sont utilisées par les Wet'suwet'en en tant que plantes médicinales, comme nourriture et pour culture matérielle. Les noms et l'utilisation de 59 espèsces de plantes vasculaires et trois taxons non-vasculaires sont documentés dans cette étude. L'utilisation des plantes décrite ici reflète les pratiques des Wet'suwet'en du vingtième siècle et ont été vérifées par des aînés contemporains.

Les plantes médicinales importantes sont: *Oplopanax horridum, Abies lasiocarpa, Picea engelmannii* x *glauca, Cornus stolonifera, Sorbus scopulina, Lonicera involucrata, Nuphar polysepalum*, et *Veratrum viride*. Les plantes alimentaires incluent: *Heracleum lanatum, Sedum divergens, Dryopteris expansa, Pinus contorta, Tsuga heterophylla, Vaccinium membranaceum, Vaccinium caespitosum, Arctostaphylos uva-ursi, Cornus canadensis, Viburnum edule*, et *Vaccinium oxycoccus*. Les plantes utilisées dans la technologie et la culture matérielle sont les suivantes: *Acer glabrum* var. *douglasii, Pinus contorta, Betula papyrifera, Salix* spp., *Thuja plicata, Alnus* spp., et *Picea engelmannii* x *glauca*.

INTRODUCTION AND SETTING

The Wet'suwet'en are an Athapaskan-speaking people who occupy the drainage of the Bulkley and Morice Rivers and the western headwaters of the Fraser River system in the area of François Lake in northwestern British Columbia, Canada (Fig. 1). Their territory is transitional between the boreal interior and the northwest coast. Many features of their social organization and ecological adaptations are also transitional, shared with the Gitksan, a Tsimshian-speaking people, and the Haisla, a Northern Wakashan-speaking group with whom they have long histories of interaction, while other features of their way of life are similar to more interior Athapaskan groups.

Little material on the ethnobotany of the Wet'suwet'en has been previously documented. Morice (1893) made pioneering studies of the Wet'suwet'en and Carriers in the late nineteenth century. He did not differentiate Wet'suwet'en plant uses or names from those of the Carrier or even the Chilcotin. An unpublished manuscript on Carrier ethnobotany was produced by Smith during 1922–1923 (Smith n.d.). No serious ethnobiological work has been done with the Wet'suwet'en people until the present study.

The Wet'suwet'en live in the villages of Moricetown and Hagwilget, which are Indian Reserves, and in the surrounding communities of Northwest B.C. Many ties exist with the Babines of Fort Babine, who speak the same language with minor dialectical variation. The Wet'suwet'en were long classed as Carrier Indians, but recent studies have argued for their distinctness (Kari 1975).

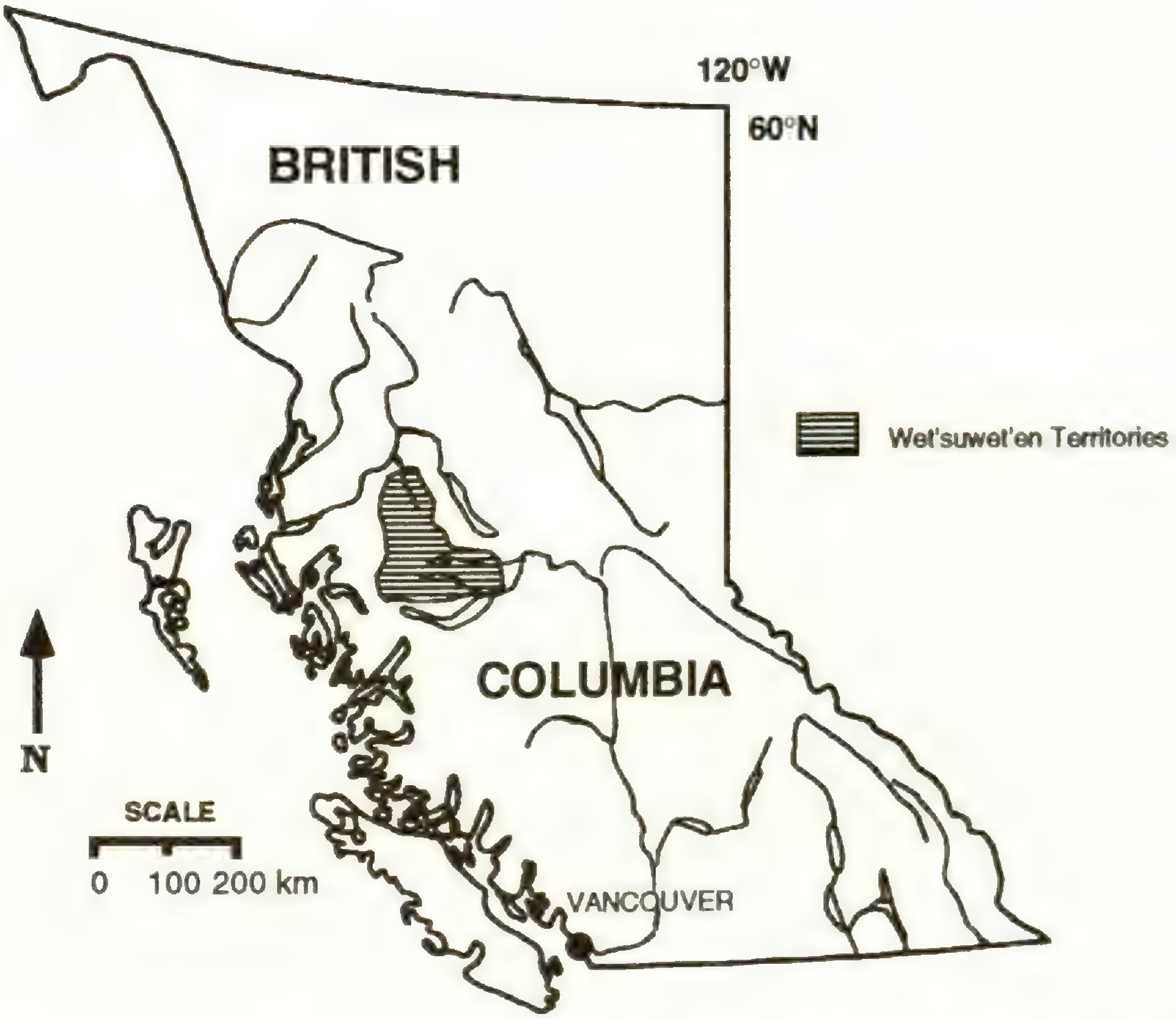

FIG. 1.—Map of the territory of the Wet'suwet'en people, northwestern British Columbia, Canada.

Vegetation of the Wet'suwet'en territory includes a fringe of coastal forest types of the Interior Cedar Hemlock Zone (Haeussler et al. 1985) near Moricetown and Hagwilget and the Coastal Western Hemlock Zone at the western margin of their territory. The bulk of the Wet'suwet'en territory is in the Sub-Boreal Spruce Zone (Pojar et al. 1984).

Until the past 30 to 50 years, the annual cycle of the Wet'suwet'en involved congregation on the Bulkley River to fish for salmon in Moricetown or Hagwilget Canyons and dispersal to hunting and trapping territories in the winter (Daly 1988). Groups from different winter hunting territories converged on the summer villages in time for the arrival of the salmon in early summer, arriving from widely scattered areas within a span of a few of days. Chinook (*Onchorynchus tshawytscha* (Walbaum)), sockeye (*O. nerka* (Walbaum)), and coho salmon (*O. kisutch* (Walbaum)) were fished with dip nets, weirs, and gaffs.

Summer was feast time for the Wet'suwet'en, when an abundant and concentrated food resource brought all the people together. Important group events such as funeral feasts and succession to new titles took place during the summer feast season (Mills 1987). The bodies of important people might be transported long distances back to the village to be buried (in historic times) or cremated with proper rites. This contrasts with the pattern seen in Coastal peoples, who dispersed to fish in the summer and came together in winter villages for a feast season.

In the fall the Wet'suwet'en people dispersed according to their clan affiliations to widely separated hunting and trapping areas, and families spent the winter hunting, ice fishing, and trapping. Trapping territories included areas in the Hazelton and Babine mountains, the Nechako Plateau, and the Tahtsa ranges of the Coast Mountains. In the spring after beaver hunting and trapping, all the Wet'suwet'en would again congregate in the Bulkley Valley, bringing furs and smoked lake fish with them.

Because of their patterns of movement, different groups of Wet'suwet'en people had access to the resources of very different biotic zones at different time of the year. Salmon and red cedar (refer to Table 1 for scientific names not listed in the text) were shared by all in the summer fishing season in the canyons of the lower Bulkley. Resources of the ecological communities of the montane and alpine slopes of the Hazelton Mountains, with western hemlock, amabilis fir (*Abies amabilis* (Dougl.) Forbes), mountain hemlock (*T. mertensiana* (Bong.) Carr.), subalpine fir, and spruce, interspersed with wet meadows and dry screes and avalanche tracks, were available to groups with western hunting and trapping territories. Resources of the rugged Babine Mountains, with spruce or pine forests and dry alpine meadows, were utilized by groups with trapping territories in the northeast part of the Wet'suwet'en lands. The drier Nechako plateau country, with rolling spruce and pine forests, aspen woodlands, grassy slopes, and willow swamps, offered diverse resources to Wet'suwet'en people with territories in the southerly portion of their lands.

Plants are used by the Wet'suwet'en people for medicine, food, and material culture. Medicines are derived from barks, roots, and foliage of a number of different species. Foods include green vegetables, fruits and berries, and root foods. Technological materials include fiber plants, wood, and dyes and pigments. Names of plants used by Wet'suwet'en people are presented in Table 1.

METHODS

The information presented in this paper was collected between 1987 and 1992 through interviews of 31 Wet'suwet'en elders and knowledgeable people about the names and uses of plants.[1] Consultants included both men and women. Most of the consultants are middle-aged or elderly people of traditional upbringing who are fluent speakers of the Wet'suwet'en language. Interviews were conducted in Wet'suwet'en, using a translator, or in English. Where possible, plants in the field, fresh plant specimens, or dried "case" specimens of known botanical identity (Bye 1986) were used to verify the identifications of the plants discussed.[2] Color photographs and line drawings were also employed to verify plant identifications.

All ethnobotanical information and Wet'suwet'en names reported here have been derived from interviews with living people. Not all plant uses reported are still being practiced by the Wet'suwet'en because of extensive changes in subsistence and culture in the past sixty years, but all plant uses described here have been observed or practiced by the consultants in the recent past. Reported historical uses of plants not confirmed by living elders will not be discussed in this paper.

TABLE 1.—Names of plants used by the Wet'suwet'en.

Common Name	Plant Species	Plant Family	Wet'suwet'en Name
Alder	*Alnus* spp.	Betulaceae	***k'is***
Aspen, trembling	*Populus tremuloides*	Salicaceae	***t'ighis***
Avens, large-leaved	*Geum macrophyllum* Willd.	Rosaceae	***ilk'it bin***
Birch, paper	*Betula papyrifera* Marsh.	Betulaceae	***k'ay***
"Black tree moss"	*Alectoria* or *Bryoria* spp.		***dikhghe***
Black twinberry, "bearberry"	*Lonicera involucrata* (Rich.) Banks	Caprifoliaceae	***sis mï' cin***
Blueberry, low-bush	*Vaccinium caespitosum* Michx.	Ericaceae	***yintimï?***
Blueberry, high-bush	*Vaccinium ovalifolium* Smith		***dïndze***
Bunchberry	*Cornus canadensis* L.	Cornaceae	***dinïhyez, dinïh t'an***
Cedar, western red	*Thuja plicata* Donn. ex D. Don	Taxodiaceae	***simggin***
Cinder conk, black burl	*Inonotus obliquus* (Pers: Fr.) Pilat.	Hymenochaetaceae	***tl'eyhtsë, dic'ah ci'ists'o'***
Cottonwood, black	*Populus balsamifera* L. *trichocarpa* (Torr. & Gray. ex Hook.) Brayshaw	Salicaceae	***ts'iy***
Cow parsnip, "wild rhubarb"	*Heracleum lanatum* Michx.	Apiaceae	***ggus***
Crabapple, Pacific	*Pyrus fuscus*	Rosaceae	***milks***
Cranberry, high-bush	*Viburnum edule* (Michx.) Raf.	Caprifoliaceae	***tsalhtsë***
Cranberry, low-bush; bog	*Vaccinium oxycoccus* L.	Ericaceae	***mï'o***
"Currant, black"	*Ribes* sp	Grossulariaceae	***dilkw'akh mï?***
Currant, red	*Ribes triste* Pall. (?)	Grossulariaceae	***k'iy ditigï***
Devil's club	*Oplopanax horridum* (Smith) Miq.	Araliaceae	***whisco***
Dogbane, spreading	*Apocynum androsimaefolium* L.	Apocynaceae	***c'indeklh***
Elderberry, red	*Sambucus racemosa* L.	Caprifoliaceae	***luts***
Fir, subalpine; "balsam"	*Abies lasiocarpa* (Hook.) Nutt.	Pinaceae	***ts'otsin***
Fireweed	*Epilobium angustifolium* L.	Onagraceae	***khas t'an***
Gooseberry, northern	*Ribes oxyacanthoides* L.	Saxifragaceae	***c'indewizgï***
Hazelnut, beaked	*Corylus cornuta* Marsh.	Betulaceae	***tsalik gg'a kun'***
Hellebore, Indian or false	*Veratrum viride* Ait.	Liliaceae	***konye***
Hemlock, western	*Tsuga heterophylla* (Raf.) Sarg.	Pinaceae	***misdzu***

TABLE 1.—Names of plants used by the Wet'suwet'en. (continued)

Common Name	Plant Species	Plant Family	Wet'suwet'en Name
Huckleberry, black	*Vaccinium membranaceum* Dougl.	Ericaceae	*digï*
Juniper, common	*Juniperus communis* L.	Cupressaceae	*detsan*
Juniper, Rocky Mountain	*Juniperus scopulorum* Sarg.	Cupressaceae	
Kinnikinnik	*Arctostaphylos uva-ursi* (L.) Spreng.	Ericaceae	*dinïh*
Labrador tea	*Ledum groenlandicum* Oeder	Ericaceae	*ldï misgïk*
Lady fern	*Athyrium filix foemina* (L.)	Polypodiaceae	
Maple, Douglas	*Acer glabrum* (Torr.) var. *douglasii* (Hook.) Dippel	Aceraceae	*'ayh*
Mountain ash	*Sorbus scopulina* Greene	Rosaceae	*dicin ilhtsin*
Nettles, stinging	*Urtica dioica* L.	Urticaceae	*holhts'ic*
Onion, nodding; "stink grass"	*Allium cernuum* Roth	Liliaceae	*tl'o ilhtsin*
Pin cherry	*Prunus pennsylvanica* L.	Rosaceae	*smïts'ok*
Pine, lodgepole	*Pinus contorta* Dougl.	Pinaceae	*cindu*
Plantain, broad-leaved	*Plantago major* L.	Plantaginaceae	*delkw'akh nelhdic*
Raspberry	*Rubus idaeus* L.	Rosaceae	*biyolhggok*
Red columbine	*Aquilegia formosa* Fisch.	Ranunculaceae	*lesokh*
Red-osier dogwood	*Cornus stolonifera* Michx.	Cornaceae	*kak dilk'i'n; wikak dilk'i'n; k'ëntsik*
Rice root; "wild rice"	*Fritillaria camschatcensis* (L.) Ker-Gawl	Liliaceae	*c'inkalh*
Rose, prickly	*Rosa acicularis* Lindl.	Rosaceae	*tselhghïl*
Salmonberry	*Rubus spectabilis* Pursh	Rosaceae	*misggile'n*
Sarsaparilla, wild	*Aralia nudicaulis* L.	Araliaceae	*scanistles*
Saskatoon	*Amelanchier alnifolium* Nutt.	Rosaceae	*lhighah*
Scouring rush	*Equisetum hyemale* L.	Equisetaceae	*lawzi'*
Skunk cabbage	*Lysichitum americanum* Hultén & St. John	Araceae	*c'it anco*
Snowberries, "grouseberries"	*Symphoricarpos albus* (L.) Blake	Caprifoliaceae	*c'itsit mï'*
Sphagnum, "diaper moss"	*Sphagnum* sp.	Sphagnaceae	*yin yil, yintl'akh yil*
Soapberry	*Shepherdia canadensis* (L.) Nutt.	Eleagnaceae	*niwis*
Spruce	*Picea engelmanii* x *glauca*	Pinaceae	*ts'o*
Spruce, black	*Picea mariana* (Mill.) Brittl, Sterns & Pogg.	Pinaceae	*ts'o; nedus*

TABLE 1.—Names of plants used by the Wet'suwet'en. (continued)

Common Name	Plant Species	Plant Family	Wet'suwet'en Name
Stonecrop; "stone berries"	*Sedum divergens* Wats.	Crassulaceae	***tsë mï'***
Strawberry, wild	*Fragaria virginiana* Duchesne	Rosaceae	***yinti dilk'i'n***
Thimbleberry	*Rubus parviflorus* Nutt.	Rosaceae	***dik dïnkay***
"Wild carrots"	*Sium suave* Walt.(?)*f*	Apiaceae	***sasco***
Willow	*Salix* spp. probably *S. lasiandra* and/or *S. scouleriar*	Salicaceae	***k'ëltay, k'endliyh***
Wood fern, spiny	*Dryopteris expansa* (K.B Presl) Fraser-Jenkins & Je	Polypodiaceae	***diyï 'n***
Yarrow	*Achillea millaefolium* L.	Asteraceae	***bi'il yesonë***
Yellow pond lily	*Nuphar polysepalum* Engelm.	Nymphaeaceae	***khëlht'ats***

f P. Kari, unpublished notes

MEDICINAL PLANTS

Many of the medicinal plants used by the Wet'suwet'en are used by other Indian peoples of northern British Columbia. Plants are generally employed as decoctions or infusions for internal or external use, mashed as poultices and wound dressings, or eaten. Many medicines are derived from the bark or inner bark of the plant (Gottesfeld 1992a). "Wood medicine," ***dicin yu,***[3] is the term for medicinal decoctions made from barks or inner barks, often mixtures of a number of species. The same medicinal category is present among the neighboring Gitksan where it is called ***haldokum gan.***[4] Roots and rhizomes are often used as poultices for arthritis and rheumatism. Crushed leaves or chewed inner bark serve as dressings for sores and wounds. Plants are also employed as fumigants for warding off disease or cleansing taboo violations. Some plants are also believed to bring luck. Medicinal plant uses are summarized in Table 2. A discussion of the more important medicinal plants follows.

Indian hellebore, ***konye*** *(Veratrum viride Ait.).*—Indian hellebore is a large forb of midelevation and subalpine moist meadows. The rhizome is gathered for medicinal use. It is toxic, containing a variety of alkaloids that act to depress central blood pressure (Kingsbury 1964). It is considered a plant of great spiritual power; its primary uses are for ritual purification and bringing or restoring "luck," especially in hunting. Usually the dried rootstock is grated and the powder used for purification, but sometimes an infusion of pieces of the dried rootstock and other ingredients such as cow parsnip root and devil's club bark may be made and the liquid used for washing. Indian hellebore is also used as a fumigant. It apparently was used in the sweat bath in the past. A piece of the dried rootstock may also be carried as a luck charm. The root can also be used externally in the

TABLE 2.—Medicinal plants.

Plant Name	Tonic	Heart	Respiratory	Skin	Rheumatism/ Arthritis	Stomach	Wounds or Burns	Unspecified/ General	Pain	Urinary	Childbirth
Avens, large-leaved				√	√		√				
Black twinberry			√	√			√				
Cinder conk									√		
Cottonwood, black			√					√			
Cow parsnip			√	√	√						
Crabapple, Pacific			√								
Cranberry, high-bush			√					√			
Devil's club	√	√	√		√		√	√			
Elderberry, red								√			
Fern Rhizome (unspec.)											√
Fir, subalpine	√		√				√	√			
Hellebore, Indian				√	√						
Juniper, common	√										
Kinnikinnik berries		√				√					
Labrador tea	√	√									
Mountain ash			√					√			
Nettles, stinging	√			√		√		√			
Pin cherry			√								
Pine, lodgepole			√					√			
Plantain, broad-leaved				√							
Pond lily, yellow	√		√		√						
Red-osier dogwood			√	√		√	√	√	√		√
Rose, prickly			√					√			
Sarsaparilla, wild			√							√	
Scouring rush										√	
Snowberries					√						
Soapberry						√		√			
Spruce			√					√			
Spruce, black			(√)					√			
Strawberry, wild											
Yarrow				√	√						

TABLE 2.—Medicinal plants. (continued)

Plant Name	Purgative	Purification/ Spiritual	Eye	Laxative	Diarrhoea	"Cleanser"	Dental	Diabetes	Hair Rinse
Avens, large-leaved									
Black twinberry			√						
Cinder conk									
Cottonwood, black									
Cow parsnip									
Crabapple, Pacific									
Cranberry, high-bush									
Devil's club	√	√						√	
Elderberry, red	√								
Fern Rhizome (unspec.)									
Fir, subalpine						√			
Hellebore, Indian		√							
Juniper, common									
Kinnikinnik berries									
Labrador tea						√			
Mountain ash									
Nettles, stinging					√				√
Pin cherry									
Pine, lodgepole									
Plantain, broad-leaved									
Yellow Pond lily, yellow									
Red-osier dogwood									
Rose, prickly									
Sarsparilla, wild									
Scouring rush									
Snowberries			√						
Soapberry				√					
Spruce							√		
Spruce, black							√		
Strawberry, wild					√				
Yarrow									

treatment of sore or inflamed joints. Indian hellebore was never taken internally by the Wet'suwet'en.

The Wet'suwet'en regard this plant as extremely powerful and dangerous and treat it with the utmost respect and care. When gathering ***konye,*** it is proper to leave a gift in the hole from which it has been dug and to cover the hole again with soil. Men should take roots from a "female" plant, which has dried flowers on top. Women should use roots from a "male" plant, which lacks dried flowers.

"Wood medicines."—Devil's club is the most widely used and gathered medicinal plant of northwest and coastal British Columbia. It is a sprawling shrub up to 2 m in height, characteristic of moist mixed and conifer forests and avalanche tracks. Its Wet'suwet'en name, ***whisco,*** "big thorn," refers to the impressive array of spines which cover the stems and leaf veins. The inner bark is used by the Wet'suwet'en in medicinal mixtures with ingredients such as subalpine fir bark, spruce bark, or mountain ash bark. It was also boiled alone (Fig. 2). These decoctions are used to treat colds, flu, or tuberculosis, or as tonics and preventative medicines. Devil's club is reported to be good for heart disease. The inner bark is also used fresh, worn around the neck as an aromatic treatment for colds. The bark is burned on the stove top to treat people with colds or to ward off sickness in a house. Bathing in devil's club infusions is part of the ritual cleansing that men undergo before hunting or trapping.

Devil's club roots can also be dug up and used. They can be chewed for cough medicine or brewed as a tea. Roots are reported to be stronger than the stems.

Red-osier dogwood is a common shrub of aspen forest and cottonwood forests, lakeshores, and river banks. It is called ***kak dilk'i'n, wikak dilk'i'n,*** or ***k'ëntsik*** by the Wet'suwet'en. The root ***dilk'i,*** "red," refers to the color of the bark. The bark or inner bark of this plant is used in medicinal mixtures for various purposes. It may be boiled with subalpine fir and spruce bark, with mountain ash and black twinberry bark, and with devil's club. It is taken for coughs and respiratory ailments. A decoction of red-osier inner bark can be used to treat psoriasis by soaking the affected body part in the solution. A decoction of red-osier inner bark is also used internally for treatment of postpartum hemorrhage, for pain after childbirth, or for stomach pain.

Black twinberry is called ***sis mï' cin,*** "bearberry," by the Wet'suwet'en. The inner bark of black twinberry is highly valued as a wound dressing and for treatment of infection. It is particularly described as being an effective medicine for burns. An infusion of the inner bark or the raw, fresh chewed bark is applied to the burn. An eye medicine can be made from the inner bark of black twinberry. It also forms one of the ingredients of medicinal mixtures of barks used for coughs and respiratory illness.

Mountain ash is called ***dicin ilhtsin,*** which means "smelly or stink wood." It is also called ***honca ts'iy cin*** and ***cinic hikh.*** The inner bark is scraped off larger stems and dried or used fresh. It can be infused alone and taken for bad colds, flu, and general sickness, or it can be mixed with other ingredients such as devil's club, subalpine fir bark, and black twinberry bark, and boiled together for a strong medicine effective against diseases such as whooping cough. Mountain ash was used along with yellow pond lily root for treatment of tuberculosis in the recent past.

FIG. 2.—The late Madeline Alfred preparing medicine from devil's club.

The bark and pitch of the subalpine fir are highly valued for medicine. The pitch may be taken alone internally for sickness or to aid in healing external wounds. The bark may be mixed with other barks, such as devil's club, mountain ash, and black twinberry, in medicinal decoctions as mentioned above.

Spruce bark is used similarly to subalpine fir bark. Both may be specified in recipes for medicinal decoctions. The young "tips" or terminal buds of young spruce trees are used to make medicine for colds. Black spruce foliage could also be used for medicine. The pitch of the black spruce was chewed to clean the teeth and as an oral antiseptic.

Foliage or tips of other conifers, such as lodgepole pine, were also used in medicines. Juniper boughs ***(detsan'il)*** and berries were used to make a medicinal decoction that was used as a tonic and for treatment of flu. A medicine could also be made from the juniper for treatment of venereal disease.

Bark of several other shrubs is used for medicinal decoctions. Snowberry bark is used for an eye medicine. Pin cherry bark, in combination with juniper boughs and willow or alder(?) bark, is used for cough. Red elderberry bark is also used for medicine. Jenness (reported in Smith 1928) noted the use of a decoction of the roots as a purgative. This practice was also found among the Gitksan in the early 1920s (Gottesfeld and Anderson 1988).

Medicinal roots.—Yellow pondlily ***(khëlht'ats),*** occurs widely in the shallow margins of lakes and ponds up to the subalpine zone. The leaves are called by the same name as plantain leaves, ***dilkw'akh nelhdic,*** "frog blanket." Yellow pond lily rootstock, ***(khëlht'atsghih)*** is used as a tonic, in medicinal mixtures taken internally in the treatment of tuberculosis, and as a poultice for rheumatic joints and fractures. One method of using yellow pondlily rootstock as a tonic is to roast and powder the peeled rootstocks. The powder is then added to food consumed at meals. Pond lily rootstock is hard to dig. Some elders describe finding rootstocks dug up by beavers or muskrats; another strategy is to wait until late summer when the water levels in ponds may be lower.

The root of the cow parsnip ***(ggusghih)*** is used as a poultice for rheumatism. A decoction of the root can be used for a cough medicine. It also can be used as an external wash, as described in the discussion of Indian hellebore.

Nettle rhizomes are boiled for medicine. They are good for "anything." A decoction of nettle rhizome with cow parsnip root, spruce bark, and subalpine fir bark is taken internally for skin rash. Nettle root is also an ingredient of a mixed medicinal decoction employed as a tonic.

The rhizomes of wild sarsaparilla ***(scanistles)*** were boiled in combination with a variety of other roots and barks as a tuberculosis remedy.

Skin treatments.—The green leaves of large-leaved avens are boiled for treatment of wounds and rashes. The affected area is bathed with the liquid. Avens can be mixed with black twinberry bark, which has similar properties, or with the inner bark of red-osier dogwood. All three ingredients boiled together are reported to make a good medicine for washing open wounds. A decoction of avens is also used as a hot soak to treat arthritic swelling. Mashed avens leaves can also be applied directly to a sore.

The leaves of broad-leaved plantain are applied directly to sores that are not healing, or a decoction of the leaves can be used to treat sores or swellings. Medicinal use of broad-leaved plantain may be of relatively recent origin, as the plant is considered a European introduction.

A decoction of yarrow is used as a skin wash to treat itching.

Other medicinal plants.—Soapberries ***(niwis)*** are used for the treatment of stomach ulcers. They are good for arthritis also. A decoction of the inner bark of the branches is used as a laxative or for a sore stomach.

Prickly rose ***(tselhghil t'an)*** can be used for medicine. The whole plant is boiled. It is "good for everything."

A decoction of scouring rush ***(lawzi')*** is used to aid in passing urine in cases of kidney dysfunction.

Slivers of cinder conk ***(tl'eyhtsë*** or ***dic'ah ci'ists'o')***, a black, amorphous-looking polypore found on birch trees, are burned on the skin as a moxibustion treatment to relieve pain (Gottesfeld 1992b).

Discussion.—Traditionally, diseases were treated either by home herbalists or ***diyin***, "Indian doctors," using plant- or animal-derived remedies. In addition Indian doctors used medicine songs and spiritual powers derived from supernatural beings as part of their healing power. Sixty-five years ago Indian doctors, the Kalutl'em ***(GGelulhem)*** Society, and the more powerful and prestigious K'yan Society were much involved in treatment of serious illness that was believed to be spiritually caused (Jenness 1943). Jenness states that the importance and numbers of such practitioners was decreasing at that time (i.e., in the mid-1920s) (Jenness 1943).

At the present time home herbal- or animal-product remedies continue to be used, but specialized healers have been largely displaced by modern physicians. Cases of illness that did not respond to other treatments, including treatment by physicians, were diagnosed as "Indian Sickness" in the recent past and required initiation by the ***GGelulhem.*** A number of people treated in this manner are still living.

Some of the plants used by the Wet'suwet'en are known to have active ingredients that may contribute to their efficacy. Recent studies have affirmed the empirical basis and potential efficacy of many ethnomedical herbal treatments even though the understandings of disease etiology and therapeutic treatments may not replicate biomedical approaches (Browner 1985; Browner et al. 1988; Etkin 1986).

A comprehensive review of the biochemistry and pharmacology of Wet'suwet'en medicinal plants is beyond the scope of this paper, but a few examples will be discussed. The bark of various species of pine is known to have antibacterial properties (Moskalenko 1986). This would suggest their effectiveness for purposes such as treatment of wounds and perhaps in oral preparations for coughs and respiratory illnesses. The root and stem bark of elderberry are emetic (Kingsbury 1964).

Research in progress on the constituents of devil's club extracts has identified several triterpenoids, but the bioactivity of the isolated compounds has not yet been demonstrated (Sheng-Chu Feng, personal communication, 1992). Clinical studies from the 1930s suggest hypoglycaemic properties for devil's club extracts (Brocklesby and Large 1938; Justice 1966).

Juniper boughs and berries contain a large number of compounds, including flavonoids, benzenoids, lignans, alkenes, diterpene polyprenoids, malic acid, malonic acid, oxalic acid, phenyl pyruvic acid, aconitic acid, tartaric acid, vanillic acid, and ascorbic acid, which have been isolated by a number of different investigators (e.g., De Pascual et al. 1980; Lamer-Zarawaka 1977; Linder and Grill 1978). Juniper berries show antitumor and antiviral effects *in vivo* and *in vitro,* and have shown embryotoxic effects *in vivo* in rats (e.g., Agrawal et al. 1980; Belkin et al. 1952; May and Willuhn 1978). The antiviral properties of juniper berries would be beneficial in the treatment of respiratory illnesses. The ascorbic acid content might also have health benefits.

Indian hellebore *(Veratrum viride)* is recognized by the Wet'suwet'en as potentially deadly. The plant contains a number of toxic alkaloids which can cause death through depression of central blood pressure (Edwards 1980; Jeger and Prelog 1960; Kingsbury 1964). The properties of external washes or of the smoke of burning dried Indian hellebore root remain unknown.

Cow parsnip contains abundant furanocoumarins that are toxic to DNA in the presence of ultraviolet radiation, causing blistering (Camm et al. 1976). Skin blistering could be involved in a counterirritant treatment of swollen rheumatic joints.

FOOD PLANTS

Food plants traditionally used by the Wet'suwet'en include roots, green vegetables, tree "cambiums," numerous wild berries, and plants used for beverages (Table 3). A number of different berries and small fruits were quantitatively and nutritionally the most significant plant foods. Few other foods rich in carbohydrate are available in this region. Only two root vegetables were extensively used by the Wet'suwet'en, spiny woodfern rootstock (Turner et al. 1992) and rice root bulbs. "Cambiums" of pine, hemlock, and spruce were harvested for food in early spring, when at their most palatable and nutritious stage. A few plants were harvested as green vegetables by the Wet'suwet'en in the spring. Nutritional analyses of various fruits and vegetables used by the Wet'suwet'en are discussed by Gottesfeld (1995). Several plants were steeped in hot water to make teas. Sometimes a medicinal value is suggested by Wet'suwet'en people, but the general feeling among my consultants is that these infusions were drunk simply as beverages. Some beverages, like Labrador tea or infusions of conifer needles, may contain significant ascorbic acid and perhaps other nutrients (Berkes and Farkas 1978; Gottesfeld 1995).

Berries.—Berries of all sorts were eaten fresh, dried on racks "like raisins," or preserved fresh in rendered grease and stored in underground storage houses. Blueberries (*Vaccinium* spp.) in particular are described as being stored in this way. In the past berries were also preserved by being made into berry cakes. This process was essentially identical to that described for the Gitksan (People of Ksan 1980). Wooden racks were placed on a frame over a small fire. The rack was lined with leaves of skunk cabbage, ***(c'it anco)*** or thimbleberry, and cooked berries were ladled on in several layers to allow partial drying and to prevent the berries from spilling (Gottesfeld 1991). The leaves were stripped off of the dried cakes, which were moistened to make them flexible and rolled up on a stick. These berry rolls were hung in a dry place for long term storage (Naziel and Naziel 1978). Huckleberries, saskatoons, and soapberries are particularly described as being preserved in this way.

Today berries are still widely picked but are usually preserved by canning in glass jars. Huckleberries and high-bush blueberries are most widely collected. Soapberries, whose bitter fruits contain saponins are another important berry still in use today. Like many other western Indian people (Turner 1982), the Wet'suwet'en

TABLE 3.— Wet'suwet'en food plants.

Common Name	Green Vegetable	"Cambium"	Root foods	Fruits	Beverage	Other
"Black tree moss"						*
Black twinberry, "bearberry"						
Blueberry, low-bush				√		
Blueberry, high-bush				√		
Bunchberry				√		
Cow parsnip, "wild rhubarb"	√					
Crabapple, Pacific				√?		
Cranberry, high-bush				√		
Cranberry, low-bush; bog				√		
"Currant, black"				√		
Currant, red				√		
Fireweed	√					
Gooseberry, northern				√		
Hazelnut, beaked				√		
Hemlock, western		√				
Huckleberry, black				√		
Kinnikinnik				√		
Labrador tea					√	
Onion, nodding; "stink grass"	√					
Pin cherry				√		
Pine, lodgepole		√				
Raspberry				√	√	
Red columbine						(√)
Rice root; "wild rice"			√			
Rose, prickly				√		
Salmonberry				(√)		
Saskatoon				√		
Soapberry				√		
Spruce		(√)				
Stonecrop; "stone berries"	√					
Strawberry, wild				√		
Thimbleberry				√		
"Wild carrots"			√			
Wood fern, spiny			√			

* reported by Morice (1893)

prepare soapberries by beating them into a froth, or they may eat the boiled berries by the spoonful.

Formerly the abundant kinnikinnik berries were important in the diet of the Wet'suwet'en people. The fruits of the bunchberry were also collected.

Root foods.—In the past ***diyi"n,*** the rootstock of the spiny wood fern, was an important staple food, as it also was among the Gitksan, Tsimshian, Haisla, and a number of other Indian groups of coastal British Columbia (Turner et al. 1992).

Fern roots were dug in the fall after the leaves had withered, or in the winter by shovelling off the snow to expose the dried tops of the plants. Apparently the rootstock is not damaged by freezing. Elders who have eaten this plant remember its flavor with pleasure, and comment that it was the "potatoes" of their people.

Annual trips were made from Hagwilget to Blue Lake to gather and store ***diyi' n.*** The meadows at the heads of Corya and John Brown Creeks were other areas where ***diyi' n*** was picked. A stock of stored fern rhizome, rich in carbohydrate (Turner et al. 1992; Kuhnlein 1990), provided a welcome source of calories in late winter when other foods might be growing scarce. To prepare this food, it was slowly baked overnight in a pit covered with birch bark and earth. Each individual leaf base was then pulled off and peeled before eating. This food was generally eaten with rendered grease or fish oil, and often accompanied by dried spring salmon eggs.

The other important Wet'suwet'en root food was ***c'inkalh,*** the bulblets of rice root, locally called "wild rice." These bulblets can be collected in reasonable quantity in rich, moist, low elevation meadows in the northwest part of the Wet'suwet'en territory. They can be gathered in spring and fall. They were pit cooked or boiled and served with sugar or salt.

Tree "cambiums."—The tree cambiums, ***misdzu*** (from hemlock) and ***k'inïh*** (from lodgepole pine), were formerly prized plant foods. Spruce cambium was also utilized. Hemlock cambium was often obtained by trade from Gitksan people, as it is more widespread and abundant in the Gitksan territory. Hemlock cambium was gathered in the spring by removing the bark of mature trees and scraping the cambium layer from the bark. It was preferentially harvested from stands with a southern exposure because "the sun makes the sap sweeter" (Richard Daly, personal communication, 1991). The cambium was pounded after collection. Some people remember dried hemlock cambium cakes, while others recall shavings. Hemlock cambium has been described as tasting like saskatoons.

Pine cambium was widely gathered in the Wet'suwet'en territories. It was harvested in May or June when the sap rises in the pines and the bark is loose. The bark was removed from a standing tree with axe or knife, and the cambrium carefully scraped from the outer surface of the exposed wood. Much of it was probably consumed fresh, especially by children, as it is rich in sugars (Gottesfeld 1995) and tastes sweet. It was also dried on wooden racks over a slow fire much as berries were dried by the Wet'suwet'en, or hung to dry as individual strips over a piece of cord. The dried strips were then crumbled to resemble cornflakes and stored for winter.

Green vegetables.—The young flowering stalks of the cow parsnip or "wild rhubarb" ***(ggus)*** are still gathered in spring, peeled, and eaten fresh. They can also be fried lightly or roasted in a campfire. Some modern Wet'suwet'en preserve this prized vegetable by freezing.

Another vegetable eaten by the Wet'suwet'en was stonecrop ***(tsë mi').*** It was gathered in May before flowering. The Wet'suwet'en people cooked the small fleshy leaves of this plant, frying it lightly and sometimes adding sugar before serving. The same species was eaten by the Gitksan and the Niska'a, who classed it as a berry and ate it raw or cooked with sugar and grease (Jensen and Powell 1979; McNeary 1976; Gottesfeld field notes 1984).

Fireweed stalks ***(khast'an)*** were stripped of their leaves, split, and bent over. The marrow was then stripped out and eaten. It is described as tasting like bananas.

Nodding onion was gathered and eaten raw in the spring. It was called stink grass ***(tl'o ilhtsin)***.

Columbine flower tips ***(lesokh)*** were bitten off and the nectar sucked by children for a sweet snack.

At the present time, the only traditional plant foods important in the Wet'suwet'en diet are various wild berries, such as saskatoons, blueberries, huckleberries, soapberries, wild strawberries, and wild raspberries (fresh, canned, or made into jam), and "wild rhubarb" (cow parsnip). Many living adults remember collecting pine cambium. The elders recall eating traditional vegetable foods such as spiny woodfern rootstock or hemlock cambium, though no one has gathered these foods for decades. Some people also recall gathering stonecrop leaves in spring for the elders. In addition, Labrador tea or raspberry leaves are collected and brewed for tea by some people. There is renewed interest in traditional foods by young people, some of whom are learning about traditional foods through local educational programs. Knowing about and eating such foods contributes to their sense of identity as Wet'suwet'en.

PLANTS USED IN TECHNOLOGY

Plants were used for construction, carving, cordage, and heating fuel; for smoking foods and hides; and for bedding, roofing, and coverings. The wood of a variety of trees and large shrubs was used for different purposes, depending on their properties and availability. Bark of various species of trees and shrubs was used for cordage, coverings, and basket construction. Leaves, stem fiber, and boughs of shrubs and herbaceous plants were also used for cordage, food preparation, and bedding. Moss and fruticose lichens were used for chinking, diapers, or tinder. The following discussion does not include complete information on carving, construction, boat-building, or smoking.

Bark uses and cordage plants.—The most important bark used for cordage by the Wet'suwet'en was the inner bark of willow trees. Willow bark ***(k'ëltay)*** (*Salix* spp., probably *S. lasiandra, S. scouleriana,* or both), was twined for cord, still especially for set lines and fish nets. Untwined green willow bark is still used for tying up fish in the smokehouse and lashing together shelters (Fig. 3). It was also used to lash beaver skin to a hoop of red-osier dogwood while the skin was being stretched and dried. Willow bark is tough and durable when wet, but brittle when dry. Willow bark and nets and cords made from it therefore had to be soaked before use to make them pliable.

Cedar bark (***hët'il***) was also used for cord, and sometimes made into twined capes and dresses in the manner of the Gitksan. The cord was used to hang fish in the smoke house, to lash together fish traps, and in the construction of wooden bridges. Cedar bark could be gathered in much longer lengths than willow bark,

FIG. 3.—Bundle of prepared willow bark to be used to hang fish in the smoke house, Moricetown.

but was only available in the northern part of the Bulkley Valley near Moricetown and Hagwilget.

Whole cedar bark and spruce bark were used for durable roofing. Cedar bark was peeled from the tree in May when the sap rises by cutting around the tree with an axe near the base and again higher up. A stick was used as a spud to peel the whole bark off the wood. While still green and flexible, bark strips were laid over the peak of the roof. The bark was laid in two layers: the lower with the inner surface up, and the upper with the outer surface up, positioned to cover the joints in the lower layer. The roofing was weighted down with poles to prevent its blowing off. Cedar bark roofing was said to last for several years, while spruce bark roofing would have to be replaced more frequently.

Birch is called ***k'ay*** which also refers to birchbark. Some consultants call birch by the word for green tree, ***dilï*** and birch wood, ***dilï tsiz*** "green firewood." Birch bark was used for basketry and in pit cooking. For baskets the bark must be collected from a living tree and used before it dries out and hardens (Modern women sometimes keep freshly stripped birch bark in the deep freeze for later use.) Birch baskets were used for food storage and for carrying water, berries, and other items (Fig. 4). Torches were also made of rolled birchbark, and birchbark was used to carry fire from one camp to the next.

The Wet'suwet'en apparently once made birchbark canoes. A birchbark canoe was constructed in the Burns Lake area as recently as the late 1970s or early 1980s (Bob Skin, personal communication, 1994).

FIG. 4.—Birchbark basket made by Jenny Naziel of Moricetown, B.C.

Split spruce roots ***(khay)*** are used for sewing birchbark baskets and stitching together birchbark canoes. Spruce roots were once used for making large cargo baskets. Such baskets were used to carry the remains of the dead back to the village if they died on the trap line or in a remote area. Thick spruce roots were also reportedly used for constructing fish traps, which were lashed together with cedar bark.

The fiber of spreading dogbane ***(c'indeklh)*** was spun and twined to make cord for rabbit snares.

Wood for carving and construction.—Spruce was formerly one of the most important woods for construction, in part because of its widespread availability. Spruce poles were used for construction of winter lodges, "A" frame buildings about 2.5 m high (Morice 1893), cabins, and caches. In the area around the summer villages of Moricetown (Kyah Wiget) and Hagwilget (Ts'e Kya), red cedar was used for construction and for totem pole carving. Red cedar can be readily split along the grain to produce durable and rot-resistant planks, which were used in the construction of feast houses. Cedar poles were used to frame these large and imposing buildings.

Cedar wood, ***simggin,*** was also used for making bentwood boxes for storing food and goods, and for cradles. According to one elder, aspen wood ***(t'ighis tsiz)*** was used also for bentwood boxes and plates.

Spruce poles are preferred for salmon gaff poles at Moricetown Falls. The gaff pole consists of a large hook is lashed to the end of a long pole and secured with a leather strap. The fisherman holds the gaff pole down in the current and jerks sharply upward when he feels a fish. If a fish is caught on the hook, the fisherman hauls the pole out of the water and removes the fish. Young trees, 5–6 cm in diameter and some 9 m long, are used. Spruce gaff poles will last three to four years. Cedar and subalpine fir are too brittle for this use, and they float up rather than stay down in the current. Hemlock saplings are too heavy for this use.

The most important use for maple, ***'ayh,*** was for snowshoes. The word ***'ayh*** means both maple and snowshoe. Maple wood is hard and strong, but heavy. Apparently ice skates were also fashioned from maple in the recent past. Maple was also sometimes used for other household implements where durability and hardness were desired, such as for tumpline looms.

Both spruce and pine were also employed for snowshoe construction. Maple does not extend into higher elevations or more interior sites and so is not available in many traditional trapping areas. Showshoes made of woods other than maple wore out much faster, lasting only a single season. Although pine wood is not very strong, it was much lighter than maple, and some considered its tendency to "fuzz" when exposed to wear to be a positive characteristic: it made pine snowshoes somewhat less likely to slip. Willow wood was also used for snowshoes. These were called ***k'ëltay 'ayh.***

Rocky Mountain juniper wood is very hard. It was formerly used to make a special knife for harvesting pine "cambium." Arrows were also made from it. The wood was boiled in grease for these uses to prevent its cracking. Juniper is limited to certain xeric, south facing slopes in the Bulkley Valley. A locality south of Telkwa was traditionally known for juniper.

Birch wood is used for carving masks, spoons, and soup bowls. Birch wood is also valued as firewood, as it is dense and has a high yield of heat energy per volume of wood.

Cottonwood was important for canoe construction. The word for cottonwood and canoe is the same, ***t s'iy.*** Canoes were traditionally dugouts constructed from cottonwood trunks. Similar canoes were made by the Gitksan and by the Carrier of Takla Lake. (The Gitksan word for cottonwood, although linguistically unrelated, means "good for canoe"). There is some evidence that the Wet'suwet'en may also have built birchbark canoes, and spruce bark canoes were apparently constructed as an emergency measure.

The different chemical properties of woods were appreciated for smoking, an important way of preserving foods and coloring and preserving hides. Cottonwood wood was used in hide smoking to give hides a very pale color. Rotted spruce wood gives a brown color to hides. Pine cones ***(dikhlengwil)*** are also used to give moosehide a brown color.

Rotten aspen wood that is lying on the ground is used for smoking beaver meat, and aspen is the preferred wood for smoking salmon. Cottonwood was also used for smoking fish and meat. Weathered driftwood could be used for the smokehouse if needed. The wood of resinous conifers was avoided for smoking foods.

Boughs and withes.—Spruce boughs, ***ts'o 'il,*** were used as thatch over the pole roof of winter lodges or small cabins. Spruce boughs can be used for bedding when camping.

The branches of red osier dogwood, ***k'ëntsec,*** are very flexible. Red osier dogwood branches were used for the frames of temporary sweat huts. Larger branches were joined to form a circular frame for stretching beaver hides. Thin, smaller branches are used to form the rim of birchbark baskets.

Moss.—"Diaper moss" is called ***yin yil*** or ***yintl'akh yil,*** "moss," or "white moss." A long, pale sphagnum moss was gathered from bogs and dried in trees or bushes. The preferred kind is about 18"–20" long. Feathermoss from hemlock stands (species such as *Hylacomium splendens* or *Rhytidiadelphis* spp.) could also be used. It was used for diapers and to absorb menstrual flow. Sufficient moss to last the winter was gathered and dried in late summer. Urine-soaked moss could be washed and reused, but moss soiled by feces or menstrual blood was considered unclean and discarded. Moss was also used to chink log cabins.

Leaves.—Leaves of several large-leaved species were used to provide clean surfaces in food processing. Skunk cabbage leaves, ***c'it'anco*** *(Lysichitum americanum),* were used to line the wooden rack used for making berry cakes. Thimbleberry leaves were also used for this purpose. Lady fern and spiny wood fern fronds were gathered to lay salmon on for curing before the fish were cleaned and cut up for drying. The fish were covered with a second layer of fern fronds. Now fish are often stored for a day in tubs of cold water, but they may still be laid on fern fronds for a while after being caught.

Tinder.—Before matches were introduced, "black tree moss," ***dikhghe*** (*Alectoria* spp. or *Bryoria* spp.), was used as tinder for starting fires with a spark made by striking rocks together. Alternatively, fire could be carried with a slow match made of a thick, tightly twisted cedarbark rope. In an oral history, a young woman who was being abandoned was secretly left a glowing ember of cinder conk (Gottesfeld 1992b), documenting a third type of tinder or slow match traditionally used by the Wet'suwet'en.

Miscellaneous plant uses.—The ash from aspen wood ***(t'ighis tsiz)*** was used as a soap. Alder bark, ***k'is,*** was used as a red dye for birch bark baskets.

DISCUSSION

As might be anticipated for people living in a heavily forested, northern environment, many of the plants used by the Wet'suwet'en are forest trees and shrubs. Important medicines and foods, as well as plants used for technology and material culture, are derived from the stems of trees and large shrubs (Gottesfeld 1992a). Berries of many kinds, also largely derived from perennial shrubs, were the most important food plants. The fleshy roots of some perennial herbs were used, such as yellow pond lily and cow parsnip for medicines, and the fern rhizome ***diyi" n*** as a carbohydrate source. Mosses and lichens were used for diapers and tinder, but not for food or medicine within living memory. They may have been used for dye in the past. Fungi, with the exception of the cinder conk, were all lumped under one term, ***c'ebedzik.*** The only reported use of fungi was use of an unidentified woody polypore for cosmetics, and of cinder conk or "black birch burl" for medicinal purposes and as a slow match (Gottesfeld 1992b). None of the many mushrooms in the region were utilized for food.

Wet'suwet'en plant uses reflect the availability of different plants in the transitional environment occupied by the Wet'suwet'en. Like the Gitksan to the north and west, the Wet'suwet'en made use of western red cedar, available in the northwestern part of their territory, for constructing plank long houses, totem poles, and wooden storage boxes, and of cedar bark for cordage. In the interior parts of their territories, spruce poles and bark or branches were used for construction. Birchbark baskets, used across boreal North America, were more characteristic of Wet'suwet'en households that the bentwood cedar boxes ubiquitous on the North coast. Willow bark and sinew or rawhide, more widely available in Wet'suwet'en country than cedar, were the most important cordage materials. Hemlock "cambium," though less important in Wet'suwet'en diet than in that of coastal peoples, was relished and gathered in the northwestern part of the Wet'suwet'en territories, or obtained in trade from their neighbors. Pine "cambium," readily available throughout Wet'suwet'en lands, was a more typical cambium food than hemlock. Similarly, Douglas maple, used by the Gitksan for snowshoes, was used by the Wet'suwet'en where available in the northwestern area, but spruce or pine were used where maple was unavailable.

Cultural concepts involving health, healing, and the spiritual world are shared by the Wet'suwet'en and neighboring groups. Two important concepts shared with the Gitksan include purification and "getting lucky." As hunting and gathering peoples, both the Gitksan and the Wet'suwet'en were dependent on success in hunting for an important part of their food supply. Hides and meat also brought prestige and paid debts when given away at potlatches. Preoccupation with hunting success led both groups to ensure the luck of the hunter by spiritual means. Plants such as devil's club, Indian hellebore, and ***hadik***[5] were used by both in rituals to purify hunters, their equipment, and their families, and to promote good fortune (Gottesfeld and Anderson 1988; Jenness 1943). These practices, generally very private, continue at the present time in both groups in more traditional families. A larger number of people are aware that these plants "bring luck."

Many of the medicinal plants utilized by the Wet'suwet'en were used in similar ways by the Gitksan, which is not surprising due to the long period of exchange and interaction between these cultures and the similarities in the environments they occupy. However, certain plants were used more frequently among the Wet'suwet'en than the Gitksan. For example, the Wet'suwet'en made extensive use of black twinberry, mountain ash, and red-osier dogwood.

A number of medicinal plants used by the Wet'suwet'en were also used by the Central Carrier (Carrier Linguistic Committee 1973). Medicinal use of spruce and fir inner bark and pitch, pine tips, red-osier inner bark, devil's club inner bark, mountain ash bark, soapberry stem bark, scouring rush, juniper, wild rose, and Indian hellebore were shared with the Central Carrier. Plants such as spruce, subalpine fir, Indian hellebore, and devil's club are found over much of northern B.C. and were used medicinally by all peoples of the region (Turner 1982).

The long association of the Wet'suwet'en with the Gitksan in the Hazelton area led to considerable cultural diffusion and some linguistic borrowing. Although for most plants the names in Wet'suwet'en, an Athapaskan language, and Gitksan, a Tsimshian language, bear no resemblance to one another, some significant plant names are shared. Words for fireweed, yellow pond lily, cedar, cedar bark, pine cambium, cranberry, wild cherry, and spreading dogbane are among the shared plant words. Some were evidently Gitksan in origin. These include the names for red cedar and cedar bark, spreading dogbane, fireweed, and possibly pine cambium.

SUMMARY AND CONCLUSIONS

The Wet'suwet'en are transitional both in territory and way of life. Their lands span the transition between the coastal rainforests and the interior spruce forests. Their social structure, belief system, and way of life show the twin influences of their nomadic hunting Athapaskan ancestors of the boreal regions and the more sedentary fishing and gathering cultures of the Northwest Coast. Plant names and uses reflect interaction with both the coastal Gitksan and the interior Carriers. Gitksan-derived plant terms are loanwords across a major linguistic boundary, suggesting a long history of contact (Rigsby and Kari 1987).

The present study documents the names and uses of 59 species of vascular plants and three nonvascular taxa by the Wet'suwet'en in the historic period. Most plants used are plants of forest or woodland; many are woody perennials or trees. Despite the traditional reliance of Athapaskan-speaking hunting peoples on animal products, a diverse array of plant species was used for food, medicine, and technology by the Wet'suwet'en. Modern Wet'suwet'en continue to collect various medicinal barks and roots, especially devil's club, spruce, subalpine-fir, and mountain ash barks and Indian hellebore rhizomes. Berry picking is still a significant activity, and wild berries are highly regarded. Carving and birchbark basket making are modern craft activities that reinforce Native identity and help to provide an economic base for the community through sale to tourists, collectors, and the local population.

NOTES

[1]The following Wet'suwet'en people generously shared their time and knowledge: Edna Alfred, the late Madeline Alfred, Katherine Arsenault, Charles Austin, Margaret Austin, the late Mary Ann Austin, Mabel Forsythe, Adam Gagnon, Andrew George, Leonard George, Joe George, Florence Hall, Alfred Joseph, Cecilia Lapalme, Bazil Michell, Caroline Michell, Doris Michell, Josephine Michell, the late Alfred Mitchell, Charlotte Mitchell,

Jenny Mitchell, Roy Morris, Lizette Naziel, Pat Namox, Lucy Namox, Elsie Tait, Sara Tait, Tommy Tait, Christina William, and Margaret Williams.

[2]Voucher specimens of important ethnobotanical species are on deposit in the ethnobotany collection of the herbarium at the Royal British Columbia Museum (V) in Victoria, British Columbia, Canada.

[3]Spellings of Wet'suwet'en words by Sharon Hargus, using the modified Hildebrandt system (informal name), were provided in 1989.

[4]Spellings of Gitksan words is after Gottesfeld and Anderson (1988).

[5]***Hadik*** is the name of an unknown plant used for ritual and medicinal purposes by both the Gitksan and Wet'suwet'en. It may be a clubmoss (most likely *Huperzia selago*), but efforts to identify the plant positively have been unsuccessful to date.

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TRADITIONAL ARROWROOT PRODUCTION AND UTILIZATION IN THE MARSHALL ISLANDS

DIRK H. R. SPENNEMANN
Johnstone Centre of Parks, Recreation, and Heritage
Charles Sturt University
P. O. Box 789
Albury, NSW 2640
Australia

ABSTRACT.—This paper examines the traditional and modern role of Polynesian arrowroot *(Tacca leontopetaloides)* in the subsistence and market economy of the Republic of the Marshall Islands, a group of atolls in the central equatorial Pacific Ocean. The plant is discussed in its biological and nutritional parameters. Aspects of traditional arrowroot production, starch extraction, and food preparation are examined. In the final section the potential role of the root crop in modern Marshallese society is discussed.

RESUMEN.—Este trabajo examina el papel tradicional y moderno de *Tacca leontopetaloides* en la economía de subsistencia y de mercado en la República de las Islas Marshall, un grupo de islas coralinas en el Océano Pacífico ecuatorial central. Se discuten los parámetros biológicos y nutricionales de esta planta, y se examinan los aspectos de la producción tradicional, la extracción de almidón y la preparación como alimento. En la sección final se discute el papel potencial de este cultivo en la sociedad moderna de las Islas Marshall.

RÉSUMÉ.—Nous examinons les rôles traditionels et modernes de l'arrowroot Polynésien *(Tacca leontopetaloides)* dans la subsistance et l'économie de la République des Ilsles Marshalles, un groupe d'attolls de l'Océan Pacifique Equatorial Central. Les paramètres biologiques et nutritifs de cette plante sont considérés. Nous examinons différents aspects de production traditionelle d'arrowroot, ainsi que l'extraction de la fécule et la préparation des aliments. Enfin, nous discutons le rôle potentiel que cette plante économique joue dans la société Marshalle moderne.

INTRODUCTION

The Republic of the Marshall Islands is currently undergoing dramatic social and cultural changes. Having been released in 1991 from the trusteeship of the United States of America and accepted as a full member of the United Nations, the young nation strides along the path of modern development. The former subsistence economy, or the remnant thereof that survived the past 40 years of consumer-oriented influences, is waning and imported foods are becoming more prominent. In the course of this change several traditional subsistence items have almost disappeared or are likely to do so in the near future. One of these is Polynesian arrowroot (*Tacca leontopetaloides,* Taccaceae). This paper reviews knowledge on arrowroot production and utilization. It examines the traditional (pre-1900) and pre-World War II production of Polynesian arrowroot, the role it plays in traditional Marshallese horticulture, and planting and harvesting procedures. A discussion of starch extraction techniques is also provided. Pre-World War II food and nonfood uses of arrowroot are presented along with the present-day utilization of the plant and its potential as a source of carbohydrates in the future.

Data for this study were compiled from ethnographic and historic sources covering the period from the beginning of intensified Western contact with the Marshall Islands until today, interviews with Marshallese from various atolls, and my own studies of plant distribution and plant status.

Geographical background.—The Marshall Islands comprise 29 atolls and five islands and are located in the northwest equatorial Pacific, about 3,790 km west of Honolulu, 2,700 km north of Fiji, and 1,500 km east of Pohnpei (Ponape) (Fig. 1).[1] The atolls of the Marshall Islands, numbering well over 1,200 islands and islets, are scattered in an ocean area of over 1.1 million km^2. The total combined land area of the atolls is only 115 km^2. With the exception of the two northwestern atolls, Enewetak and Ujelang, the Marshall Islands are arranged in two island chains, the western Ralik Chain and the eastern Ratak Chain, which run roughly NNW to SSE (Fig. 1). Atolls range from very small, less than 3.5 km^2 (Nadikdik [Knox]) to very large (Kwajalein, the world's largest lagoon [2,173 km^2 lagoonal area]). The more or less ring-like reef platforms of the atolls support narrow sand cays, very few of which are larger than 2 km^2. Traditionally (i.e., without importation of food from outside the Marshall Islands), atolls of the southern Marshalls had a higher carrying capacity than the northern ones, a distribution which coincided with precipitation (Williamson and Sabath 1982).

The plant.—The family Taccaceae consists of only one living genus, *Tacca*, which includes several species. In the Marshall Islands only one species, *Tacca leontopetaloides* (L.) Kuntze, occurs.[2] Polynesian arrowroot is a large perennial terrestrial herb that grows as a volunteer plant on every inhabited island in Micronesia (Fig. 2).

The Marshallese distinguish between a "male" and a "female" arrowroot plant, although this is not a botanical distinction. Morphologically, male and female plants can be distinguished by their flowering stalks and leaves. The leaves of the male plant are less deeply serrated, somewhat darker in coloring, and have a coarser surface than those of the female. The female arrowroot is known to bear more and especially larger tubers, with the result that these plants are preferred for harvesting over their male counterparts.

Two varieties of *Tacca leontopetaloides* have been reported from atolls in Micronesia (Sproat 1968:64). On Mile Atoll I observed four varieties or subvarieties recognized by the Marshallese, albeit not separately named. Three varieties have green stems and stalks, while one possesses violet-purple leaf stalks. Tubers of the purple-stemmed variety have a brown skin and a yellow to white interior. Of the three green-stalked varieties, one produces a single large tuber and two produce more than one tuber. One of the latter varieties has purple-red flesh, the other

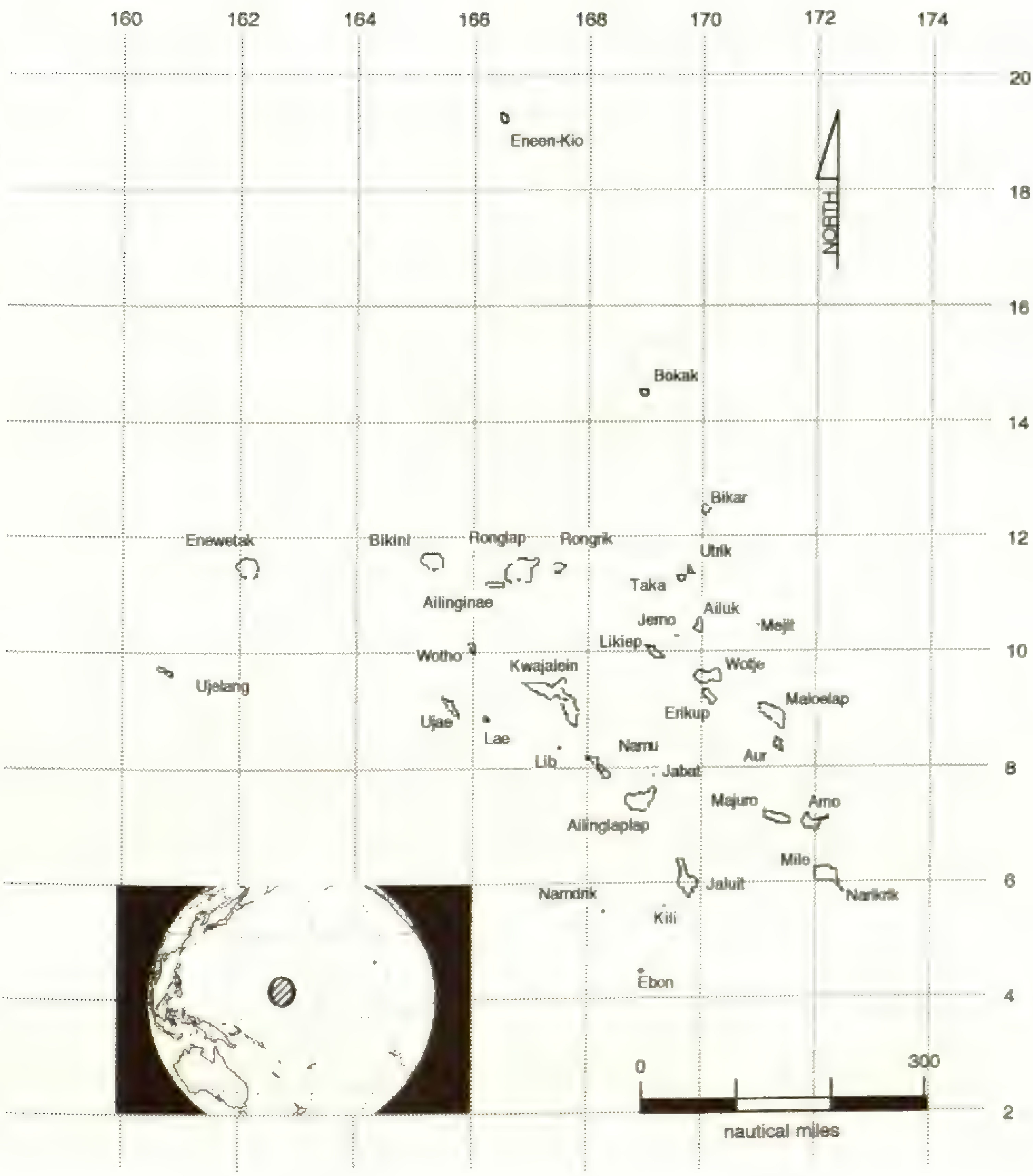

FIG. 1.—Map of the Marshall Islands.

FIG. 2.—Arrowroot (*Tacca leontopetaloides* L. Kuntze) (after Lisowksi et al. 1976).

TABLE 1.—Nutritional value of arrowroot flour (per 100 g edible portion).

Water	12.1	%
Calories	346	
Protein	0.18	g
Fat	0.05	g
Carbohydrate (Total)	85.74	g
Carbohydrate (Fibre)	0.0	
Ash	1.89	g
Calcium	58.0	mg
Phosphorus	7.2	mg
Iron	0.55	mg
Riboflavin	0.0	
Niacin	0.0	

Source: Murai et al. 1958:104.

yellow-white flesh. According to an informant, the purple variety was introduced from Pohnpei by the Japanese sometime in the 1930s.

Tacca thrives well in areas protected from salt-spray that are only slightly shaded and well drained. Such conditions are found in breadfruit and coconut groves without substantial understory, for example (Stone 1951:24).

Arrowroot starch is the richest natural starch (Murai et al. 1958; Wohltmann 1905). Starch content of tubers varies according to growing conditions and soil substrate. It ranges from 10% to 25% of tuber weight (Table 1).

Distribution of arrowroot.—Tacca leontopetaloides is a pan-Pacific cultigen that is believed to have originated in Southeast Asia (Herklots 1972:473; Purseglove 1972:517). Its distribution includes Africa, the Indian subcontinent including Sri Lanka, islands in the Indian Ocean, and Australia (Brown 1954:383–384; Fosberg 1957:15; Lisowki et al. 1976; Masefield 1948:45). The plant is believed to be of aboriginal (Austronesian) introduction into Oceania as a whole, and to all inhabited islands groups in particular (Kirch 1979:290; Doty 1973:12; Fosberg 1990:24; Spennemann 1991). Once established, arrowroot readily self-propagates.

In the region surrounding the Marshall Islands arrowroot has been reported from the following areas: Kiribati, Tuvalu, Pohnpei, Kosrae, Eastern Carolines (outer islands of Pohnpei), Yap, Western Carolines (outer islands of Yap), Chuuk, Mortlock Islands (outer islands of Chuuk), Belau, southwestern Carolines (outer islands of Belau), atolls north of Belau, Guam, and the northern Marianas (for details on distribution see Spennemann 1991). Arrowroot distribution in the western Pacific is illustrated in part in Fig. 3.

Apart from coconut (*Cocos nucifera* L.) and screwpine (*Pandanus tectorius* L.) arrowroot is the most widely distributed cultivar in the Marshall Islands. Arrowroot is absent only from Wake (Eneen-Kio), Bokak (Taongi), Bikar, and Lib (Fosberg 1990; personal observation). The absence of arrowroot on Lib is somewhat doubtful, given the fact that no adequate botanical research has been conducted on that island. Its absence on the northern three atolls is likely, however, since these atolls lack reliable rainfall and are not utilized on a regular basis.

FIG. 3.—Distribution of *Tacca leontopetaloides* in Micronesia and the western Pacific. Distribution in Melanesia is greater than shown.

TRADITIONAL PRODUCTION OF ARROWROOT

A number of plant species were utilized in traditional Marshallese horticulture. Among these are giant taro (*Alocasia maccrorhiza* L.), swamp taro (*Cyrtosperma chamissionis* Schott), breadfruit (*Artocarpus altilis* Parkinson and *A. mariannensis* Trec.), *ti*-root (*Cordyline fruticosa* L.) coconut, banana (*Musa sapientum* L.), spider lily (*Crinum bakeri* K. Schum.), and *Pandanus*. All were most likely introduced by the Marshallese, either at the initial settlement of the region or in later times of contact. In addition, the following pan-Pacific cultivars introduced by Europeans in the last century are today found in the Marshall Islands: *Dioscorea alata* L. (yam); *D. bulbifera* L. (bitter yam); *Ipomoea batatas* (sweet potato); *Carica papaya* L. (papaya) (Erdland 1906, 1914; Fosberg 1990; Hager 1886; Hathaway 1953; Hernsheim 1887; Krämer 1906; Krämer and Nevermann 1938; Wendler 1911).

The main food plants at the turn of the twentieth century were taro, breadfruit, and *Pandanus*, while arrowroot, *ti*-root, spider lily, and other plants, such as *Triumfetta procumbens* Forst. and *Wedelia (Wollastonia) biflora* L., were famine foods (Anonymous 1895; Stone 1951:25). There is some seasonality in the food supply because of rainfall. Seasonal resources include breadfruit, *Pandanus*, and, to a lesser extent, arrowroot. In assessing the horticulture of the Marshall Islands as a whole, Krämer (1906:420) gives arrowroot the status of the second most important food after *Pandanus*. This assessment is largely based on the geographical distribution, and thus the availability, of the plant throughout the Marshalls.

To evaluate the contemporary relative importance of arrowroot in Micronesia, I analyzed the frequency of occurrence of words relating to arrowroot in dictionaries for Micronesian and northwestern Polynesian languages. Table 2 shows the overall importance that contemporary peoples (here considered as post-World War II) in greater Micronesia attach to arrowroot. The Marshallese

TABLE 2.—Comparison of arrowroot terms in modern dictionaries in Micronesia and northwestern Polynesia.

Language	Plant	Terms for Food	Use	Total terms	Total entries[1]	Index[2] (‰)	Rank
Marshallese	**3**	**4**	**10**	**17**	**8,500**	**2.00**	**1**
Tuvaluan	3	–	–	3	4,000	0.75	2
Chamorro	2	–	–	2	8,400	0.23	3
Mokilese	1	–	–	1	4,500	0.22	4
Kiribati	1	–	–	1	5,000	0.20	5
Yapese	1	–	–	1	5,000	0.20	5
Kapinga	1	–	–	1	6,000	0.17	7
Palauan	1	1	–	2	12,000	0.17	7
Woleaian	1	–	–	1	6,200	0.16	9
Pohnpeian	1	–	–	1	6,750	0.15	10
Kosraean	1	–	–	1	7,650	0.13	11
Nukuoro	1	–	–	1	14,500	0.07	12

[1] The number of entries in a dictionary was computed by multiplying the total number of pages with the average entry count derived from a count of five sample pages.
[2] The index has been computed as follows: number of entries under arrowroot X 1000 / number of local language words contained in the dictionary. That this is valid measure becomes evident if one compares the representation of other food plants or names for fish in the dictionaries. See for example, the names for yams in Pohnpeian (87 entries in the English section; Rehg and Sohl 1979:253).

have by far the greatest number of words for arrowroot and its uses as well as the greatest range of terms in their vocabulary. This finding serves to support older ethnographic observations that arrowroot was only really important as a food crop in the Marshall Islands (Wendler 1911).

Arrowroot was a welcomed addition to the other cultivated plants of the Marshall Islands, especially since it did not compete with taro or breadfruit for prime gardening space. In the traditional way of setting out land, a household would own a land allotment *(wato)* running from the lagoonal to the ocean shore, thus having access to a variety of resources and vegetation zones. The vegetation on the ocean-side commonly consisted of a mixed littoral forest growing on a boulder ridge and on gravelly land. Inland, the soil gradually becomes finer, and humus content increases. An abundance of breadfruit trees are planted in this zone. In the very center of the island, where the underlying ground water lens (Ghyben-Herzberg lens) is the thickest, artificial depressions in the ground allow the cultivation of swamp taro (Krämer and Nevermann 1938; Spennemann 1991). Towards the lagoonal shore vegetation zonation is again breadfruit trees giving way to utility and ornamental shrubs along the rear side of the household units. House sites and yards are located along a sand-covered road or track running parallel to the lagoon shore. Coconut palms are distributed only along the immediate lagoon area, such as the zone of the houses and their backyards. Uninhabited and uncleared stretches of lagoon shore are covered by coconut scrubland with an abundance of *Scaevola taccada* Vahl and *Tournefortia argentea* L. shrubs.

The typical arrowroot planting zone was located between the houses and the

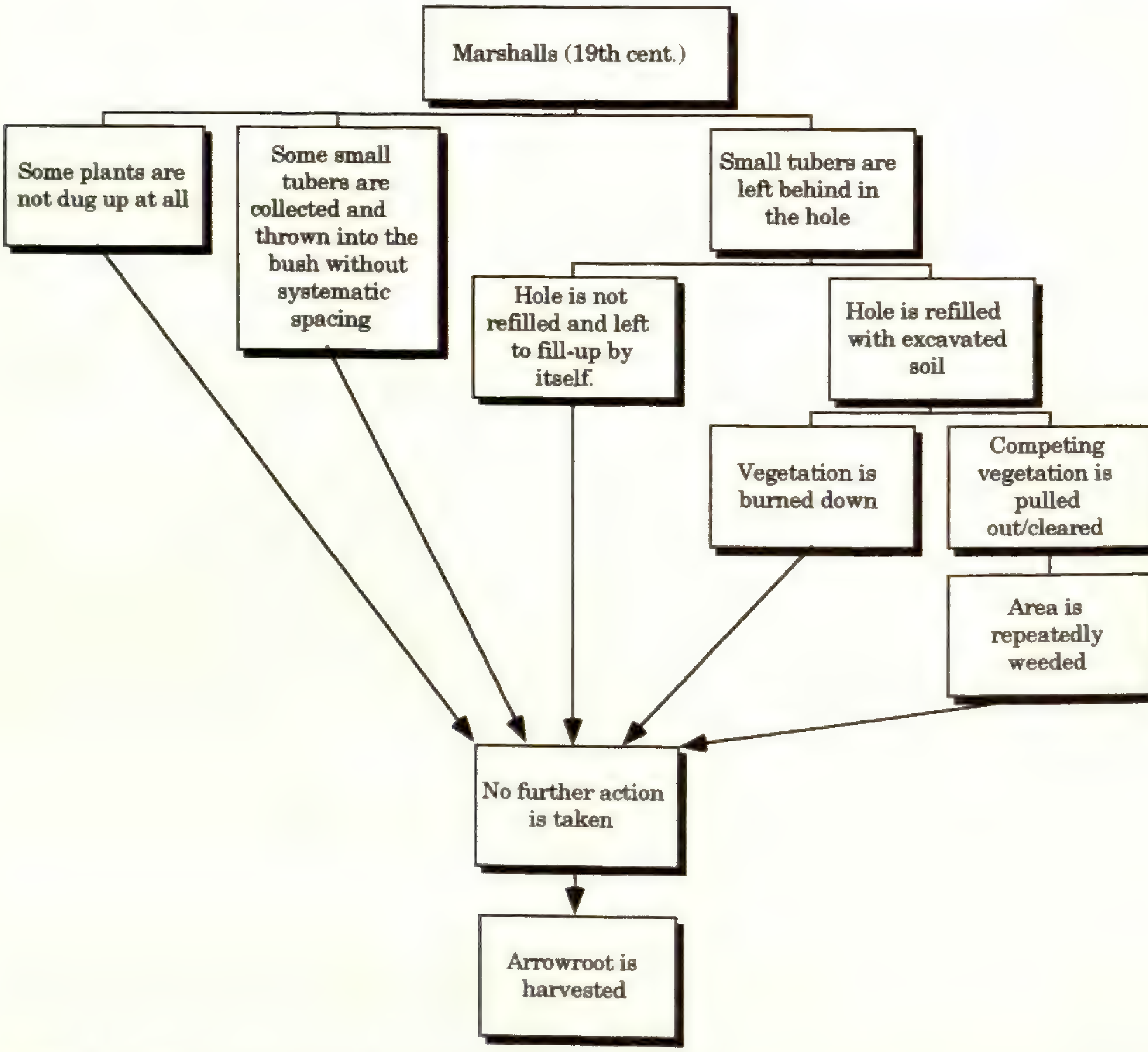

FIG. 4.—Organizational flowchart of traditional (nineteenth century) arrowroot horticulture in the Marshall Islands.

lagoon, as well as between the houses and the onset of the breadfruit forest. Arrowroot could also be grown on the smaller islands of an atoll where breadfruit would not thrive because of the absence of a (reliable) fresh water lens, and where permanent human habitation would have been impossible.

Because the influence of European economy on Marshallese agroforestry led to the systematic replacement of breadfruit forests by coconut plantations for copra production, the habitat for arrowroot has changed. When island centers were cleared of breadfruit to make way for wide-spaced copra plantations, an ideal, semi-shaded habitat for *Tacca* was produced in areas where soils were not too humid. Thus *Tacca*, a plant preferring open spaces traditionally only found in the nearshore areas, came to be an inland plant as well.

Arrowroot planting and tending.—At the beginning of the planting cycle, the tuber crop from the previous year was harvested (Fig. 4). Only the large tubers of "female" plants were taken; small tubers, as well as tubers of "male" plants, were not. Small tubers, even if numerous, were not dug up or were thrown back into the hole. These were called *lep in mãkmõk* or "eggs of arrowroot" (Erdland 1914:38; Wendler 1911) since they acted as seedlings for next year's crop. The harvesting hole was then commonly refilled with loose soil (Hiyane 1967), although there are some reports that the hole was left to be filled in naturally (Kiste 1968:37; Taylor 1950:17). Apparently no systematic, spaced planting of small tubers occurred in the Marshall Islands.

More attention to arrowroot tending was given in areas surrounding the Marshall Islands, which is surprising in view of its relatively low importance in these areas. In Chuuk, for example, arrowroot was intentionally planted at new moon or full moon. Land was carefully cleared before planting and the cleared weeds collected in a pile and burnt. One or two small tubers less than 25 mm in diameter were placed in a small hole, on average 50 mm deep. The hole was filled with loose soil. No fertilizer was used. Planting occurred in a rough grid, every plant spaced some 75 cm apart (Paul 1965). In Hawaii *Tacca* was either left to grow "wild" or was intentionally planted along the ridges of taro patches (Handy 1940:299). On Namoluk Atoll, Western Carolines, *Tacca* had been "partially cultivated," and "now grows wild in relatively open coconut groves near the beach" (Marshall and Fosberg 1975:31).

Informants I interviewed mentioned that Marshallese children are sometimes asked to spread out small tubers in the bush if an abundance of small ones were recovered from a bunch. *Tacca* can also be propagated by seeds, but this was apparently never practiced in traditional Marshallese horticulture. This is in keeping with the pan-Pacific horticultural tradition, in which tuber- or shoot-propagated plants dominate, while seed-propagated plants are almost absent. One of the reasons advanced by my informants for the decline of *Tacca* in the Marshalls was the fact that children no longer use the leaf stalks as spears. It is possible that childrens' play added to the dissemination of *Tacca* seeds.

Since *Tacca* plants tend to spread like weeds, no care needs to be taken to prepare a planting bed or to provide mulch or fertilizer. According to Wendler (1911), it is not possible to make out where the previous year's arrowroot harvest was obtained. However, he noted that the arrowroot area was weeded regularly, and competing vegetation pulled out. *Tacca* was "spared when other vegetation was slashed in the [coconut] groves, and it clearly benefit[ted] from this weeding" (Stone 1951:24; see also Sproat 1968:66). Polynesian arrowroot is a very hardy plant that can withstand droughts relatively well. In case of a severe drought, the top leafy part of the plant may die off, but the tubers survive and send up new shoots with the return of moisture (Soucie 1983:197).

Since the end of the nineteenth and beginning of the twentieth centuries, when coconut plantations became more common, arrowroot has been "traditionally" grown in coconut groves, often intercropped with papaya, banana, breadfruit, and *Pandanus*. Mixed stands of coconut, *Tacca*, and wild vegetation are very common, especially on the smaller, not generally inhabited islands of atolls.

Burning the underbrush seems to be a new *Tacca* horticultural practice, possibly introduced as late as the post-World War II period (Fig. 5). Burning damages coconut palms and breadfruit trees (Hiyane 1967), but, more thoroughly than any weeding can achieve, destroys the shallow roots of competing plants, leaving the

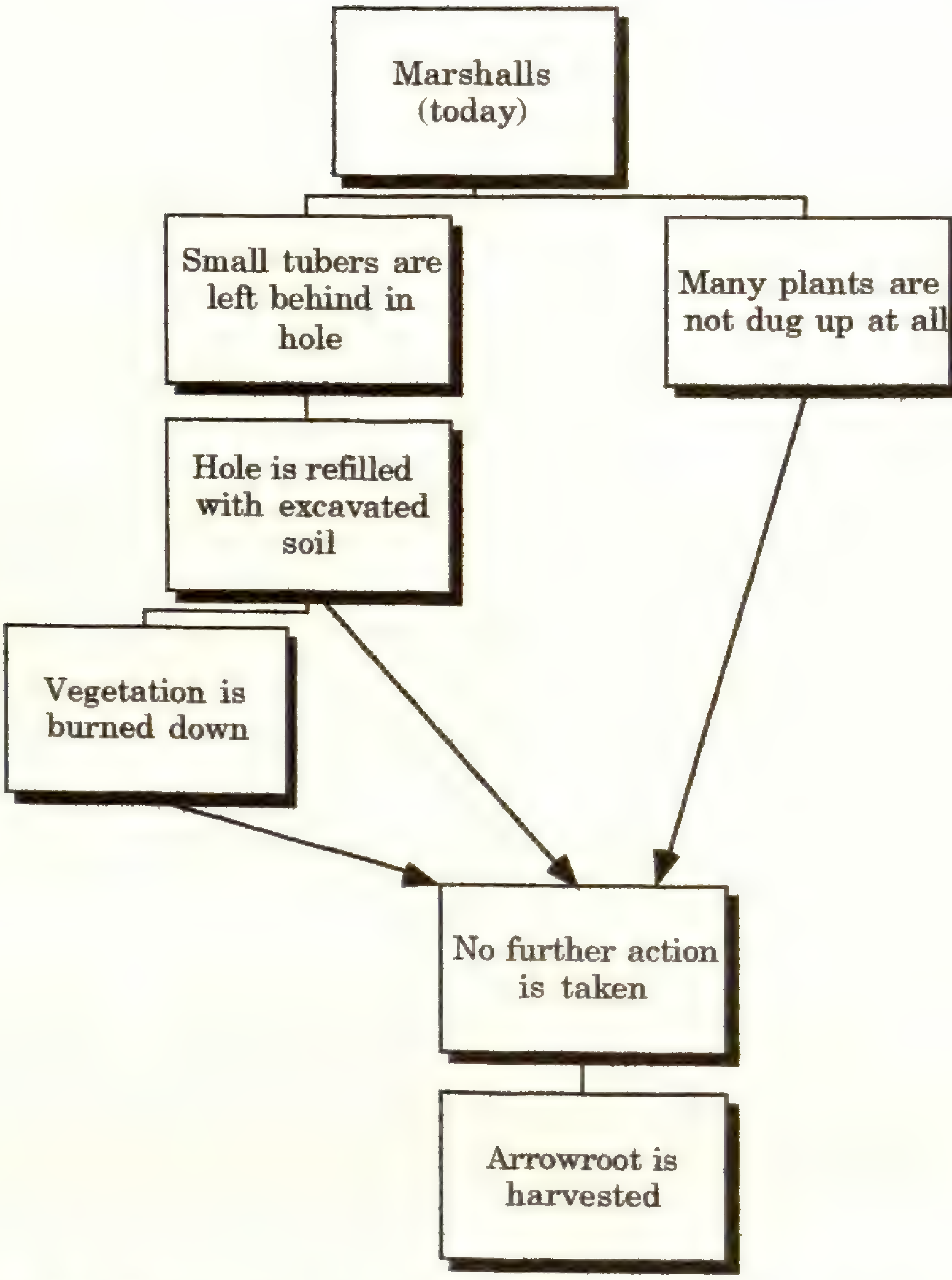

FIG. 5.—Organizational flowchart of modern arrowroot horticulture in the Marshall Islands.

deeper resting tubers of the arrowroot intact. Thus arrowroot can regrow without any competition. Sproat (1968), conducting research on local subsistence agriculture in Micronesia, notes that "in the atolls of the Marshall islands arrowroot is considered as a 'volunteer', subsistence crop, which is allowed to grow under coconuts, breadfruit, and *Pandanus* trees. It grows with other plants such as banana and papaya. Often times large areas of underbrush are burnt out under the coconut groves in the dry season. The bush plants are killed and the *Tacca* plants immediately re-sprout and predominate" (Sproat 1968:64–66).

Harvesting.—By the time the arrowroot plant matures, its leaves have turned yellow and the plant dies back. This commonly occurs between the end of

November and the beginning of December in the northern atolls, and between January and February in the southern (Poyer 1990; Spennemann 1991). These changes indicate it is time to harvest the crop.

The Marshallese I interviewed could easily decide which plants would bear many tubers, for every leaf stem corresponds to one root, and at the end of each root is a tuber. In times of relative affluence, only "female" plants are dug up, while "male" plants and plants located on stony ground are spared. The digging up of the tubers traditionally was done with sharpened sticks *(kübwij)* (Abo et al. 1976:170). Since the turn of the twentieth century, spades, shovels, crowbars, and pick axes have become the sole means for excavation, both in soft sands and in gravelly and rubble ground. Before 1900 the collected tubers were placed in a flat coconut leaf basket with two handles *(banonoor)* for transport to the processing site (Abo et al. 1976; Krämer 1906; Krämer and Nevermann 1938; Wendler 1911), while today a discarded sugar bag ("copra-bag") suffices.

EXTRACTION OF STARCH

Traditionally (i.e., pre-World War II) there were a number of slightly different techniques to make starch (described in Krämer 1906:428–429; Krämer and Nevermann 1938:110; Mural et al. 1958:102; Wendler 1911). Extraction techniques have varied over time, especially as modern appliances have become available. However, the extraction of starch always followed the same general principles (Fig. 6). This description follows Wendler (1911) with additions from other sources (Abo et al. 1976; Curtis 1986; Erdland 1906, 1914; Feeney 1952; Fosberg 1990; Grosser 1902; Hiyane 1967; Krämer 1905, 1906; Krämer and Nevermann 1938).

The collected arrowroot tubers are brought to the processing site and poured into a wide-meshed sack made of plaited coconut (sennit) that resembles a fishing net *(mädo, do)*. The sack is tied on the top with string and carried into the lagoon where the tubers are cleaned of earth and sand by pushing the sack around with the feet. After this cleaning process, the sack is pulled out of the water and carried to the location where the grating takes place. Every single tuber is grated with a rough but soft coral *(pukor)* until it is reduced to a reddish mass *(üne rup)* not dissimilar in consistency and appearance to grated potatoes. In modern times a grater made of a tin plate punched by many nail holes may substitute for the grating stone. In the Ralik Chain, the skin of the tuber is commonly removed after the washing and before the grating process, either with a paring knife or a shell, which results in a cleaner and whiter flour. Washed tubers were also grated with their skins intact in the Ratak Chain, however. The *üne rup* was traditionally collected in large leaves or on old mats *(goid in liklik)* and placed into the processing unit (see below). Today copra bags serve the same purpose.

The men who perform the task of processing arrowroot usually sit in a circle around a pit measuring 1–2 m in diameter and 50–70 cm deep (Fig. 7). The sides and bottom of the pit are lined with leaves or coconut fronds (today: copra bags). A large, strongly woven mat (today: copra bags sown together) is placed on top of these leaves, and its edges protrude a good distance over the edge of the pit. This mat serves as a trough for catching the strained arrowroot flour.

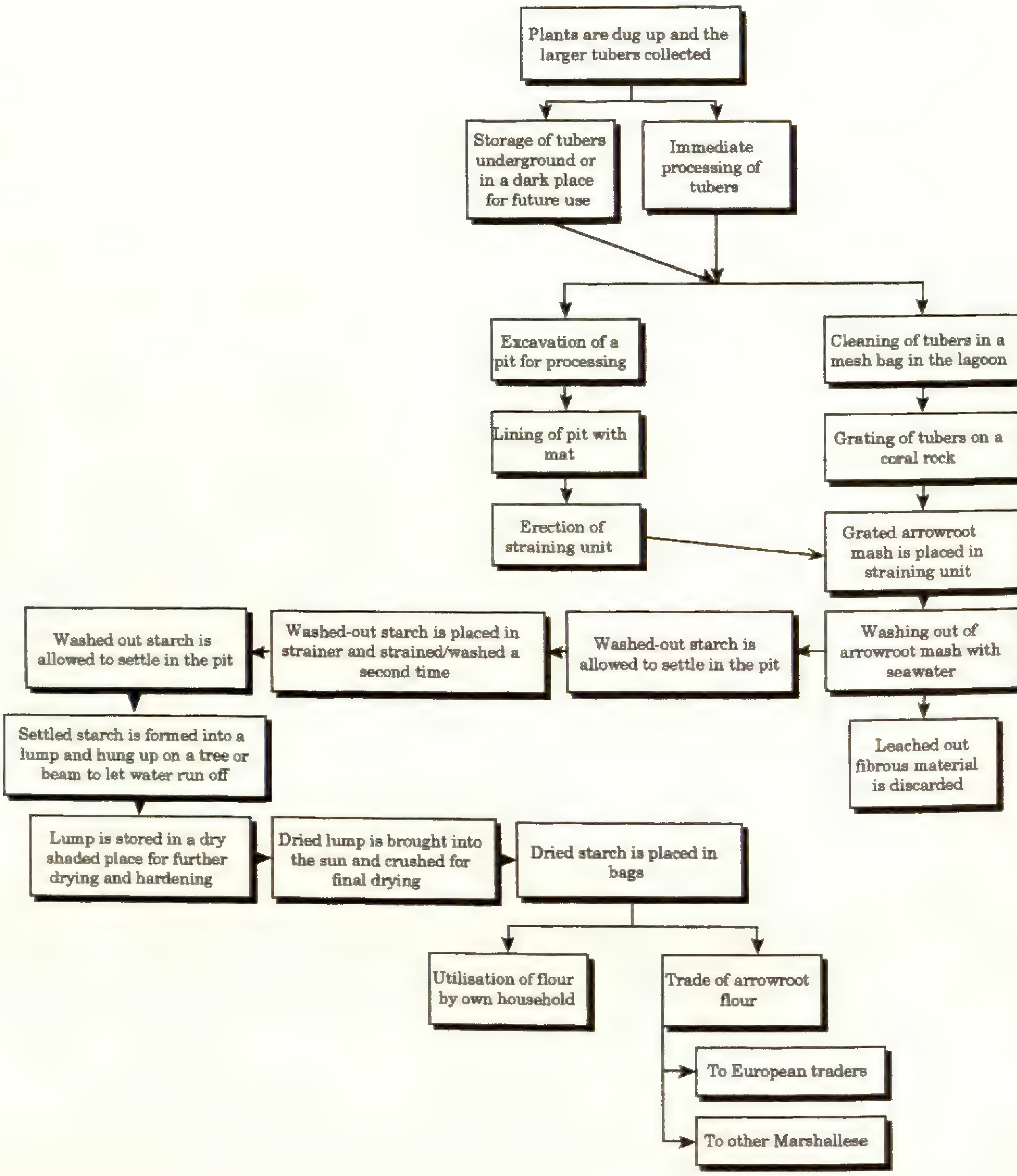

FIG. 6.—Processural flowchart showing the arrowroot preparation process.

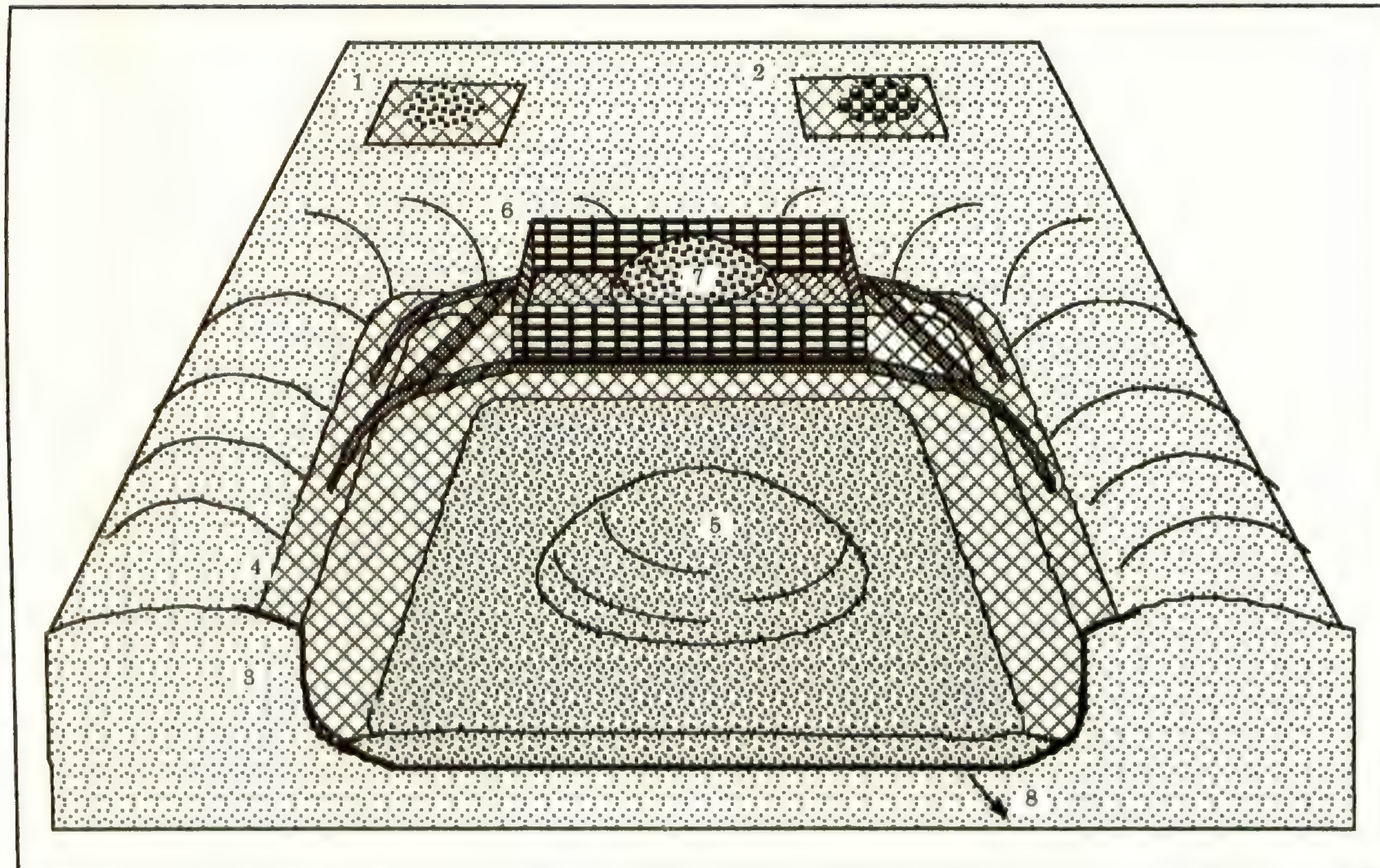

FIG. 7.—Schematic view of the arrowroot sifting process. (1) mat with ground arrowroot tubers; (2) mat with cleaned arrowroot tubers; (3) pit excavated into sand; (4) coarse mat used as lining of the pit, placed above a layer of coconut leaves (not shown); (5) heap of sifted arrowroot starch in the pit; (6) arrowroot strainer *(waliklik)*; (7) ground arrowroot ready for washing with sea water; (8) excess water dissipates into the ground.

Resting on the orifice of the pit and supported by four legs is a rectangular container woven from *Pandanus* roots or from young shoots of the mangrove *Bruguiera gymnorrhiza* L. In order to prevent any large pieces of the *üne rup* or any foreign material from falling into the mat, the coconut mesh is covered with a sticky flexible creeping root (*kil-in-kaönön;* species unknown). In more recent time this has been replaced by a wooden box *(waliklik)* that acts as a strainer, and whose lower part is open and only covered with a mesh made from coconut coir *(ekkwal).* An alternative setup dispenses with the need for a pit altogether and suspends the mat catching the water and washed-out starch on four sturdy stakes. This arrangement permits placing the entire sifting unit at the beach, within easy access to seawater.

The *üne rup* is then enclosed in a net-like wrapper of young coconut leaves (today: bed sheet) that acts as a filtering cloth. This is placed in the box and watered with seawater and continuously kneaded with the hands. While one man kneads, the other from time to time sprinkles the mass with seawater from a canoe bailer *(lem)* or tin can. The water runs off, carrying with it the dissolved arrowroot starch into the trough-like mat underneath. This mixture of water and arrowroot stays in the mat for one to two hours and the starch gradually settles to the bottom. Then water that has not yet escaped through the mat and leaves is skimmed off. The material left over from the kneading *(bwe)* has been leached of its starch content and is thrown away.

Two or three hours later the starch is sifted again in the same manner *(epta),* and if there is large amount of flour processed, even for a third time. Commonly, but apparently not as a rule, the last washing is with fresh water. During this pounding and leaching process, the arrowroot is said to loose its bitterness.

When all water is skimmed off or has dissipated, a small hole is excavated and lined with leaves. The starch lump wrapped in young coconut leaves is placed into the hole in which the excess water will run off *(likatöttöt).* Another way of getting the starch lump to dry is to scrape together the flour and hang it up in a wrapper made from a young coconut leaf (or bed sheet), thus allowing the water to run off and drip out of the starch *(bobo en Ujlan).* In order to expedite the process, some people beat the suspended starch ball with a stick, although most are satisfied to let gravity do the work. The latter is the preferred method in the rest of the Marshall Islands, especially in Likiep and Utirik. As soon as the water has dripped out, the hardened, rounded lump of arrowroot starch *(jibwil)* is placed in a shady place, usually a hut, so that it can dry and harden still more. After two or three days the *jibwil* is crushed on a mat and placed in the sun to dry further. This process, in which the flour is frequently turned and broken into grains, takes about two to four days.

The dry, snow-white flour is then wrapped in *Pandanus* leaves or stored in mat bags *(böjo).* It will last for well over a year. About seven baskets of unprocessed tubers result in one basket of processed, dried flour (Wendler 1911). Krämer (1905) also mentions that a thoroughly dried *jibwil* may be kept as such and not broken up. In this case the drying process creates an hourglass-shaped object from which arrowroot flour is broken off as needed.

Time expenditure.—The process of arrowroot starch production as outlined above is time consuming. I estimated time expenditure costs based on interviews with numerous Marshallese who had actively made arrowroot starch at one point in their lives. All time estimates are based on processing two copra bags of tubers estimated to hold a total of about 125 lb. of arrowroot tubers. This quantity is said to produce between 25 and 30 lb of pure starch. Harvesting tubers to fill two bags is said to have taken about two days. Over half a day is spent cleaning tubers in the lagoon and grating them into a mash. The first sifting usually occurs before the day is over, and the starch is allowed to settle overnight. The second and third sifting of the starch takes another day, after which the starch ball is suspended to dry. Over the next three days the predried starch ball is broken up and sun-dried.

Storage and trade of arrowroot.—There are two options for storing arrowroot. One is to store it in processed form, the other to store it unprocessed in a cool dark place, such as in pits along the beach. Unprocessed tubers can be stored for up to six months, after which they begin to sprout (Hiyane 1967; Stone 1951:24). Provided the processed starch is kept dry and away from weevils, ants, cockroaches, and the like, it will keep indefinitely, making it a suitable trade item (Kotzebue 1821: I126).

Trade in arrowroot starch in the Pacific developed at the end of the nineteenth century when European traders added it to their list of desirable trade items (Fiji: Safford 1905:380; Philippines: Brown 1954:383). Before World War I, a finely woven *Pandanus* bag was used to package arrowroot traded to Jaluit, the German trading port of the Marshall Islands (Hernsheim 1887; Krämer and Nevermann 1938:138). When starch became an export commodity to the European and Asian markets, it had to be prepared more carefully. This brought about changes in local production techniques. In the Philippines, for example, grating of arrowroot tubers was done underwater to prevent them from turning brown and discoloring the starch (Brown 1954:388). In Fiji a "grater of mushroom coral *(Fungia)* was used and the colour of the arrowroot was grey since the tubers were not properly washed" (Safford 1905:380).

TRADITIONAL AND MODERN USAGE OF ARROWROOT

In traditional Marshallese culture arrowroot was mainly utilized as a food item. Tubers and other parts of the plant were used in a variety of ways, however. Food and nonfood uses are discussed below.

Foods prepared from arrowroot.—Traditionally, as well as today, flour (starch) is the most common form in which arrowroot is used as a food. A number of Marshallese dishes are prepared solely from or with the addition of arrowroot starch (flour). The addition of arrowroot starch gives many dishes a gelatinous, brain-like appearance; for this reason these dishes are called in Marshallese *kömälij.* (Krämer 1906:429; Abo et al. 1976:162). All Marshallese dishes are solids, unlike in the Tuamotus, where *Tacca* starch is also used to make (alcoholic ?) beverages (Doty 1954:34). Commonly arrowroot flour was mixed with water to form a thin paste, *lagalba* (Wendler 1911), which was then mixed with other ingredients (see

Table 3). In addition to the dishes described in Table 3, arrowroot flour was sometimes added to dried and preserved *mogan* (made from the pulp of cooked or raw *Pandanus* keys) during the production process, thus increasing the volume of the *mogan* preserve and adding further starch to it.

For post-World War II times it is mentioned that arrowroot tubers are "cooked like a potato and eaten at meals with other foods" (MacKenzie 1961:60). Stone (1951:24–25), in his treatment of the agriculture of Arno Atoll, notes that "it is possible to eat them [arrowroot tubers] baked." Both cooking methods may be recent developments. According to Merrill (1945:185) the bitter taste attributed to arrowroot will disappear when it is cooked. Raw tubers, however, not only have a bitter taste, but are also credited with being mildly poisonous (Murai et al. 1958:100). In Hawaii fresh *Tacca* was mixed with coconut milk, wrapped in *ti* leaves and baked in an earth-oven (Handy 1940:299; Ihara 1971). Another modern development in the Marshall Islands is the practice of grating arrowroot and boiling it in water to form a spongy ball, which then is covered with freshly grated coconut meat (MacKenzie 1961:60). Today arrowroot starch is mainly used as a thickener in numerous dishes (Poyer 1990:64).

Nonfood uses of arrowroot.—Apart from the predominant use of the plant as a source of carbohydrates, arrowroot was also used for other purposes. When the stems, especially those of the flower stalks, are broken up, they provide thin fibers that can be woven into hats. Because of the great amount of labor involved in manufacturing these hats, they were the property only of chiefs (Wendler 1911). In Tahiti "straw" hats were made by splitting the flower stalks and the petioles of arrowroot into narrow strips, then curing and drying them. The material was woven into white, glossy hats of little weight (Safford 1905:380).

Mason, in his study of the economic organization of the Marshall Islands, states that arrowroot flour is used as a medicine, but does not elaborate (Mason 1947:71). On Namoluk Atoll, Caroline Islands, the seeds (fruits) are collected and used in leis, the leaves are considered to be essential in the treatment of persons bitten by a sea ghost, and the stem has medicinal uses (Marshall and Fosberg 1975:31).

A common use for arrowroot starch developed with the advent of Christianity in the islands and the increased use of European clothes, especially white dresses worn for Sunday church services: use as laundry starch. *Tacca* starch was widely used in the Marshall Islands for that purpose (MacKenzie 1956; Pollock 1970:162).

The long green stalks (up to 2 m) supporting the flower and the seeds of the plants *(aetöktök)* served village children as spear-like projectiles (Abo et al. 1976:6; Wendler 1911). In the modern Marshall Islands, *Tacca* stems are also used as cigarette holders, mainly during the frequent times when there is little tobacco on the islands. A medium-sized *Tacca* stem is chosen, pulled out, and cut to a length of about 15 cm. A cut piece of a cigarette or a cigarette stub is inserted in the end and smoked. In this way the cigarette can be smoked until virtually no tobacco is left. These arrowroot cigarette holders, when no longer usable, are carefully kept and dried. When the tobacco shortage becomes so severe that there are no stubs left to smoke, the nicotine-drenched tips of the dried arrowroot cigarette holders are chopped up and smoked in fresh holders (see also Pollock 1970:250).

TABLE 3.—Traditional Marshallese dishes prepared with arrowroot.

Name of dish	Ingredients and preparation of dish
Aikiu	Soup made from *iu* (spongy coconut/coconut embryo) and arrowroot flour.
Auiik	Arrowroot flour boiled with (rolled in?) grated coconut.
Benben in mokmok	The most common use. Arrowroot flour boiled in water with coconut sap *(jekaro)* added until it attained a thick, jelly-like consistency. Shaped into small balls or patties and rolled in grated coconut.
Beru	Soft pulp from the ends of boiled *Pandanus* keys *(mokwan)* combined with arrowroot flour, poured into a cone-shaped or triangular receptacle made of two fresh breadfruit leaves; cooked together as a dessert. Coconut cream *(el)* may be added for taste. Commonly cooked in the earth oven *(um)*.
Bobo	Arrowroot flour mixed with coconut water and cooked in coconut shells (with some sugar added). When jelled and cooled down, the jelly is cut into squares and rolled in grated coconut. This food is mainly used for sick and old people (and infants?).
Buiabui	Starvation food made by pounding the internal part of a driftwood tree (or old coconut palm) to pulp and mixing it with arrowroot flour and water.
Bwiro iiök	Preserved breadfruit *(bwiro)* mixed with arrowroot flour and *jekaro* wrapped in breadfruit leaves and baked.
Iek	*Bwiro* mixed with arrowroot flour, kneaded, and shaped into a ball. It is then sun-dried and can be stored for a limited period of time. When it is to be eaten, it is soaked for an hour in water. At meal time the water is poured out and the ball is mashed with a *Tridacna* pounder. Grated coconut is added to the mixture when pounded.
Jaboen	Arrowroot starch boiled in water with coconut sap *(jekaro)* added. Allowed to cool, formed into a ball, and rolled in grated coconut.
Jamok(ok)	Arrowroot flour mixed with grated coconut meat from semi-ripe coconuts and baked.
Jinkap	Arrowroot flour mixed with coconut water and cooked in coconut shells. Solely used for postpartum women.
Jokwob	Boiled arrowroot flour with fish added. A soup-like dish.
Jup in mokmok	Arrowroot flour, *iu*, fish, and coconut milk.
Kärek	*Bwiro* mixed with arrowroot flour.
Kebieltak	Arrowroot flour, crackers, and *jekaro*.
Likbbla	Arrowroot starch is first mixed with water, sugared water, or *jekaro* into a watery consistency (at a ratio of three to one). Then the mixture is slowly poured into a pot of boiling water and stirred until a soft, sticky substance is obtained.
Managedien	Same as *lek*, but not rolled in grated coconut.
Peaut Iu	Cooked with water or coconut milk and arrowroot flour.
Wagakgak	Meal prepared from arrowroot flour boiled with grated coconut.

TABLE 3.—Traditional Marshallese dishes prepared with arrowroot. (continued)

Name of dish	Ingredients and preparation of dish
no name	An innovative dish, apparently introduced by the UNDP Integrated Atoll Project, was reported for Taroa, Maloelap Atoll. Papaya and arrowroot are mixed with water, apparently to make a *poi*-like dish.

Data compiled from Abo et al. 1976:297; Erdland 1906:165, 177; 1914:221; Hiyane 1967, 1971b:14; Kotzebue 1821:1126; Krämer 1905:144; Krämer and Nevermann 1938:139–141; MacKenzie 1961:60; Mason 1947:71; Murai 1954:2; Murai et al. 1958:102–103; Pollock 1970:319; Poyer 1990:64; Wendler 1911).

Contemporary role of arrowroot.—At the end of World War II arrowroot starch still played a major role in the subsistence economy of the Marshallese, especially of the more northern atolls. A nutrition survey undertaken during the early 1950s in the northern Marshall Islands showed that "arrowroot flour was used extensively where imported goods were not available and before the breadfruit season began (Murai 1954:102).

Previous botanical and agricultural studies (e.g., Hatheway 1953) had shown that arrowroot does well planted under coconut, provided that competing vegetation is cleared. This finding was applied in the recommendations of an agriculture survey of Kili Island and islands in Jaluit Atoll. In order to maximize production for feeding the dislocated Bikini people, it was proposed that all coconut scrubland on the islets be cleared, with the exception of Jabwor, and that *Tacca* be interplanted as a starch source (MacKenzie 1956:3, 4, 8, 20).

From June to August, 1967, the subsistence patterns of some families on Laura, Majuro Atoll, were investigated (Domnick and Seeleye 1967). At the time, some 700 people lived on Laura and it was not as urbanized as it is today (in 1988, population was 1,575; OPS 1989; Kabua and Pollock 1967). The 1967 assessment found that none of the nine households analyzed utilized arrowroot starch. This finding may be a result of the time of year when the study was conducted, but the omission of arrowroot from the introduction to the study and the discussion of food items suggests that it had lost its importance altogether.

These data from Laura contrast to some degree with findings on the outer islands, where arrowroot production was still practiced, although gradually declining, through the 1960s. In a 1968 assessment of nutrition on Namu Atoll, Pollock states that in "November when arrowroot corms should have been ready to dig up, there were only barely enough to make starch for clothes, let alone for food." (Pollock 1970:162–163). At the time, arrowroot cultivation—like taro cultivation—had almost died out since seed corms were no longer planted to ensure a supply for the following year. According to Namu informants it was easier to gather coconuts for copra to sell to buy rice than to grow taro and arrowroot as staple foods. The sequence in which the use of arrowroot starch is mentioned, first as starch for clothes, then as a food, indicates that the starch has lost its position as a major food source.

The role of arrowroot starch in the contemporary (i.e., 1990s) Marshall Islands economy is hard to ascertain. The starch is virtually impossible to obtain in the urban atolls Majuro and Kwajalein, and is also very rare in the outer islands. Based on my interviews, arrowroot starch is still produced, although not in very large quantities. When the starch is available, it is almost invariably quickly exhausted for daily consumption, rather than stored and used over a longer period of time. Quantitative data, however, cannot be provided.

It appears that the decline of arrowroot in the Marshall Islands is a result of a simultaneous demise in importance of all traditional food items. With lack of weeding, arrowroot quickly becomes crowded by competitors and is eventually overgrown. The fact that the plants have to put all their energies into leaf growth, in order to keep up with weedy competitors, rather than producing a seed stalk and a large tuber, results in the recovery of very small tubers from modern arrowroot plants.

THE FUTURE OF ARROWROOT PRODUCTION

One major issue remains to be discussed: whether there is a future for arrowroot production in the Marshall Islands. From the previous discussion, it is apparent that arrowroot has lost its importance. In fact, throughout the Pacific region the role of arrowroot in the local subsistence economy has seen a major downturn. Colonial interference with traditional food production was limited during the first half of this century, and the small amount of money circulating in the islands made subsistence agriculture a necessity on the atolls. In the immediate post-World War II period, many traditional subsistence systems still existed, although in a phase of transition to a consumer society. Arrowroot was still a staple crop on some atolls, although it had become restricted to a source to rely on in times of food scarcity. Over time arrowroot starch was produced as a laundry starch, rather than as a food. Finally, the advent of washing powder—as opposed to bar soap—and the general decline of the habit of wearing starched clothes brought about the decline of arrowroot starch altogether. This is true for the Tuamotus (Doty 1954:12–13) and Belau (Otobed 1977:8) as well as for the Marshall Islands.

The cash economy brought upon the islanders by the burgeoning Pacific trade and the high return for copra, the staple export crop for most atolls, changed food production to food purchases. It became easier to produce copra and to purchase staple foods from the proceeds. This was even more compelling since modern introduced foods could be cooked with less preparation time than traditional foods. This has pointedly been called the "copra-tin can economy" and has been observed on numerous atoll groups (Doty 1954:13). While this made economic sense in the heyday of copra production and high copra prices of the 1970s and 1980s, this makes little economic sense in the days of low copra profits in the 1990s.

The modern economy of the Republic of the Marshall Islands is heavily supported by outside funding. Available balance of payment figures show a trend towards increasing imports, while exports stagnate or at best increase negligibly. The balance of trade is highly negative: exports would have to be raised 1500% to level out the balance (OPS 1989a:138). For most outer islanders, copra is still the sole means of a cash income, apart from handicraft production, but it has become less and less lucrative. Other income-generating schemes do not always work, and in order to increase the standard of living, the lowering of expenditure by import substitution is a feasible option.

Previous botanical and agricultural studies have shown that arrowroot does very well under coconut, provided that competing vegetation is kept in check. Thus arrowroot would be a very suitable intercrop in copra plantations. Based on the analysis of arrowroot tending, production, and starch extraction described above, a comparison of the costs of producing arrowroot and copra can be made. I have used a household comprising two able-bodied males (15–64 years of age) and two male minors for purposes of this comparison. Female labor input, which would speed up the process, was not taken into account since this is not "traditional."

As shown elsewhere (Spennemann 1992) daily income from copra production is $3.00 per person (male) *on very productive atolls*. Thus the seven days of labor invested in the production of 25 lb. arrowroot starch (refer to previous discussion) are equivalent to at most $21.00 of copra production. Processing arrowroot instead of copra, therefore, costs the producer and self-consumer $0.84 per pound of arrowroot. In view of the fact that both copra income figures and arrowroot labor investment figures have been rather conservatively calculated, the actual per pound cost of arrowroot starch is very likely substantially less than $0.84. For example, if weeding of plots and drying of the extracted starch were done by children, who are not involved in copra-making, the labor investment for men is reduced to four days, resulting in a cost of $0.48 per pound of arrowroot starch. Alternatively, the cost per pound of starch is reduced to $0.37 if copra income *averaged for all copra-producing atolls* is used in the calculation, and then to $0.21 per lb when a 4-day labor investment figure is used.

This cost of $0.84 or less per pound of arrowroot starch can be compared with the cost of corn starch in Majuro ($1.15 or more) and in outer island retail stores ($1.50 or more). Because of the remote location of the Republic of the Marshall Islands, all imported foods are expensive due to transportation costs and mark-ups. Substitution of locally produced products therefore is feasible and, in view of the economic situation of the outer atolls, also desirable.

CONCLUSIONS

The goal of this study was to review the state of knowledge on arrowroot production and utilization in the Marshall Islands and to assess its potential as a future source of carbohydrate. In many Pacific Island nations the former subsistence economy is waning in view of consumer-oriented influences, and imported foods are becoming more prominent. In the course of this change several traditional subsistence sources, such as Polynesian arrowroot, have almost disappeared. A review of arrowroot and its role in Marshallese horticulture has shown that the plant was a common staple before World War II, but that in the 1960s its role changed from a food source to a provider of laundry starch. Where arrowroot is still produced in small quantities, it is a sought after food item. A brief economic assessment demonstrates that arrowroot starch is a cheap alternative to imported starch. Because it thrives well intercropped under coconut, arrowroot is an ideal plant for import substitution.

NOTES

[1]It should be noted that the Republic of the Marshall Islands, in its internationally recognized boundaries, comprises 28 atolls and five coral islands. The geographical term "Marshall Islands," however, also includes Eneen-Kio (Wake Atoll), currently under the jurisdiction of the United States of America. The Republic of the Marshall Islands has repeatedly made clear its position that Eneen-Kio forms an integral part of the Republic of the Marshall Islands.

[2]In Western literature on Pacific plants, *Tacca leontopetaloides* (L). Kuntze is known as arrowroot, Tacca, East Indian arrowroot, Island arrowroot, Polynesian arrowroot, Tahiti arrowroot, or Fiji arrowroot. African arrowroot is the common name synonym for *Tacca involucrata* Schumacher and Thonn (1827), which in turn is a synonym for *T. leontopetaloides*. The German ethnographic literature on the Marshall Islands, the main source for nineteenth century data, describes arrowroot as *Pfeilwurz*. For comparison, Indian arrowroot *(Curcuma angustiofolia)* and Queensland arrowroot *(Canna edulis)* have similar vernacular names, but belong to totally different plant families. The name East Indian Arrowroot is also used to contrast *Tacca* with West Indian Arrowroot *(Maranta arundinacea)*, which was discovered first by Europeans and received its name from the fact that the plant was used by West Indian natives to treat wounds inflicted by poisoned arrows (Masefield 1948:44–45).

Apart from the official Marshallese spelling *mäkmök* as shown in the current edition of the Marshallese-English Dictionary (Abo et al. 1976:212), there is an abundance of phonetic variations by which the Marshallese name has been spelled, such as *makemok* (Bryan 1972:132); *mogumok* (Kotzebue 1821:1126); or *mok mok* (Fosberg and Sachet 1962:13)

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BOOK REVIEW

Barley: Chemistry and Technology. Alexander W. MacGregor and Rattan S. Bhatty (Editors). St. Paul, Minnesota: American Association of Cereal Chemists, Inc., 1993. Pp. viii; 486. $145.00 (in United States), $169 (outside of United States) (add $2.00 postage). BEF 5575.

One of the oldest of cultivated plants, barley, is treated in this valuable book by seventeen contributors from six countries, an extraordinary collection of outstanding experts who in ten chapters present the most up-to-date data on the chemistry and technology of *Hordeum*. As stated in the preface, "The intention of the editors was to produce a volume that was broad in scope yet covered each topic in depth." Their intention has indeed been fulfilled. The book must be considered a major contribution to economic botany.

The ten chapters present a mass of information organized in a most orderly sequence: (1) The taxonomy, origin, distribution, production, genetics, and breeding of barley; (2) Formation of the barley grain—morphology, physiology, and biochemistry; (3) Carbohydrates of the barley grain; (4) Barley seed proteins; (5) Barley lipids; (6) Physiology and biochemistry of barley germination; (7) Malting technology and uses of malt; (8) Non-malting uses of barley; (9) Potential improvement of quality through genetic engineering; and (10) Whole crop utilization of barley, including potential new uses.

Each chapter naturally has its own extensive bibliography. The index, which occupies eleven and a half pages, is extremely detailed.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138

J. Ethnobiol. 14(2):235–240 Winter 1994

RECENT DOCTORAL DISSERTATIONS OF INTEREST TO ETHNOBIOLOGISTS XII

JOSEPH E. LAFERRIÈRE
Herbarium, 113 Shantz Bldg.
University of Arizona, Tucson AZ 85721 USA
and
TERENCE E. HAYS
Department of Anthropology and Geography
Rhode Island College
Providence, RI 02908 USA

In this year's column, we set a new record: four dissertations which actually contain the word "ethnobotany" in the title. It is, however, the first time in ten years we lack Worldwide dissertations from Volume C of Dissertation Abstracts (D.A.). Unfortunately, no copy of this was available this year to either author.

This is the twelfth in an annual series of bibliographies listing selected dissertations drawn from the pages of Dissertation Abstracts. As in the past, this list was compiled by scanning the titles and abstracts published in D.A. and making subjective decisions as to which ones might be relevant to work in ethnobiology or related disciplines such as ecological anthropology and economic botany. Dissertations categorized in D.A. under Agricultural Economics, Agriculture, American Studies, Anthropology, Biology, Botany, Chemistry, Ecology, Folklore, Geography, Health Science, Home Economics, Language, Linguistics, Paleoecology, Physical Geography, Sociology and Zoology were considered for inclusion in the list. An attempt was made to be as inclusive as possible, but some dissertations may have been overlooked. Comments and suggestions would be welcome for items to include in next year's edition.

Dates covered by the present paper include: for Volume A, September 1993–August 1994; Volume B (Sciences and Engineering), September 1993–July 1994. Note that these are the dates for the issues of D.A. in which the abstracts appear, rather than the dates of acceptance of the dissertations themselves.

The dissertations are listed below alphabetically by author, along with the year of acceptance, title, institution, length, adviser or major professor, number(s) of the page(s) in D.A. on which the abstract may be found, University Microfilms order number, and the ISBN number when this information was included.

Most of the dissertations accepted at institutions in the United States, and some of those from Australia, Canada, South Africa, and the United Kingdom may be obtained from University Microfilms International, P.O. Box 1764, Ann Arbor, MI 48106-1346, either on microfilm or published by microfilm xerography. Quality of printed matter is generally excellent, but that of figures and photographs varies with the quality of the original. Abstracts of all dissertations below are published in D.A., in English except as noted. D.A. is now available in many libraries on CD-ROM.

Current prices may be obtained by calling 800-521-3042; 313-761-4700 from Alaska, Hawaii, or Michigan; or 800-343-5299 from Canada. Further information may be obtained from UMI Dissertations Information Service, 300 North Zeeb Road, Ann Arbor, MI 48106-1346, USA.

RESUMEN.—En este bibliografía se incluyen disertaciones recientes de interés a los etnobiólogos. Por cada uno se da el número de la página donde se halla el resumen en Dissertation Abstracts (D.A.), y el número de encargar un ejemplar de la disertación de University Microfilm International, P.O. Box 1764, Ann Arbor, MI 48106-1346 USA (teléfono: 313-761-4700 o 800-521-3042; desde Canada 800-343-5299).

RÉSUMÉ.—Cette bibliographie comprend quelques dissertationes recentes d'interet aux ethnobiologistes. Chez chaqu-une où donne le número de la page où se trouve le résumé dans Dissertation Abstracts (D.A.), et le número de commander un exemplaire de la dissertation de University Microfilm International, P.O. Box 1764, Ann Arbor, MI 48106-1346 USA (telephone: 313-761-4700 ou 800-521-3042; de Canada 800-343-5299).

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Amarquayé, Ambrose. 1993. Isolation of spasmogenic principles from *Byrsonima crassifolia* Richard ex Jussieu (Malpighiaceae). University of Illinois at Chicago, Health Sciences Center, 150 pp. D.A. 54(4):1910-B. Order no. DA9324364.

Arzigian, Constance Marie. 1993. Analysis of prehistoric subsistence strategies: A case study from southwestern Wisconsin. University of Wisconsin-Madison, 506 pp. Supervisor: James B. Stoltman. D.A. 54(4):1432-A. Order no. DA9309494.

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Casey, Joanna Louise. 1993. The Kintampo Complex in Northern Ghana: Late Holocene human ecoloy on the Gambaga Escarpment. University of Toronto (Canada), 355 pp. ISBN 0-315-82756-4. Adviser: Maxine Kleindienst. D.A. 54(9):3486-A. Order no. DANN82756.

Colten, Roger Henry. 1993. Prehistoric subsistence, specialization, and economy in a southern California chiefdom. University of California, Los Angeles, 258 pp. Chair: Jeanne E. Arnold. D.A. 54(10):3876-A. Order no. DA9408227.

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Crawford, Patricia Louise. 1994. Man-land relationships in the Wadi Tumilat of Egypt at Tell el-Maskhuta: A paleoethnobotanical perspective. Boston University, 355 pp. Major Professor: Julie Hansen. D.A. 55(1):106-A. Order no. DA9417315.

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Foderado, Tommaso Antonio. 1993. Chemical analysis of *Penstemon* and *Castilleja* (Scrophulariaceae), *Thessalia* (Lepidoptera) and *Pinus* (Pinaceae). Colorado State University, 193 pp. D.A. 54(6):3069-B. Order no. DA9331375.

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Hockett, Bryan Scott. 1993. Taphonomy of the leporid bones from Hogup Cave, Utah: Implications for cultural continuity in the eastern Great Basin. University of Nevada, Reno, 264 pp. Adviser: Gary Haynes. D.A. 54(6):2200–2201-A. Order no. DA9331876.

Hunter, Andrea A. 1992. Utilization of *Hordeum pusillum* (little barley) in the midwest United States: Applying Rindos' co-evolutionary model of domestication. University of Missouri-Columbia, 361 pp. Supervisor: Deborah M. Pearsall. D.A. 54(5):1852-A. Order no. DA9327836.

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Johnston, Bernard Charles. 1992. Plant use among the Metis near Lac La Biche, Alberta: A study of tradition and change. University of Northern Colorado, 175 pp. D.A. 54(3):1053-A. Order no. DA9319987.

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Meeker, James Edwin. 1993. The ecology of "wild" wild-rice (*Zizania palustris* var. *palustris*) in the Kakagon Sloughs, a riverine wetland on Lake Superior. University of Wisconsin-Madison, 376 pp. D.A. 54(8):3945-B. Order no. DA9326045.

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Pendleton, Michael Wayne. 1993. Late Holocene paleoenvironment and human ecology in southwestern New Mexico. Texas A & M University, 242 pp. Chair: Vaughn M. Bryant, Jr. D.A. 54(5):1853-A. Order no. DA9328786.

Phillips, Oliver L.B. 1993. Comparative valuation of tropical forests in Amazonian Peru. Washington University, 312 pp. D.A. 54(10):5007-B. Order no. DA9409067.

Price, Lisa Marie Leimar. 1993. Women's wild plant food entitlements in Thailand's agricultural Northeast. University of Oregon, 223 pp. Adviser: Carol Silverman. D.A. 54(12):4499-A. Order no. DA9415141.

Salafsky, Nick N. 1993. The forest garden project: an ecological and economic study of a locally developed land-use system in West Kalimantan, Indonesia. Duke University, 342 pp. D.A. 54(10):5082-B. Order no. DA9404268.

Shaw, Chester Worth, Jr. 1993. Human responses to past climate, environment, and population in two Mogollon areas of New Mexico. University of Arizona, 254 pp. Directors: J. Jefferson Reid; Donald A. Graybill. D.A. 54(4):1434-A. Order no. DA9322667.

Shelley, Steven Douglas. 1993. Analysis of the faunal remains from the Wallace Ruin: A Chacoan outlier near Cortez, Colorado. Washington State University, 376 pp. Chair: Carl Gustafson. D.A. 54(12):4496-A. Order no. DA9414812.

Singleton, Dawn. 1993. A gathering of wisdoms: mental health concerns as identified by urban Indians in the Dallas–Fort Worth metroplex. Texas Woman's University, 144 pp. D.A. 54(12):6129-B. Order no. DA9407783.

Sobel, Gail L. 1993. The ethnobotany of the grain amaranths with special reference to San Miguel del Melagro, Tlaxcala, Mexico. City University of New York, 346 pp. D.A. 54(9):4482-B. Order no. DA9405586.

Soule, Jacqueline Anne. 1993. Systematics of *Tagetes* (Asteraceae-Tageteae). University of Texas at Austin, 806 pp. D.A. 54(12):6019-B. Order no. DA9413605.

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Sumarriba, Eduardo José. 1993. Allocation of farm area to crops in an unstable

Costa Rican agricultural community. University of Michigan, 176 pp. D.A. 54(7):3403-B. Order no. DA9332167.

Sussenbach, Tom. 1993. Agricultural intensification and Mississippian developments in the confluence region of the Mississippi River Valley. University of Illinois at Urbana-Champaign, 177 pp. Adviser: R. Barry Lewis. D.A. 54(11): 4154-A. Order no. DA9411796.

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Wakhungu, Judi Wangalwa. 1993. Energy resources management in Kenya: the solution as the problem. Pennsylvania State University, 235 pp. D.A. 54(5): 2420-B. Order no. DA9326962.

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Warren, Sarah Timberlake. 1993. The political ecology of rural development forestry: land use and species choice in Gujarat, India. Yale University, 298 pp. D.A. 54(5):2303–2304-B. Order no. DA9325424.

Wells, Carl D. 1993. Isolation and evaluation of insecticidal volatiles from the genus *Tagetes*. University of Alabama, 208 pp. D.A. 54(3):1376-B. Order no. 9313076.

J. Ethnobiol. 14(2):241–264 Winter 1994

ABSTRACTS

of presentations (contributed papers and poster sessions) at the Seventeenth Annual Conference of the Society of Ethnobiology The Environmental Studies Program, University of Victoria and the Royal British Columbia Museum 16–19 March 1994

E. N. ANDERSON, Department of Anthropology, University of California, Riverside, CA 92521

GARDENS OF CHUNHUHUB

This paper reports a survey of a sample of gardens in Chunhuhub, Quintana Roo, Mexico. Gardens range from four to 92 species of plants. Most are deliberately planted, but some are tolerated and utilized weeds. Plants are used for food, forage, firewood, medicine, ornament, and other purposes. Commercial crops are numerous. Gardens are extremely varied, partly due to a fondness for experimentation and for having something unique in one's yard.

M. Kat ANDERSON, Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720; home address: 3692 Wood Duck Circle, Stockton, CA 95207

A MORE COMPREHENSIVE APPROACH TO ASSESSING THE ROLE AND IMPACT OF NATIVE PEOPLE ON THE DYNAMICS OF WILD PLANT POPULATIONS

Many of the seminatural areas surrounding unique habitats will have to be managed with the objectives of biodiversity, conservation, and resource production, and this integration may be one of our greatest challenges. I will discuss some of the specifics of plant-human interactions that allow for resource use while simultaneously preserving the habitat, reflected in selected Indigenous wild plant management systems around the world. As the focus on management and production of single species is expanded to include a larger number of resources in temperate and tropical ecosystems, this will require a different, more comprehensive approach to the assessment of human impacts on natural resources. Descriptive and interpretive studies in the social sciences establish a solid foundation for more definitive studies of the role and impacts of Native people on the dynamics of wild plant populations. More quantitative longer-term studies and experiments can lead to the development of a set of management principles and ecological concepts embedded in Indigenous systems, which will be useful to ecologists, resource managers, and small entrepreneurs in the management and harvest of wildlands for an array of cultural products. Such studies and experiments need to be addressed to answer specific questions and test hypotheses. These kinds of studies will also uncover the degree to which particular habitat types and plant species are dependent upon Indigenous disturbance regimes for maintenance of their productivity, crystallizing the complex relationships between biological and cultural diversity.

Mary E. BAKER, Department of Anthropology, University of California, Riverside, CA 92521-0418

MEDICINAL PLANT USE BY CAPUCHIN MONKEYS (*Cebus Capucinus*)

There is a growing body of evidence documenting animals' selective use of plants found in their environment for medicinal purposes. During research conducted in Costa Rica, capuchin monkeys (*Cebus capucinus*) were observed applying plant material of three genera, *Citrus, Clematis,* and *Piper.* These plants all contain secondary compounds which are known to have anti-insect and/or medicinal benefits. The monkeys are precise in their selection and utilization of these plants. The ethnographic record shows that Indigenous peoples throughout the New World use these plants for similar purposes and in similar ways. This is evidence for the topical use of plants by free-ranging nonhuman primates for their potential medicinal purposes. Medicinal plant use is not restricted to this population or species of capuchin monkey.

Pierre BEAUCAGE, Département d'anthropologie, Université de Montréal, c.p. 6128, Succ. A. Montréal, Québec H3C 3J7

THE DOMESTICATION OF INNOVATION: THE TRADITIONAL COFFEE ORCHARD OF EASTERN MEXICO

Since the Rio Conference proclaimed the necessity of preserving biodiversity as well as cultural diversity, there has been a renewed interest in studying Native or "traditional" ways of dealing with the environment. Both Native peoples and non-Native scholars are interested in finding alternative methods of producing food and other raw materials without putting to risk the productive potential of the environment. In spite of the very fragmentary state of present-day knowledge, it has been shown that various groups have developed techniques not only for preserving basic resources such as soil and water, but for reclaiming land that is considered exhausted or near-exhausted.

Yet there is a considerable amount of confusion as to what is really "native" or "traditional," particularly in areas such as Mexico where the original inhabitants have been in direct contact with Europeans for centuries. For some scholars the terms must be limited to resources and techniques of pre-Columbian (or at most, colonial) origin. On the basis of long-term research in the Sierra Norte de Puebla (Mexico), I want to demonstrate, first, that the generalized adoption of coffee-growing by Nahuat and Totonac peasants in lower Sierra de Puebla, well into the twentieth century, was an ecological response to rapid population increase that challenged the continuation of the previous short-fallow milpas agriculture. I will refer to the large body of local and regional archives that my collaborators and I investigated, and which are now being processed. Second, I will analyze the extensive data we collected on plant and animal associations to show how the Native way of managing the coffee orchard, far from being "disastrous monocultivation" in fact recreated on the hilly ground a diversified environment that was analogous to the natural tree cover that had been removed (with dozens of associated vegetal and animal species). And, third, that the pattern of interspersing milpas with coffee groves on the gentler slopes, while planting orchard on the steep and rocky parts, helped to preserve soil fertility.

Robert BYE and Edelmira LINARES, Jardín Botánico, Instituto de Biología, Universidad Nacional Autónoma de México, Apdo. Post. 70-614, 04510 México, DF
AZTEC GREENERY—CONTINUITY OF *QUELITES*

As an extension of the studies on continuity of plant use in central Mexico, this study examines the quílitl or edible greens (*quelites*) that are reported in the *Florentine Codex* (completed in 1577 and written in Nahuatl and Spanish languages under the supervision of Bernardino de Sahagun). The prominent cultural significance placed on these plants is corroborated by the Aztec's classifying them as one of the six major vegetal life forms. The 54 quelites are divided into two major groups based upon their form of consumption: crude or cooked. As a central ceremonial element, *quelites* were the highlights of feasts such as the ***ixcozauhqui,*** which marked the end of an Aztec annual cycle and the preparation for new growth of fire and children. Although practiced on the date that corresponded to the 8th of January, this native feast probably was supplanted by European rituals involving edible greens representing Catholic renewal during the Lenten (*Cuaresma*) season later in the calendar year. Over half of the quelites mentioned and illustrated in Sahagun's classic work can be identified botanically today. Many are multiple use species that provided other edible parts as well as medicine. Although a quarter of these *quelites* are still eaten today, these greens do not maintain their prominent pre-Hispanic status in contemporary folk taxonomy and food preference. The continuity of *quelite* consumption endures despite the reduction in the number of species and the substitution by European cultivated leafy vegetables. The prestige of edible greens has declined in the dietary and the ceremonial domains.

Daniel CLÉMENT, Canadian Ethnology Service, Canadian Museum of Civilization, 100 Laurier Street, Hull, Quebec, Canada J8X 4H2
WHY IS TAXONOMY UTILITARIAN?

Cognitive and utilitarian explanations of taxonomy have always been opposed in ethnobiological studies. In this paper, data from Montagnais and Cree taxonomies show a relation between taxonomic structure and uses of plants and animals. This relation operates through partons (parts of the entities that are classified).

The Montagnais and the Cree are Native groups from the eastern Subarctic. A study was conducted among the Montagnais in 1981 and revealed general ethnobotanical categories based on uses of plants (e.g., wood for *mishtukuat*, or 'tree'; fruit for *atishîa*, or 'small shrub'). Additional proof of these links is provided by the morphemes that compose words for either objects fabricated with the part that is the basis of a category (e.g., *askhu*[u], the bound form for 'wood,' which is used in words designating objects made out of trees) or names of entities in the category (e.g., *akashî*, or 'fruit plant', the bound form appearing in words in the category *atishîa*, or 'small shrubs,' used mainly as foods).

A second study was conducted between 1982 and 1988, also among the Montagnais people. The hypothesis of a relation between uses of zoological entities, partons, and taxonomy was also examined. The ethnozoological taxonomy hence appeared to be based on food as a main operational key. First, consumable animals (*aueshîshat*) are distinguished from inconsumable animals (*manitûshat*). Then, among consumable animals, quadrupeds and birds or animals (*aueshîshat*) with *uiâsh* ('meat') are separated from aquatic animals (*nameshat*), or animals with *namesh* ('flesh'). Finally, *pineshîshat* ('small birds') are also differentiated from other animals with *uiâsh* by their utility, since they are said not to be consumed even if consumable. Cree data gathered in 1990 provides linguistic proof of the Montagnais general ethnozoological taxonomic structure: James Bay Cree still use a word for the 'flesh' (*uhkuwaau*) of fish to distinguish it from the 'meat' (*wiyaas*) of animals.

Primitive societies are not the only ones to show such taxonomic features. Linnaean taxonomy was also based on a very specific historical context in which there were direct relations between utility and taxonomic development. On the other hand, the relation between taxonomy and utilization through parts of the entities classified can further help us to understand folk taxonomic anomalies or why an entity can be classified in more than one category.

Susan CROCKFORD, Pacific Identifications, 6011 Oldfield Road, R. R. 3, Victoria, B. C. V8X 3X1

A TAXOMONIC REVIEW OF THE TRACHEAL BULLAE (BONY SYRINX) OF THE DUCKS OF THE GENUS *Anas* OF THE PACIFIC NORTHWEST (POSTER)

This poster presents a taxonomic review of the tracheal bulla (or bony syrinx) of the ducks of the genus *Anas* found in the Pacific Northwest of North America. The taxonomic implications of similarities between tracheal bullae of the tribe Anatini and other tribes of the subfamily Anatinae are discussed. A general identification key for Northwest duck genera is provided, as well as a specific key for the genus *Anas* and those species from other genera with which it might be confused. It is expected that these keys will prove useful

(1) for the correct identification of isolated tracheal bulla, such as might be found in archaeological or subfossil contexts;

(2) for confirmation of correct identification of whole duck specimens, where juvenile or eclipse plumage of males produces uncertainties;

(3) for correct identification of whole duck specimens, where condition of the carcass produces uncertainties (e.g., oiled birds); and

(4) for correct identification of partial duck specimens, where head and/or feathers have been intentionally removed to avoid prosecution (i.e., wildlife conservation violations).

Christoffel DEN BIGGELAAR, Department of Forestry, Michigan State University, East Lansing, Michigan 48824-1222

INDIGENOUS AGROFORESTRY SYSTEMS IN RWANDA: GENDER, SPECIES DIVERSITY, TREE MANAGEMENT, AND UTILIZATION

The combined effects of both farmers' efforts and external pressure to plant more trees in recent decades have resulted in an increase in the number of trees in the landscape and the complex agroforestry systems found in Rwanda today. This paper will present evidence of the complexity of contemporary agroforestry systems using the results of a tree inventory undertaken as part of a dissertation research project in Rwanda in 1992. The objective of the research was to obtain an "emic" perspective of agroforestry, and to determine and understand farmers' knowledge of agroforestry and its sources. The term "tree" (*igiti* in *kinyarwanda*) was interpreted broadly and determined by the farmers themselves in accordance with its Bantu-Rwandan philosophical meaning of "plants that are not grasses."

The inventory was undertaken on two samples of farmers (44 tree experts and 70 comparison farmers) in three research areas: Kibingo, Maraba, and Simbi secteurs in southern Rwanda. On the tree expert farms, inventories were taken as part of a case study of farmers' knowledge and farm/tree histories using repeated visits. Comparison farmer inventories were done in a single visit.

The results indicate that Rwandan agroforestry systems have a great species diversity (152 species were found) with complex arrangements of species over space and/or time. Over 80% of the trees are planted and owned by men. Women plant and own few trees, but the percentage is higher among female heads of household than among married women. Although men do most of the tree maintenance and harvesting, both women and children do significantly greater shares of these activities than their ownership of trees indicates. The tree experts were called experts as they had much experience with a great variety of species (in Rwandan thought, knowledge equals experience with a plurality of objects). However, their being the most knowledgeable farmers about a diversity of tree species and their cultivation may not necessarily mean that they are also the persons having the most knowledge of managing these trees in an agroforestry *system*. Comparison farmers, having much smaller farms with less species diversity, have more trees of each species and have on average more than twice the number of trees per hectare than tree experts. These small but high density farms require farmers to have higher levels of management skills and greater knowledge of the various components and their interactions in order to produce sufficient food and other products to maintain the family. In the future, it may, therefore, be necessary to study both groups of farmers in greater detail regarding their knowledge as their knowledge may be divergent.

Scott L. FEDICK, Department of Anthropology, University of California, Riverside, CA 92521

ANCIENT MAYA LAND MANAGEMENT: MODELING THE DISTRIBUTION OF AGRICULTURAL TERRACES

Ancient agricultural terraces represent a form of land-resource management practiced by the ancient Maya of southern Mexico and Central America. While the existence of terraces has been reported sporadically in the archaeological literature for many years, the apparent lack of patterning in the distribution of these terraces across the landscape has often puzzled investigators.

This study examines the local distribution of ancient terraces within the upper Belize River valley of Belize, Central America. A predictive model for terrace distribution was developed, incorporating the variables of slope, soil type, and geological parent-material. This model was tested through field survey, and the resulting observations were used to refine the model. Within the study area, a variety of terrace forms were identified, all of which were restricted to the lower slopes. Slope alone, however, is not a good predictor of terrace distributions. The variables of soil type and geological-parent material represent the other important criteria for predicting the distribution of ancient terraces. Fine-scale analyses of land resources provides the necessary context in which ancient land-management decisions can be understood.

Gregory FORTH, Department of Anthropology, University of Alberta, Edmonton, Alberta T6G 2H4

***PO:* QUESTIONS CONCERNING THE CLASSIFICATION OF SOUNDS, SPIRITS, AND BIRDS AMONG THE NAGE OF EASTERN INDONESIA**

The Nage of eastern Indonesia possess a word, *po,* which refers to a class of birds focused on owls. This paper addresses the question of how far the term identifies an ethnoornithogical taxon. As an onomatopoeia, *po* describes various nocturnal sounds, and when joined with certain other words, resulting compound terms allude to kinds of spiritual beings distinguished by audial qualities of sounds associated with each. Other compounds of *po* refer more directly to kinds of sounds, while yet others denote physical owls. According to the Nage, however, the latter do not each name distinct owl taxa, but represent alternative ways of distinguishing all owls from other referents of *po,* including other raptors associated with the term. By analyzing various senses of the word the paper considers more general problems of ethnozoological classification, including the relative value of visual and nonvisual criteria in distinguishing animal kinds and the conceptual, as opposed to perceptual, bases of the associated nomenclature.

Catherine S. FOWLER, Department of Anthropology, University of Nevada, Reno, NV 89557

HISTORICAL PERSPECTIVES ON TIMBISHA SHOSHONE LAND MANAGEMENT PRACTICES, DEATH VALLEY, CALIFORNIA.

At the time of contact and disruption, the Timbisha Shoshone people lived by hunting and gathering the diverse flora and fauna characteristic of the Mojave

Desert and its uplands. Floral resources particularly favored for food were honey mesquite (*Prosopis glandulosa*), single-leaf pinyon (*Pinus monophylla*), several plants that produced bulbs or corms, and a variety of seed-producing annuals and perennials. Several of these resources were carefully managed. Mesquites were trimmed of lower branches, thus keeping them open and free of dunes formed by blowing sands. Pinyon trees were similarly trimmed, but also whipped and hand pruned to produce more cone growth. Undergrowth was cleared by hand and by fire further facilitating the collection of pine nuts, but also fostering fire-following plants such as native tobacco (*Nicotiana attenuata*) and desert mariposa (*Calochortus kennedyi*). Fire was also used in the marshes to discourage cattail (*Typha* spp.) and increase forage plants and other seed producers. Springs were cleaned and cleared as part of routine maintenance.

In 1933, when Death Valley National Monument was created, management of these lands and resources shifted to the National Park Service. Native practices were discouraged and finally disallowed altogether. This paper reviews the history of this situation and some of the results, based on recent field work in the Death Valley area.

Elliot FRATKIN, Department of Anthropology, Penn State University, 409 Carpenter Building, University Park, PA 16802

TRADITIONAL HEALING AMONG SAMBURU AND MAASAI PASTORALISTS OF EAST AFRICA

Traditional healing among Samburu and Maasai pastoralists of East Africa is carried out both by general practitioners using herbal medicines and specialized practitioners of ritual medicines known as *loibonok*. Samburu categorize illness into "natural" diseases, which block circulation and whose remedies include ingestion of purgatives and emetics obtained from over 100 species of trees and shrubs, and "mystical" illnesses, which include infertility, mental illness, and unusual events that are believed to be caused by the sorcery of jealous enemies. Treatment of sorcery demands the intervention of the *loibon*, who uses divination and protective medicines to combat the sorcery. This paper discusses Samburu concepts of disease and describes their treatments.

José GONZALES, Departamento de Antropología, Universidad Autónoma Metropolitana-Iztapalapa, Av. Michoacán y La Purísima s/n, Col. Vicentina, Iztapalapa C.P. 09340, México, and Regina LEAL, Departamento de Economía, Universidad Autónoma Metropolitana-Iztapalapa, Av. Michoacán y La Purísima s/n, Col. Vicentina, Iztapalapa C.P. 09340, México

ASSIGNMENT RULES FOR THE MANAGEMENT OF NATURAL RESOURCES IN AN INDIGENOUS COMMUNITY

In this paper, we review the nonformalized rules set that exists at the Náhuatl community Santa Catarina del Monte (Texcoco, Mexico). These rules determine the inhabitants' rights and obligations concerning the management of natural resources within the common and public land. Attachment to these rules is an essential condition for their economic growth within a social structure where the available resources are scarce. Some cultural elements are analyzed in order to define the social rights and obligations relevant to the management of these natural resources.

It is necessary to regard the adequacy of such rules and obligations which have an effect on the management of natural resources, since this Indigenous community is inserted on a dynamic social and economical context. In this sense, we analyzed the changes generated as a result of this process.

Claudia GONZALEZ ROMO, W. Hardy ESHBAUGH, Department of Botany, Miami University, Oxford, Ohio 45056, and **A. G. GREENBERG,** Department of Sociology and Anthropology, Miami University, Oxford, Ohio 45056

CAMPESINO HOME GARDEN RESOURCE MANAGEMENT AT El CIELO BIOSPHERE RESERVE, TAMAULIPAS, MEXICO (POSTER)

El Cielo Biosphere Reserve, which was established in 1985 (144,000 Ha) and is located at the Neotropical Holartic boundaries as well as the northeastern limits of Mesoamerica in Mexico, has scattered campesino mestizan villages within the preserved area. The Joya de Salas (20 de Abril village, 1500 m) used to be part of the Hacienda system of the Spaniards. In 1974, the land was granted to the village as an ejido. The resource management practices that today exist in Joya de Salas have not been modified in spite of its protected area status. The home gardens are actively managed by both women and men, including children. Over 100 cultivated and wild plant species are managed within the home gardens, including poultry (chicken and turkey), pigs, cats, dogs, cattle (horses, donkeys, cows and calves, goats), some honeybee keeping with European and native bees, and small and large mammals.

Leslie M. Johnson GOTTESFELD, Anthropology Department, 13-15 HM Tory Building, University of Alberta, Edmonton, Alberta T6G 2H4

WET'SUWET'EN PLANT CLASSIFICATION AND NOMENCLATURE: A PRELIMINARY EXAMINATION

Plant classification of the Wet'suwet'en of northwest British Columbia, Canada, is explored in this paper. Wet'suwet'en plant classification includes a large number of generics or basic terms that are designated by primary or unproductive secondary lexemes, or sometimes by descriptive phrases. There are also major plant classes, or "life-forms" and intermediate groupings. Only one generic so far described, *tl'o,* appears to be divided into folk specifics. Life-forms include 'tree,' 'plant,' 'berry,' 'flower,' 'moss,' 'fungus,' and perhaps 'grass.' The first two satisfy criteria proposed by Berlin and Brown in being morphologically defined, transitive, and containing relatively large contrast sets. The remainder are cross-cutting ('berry'), utilitarian ('berry'), or empty ('moss,' 'mushroom,' 'flower'), showing similarities to life forms reported for other northwestern North American peoples. Several intermediate groupings are proposed, defined either by morphology or utility, including such types as 'willows,' 'spines,' and 'poisonous plants'. Utility seems to be important in perception and grouping of plants, and may be directly or indirectly coded in plant names. A number of Wet'suwet'en

plant names are loanwords from Gitksan, an unrelated Tsimshianic language spoken to the north and west.

Kristen J. GREMILLION, Department of Anthropology, Ohio State University, 244 Lord Hall, 124 W. 17th Avenue, Columbus, OH 43210-1362, **Kathryn JAKES,** Department of Textiles and Clothing, Ohio State University 262 Campbell Hall, 1787 Neil Avenue, Columbus OH 43210-1220, and **Charles T. FAULKNER,** Department of Environmental Practice, University of Tennessee, PO Box 1071, Knoxville, TN 37901–1071

PALEOFECAL EVIDENCE FOR EARLY AGRICULTURAL DIET AND ECOLOGY IN EASTERN NORTH AMERICA (POSTER)

Desiccated paleofeces of probable human origin from the Newt Kash Hollow and Hooton Hollow rockshelters in eastern Kentucky, U.S.A. were found to contain, in varying combinations and quantities, remains of native domesticated plants including sunflower (*Helianthus annuus*), sumpweed (*Iva annua*), and chenopod (*Chenopodium berlandieri*). These materials, which date to around 1000 B.C., provide evidence for the dietary role of domesticates before food production acquired central subsistence importance. The feces also contain fibres, some of which display features similar to bast or phloem fibres used to produce textiles. Symbiotic relationships between humans and other animal species occupying rockshelters are suggested by anthropod remains and the occurrence of cultigens in feces of possible nonhuman origin.

Sybille HAEUSSLER, Skeena Forestry Consultants, RR #2, Site 81 C-2, Smithers, B. C. V0J 2N0

BURNING BY ABORIGINALS AND THE MAINTENANCE OF GRASSLAND/STEPPE ECOSYSTEMS IN NORTHWESTERN BRITISH COLUMBIA (POSTER)

The biological diversity of any region is the result of both natural and anthropogenic processes. In Canada, there is relatively little awareness that Indigenous peoples have long played an important role in shaping their environment through land use practices such as burning. In a sparsely populated region such as northwestern B.C., burning by aboriginals may have helped to maintain plant and animal populations that would otherwise have been lost as a result of climate change.

One example is the grassland/steppe ecosystem that today occupies isolated south-facing hillsides from the Nechako Plateau, along the Bulkley Valley and the shores of Babine Lake, to Kitwanga and Telegraph Creek. This vegetation type was probably much more widely distributed during the period of warm, dry climate (the "Xerothermic") that followed the retreat of continental glaciers some 10,000 years ago. I hypothesize that periodic spring burning by aboriginals around village sites and camps has played an important role in allowing grassland/steppe ecosystems to persist through subsequent periods of cooler, wetter climate. Without human intervention, many of these ecosystems would have reverted to forest. The rare and unusual plant and animal species that occupy them would have been lost to northwestern B. C.

Regular burning in the early spring allows the grassland/steppe biota to survive because it maintains the open, sunny conditions they require, while at the same time not causing much damage because fire severity is low. Infrequent, lightning-caused fires are more destructive because there is greater fuel build-up between events and the fires are more severe. With a few exceptions (on Indian reserves), the grassland/steppe ecosystems have not been burned regularly for several decades because of fire suppression policies and public attitudes against burning.

Richard HEBDA, Royal British Columbia Museum, Victoria, B.C. V8V 1X4, and **Nancy J. TURNER,** Environmental Studies Program, University of Victoria, PO Box 1700, Victoria, B. C. V8W 2Y2

USE OF BARK MEDICINES BY COASTAL INDIGENOUS PEOPLES OF NORTHWESTERN NORTH AMERICA (POSTER)

Bark comprises the most important botanical ingredient of the pharmacopoeia of Indigenous peoples of coastal northwestern North America. Bark uses of 51 woody species including 10 coniferous trees, 15 angiosperm trees, and 26 angiosperm shrubs and vines have been recorded. Of conifers, 10 of 13 species yielded bark for medicines. *Tsuga heterophylla* (western hemlock) was most widely used for purposes ranging from eye and digestive problems to venereal diseases, and as heart and circulatory aids. *Abies* spp.(firs) were widely used too, especially for respiratory problems. *Picea sitchensis* (Sitka spruce), *Pseudotsuga menziesii* (Douglas-fir), and *Pinus contorta* (lodgepole pine) were also widely employed. Among angiosperm trees most important were: *Alnus rubra* (red alder), *Arbutus menziesii* (arbutus), *Malus fusca* (Pacific crabapple), and *Prunus emarginata* (bitter cherry). The efficacy of *Rhamnus purshianus* (cascara) with respect to digestive complaints was widely recognized, making it the most popular bark medicine from an angiosperm tree. The bark of *Oplopanax horridus* (devil's club) had more medicinal applications (at least 63) than any woody species on the coast. Indigenous peoples treated a wide range of maladies with this plant including problems of the respiratory, digestive, reproductive, and skeletal systems. *Sambucus racemosa* (red elder) was another widely used shrub species. Our analysis suggests that Indigenous people had a thorough knowledge of the medicinal value and application of the numerous woody species of the region.

Eugene S. HUNN, Department of Anthropology, University of Washington, Seattle WA 98195

LUSHOOTSEED SHELLFISH CLASSIFICATION AND NOMENCLATURE

I summarize what is known of Lushootseed/Puget Salish shellfish terminology. The legal issue of Native shellfish harvest rights under treaty provisions in western Washington State is currently in litigation. The cultural value and economic role of shellfish is at issue in these deliberations. I assess the relationship between documented linguistic recognition of shellfish taxa and ethnographic, ethnohistoric, and archaeological evidence of the value of shellfish to Puget Sound Indian peoples at treaty time. More than 25 named taxa have been re-

corded, the majority for bivalve mollusks, which is more than half the number of finfish taxa recognized. Lushootseed naming closely approximates the scientific species level for all relatively large, widely distributed local shellfish species. Anomalies in the correlation of linguistic distinctions with midden frequencies are attributed to biologically and culturally patterned harvest practices.

Chief Ronald IGNACE, Chief, Skeetchestn Band, Savona, B.C. and President, Secwepemc Cultural Education Society, 345 Yellowhead Highway, Kamloops, B.C. V2H 1H1

TRADITIONAL LAND AND RESOURCE RELATIONSHIPS OF THE SECWEPEMC PEOPLE

Traditional ecological knowledge and its role in determining resource management for hunting, fishing, and gathering will be discussed. The role of narrative and discourse in perpetuating traditional knowledge will also be presented, with examples of stories illustrating ecological knowledge. Chief Ignace's presentation will provide first hand evidence of past and on-going strategies for sustainable resource use. He is joined by Secwepemc elders Mary Thomas, Nellie Taylor, and Christine Simon.

Marianne B. IGNACE, Secwepemc Cultural Education Society, 345 Yellowhead Highway, Kamloops, B. C. V2H 1H1

MORE THAN THE SUM OF THE PARTS: SOME REFLECTIONS ON SECWEPEMC DISCOURSE ABOUT PLANTS

In ethnobotanical usage, aboriginal knowledge about plants is usually presented in terms of taxonomies or "types" of plant use, often accompanied by, or organized as, sets of charts and tables. Jack Goody has alerted us to the extent to which writing and the construction of tables of opposites reduces oral complexity to graphic simplicity, with the result that complex statements of interrelationships about humans, animals, plants, and the rest of the environment are frozen into systems of permanent oppositions. Such analysis may simplify reality for the observer, but does so at the expense of an understanding of the aboriginal philosophy of knowledge.

In this paper, I will examine what may be appropriate ways of eliciting and organizing knowledge about plant use, based on examples from a Secwepemc ethnobotany project. The issue of eliciting knowledge itself will be discussed, as will be the presentation of plant knowledge by Native elders in the form of oral narratives which present knowledge about plants and plant ecology within the context of Indigenous ways of knowing and explaining the natural environment.

Colleen JONES, Department of Anthropology, University of Victoria, Victoria, B. C. V8W 2Y2

USING LOCAL AND INDIGENOUS KNOWLEDGE IN THE DESIGN OF AN AGRICULTURAL DEVELOPMENT PROJECT

Since 1987 when the Brundtland Commission called for the use of Indigenous people's knowledge to meet their needs in development projects throughout the

developing world, numerous authors have supported the importance of this task. Unfortunately, few have offered suggestions or models on *how* to do this. In this paper, using a cultural ecology perspective, I discuss three methods of gathering local and/or Indigenous knowledge necessary to design an appropriate development plan. These methods are: the use of general systems diagrams of the cultural and social linkages with agricultural pursuits, decision-making models of the individual's influence on crop choices and land uses, and traditional ecological knowledge (TEK) regarding their understanding of the unseen interconnections between environmental components. Together, these methods of gathering Indigenous knowledge can help to provide the vital socio-cultural and ecological-linked information necessary to design a project suited to those particular people's needs.

Frank Andrew JONES and David L. GORCHOV, Department of Botany, Miami University, Oxford, Ohio 45056

ECOLOGICAL AND HUMAN FACTORS INFLUENCING POPULATION DENSITIES OF THE UNDERSTORY PALM (*Chamaedorea radicalis*) IN THE "EL CIELO" BIOSPHERE RESERVE, TAMAULIPAS, MEXICO (POSTER)

The leaves from several species of the palm genus *Chamaedorea* are harvested throughout Mexico and Central America and used as floral greenery locally and in the United States and Europe. *Chamaedorea radicalis* grows throughout the mountainous regions of Mexico and is harvested by *campesinos* in the "El Cielo" Biosphere Reserve. While the perennial harvesting of palm leaves by local *campesinos* represents a major external source of income for many people, effects on local palm populations have not been studied.

The study was undertaken in montane cloud forests, near the village of San Jose (population 30). We investigated the abiotic, biotic, and anthropogenic factors influencing local population densities of *C. radicalis*. *C. radicalis* has been listed as a vulnerable species in Mexico, indicating that it may become endangered if the assumed causal factors of its decline, deforestation and overexploitation, continue. Plant densities ranged from 0 to 35,000 palms/ha, with a mean of 9,100 palms/ha. A multivariate analysis of the important abiotic, biotic, and human factors and their effect on palm populations will be presented. Because the plant is not killed during the harvest process and subsequent leaves grow from previously harvested plants, human exploitation may not pose a direct threat to populations of *C. radicalis*. Management strategies employed by local *campesinos* will be discussed as well.

Elaine JOYAL, Department of Botany, Arizona State University, Tempe, AZ 85287

TRADITIONAL RESOURCE MANAGEMENT AND CONSERVATION BIOLOGY: AN ETHNOECOLOGICAL CASE STUDY FROM SONORA, MEXICO

Traditional resource management (TRM) can be defined as the management of natural resources by traditional people, i.e., indigenous and local people not trained in Western scientific methods. A combination of quantitative ecological and ethnographic methods may prove effective in evaluating TRM and thus lead to more rapid assessment of the conservation status of poorly-known but economically important species.

Sabal uresana Trelease is the most valuable and widespread of six palms native to northwest Mexico. It is an important nontimber resource, its leaves being used for weaving and thatching. *S. uresana* is thought to be overexploited and is listed as "rare" by the Mexican government. Populations typically have few seedlings, many juveniles, a few immatures, and some adults. Individuals are slow-growing and long-lived. Experimental manipulations to simulate harvest reduced leaf production. TRM consists of controlling harvest times and levels, choice of leaf age and palm size, and "sparing." Reasons stated for these practices were that they produced the best fiber or were practical. A preliminary model predicted that populations are sustainable, as uneven as their size-class distribution appears.

Characteristics that make for good quality fibre also make for good management. Because such practices seem to be little more than common sense, they are likely to be overlooked and forgotten as a result of acculturation and changing market demand. TRM, developed in a subsistence economy and combined with Western scientific methods, may offer the best approach to future management of wild plant resources made scarce by changing cultures and economies.

Dana LEPOFSKY, University of California, Berkeley, CA; Home address: 4553 Raeburn Street, North Vancouver, B. C. V7G 1K3

PREHISTORIC HUMAN-INDUCED ECOSYSTEM CHANGES AND AGRICULTURAL PRODUCTION IN THE OPUNOHU VALLEY, SOCIETY ISLANDS

Human-induced ecosystem changes played a central role in the development of prehistoric agriculture in many Pacific Islands. I test a model of the relationship between human-induced geomorphic and vegetation changes and the development of agricultural production in the Opunohu Valley, Society Islands, French Polynesia. Stratigraphic profiles, sediment analyses, and the identification of charred plant remains are used to examine predictions of the model. The results suggest a long history of human modification to the Opunohu landscape. Prehistoric agricultural production was both instrumental in causing these changes and was profoundly effected by the resultant modifications to the landscape.

Walter S. LEWIS, Department of Biology, Washington University, St. Louis, MO 63117

GOALS OF THE INTERNATIONAL COOPERATIVE BIODIVERSITY GROUPS

The unifying theme of this new U.S. Government-sponsored program is the belief that the discovery and development of pharmaceuticals from natural products can, under appropriate circumstances, promote sustained economic growth in developing countries while conserving the biological resources from which these products are derived. Aspects include the utilization of traditional medicine, development of long-term strategies to ensure sustainable harvesting, biodiversity surveys, and graduate student training. Intellectual property agreements exist among participating institutions so that economic benefits from pharmaceutical discoveries can be equitably shared with local communities and

Indigenous peoples involved in the ethnomedicinal use of specific natural products. The five groups awarded grants will be briefly outlined, and the award made to the Washington University (St. Louis) group described in more detail.

Edelmira LINARES and Robert BYE, Jardín Botánico, Instituto de Biología, Universidad Nacional Autónoma de México, Apdo. Post. 70-614, 04510 México, DF
MANAGEMENT INTENSIFICATION OF *ARNICA* (*Heterotheoa inuloides*; ASTERACEAE)—A NATIVE MEXICAN MEDICINAL PLANT (POSTER)

Arnica has a long tradition in Mexico as a remedy for skin and gastrointestinal ailments. The popularly recognized effectiveness of infusions of the flowers and leaves has led to an increased demand upon this perennial plant of the forests of central Mexico. Until recently, *arnica* was sold in the markets as fresh herbs only during the rainy season and as dried plants during the remainder of the year. Due to increased demand, some plant collectors have initiated the cultivation of this herb in order to provide fresh material throughout the year.

Although this species has evolved two modes of sexual reproduction based upon their dimorphic fruits, which assures its successful establishment in disturbed habitats, the Mexican farmers prefer vegetative propagation using the underground offshoots (rather than seed germination which requires greater cultivation time to produce large plants). Home gardens provide the initial site of production, and now some farmers are converting their *milpas* (traditional maize-bean-squash fields) to cultivated parcels of medicinal plants. This change in plant resource management and land use reflects not only increased economic benefits from this class of specialty crops, but also the broadening market for raw vegetal material used in traditional teas and washes, as well as for novel products such as skin creams and dental powders.

Lisa MEEKISON, Department of Anthropology, University of Alberta, Edmonton, Alberta T6G 2H4
LIVING LANDSCAPES: APPLYING MODELS FROM ETHNOBIOLOGY TO ECOLOGICAL RESTORATION

Ecological restoration is the practice and process of restoring ecosystems that have been damaged by development, the intrusion of exotic species, or any other factors that may have compromised the ecosystem's health and integrity. Restoration projects are underway all over the world, and in North America, local communities, government agencies, corporations, and academics and volunteers are attempting to heal damaged prairies, wetlands, rainforests, and so on.

Restoration is still a new dicipline, however, and such aspects as its definition, methods, and goals are still being debated. For example, is ecological restoration best understood as an art or a science? Should restorationists be certified professionals, or can the work be left open to those who live close to the land in question? Can we rely on "technological fixes" and Western science for our models of restoration, or do restorationists neeed to look elsewhere for information and ideas?

The above questions raise the point that we need to broaden the scientific practice of ecological restorstion to include issues of culture; we need to recognize that nature and restoration are cultural categories. One of the major implications of this point is that the input from different cultures may lead to a wide array of methods and goals in restoration. While I believe this aspect of restoration to be fundamentally promising, there is a danger that, given existing power dynamics, Native American sciences and ecological knowledge, as well as other "alternative" systems of knowing the world, will be excluded from, or marginalized within, restoration practice.

Daphne NASH, Human Sciences, Department of Geography, Australian National University, 57 Wilshire Street, Dickson ACT 2602, Australia
ABORIGINAL GARDENING IN CENTRAL AUSTRALIA

Most observers have regarded Australian Aborigines as hunter-gatherers who merely appropriate their resources from the environment. In an examination of modern plant resource management in three Central Australian Aboriginal communities, my field studies demonstrate the use of various gardening techniques. These techniques are more commonly associated with regimes of plant management other than hunting and gathering.

There are two kinds of gardens: 'bush-gardens' and 'home-gardens.' In the bush-gardens, people continue traditional management practices, including digging, sowing, transplanting, thinning out, and burning to promote their indigenous plant resources. In the home-gardens, both indigenous and exotic species are managed not only for food and shade but to maintain connection with traditional country and culture. So, although European fruits and vegetables may be part of the garden planting, they are not the main reason for its existence.

Continuity of ideas and practices are reflected in people's choice of their food and other resources, which suggests that they are motivated by social and cultural reasons and not solely by biological survival. In both garden locations, culturally significant species are planted, protected, and/or encouraged in ways that are readily recognized as gardening when used by other cultural groups, but rarely recognized as such in Aboriginal Australia. There are strong social and cultural motivations for people to maintain their relationship with their traditional resources and for the people of Kintore, New Bore, and Mt. Liebig, gardening represents one aspect of this complex system of resource use.

M. NATHAN, E. FRATKIN, K. SMITH, Department of Anthropology, Pennsylvania State University, University Park, PA. 16802, and **E. ROTH,** Department of Anthropology, University of Victoria, Victoria, B. C. V8W 2Y2
SEDENTISM AND CHILD HEALTH AMONG RENDILLE PASTORALISTS OF NORTHERN KENYA

Recurrent drought and concomitant livestock loss forced many formerly nomadic Rendille pastoralists to increasingly adopt sedentism. Today sedentary subsistence patterns range from cattle and milk marketing, through dependence on food aid, to irrigation agriculture. To delineate the consequences of these changes for child health, a 1992 survey of five Rendille communities collected morbidity, dietary, and anthropometric data for children under seven years of age.

Conducted during the most difficult time of the traditional Rendille annual cycle, the end of the dry season, these data assess patterns of childhood disease and nutrition for diverse sedentary strategies in relation to a still nomadic Ariaal Rendille population sample. In addition, they provide comparisons for previously collected wet season data for the same communities. Results are discussed in relation to anthropological and economic literature linking sedentism with increased childhood morbidity and deteriorating nutrition.

Irene OCKENDEN, Biology Department, McMaster University, 1280 Main Street West, Hamilton, Ontario L8S 4K1

INTERNAL STRUCTURE AND COMPOSITION OF ARCHAEOLOGICAL SEEDS (POSTER)

Seeds of both cultivated and wild plants make up the bulk of plant remains found in middens and features of southern Ontario archaeological sites. Corn kernels are found more frequently than seeds of the other four cultigens: beans, squash, sunflower and tobacco. All the recovered seeds are black and brittle and are believed to be charred. However, study of the internal structures of the preserved seeds shows considerable variation in both morphology and elemental composition suggesting that despite being in the same area, the seed matrix was differentially affected. For example, intact corn kernels had reddish embryos which contained iron while the endosperm was black and had no iron. Bean cotyledons had areas of solid matrix rich in calcium with hollow areas lined with inclusions made up of calcium and phosphate. Bean matrix was reduced in density by mineral acid while equally dense areas of corn kernels were not affected. The preserved squash and sunflower seeds did not have the thickened matrix and so retained a more distinctive cellular structure. Wild plant seeds also varied in their internal structures. There is still reasonable doubt about the damage that may be caused by flotation despite the fact that small seeds can only be recovered using flotation. The differences in structure, density, and composition of seeds from the same areas suggests that more study is needed to determine the fragility of the preserved specimens under various procedures for their recovery.

PACIFIC FORESTRY CENTRE, 506 Burnside West, Victoria, B. C. V8Z 1M5

THE FIRST NATIONS WOODLANDS PROGRAM (POSTER)

Guy PROUTY, Department of Anthropology, University of Oregon, Eugene, Oregon 97404

PALEOETHNOBOTANY IN THE FORT ROCK BASIN, OREGON: SETTLEMENT AND SUBSISTENCE INTENSIFICATION IN THE BOULDER VILLAGE UPLANDS

Research currently underway examines interrelationships between economic plants and the subsistence/settlement strategies practiced in the Fort Rock Basin over the last 1500 years. Specifically, I wish to examine how the distribution and productivity of traditional Northern Paiute and Klamath/Modoc plant foods, such as biscuitroot (*Lomatium* spp.) and other species, affected the development and spatial distributions of semisedentary villages and seasonal plant collection and processing sites. The research is focused on Boulder Village, the largest village of its kind in the Northern Great Basin, with over 100 pithouses and numerous cache pits thought to store geophytic roots. Ethnographic modelling, aerial photo interpretation, pedestrian plant survey, and paleoethnobotanical analyses will be discussed as techniques for understanding these relationships. Finally, a model of population pressure and environmental change will be presented as possible reasons for intensification in the Boulder Village uplands.

Elizabeth J. REITZ, Museum of Natural History, University of Georgia, Athens, GA 30602-1882

CHANGES IN AGE AND GROWTH OF ATLANTIC CROAKER RELATED TO SPANISH COLONIZATION IN THE SIXTEENTH CENTURY (POSTER)

Comparing age and growth data from archaeological contexts at St. Augustine, Florida, with data from modern Atlantic croaker (*Micropogonias undulatus,* Perciformes: Sciaenidae) suggests the maturation and growth habits of these marine fish have changed dramatically. Comparing incremental growth rings of fish otoliths deposited prior to the sixteenth-century Spanish colonization of the Florida peninsula with First Spanish Period and modern catches indicate that croaker grew more slowly and lived longer prior to the sixteenth century than they did during the eighteenth century or today. These differences suggest a species whose rates of exploitation have increased; although climatic variation may be another explanation.

E. M. RITCH-KRC, College of New Caledonia, Prince George, B. C., V2N 1P8, **S. THOMAS,** Herbalist and Elder, Stoney Creek Reserve, Vanderhoof, B. C., V0J 3A0. **N. J. TURNER,** Environmental Studies Program, University of Victoria, Victoria, B.C., V8W 2Y2, and **G. H. N. TOWERS,** Department of Botany, University of British Columbia, Vancouver, B. C., V6T 2B1

HERBAL MEDICINE OF THE CARRIER PEOPLE OF NORTHCENTRAL BRITISH COLUMBIA

This presentation documents some traditional and contemporary knowledge of the medicinal properties of plants used by the Carrier people of British Columbia, as well as their traditional use of the land and these plant resources. Important medicinal plants include: *Abies lasiocarpa, Alnus incana, Arctostaphylos uva-ursi, Artemisia frigida, Fragaria virginiana, Juniperus communis, Picea glauca, Pinus contorta, Populus tremuloides, Rubus idaeus, Salix* spp., and *Shepherdia canadensis.*

The antimicrobial properties of some of the traditional herbal preparations were evaluated using the agar dilution method. Pitch preparations were screened against known human pathogens: *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans,* and *Aspergillus fumigatus.* The results indicated definite antimicrobial activity in the pitch preparations of *Picea glauca* and *Pinus contorta* and provide a starting point for the pharmacognostic evaluation of these plants. In addition, cytoxicity assays, to test the anticancer activity of methanolic extracts of *Alnus incana* and *Shepherdia canadensis* against mouse mastocytoma cells, were positive.

Kristin T. RUPPEL, Idaho State University, 355 N. Lincoln, Pocatello, Idaho 83209
INDIGENOUS USES OF SOME INTRODUCED PLANT SPECIES AMONG THE NORTHERN SHOSHONE AND BANNOCK OF SOUTH-EASTERN IDAHO: A PRELIMINARY STUDY (POSTER)

The ways in which plant species are incorporated into new natural and cultural environments are explored in terms of a few species that, in historic times, have gained prominence in the Shoshone/Bannock ethnobotanical repertoire. The Snake River plain of southeastern Idaho in presettlement times supported a delicately balanced native plant community in a harsh, cold desert environment. However, since at least the mid-1800s, the native floral composition of some parts of this desert has been completely altered through a combination of environmental disturbances and the intentional or accidental introduction of exotic species. Whereas a few of these exotics are verifiably noxious (i.e., Russian thistle, tumblemustard, and cheat grass) others have harmlessly filled niches in both the natural and cultural environments of the region. The focus of this preliminary study is on the natural and cultural history of a few of these "friendly" invaders.

Enrique SALMÓN, The Heard Museum, 22 East Monte Vista Road, Phoenix, Arizona 85004
BIOREGIONAL EFFECTS ON LEXICAL DEVELOPMENT

Past approaches towards the topic of environmental effects on language have split over whether or not taxonomies and lexicons are a result of the human recognition of the "discontinuities" of nature in gross morphological form, or from human adaptation to, and recognition of, environmental utility. Although contradictory, both approaches imply that lexicons are a result of a human need to categorize biodiversity; that humans act upon an inactive bioregion to categorize it. Bioregions, however, have not been passive bystanders during human lexical evolution. On the contrary, they are active participants in human lexical development. Bioregional members influence what humans will perceive and, therefore, what will be categorized. This occurs after humans have settled into a bioregion. Soon they begin to relate to and identify the surrounding diversity. The resulting lexicon can only identify what is there.

In the Sierra Tarahumara of Chihuahua, Mexico, live the Rarámuri-speaking people. Their language consists of several dialects, all of which are interrecognizable. Still, some lexical variation occurs due to which part of the mountains or the deep Barrancas a group might inhabit. Based on my field studies, I will demonstrate that a community of mountain-inhabiting Rarámuri maintain no lexicon for poisonous plants. This is because no toxic plants share their rugged bioregion. The mountain folk suggest, however, that those that live in the Barrancas have words for poisonous plants since there are many such plants growing there.

This paper neither contradicts nor supports the intellectualist and utilitarian approaches to lexical development but suggests that cognitive/linguistical studies must search beyond human-centered approaches to language and consider humans as part of a larger complexity.

C. Margaret SCARRY, Department of Anthropology, University of Kentucky, 101 American Building, Lexington, KY 40503

HOUSEHOLDS, STORAGE, AND FOOD PLANTS AT THE TURNER SITE IN SOUTHEAST MISSOURI (POSTER)

The Turner site, located in southeast Missouri, was a late prehistoric (AD 1300) village composed of about 45 households. The village was built and occupied for about 5–10 years by people whose culture we classify as Mississippian; they were agriculturalists and their society was hierarchically organized. In the late 1960s and early 1970s, archaeologists from the University of Michigan excavated virtually all structures and associated features at the Turner site. These excavations produced an unprecedented wealth of information about community organization and about the nature and distribution of material goods and subsistence remains at the site. Since the village had burned, food plant remains were exceptionally well preserved. The site was excavated when flotation was still in its infancy and only a small fraction of floor deposits and pit fill was processed by flotation. While small food remains are undoubtedly missing from the archaeobotanical assemblage, the collection contains immense quantities of both by-products of food processing (e.g., nutshells and maize cobs) and stored foodstuffs (e.g., nutmeats and harvested crops). In this paper, I discuss the food plants that were major elements in the diets of the residents of the Turner site. I then examine the distributions of edible plant parts and food by-products across the site. This allows me to make some observations about the locations of food processing areas and storage facilities vis à vis households and groups of households.

G. K. SHARMA, Biology Department, University of Tennessee, Martin, TN 38238

ETHNOMEDICINAL SIGNIFICANCE OF *Taxus baccata* L. IN THE HIMALAYAS (POSTER)

The Himalayas are a treasure-trove of medicinal plants, and the Himalayan yew (*Taxus baccata* L.) is one of the most useful medicinal plants in the area. It grows in a wide variety of microhabitats ranging from the subhumid eastern Himalayas to the high elevation of 4,000 m and above in the western Himalayas. It is used for a wide variety of medicinal purposes by the inhabitants of the area. Its use in controlling skin tumours has gained momentum in the last few years, although ancient scriptures of the area confirm its utilization in prehistoric times. It has been suggested that the relatively warm and humid habitat populations of this taxon are the most potent in the production of taxol, which is used for its medicinal properties.

Leaf samples of several populations of this plant species were collected from a wide variety of habitats in the Himalayas to study the cuticular dynamics of various populations of the taxon. Furthermore, the cuticular analysis has been completed to develop a relationship between the cuticular dynamics and the biodynamics of the plant. Ethnomedicinal data have been thoroughly investigated for a complete understanding of the relationship.

Florence SHIPEK, 2932 Lawrence Street, San Diego, CA 92106
FREE GOOD OR UNRECOGNIZED PAYMENT?

A debate has been initiated about the translation of a supposedly "free good," or the Indigenous knowledge of herbal medicine, into a commercial "paid good," or medicinal drug in the developed or mechanized world. How are Indigenous rights to be protected in the commercial world? An additional question is, "Was it a 'free good', or general knowledge in the Indigenous world, or was it the specialized knowledge of a healer, for which a payment was made, but the 'coin of the realm' was not recognized by an outside observer?" By general knowledge, I mean knowledge such as that in seventeenth century Europe wherein most villagers knew that willow bark tea eased pain. The medicinal practitioner was only called for something the willow could not ease; much later a pharmaceutical company isolated the active factor and produced aspirin. The medicinal practitioner was paid in some way for the specialized knowledge of healing herbs for specific problems. Among the southern California tribes, the same dichotomy existed between generalized knowledge held by all and specialized knowledge, held specifically by a healer. Persons holding such specialized knowledge were paid for its application by the family of the patient. Indigenous rights must be protected, both at tribal and individual levels. Care must be taken to recognize and acknowledge all levels of knowledge.

Evelyn Vicky SIEGFRIED, Department of Archaeology, University of Calgary, 2500 University Drive N.W., Calgary, Alberta T2N 1N4
ETHNOBOTANY OF THE NORTHERN CREE OF WABASCA/DESMARAIS, ALBERTA (POSTER)

During the summers of 1992 and 1993, field research was conducted on the ethnobotany of northern Cree people from the community of Wabasca/Desmarais. Although this community has been missionized since the turn of the century, many people continued to live in the surrounding regions and practiced more traditional lifestyles. The community has become less isolated since the 1960s, when an all-weather road was constructed that was finally completely paved during 1993. Throughout the last three decades, much of the traditional knowledge and practices of people within the community have ceased to be carried on. One of the goals of this ethnobotanical study was to collect traditional knowledge specific to the community before it is lost forever as Elders, who still remember the past lifestyle, pass away. Though much has been lost already, information recorded provides an interesting perspective on what life was like in the past for people living off the local resources that the boreal forest can provide. Far from being a generic, vegetational realm, the boreal forest in northern Alberta is a dynamic, ever-changing environment, requiring extensive knowledge of the landscape as well as the plant and animal species living upon it. The entire region of northeastern Alberta has been neglected for environmental research of any kind. This study represents an initial foray into one community; hopefully others will follow.

Information gathered during fieldwork included specific knowledge of the use of plants both in the present and past. Elders were consulted in informal interviews that were tape-recorded; notes were taken as well. None of the Elders consulted will be specifically identified in the study. Information on approximately 60 plants provided some 120 different uses. Many plants had multiple uses identified, as in the cases of white spruce (*Picea glauca*) and paper birch (*Betula papyrifera*). Names of plants were recorded in Cree and transcribed in the International Phonetic Alphabet (IPA), which provides data for comparative studies with other Cree ethnobotanical research.

Daisy SEWID-SMITH, Mamaliliqala Tribe, Village Island, B.C., and First Nations Education Department, School District No. 72, 425 Pinecrest Road, Campbell River, B.C. V9W 3P2
CEDAR: THE SACRED TREE

As a K^{w}agulh historian, an elder, and descendant in a family of culturally active people, Daisy Sewid-Smith is a trained orator. She will be explaining and interpreting the performance of the K^{w}agulh Dancers of the sacred Red-Cedar Bark Ceremonial Dance, in which the origins of her people, and their ancient association with the western red-cedar tree (*Thuja plicata*), are re-enacted in a special series of dances. The significance of the different motions and sequences of the dance, and of the masks and costumes being used, will be explained, and the roles of the different dancers interpreted. Daisy Sewid-Smith is joined by members of her extended family from different corners of the K^{w}agulh nation who have rights and privileges and knowledge to participate in, and demonstrate aspects of, the Red-Cedar Bark Ceremony; Chief Adam Dick, Kim Recalma-Clutesi, Chris Cook III, and George Shaughnessy.

Jan TIMBROOK, John R. JOHNSON, Department of Anthropology, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road, Santa Barbara, CA 93105, and **Demorest DAVENPORT,** Department of Biological Sciences, University of California, Santa Barbara, CA 93106
MYSTERY OF THE "LITTLE MONSTERS" (POSTER)

In his 1929 book, *Prehistoric Man of the Santa Barbara Coast,* David Banks Rogers reported that "peculiar marine growths, like effigies" had been discovered in excavations on Santa Cruz Island, the largest of the Northern Channel Islands located off the coast of southern California. Rogers inferred from their archaeological context that these unusual objects had been regarded as talismans and catalogued them under the name "little monsters." For 65 years they lay unidentified in the collections of the Santa Barbara Museum of Natural History, their faunal source a mystery. This paper reports on our research into the origin of the "little monsters" and discusses their significance to the native Chumash people of the Channel Islands.

Mollie S. TOLL, Museum of New Mexico, Office of Archaelogical Studies, Box 2087, Santa Fe, NM 87504

BOTANICAL INDICATORS OF EARLY PREHISTORIC LIFE IN CHACO CANYON AND THE TOTAH, NORTHWEST NEW MEXICO

Botanical studies at sites early in the Chaco sequence provide some particularly interesting details in the emerging picture of economic life in northwestern New Mexico. Perhaps the most salient aspect of wild plant use is its general consistency from one era to the next, focussed on weedy annuals with both edible greens and tiny seeds. Some noteworthy differences between Chaco and other nonriverine areas of the central San Juan basin, and sites in the San Juan and La Plata river valleys, suggest differing approaches to coping with population pressure.

Farming was a vital part of Basketmaker/early Pueblo economic life in Chaco, as shown by some of the largest corn recovered from Chaco small sites, and bean and squash seed morphometrics consistent with specimens from later periods. Row number patterns give evidence that early Chaco farmers may have been dealing with a different genetic strain.

Both construction and firewood show early utilization of conifer species from the central basin (piñon, juniper, and some ponderosa pine). The Pueblo II era in Chaco shows considerable pressure on local resources, with local conifers at their lowest levels for fuel. From this period, as building progresses rapidly and population levels also presumably increase, there is compelling evidence that Chaco beams came increasingly from mountain forests outside the San Juan Basin. The shrub component of fuelwood decreases in quantity and diversity over time, while piñon and juniper increase, suggesting that firewood may also have been imported late in the Chaco sequence.

Gail WAGNER, Department of Anthropology, University of South Carolina, Columbia, SC 29208

SEQUENCES OF PLANT UTILIZATION ALONG THE SOUTH ATLANTIC COAST: A PALEOETHNOBOTANY OF SOUTH CAROLINA

A moderately detailed sequence of plant utilization has been worked out for parts of the midcontinental U.S.A. The record begins with the use of probably wild gourds and squash as early as 7000 years ago. Through time we can trace the development of domesticated sumpweed, squash, gourd, chenopod, sunflower, corn, tobacco, and beans, and record the cultivation or encouragement of plants such as maygrass, erect knotweed, little barley, sumac, and maypops.

A growing number of studies illustrate that this sequence was far from uniform across the south and southeast. A lack of concerted recovery efforts, the scattered nature of the evidence in poorly distributed contract reports, and perceived poor preservation have hindered the development of a plant utilization sequence along the South Atlantic coast. In this paper I summarize the botanical record from sites in South Carolina.

Steven A. WEBER, Department of Anthropology, Franklin and Marshall College, Lancaster, PA 17604

IS *Chenopodium album* A MILLET? A QUESTION OF CLASSIFICATION (POSTER)

In modern botanical classification schemes, *Chenopodium* is not placed in such popular seed grain categories as millets, even though it shares many physical features. Ethnoarchaeological and palaeobotanical data from South Asia suggest that such formal categories may not be the best guide to the choices and practices of prehistoric peoples.

Elizabeth S. WING, Florida Museum of Natural History, Gainesville, FL 32611-2035

LAND CRABS IN CARIBBEAN PREHISTORY

The remains of land crabs, in the family Gecarcinidae, are abundant in early ceramic age sites in the Caribbean but are rare in later ceramic period sites. This faunal change through time was first described by Rainey in 1940 and noted many times subsequently. The cause for this change is still debated. Sequences of faunal data from the Maisabel site in northern Puerto Rico, reported by deFrance in 1988, the Tutu site on St. Thomas in the Virgin Islands, and the Hope Estate site on St. Martin in the Lesser Antilles provide evidence for this faunal change. These data support overexploitation by early ceramic age people as one of the causes for the decline in use of land crabs. Other factors will be discussed.

Sandy WYLLIE-ECHEVERRIA, Research Analyst, School of Marine Affairs, University of Washington, Seattle, WA 98195, and **Eugene S. HUNN,** Department of Anthropology, University of Washington, Seattle, WA 98195.

TRADITIONAL SEAGRASS USE (POSTER)

Two genera of seagrasses (*Zostera* spp. and *Phyllospadix* spp.) grow in the coastal waters of the Northeast Pacific (30o N. Lat. to 60o N. Lat.). *Phyllospadix* spp. grows on the rocky, wind swept coasts, while *Zostera* spp. is commonly found in the soft-bottoms of estuaries and coastal lagoons. Both genera were used for food, technology, and, to a limited extent, medicine by coastal native groups. Seagrasses also provide shelter and substrate for other human food (e.g., Pacific herring, *Clupea harengus pallasi*, and Dungeness crab, *Cancer magister*). In addition, these plants are grazed by the green turtle, *Chelonia mydas*, once an important food resource for the Seri in the coastal deserts of Sonora, Mexico.

The interaction between people, prey, and seagrass has been described by ethnobotanists at several locations. There are, however, locations where use might be expected and, even though other marine flora growing within the "seagrass zone" are used, no seagrass use is reported. We present a catalogue of reported seagrass use in the Northeast Pacific and discuss the implications of the resulting pattern.

Melinda A. ZEDER, Laboratory of Archaeobiology, Smithsonian Institution, MRC 112, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560

POST-NEOLITHIC SUBSISTENCE IN NORTHERN MESOPOTAMIA FROM 6000 TO 2500 B.C.

Recent studies have demonstrated a far greater diversity in the pathways to food production world-wide than predicted by traditional views of Neolithic Revolution. It is not surprising, then, that archaeologists are also finding that the times after the Neolithic Revolution do not conform to earlier conceptions that saw agriculture as either a technological blessing or an environmental blight that locked people into an economy based solely on domestic resources. A fine-grained study of subsistence from several communities in the Khabur Drainage of Northern Mesopotamia, dating from the eighth to the fourth millennia B.C., has revealed a remarkable degree of flexibility in post-Neolithic subsistence economies. This is especially the case in marginal areas where both domestic and wild resources were exploited in unique and individualized ways. Only in the third millennium with development of urbanism are the eclectic subsistence strategies formerly practiced in this fragile environment replaced by a more "conventional" agro-pastoral economy based solely on domestic plants and animals. This study has immediate implications for our understanding of the economic and ecological impact of the origin and intensification of agriculture in the land of the first farmers and earliest kings.

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NEWS AND COMMENTS

COMMENTS and **RESPONSES** to articles; **OPINIONS; REQUESTS FOR INFORMATION;** and notes on **COURSES AND DEGREES IN ETHNOBIOLOGY, PAST AND FUTURE MEETINGS, FOUNDATIONS AND GRANTS,** and **PROJECTS, PROGRAMS, AND NETWORKS** may be submitted to the News and Comments editor. Because the *Journal* is published only twice a year, dated items must be received at least six months in advance of the event.

OPINIONS

Readers are invited to submit articles of less than 500 words that comment on the applied aspects of ethnobiological research or other issues of concern to ethnobiologists. Opinion pieces are selected and edited by the News and Comments editor but are not sent for outside review. The opinions expressed are those of the author(s) and do not necessarily reflect the policy of the Society of Ethnobiology, the *Journal of Ethnobiology,* or its editors.

ETHNOECOLOGY AND POSTMODERNISM: FRIENDS OR FOES? by Gary J. Martin, *People and Plants Initiative, Division of Ecological Sciences, Man and the Biosphere Program, UNESCO, 7, Place de Fontenoy; 75352 Paris, CEDEX 07 SP FRANCE*

With the publication of *Higher Superstition: The Academic Left and its Quarrels with Science,* Paul Gross and Norman Levitt have called scientists to arms against the spathe of recent critiques of science by academics of postmodern persuasion. The authors sum up the difference between these two world views as follows (Gross and Levitt 1994:72):

> Contrasted to the Enlightenment ideal of a unified epistemology that discovers the foundational truths of physical and biological phenomena and unites them with an accurate understanding of humanity in its psychological, social, political, and aesthetic aspects, postmodern skepticism rejects the possibility of enduring universal knowledge in any area. It holds that all knowledge is local, or "situated," the product of interaction of a social class, rigidly circumscribed by its interests and prejudices, with the historical conditions of its existence.

Leaving readers to judge for themselves the merits or weaknesses of the Gross and Levitt arguments, I would like to pose a question that was on my mind as I read this provocative book: Are ethnoecology and postmodernism friends or foes?

At first sight, we might consider that they are natural allies, because in several aspects they appear to have a similar agenda. Various ethnoecologists have expressed a desire to combine empirical and interpretationist perspectives. Victor Toledo (1991, 1992), for example, considers that economic botany and ethnoscience have overemphasized the empirical side of folk knowledge, excluding symbolic approaches that could give a broader picture of how people perceive and manage their natural surroundings. Authors such as Alcorn (1984) have adopted with positive results some of the postmodernist vocabulary and concepts, such as analyzing culture as a text and describing "scripts" of behavior. There is a basic sympathy—though not unqualified acceptance—for the idea that our Western science and our views of other peoples' ecological knowledge are in part a product of our own cultural orientation (are "cultural constructions" as postmodernists may assert).

The similarities do not end there. Products of social and intellectual unrest of the 1960s, both postmodernism and a politicized form of ethnoecology (sometimes referred to as an "applied" or "advocacy" approach) seek fundamental change in the social and economic factors that contribute to the oppression of marginalized people and the destruction of nature. There is a tendency to resist at least some elements of monolithic Western science—the putative villain of the arms race, environmental catastrophes, and cultural domination—and to embrace other ways of exploring the natural and social landscape.

Advocates of both ethnoecology and postmodernism have an expressed desire to empower and respect the voice of marginalized classes of people who have not traditionally had a privileged place in academia, science, and technology. For postmodernists, this is expressed as an interest in valorizing perspectives from ethnic minorities, feminists, and gays. For ethnoecologists, it is in respecting and validating the traditional ecological knowledge of a broad range of local peoples living in close contact with nature. Both academic trends are interested in putting back together the pieces of a "humpty-dumpty" science, splintered into myriad specializations and reductionistic approaches. This often includes an expressed desire to integrate perspectives from various academic disciplines, and letting this multidisciplinary approach lead the way to achieve a holistic science.

If there is so much common ground between these approaches, then why do we find no love lost between their adherents? I cite just two examples. Bernard Ortiz de Montellano (1991a, 1991b, 1992a, 1992b), author of *Aztec Medicine, Nutrition, and Health* and other works on Mexican ethnobotany and ethnopharmacology, has been questioning—from a solid empirical base—the assertions of Afrocentric scholars on issues ranging from creationism, the contribution of sub-Saharan Africans to ancient Egyptian culture, and African presence in the Americas before Columbus. On the flip side, Eugene Parker (1992, 1993)—a geographer at the University of Maryland—has been challenging the ethnoecological research of Darrell Posey (1985, 1988, 1992), an ethnobiologist who has lived among the Kayapo Indians of Brazil for several years. Although Parker does appeal to empirical methods in his articles, his critique of Posey pulls at least some arrows from the quiver of postmodernist literary critics (who "read the historical landscape" and "deconstruct" sentences, as does Parker [1992; 715, 721]). The contents of his recent articles in the *American Anthropologist* betray a prejudice for comparative analysis of Posey's writings and a focus on the researcher rather than the object of his study (the Kayapo Indians, in this case).

Why then, this often strident opposition? The answer to this apparent dilemma lies in two fundamental differences between ethnoecological and postmodern doctrine. First, ethnoecology appeals to the rationalist tradition in the natural and social sciences whereas postmodernism harbors an extreme stance on cultural relativity (Bernard 1984; Sperber 1985). Ethnoecologists are convinced of the reality of nature, that the natural world is really out there, waiting to be discovered by empirical observation and experimentation. Postmodernists assert that reality—even the reality of the natural world—is a cultural construction.

Second, ethnoecologists have adopted (and adapted) a specific set of methods for exploring the environment from the natural sciences, and have borrowed a set of methods from the empirical approach in anthropology (particularly ethnoscience) to describe the various ways in which local peoples perceive, classify, utilize, and manage the natural world (Martin 1994). Postmodernists reject the efficacy of empirical methods from both the natural and social sciences, considering that all research results so derived are *de facto* artifacts of the methodology employed.

As a result ethnoecologists and postmodernist scholars focus their attention on distinct enterprises: ethnoecologists on producing a detailed comparison and practical cross-fertilization between science and traditional knowledge; postmodernists on analyzing or "deconstructing" the writings of academics and the history of science while applauding (but not participating) in the laudable efforts of marginalized people who write about their own culture and knowledge. Ethnoecologists, sure of their ability to understand science and traditional knowledge as two reflections of the same reality, are rolling up their sleeves to work on community development and conservation initiatives. Postmodernists observe the scene, passing judgment on the political correctness of the actions.

This caricature allows us to put in perspective some current debates carried on in the halls of academia and in scholarly journals. Posey has studied the traditional ecological knowledge in collaboration with the Kayapo and in association with many natural scientists, seeking to apply the results to Amazonian conservation and to promote the right of indigenous peoples to maintain the lifestyle they choose. Parker, who may be in sympathy with the goals of understanding the Kayapo's perception of the natural world and defending their right to defend their cultural legacy, has elected to dedicate his time to analyzing Darrell Posey.

Although most scientists have been oblivious to the sticks and stones of the postmodernists (Gross and Levitt 1992:234–237), it behooves ethnoecologists to listen to their words closely. Adherents of the two approaches, because they do have some common objectives and often co-inhabit university departments, are living in the same neighborhood of the academic world. As many anthropological studies and current world events prove, closest neighbors often become the bitterest of enemies. We can only hope that our goal of documenting and promoting diverse ways of classifying, utilizing, and managing the natural world is not derailed by senseless skirmishes on academic turf.

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PROJECTS, PROGRAMS, AND NETWORKS

The Network for Analytical and Bio-Assay Services in Africa

The Network for Analytical and Bio-Assay Services in Africa (NABSA) was formed in 1992 by five African laboratories to provide analytical and bioassay services on a free-of-charge basis to chemists in Africa. The creation of the network was catalyzed by the International Organization for Chemical Sciences in Development (IOCD), with funds provided by UNESCO. Among the participating institutions are the Department of Chemistry at Addis Ababa University (which provides measurements of Fourier-transformed Nuclear Magnetic Resonance spectra, Fourier-transformed Infrared spectra and optical rotations), Department of Chemistry at the University of Nairobi (Ultraviolet visible and Infrared spectra as well as locust-antifeedent and mosquito larvicidal assays), the International Center of Insect Physiology and Ecology (Mass Spectrometry, Gas Chromatography/Mass Spectrometry, and bibliographic searches) and the Institut Malgache de Recherches Appliquées (antimalarial assay). The NABSA coordinator encourages directors of other African laboratories to join the Network and offer additional services. More information is available from the NABSA

Coordinating Office at the following address: Dr. Berhanu M. Abegaz; NABSA Coordinator; Addis Ababa University; Department of Chemistry; P. O. Box 1176; Addis Ababa, ETHIOPIA; Fax 252.1.551244.

THE PLANT RESOURCES HANDBOOK

During the first two years of the WWF/UNESCO/Kew People and Plants Initiative, field coordinators have collected a large amount of information on programs, projects, foundations, professional societies, journals, newsletters, and individuals linked in some way to the broad subject of ethnobotany, biodiversity conservation, and community development. At the same time, they have been receiving a growing number of requests for information on these subjects. As a way of disseminating information and responding to these requests, People and Plants will produce a Plant Resources Handbook that can later be transferred to a computerized network and updated on a regular basis.

As a companion volume to the People and Plants conservation manuals published by Chapman and Hall, the handbook will be a valuable aid to park managers, foresters, cultural promoters, members of nongovernmental organizations, and other people interested in ethnobotany. In addition to giving general advice to readers, it will provide specific answers to many of the practical questions posed by participants in basic or applied research projects.

The handbook will be divided into a number of modules that provide easy access to the subjects about which colleagues around the world request information. These include: Foundations and grant-writing; Literature and other media (including new and landmark books, journals and newsletters; videos and other innovative modes of communication); Professional societies and congresses (e.g., International Society of Ethnobiology, Society for Ethnobiology); Projects and programs (e.g., selected research initiatives carried out by individuals or institutions that highlight an innovative approach); Research themes (such as joint forestry management or the harvesting of nonwood forest products); and other topics that will be specifically defined in the course of editing the handbook.

Preliminary versions of selected modules will be sent to the network of colleagues that is being developed as part of the People and Plants initiative. They will be invited to comment on the style and contents and will be encouraged to send additional information that could appear in subsequent modules which will be issued for review throughout 1995. The final editing of all modules will be finished by January 1996, allowing the completed handbook to be distributed during early 1996. Transfer to a computerized network and updating of information on a continual basis will take place if resources permit.

If you wish to contribute to the Plant Resources Handbook, please send to the editors a description of your own activities as well as any pamphlets, publications, posters, popular articles, project reports, or other materials that illustrate the work you are carrying out. All information received will be kept in permanent files at UNESCO or the Royal Botanic Gardens, Kew, for future reference.

For more information write or fax:

Gary J. Martin
Editor

Vinciane de Bohan
Assistant Editor

Plant Resources Handbook
People and Plants Initiative
Division of Ecological Sciences
Man and the Biosphere Program, UNESCO
7, Place de Fontenoy; 75352 Paris
CEDEX 07 SP - FRANCE
Fax 33.1.40659897

BOOK REVIEWERS NEEDED

The following new titles have been received for review in the *Journal of Ethnobiology:*

Corn and Culture in the Prehistoric New World. Sissel Johannessen and Christine A. Hastorf (Editors). Boulder, Colorado: Westview Press, 1994. Pp. xvii; 623. $58.00 (softcover). ISBN 0-8133-8375-7.

The Cultural Relations of Classification: An Analysis of Nuaulu Animal Categories From Central Seram. Roy Ellen. New York: Cambridge University Press. Cambridge Studies in Social and Cultural Anthropology, 1993. Pp. xxi; 315. $64.95 (hardcover). ISBN 0-521-43114-X.

Domestication of Plants in the Old World (Second Edition). Daniel Zohary and Maria Hopf. New York: Oxford University Press. Oxford Science Publications, 1993. Pp. x; 278. ($35.00?) (hardcover). ISBN 0-19-854795-1.

Edible Wild Plants of Sub-Saharan Africa. Charles R. Peters, Eileen M. O'Brien, Robert B. Drummond. Kew, Richmond, Surrey: Royal Botanic Gardens, 1992. Pp. 239. (15 £) (softcover). ISBN 0 947643 51 6.

Essential Substances: A Cultural History of Intoxicants in Society. Richard Rudgley. New York: Kodansha International, 1993. Pp. 195. ($22.00) (hardcover). ISBN 1-56836-016-9. [in the office]

The Ethnobotany of Southern Balochistan, Pakistan, with Particular Reference to Medicinal Plants. Steven M. Goodman and Abdul Ghafoor. Chicago, Illinois: Field Museum of Natural History. Fieldiana, Botany, New Series, No. 31, 1992. Pp.v; 84. (Price?) (paperbound). ISSN 0015-0746. [in the office]

Ethnobotany of the California Indians, Volume 1: A Bibliography and Index. Beatrice M. Beck. Pp. 165. **Volume 2: Aboriginal Uses of California's Indigenous Plants.** Sandra S. Strike. Pp. 210. Champaign, Illinois: Koeltz Scientific Books, USA/Germany, 1994. ($80.00 for both volumes) (softcover). ISBN 1-878762-50-8 (USA)/ 3-87429-353-X.

The Iron Age Community of Osteria dell'Osa. A Study of Sociopolitical Development in Central Tyrrhenian Italy. Anna Maria Bietti Sestieri. Cambridge and New York: Cambridge University Press, 1992. Pp. xii; 271. ISBN 0-521-32628-1.

Life Cycles. Reflections of an Evolutionary Biologist. John Tyler Bonner. Princeton, New Jersey: Princeton University Press, 1993. Pp. 209. ($19.95) (hardcover). ISBN 0-691-03319-6. [in the office]

Lok Swasthya Parampara Samvardhan Samithi Monograph Series on **Traditional Medicine.** (prices include shipping and handling). (Note: To be reviewed as a set):

Monograph 1. **Local Health Traditions: an Introduction.** 1989. ($10.00);

Monograph 2. **Ayurvedic Principles of Food and Nutrition, Part I.** 1990. ($10.00);

Monograph 3. **Mother and Child Care in Traditional Medicine, Part I.** 1990. ($8.00);

Monograph 4. **Mother and Child Care in Traditional Medicine, Part II.** 1990. ($8.00);

Monograph 5. **Marma Chikitsa in Traditional Medicine. 1991.** ($8.00);

Monograph 6. **Ayurvedic Principles of Food and Nutrition, Part II.** 1991. ($12.00);

Monograph 8. **Bheshaja Kalpana Pharmacology in Traditional Medicine.** 1991. ($8.00);

Monograph 9. **Vrkshayurveda: An Introduction to Indian Plant Science.** 1993. ($12.00);

Monograph 10. **Plant Propagation Techniques in Vrkshayurveda.** 1993. ($12.00);

Monograph 11. 1993. **Nomenclature and Taxonomy in Vrkshayurveda.** 1994. ($10.00). All volumes available from Lok Swasthya Parampara Samvardhan Samithi. c/o Centre for Indian Knowledge Systems. No. 2, 25th East Street, Thiruvanmiyur, Madras-600 041; Phone: 415909. No ISBN numbers.

Myths and Tales of the White Mountain Apache. Grenville Goodwin. Tucson: University of Arizona Press, 1994. Pp. xxix; 223. $16.95 (softcover). ISBN 0-8165-1451-8.

The Nature of Shamanism: Substance and Function of a Religious Metaphor. Michael Ripinsky-Naxon. Albany: State University of New York Press, 1993. Pp. xi; 289. $57.50 (hardcover). ISBN 0-7914-1385-3.

Paleonutrition: The Diet and Health of Prehistoric Americans. Kristin D. Sobolik (Editor). Carbondale, Illinois: Southern Illinois University, Center for Archaeological Investigations. Occasional Paper No. 22, 1994. Pp. xv; 321. ISBN 0-88104-078-9.

Pastoralists at the Periphery: Herders in a Capitalist World. Claudia Chang and Harold A. Koster (Editors). Tucson: University of Arizona Press, 1994. Pp. xvi; 262. $45.00 (clothbound) ISBN 0-8165-1430-5.

Phytolith Systematics: Emerging Issues. George Rapp, Jr. and Susan C. Mulholland (Editors). New York: Plenum Press, 1992. Pp xxiv; 350. $49.50 (hardcover). ISBN 0-036-44208-6.

Polynesian Herbal Medicine. W. Arthur Whistler. Lawai, Kauai, Hawaii: National Tropical Botanical Garden, 1992. Pp. x; 238. ISBN 0-915809-16-8.

Pottery from Spanish Shipwrecks, 1500–1800. Mitchell W. Marken. Gainesville, Florida: University Press of Florida, 1994. Pp. xvi; 280. $39.95 (clothbound). ISBN 0-8130-1268-6. (Toll free order number: 1-800-226-3822).

Progress in Old World Palaeoethnobotany. A retrospective view on the occasion of 20 years of the International Work Group for Palaeoethnobotany. Willem van Zeist, Krystyna Wasylikowa and Karl-Ernst Behre (Editors). Rotterdam, Netherlands and Brookfield, Vermont: A. A. Belkema, 1991. Pp. ix; 350. $60.00 (hardcover). ISBN 90-6191-881-2.

Smallholders, Householders. Robert McC. Netting. Stanford, California: Stanford University Press, 1993. Pp. xxi; 389. $49.50 (hardcover), $16.95 (paperback). ISBN 0-8047-2061-4 (hardcover), 0-8047-2102-5 (paperback).

Soils in Archaeology: Landscape Evolution and Human Occupation. Vance T. Holliday (Editor). Smithsonian Institution Press, 1992. Pp. xiii; 254. $39.95 (hardcover). ISBN 1-56098-111-3.

Weaving the Threads of Life: The *Khita* Gyn-Eco Logical Healing Cult Among the Yaka. Rene Devisch. Chicago, Illinois: The University of Chicago Press, 1993. Pp. x; 323. (paperbound). ISBN 0-226-14326-7.

If you would like to review any of these books and would be able to have your review completed within four months after receiving the book, please write to:

Nancy J. Turner
Book Review Editor for the *Journal of Ethnobiology*
Environmental Studies Program, P.O. Box 1700
University of Victoria
Victoria, British Columbia
CANADA V8W 2Y2
phone: (604) 721-6124;
FAX (604) 721-7212
e-mail: njturner@SOl.uvic.ca

BOOK REVIEWS

Alkaloids: Chemical and Biological Prospectives. S. William Pelletier (Editor). New York: Springer-Verlag, 1992. Pp. xvi; 365.

This volume, number 8 in a series dedicated to that biologically most important series of secondary organic compounds, the alkaloids, has much of interest for ethnobiological research in curare, food of insect herbivores, synthesis of the medicinally interesting yohimbine alkaloids, and the loline group of pyrrotizidine alkaloids of interest as insect deterrents and cattle toxins in certain grasses infected with endophytic fungi.

Of very special ethnobotanic interest is chapter 1, an extraordinarily complete 150-page discussion of curares with a bibliography of 564 items, by the late authority on arrow poisons, Dr. Norman J. Bisset. It is divided into (1) Introduction; (2) Ethnographic Background; (3) Botany; (4) Chemistry; (5) Pharmacology; (6) Development of Modern Muscle Relaxants, and (7) Conclusion. It is the most up-to-date, whole-length and authoritative summary of what is now known from an interdisciplinary point of view that has ever been published. Arrow poisons of South and Central America, central Africa, and western Malaysia are considered. It should be available to specialists in many fields tangentially interested in any aspect of arrow poisons, but most certainly to ethnobotanists, botanists, chemists, pharmacologists, and anthropologists.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138

Ayahuasca Analogues, Pangaean Entheogens. Jonathan Ott. Kennewick, Washington: Natural Products Co., 1994. Pp. iii; 128. $30.00 (hardcover), $15.00 (paperback). ISBN 0-9614234-4-7 (hardcover), 0-9614234-5-5 (paperback). (Available from: Jonathan Ott Books, Box 1251, Occidental, California 95465.)

Jonathan Ott is one of the most knowledgeable scientists in various aspects of the use by native peoples in numerous parts of Amazonia of the sacred hallucinogen, *Banisteriopsis Caapi*. He has produced in *Ayahuasca Analogues, Pangaean Entheogens* a beautifully published and highly authentic book which will undoubtedly be received gratefully by a wide circle of readers in a variety of disciplines. The reader is immediately struck with three impressions: the clarity of the language; the diversity of coverage; and the authority of treatment.

The main part of the book is divided into four chapters following an introductory-type Exordium: The Amazonian *Amrta* and the Entheogenic Reformation. The chapters cover a wide range of interesting material in a diverse disciplines: (1) Natural History of Ayahuasca—a Pan-Amazonian Entheogen; (2) Pharmacognosy of

Ayahuasca Plants and Potions; (3) Ayahuasca Analogues with Psychonautic Reports; (4) From Pan-Amazonian to Pan-Gaean Entheogen. There follow ten pages of highly useful notes and the Bibliography of 383 items. The complete, eight-page index provides easy access to the interdisciplinary information in this volume, much of which is difficult to find even in many of our large libraries.

This first edition of *Ayahuasca Analogues* consists of 5,000 copies, and it is this reviewer's opinion that it will soon be unavailable in view of the inexpensive price of this most useful publication that will appeal to such an interdisciplinary audience.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138

Foraging and Farming in the Eastern Woodlands. C. Margaret Scarry (Editor). Florida Museum of Natural History Ripley P. Bullen Series. Gainesville: University Press of Florida, 1993. Pp. xiv; 366. $49.95 (hardcover). ISBN 0-8130-1235-X.

This book is a collection of 14 essays that grew out of two separate symposia concerning paleoethnobotany in 1988, one organized by Scarry and the other by Donna Ruhl. The book focuses on prehistoric plant food procurement and production in the eastern Woodlands of North America. While pollen records are touched on and two papers focus on interpretation of ancient wood, the majority of this book deals with food macroremains: seeds, nutshell, and other plant parts. After an introductory essay by the editor, the book is divided into three sections. In the first, articles by R. Yarnell, J. Chapman and P. Watson, G. Fritz, S. Johannessen, and Scarry provide an introduction to the major issues and a chronological sweep through the region from the Middle Archaic to the Mississippian (5000 B.C. to ca. 1500 A.D.). In the second, articles by D. Decker-Walters, S. Dunavan, and L. Newsome showcase new approaches in paleoethnobotany, including the potential of plant genetics, wood anatomy, and museum collections research. The third section offers regional case studies by D. Wymer (Middle to Late Woodland in Ohio), Scarry (Moundville), Johannessen (American Bottom, focusing on food production and preparation), N. Lopinot and W. Woods (American Bottom, focusing on wood resources), F. King (Oneota), and Ruhl (postcontact Atlantic Coast).

The 10,000 year long prehistoric record of the eastern woodlands includes the dramatic transition between at least three successive prehistoric food production systems. Here, there were *two* "agricultural revolutions:" the first, the cultivation and domestication of native plants such as squash, chenopodium, knotweed, and sunflower; and the second, the introduction of maize and tobacco from Mexico three thousand years later. While foraging is covered in the first section of the book, its primary focus is on the shift toward crop production and the impact of agriculture on cultural and environmental systems. (A third transformation, the introduction of European crops after contact, is covered in the chapter by Ruhl). The sequence and dating of domestication and relative importance of the crops in these agricultural complexes was an almost complete mystery until the research of the last 30 years described in this book.

These papers are significant contributions to the culture history of the region and are general contributions to the study of agricultural systems in a social and political context. The painstaking analysis reported here has allowed the authors to document the selection of native plants as cultigens; the emergence of garden and field systems, storage facilities, and dining customs; and the adoption of, and then local heavy dependence on, an exotic crop, maize. Most important, they provide counter-examples to easy generalizations about the abilities of native agriculture systems to support complex societies, and the use of population-pressure models to explain the spread of maize cultivation. One striking pattern is the stability of food production systems over periods of considerable settlement and social changes, right up until the time that maize begins to dominate most of these river valley systems. Any mistaken impression of an "American wilderness" before contact fades as one confronts many millennia of manipulation of plants and their environments.

There are three issues which I felt had been slighted, but which may offer richer possibilities than are realized here. First, archaeological context (the location, function, or association of remains in relation to others) is seldom mentioned while reporting or interpreting finds of plant remains. Archaeologists providing sample material are responsible for providing this information, but analysts must also make the best use of it. Second, the nutritional implications of agricultural innovation are sometimes dismissed or ignored, whereas they must have been just as important or more important as some of the social changes that were taking place at the same time (the replacement of hickory nuts by maize as a staple, for example). Third, the technological implications of tilling, harvesting, and processing these crops are seldom mentioned. The wood and bone implements used in some of these regions do leave few archaeological examples, true. But, the thousands of stone implements and ceramic vessels collected over the decades before these plant remains came to light surely deserve explicit reconsideration now that the economic systems of the southeast have been documented (the paper by Sissel Johannessen is an exemplary study of this type). Archaeologists and biological anthropologists should be attracted to the rich data base which these authors can provide.

The book has become slightly dated during production. Few of the references postdate 1988, though the editor notes that direct radiocarbon determinations on maize (ca. 100 B.C. from the Holding site, the work of Riley and Walz) have given a new "basement" date for the introduction of maize to the Mississippi/Ohio valley. A minor "glitch" of this collected volume is that similar (or identical) material appears in several places, including a figure that appears twice. Nevertheless, it is obvious that much care was taken in editing and production, including the preparation of a comprehensive bibliography, index, and list of contributors. The consistency of nomenclature and terminology here will provide a standard for works which span several fields.

Katherine M. Moore
Department of Behavioral Science
Bentley College
Waltham, Massachusetts 02154-4705

Health and the Rise of Civilization. Mark Nathan Cohen. New Haven, Connecticut and London, United Kingdom: Yale University Press, 1989. $35.00 (clothbound), $13.00 (paperbound). Pp. x; 285. ISBN 0-300-04006-7 (clothbound), 0-300-05023-2 (paperbound).

Readers of Mark Nathan Cohen's *Health and the Rise of Civilization* risk getting lost, as I did, foraging in the notes. Those who do will be rewarded by detail rich enough to fill several additional volumes; in the present one they comprise nearly half of the 270 pages. I found myself reading the chapters twice, once for the notes, and once for the text, in which Cohen delivers what he has promised in the Preface: "a broad overview of the impact of cultural evolution on human health."

The book begins by examining how our perceptions of "primitive" and "civilized" societies conflict with ideas about progress and development. Cohen then examines the relationship between health and the evolution of human societies by examining changes in human behavior and their effects on health (Chapter 1), the changing patterns of human behavior in increasingly large-scale societies (Chapter 2), and the epidemiological and nutritional consequences of the shift in human social structure from nomadic foraging groups to large sedentary populations (Chapters 4, 5, and 6). He draws largely on examples from contemporary hunter-gatherer societies. Finally, Cohen presents evidence from archaeological excavations of human skeletons that, on the one hand, supports the belief that prehistoric hunter-gatherer societies were burdened by disease and hunger, and that they often adopted violent social measures to maintain small populations. On the other hand, Cohen's analysis suggests that "civilization," "progress," and "development" have produced far fewer benefits to all but the most privileged members of human society in health, nutrition, and life expectancy than we suppose.

Professor Cohen deftly combines models and examples from many fields of inquiry—notably medicine and epidemiology, anthropology and archaeology, and demography and ethnography—in an engaging analysis that challenges common assumptions about health and social development. This book will be of interest not only to researchers in these fields, but also to those involved in health and development policy and programs.

In addition to the extensive notes, the book is indexed and has a comprehensive bibliography.

Danna J. Leaman
Department of Biology
University of Ottawa
Ottawa, Ontario K1N 6N5
Canada

Herbal Dentistry. Herbal Dental Remedies from Ancient Times to the Present Day. Joseph G. Carter and William J. Carter. Chapel Hill: The University of North Carolina, 1990. Pp. 77 (typescript). $17.95 (softcover). ISBN 0-930989-01-8.

Folk Dentistry. Cultural Evolution of Folk Remedies for Toothache. Joseph G. Carter and William J. Carter. Chapel Hill: The University of North Carolina, 1990. Pp. 104 (typescript). $17.95 (softcover). ISBN 0-930989-01-9.

Information addressing herbal dentistry is rarely a prominent theme in folk medical and ethnobotanical studies. Dental information is usually buried among the menagerie of ethnobotanical data. But in *Herbal Dentistry* is an impressive array of history, ethnobotany, and folk dental practices compiled into a compact and very readable volume.

This booklet contains 47 plant illustrations, four pharmacological tables, a two-part Appendix, a glossary, and a bibliography. The information is arranged so that one can approach the book with a question regarding cultural uses of plants. Unfortunately, this arrangement makes it difficult if one is searching for the use of a specific plant. The first section concentrates on the pharmacological aspects of herbal plant use pertinent to herbal dentistry. The authors assume some prior knowledge of pharmacology and plant taxonomy. The section is broken down as follows: Counterirritants, Anesthetics, Analgesics, Narcotics, and Astringents. Next, applications of herbal toothache remedies and magical and superstitious herbal remedies are discussed. Although the book is 77 pages in length the two-part Appendix begins on page 19. Part A of the Appendix is a taxonomic listing of plants by family. Each entry provides scientific and common nomenclature, pharmacological data, plus geographical and cultural identification. Part B is an alphabetical listing of cultural and geographic plant uses. This section is divided regionally into: North American Indians; United States (1600–1980); Mexico; Caribbean Islands; Central America; Middle America; South America; Ancient Greece and Rome; Modern Sicily; Germany and Austria; Eastern Europe; France; Great Britain; General Europe; Russia; Egypt and the Middle East; Southern Asia; Africa; Western Indian Ocean; East Asia and Japan; Western Pacific; and Oceania and Australia.

The booklet contains an array of useful ethnobotanical information but is also teeming with brief historic summaries of folk dental use that beg for longer discussions; the companion publication by the same authors, *Folk Dentistry: Cultural Evolution of Folk Remedies for Toothache* meets this need. For an additional $17.95 this 104-page booklet is an illuminating complement to *Herbal Dentistry.*

Herbal Dentistry requires an index to enhance the search for specific information and the tables should be printed so that they do no blend with the general text. Minor problems aside, both books would be handy additions to the library of anyone interested in ethnobotany, ethnopharmacology, and historic folk-remedies.

Enrique Salmón
Arizona State University
Department of Anthropology
Tempe, Arizona 85287

L'Ethnobotanique Montagnaise de Mingan. Daniel Clément. Québec: Département d'anthropologie, Faculté des Sciences sociales, Université Laval, Collection Nordicana no. 53, 1990. $10.00 Can. Pp. 108. ISBN 2-920197-53-3 (paperbound).

In this book Clément criticizes the school of anthropology called "ethnoscience," which stresses the role language plays in the way a culture interprets and categorizes nature. The author proposes and demonstrates an alternative approach, i.e. examining the way in which the natural world affects language. It is likely that both approaches are useful and valid. People must use language to understand and express concepts important to their daily lives. If a society migrates into a new area, or if culture contact results in the introduction of new concepts, people will invariably interpret the novel ideas in their pre-existing modes of thought. Over a longer period, however, the language and the thought processes must adjust to accomodate the new ideas, especially if they prove essential to the well-being of the community. Thus language and the natural and cultural environment can each affect the other. Over-emphasis of either one as a causative factor results in an incomplete analysis.

The people studied are the Montagnaise of the Mingan region of northeastern Québec. They are hunter-gatherers of the coastal boreal forest. The book thoroughly investigates their system of plant classification as well as their methods of identification and utilization of plants. The book is worthwhile both in adding to the theoretical framework of ethnobiology and in expanding our knowledge of these little-known people.

Joseph E. Laferrière
Herbarium, 113 Shantz Bldg.
University of Arizona
Tucson AZ 85721 USA

Lore. Capturing Traditional Environmental Knowledge. Martha Johnson (Editor). Ottawa, Ontario: International Development Research Centre, 1992. $14.95 Can. (softcover). Pp. X; 190. ISBN 0-88936-644-6.

Lore presents the results of an international workshop which was held in July 1990, at a camp situated along the MacKenzie River near Fort Good Hope, British Columbia. The purpose of the workshop was to study the documentation and application of traditional environmental knowledge through community-based research. This book is intended as an educational device for people interested in developing ethical and culturally-sensitive research methods for documenting traditional knowledge. Throughout the preamble and the discussion of five case studies, insightful recommendations are provided, applicable cross-culturally and world-wide, for indigenous communities and researchers.

Both the workshop and the book were a joint project of two Canadian organizations, the Dene Cultural Institute and the International Development Research Centre, and represent an aboriginal and scientific concerted effort towards amalgamating different approaches to knowledge and resource management. *Lore* is a result of these efforts and is an honest appraisal of the cultural and political realities embedded in traditional knowledge research.

In a brief preamble, editor Martha Johnson reviews the history of traditional environmental knowledge (TEK) research and, in basic point form, gives a comparison of the values, principles, and paradigms of TEK and Western science. Readers will not only find Johnson's evaluation of the difficulties inherent in integrating TEK and scientific knowledge refreshingly concise, but they will appreciate her candid summary of the conditions necessary for a successful blend of the two.

The first case study describes and evaluates a one-year pilot project which took place during 1989–1991, in the Denendeh community of Fort Good Hope. The project's purpose was to develop a participatory action research methodology to document TEK and to further understand Dene TEK within the context of their land and resource utilization practices. The authors, Martha Johnson and Robert Rutten, demonstrate a good comprehension of the components of Dene TEK and clearly recognize the number of variables involved in gathering information. Step-by-step, the reader is led through the community-based research process and is brought, not only to the realization of the necessity for a flexible and innovative research approach, but to the conclusion that, for successful documentation, the initiative must come from the local people themselves.

The second case study, written by Miriam McDonald Fleming, provides a report on the Belcher Island Adaptive Reindeer Management Project in Canada's North. This paper describes the methods employed for documenting and using TEK within a cooperative management context. The author relays Inuit perceptions of the arctic environment to emphasize the need for arctic wildlife management to assume a broader ecological perspective. She demonstrates that an enhancement of arctic ecological knowledge can ultimately be achieved by the recognition and incorporation of the values, beliefs and practices of the Inuit communities into management strategies.

The Marovo Lagoon Project, initiated by the Marovo community of Western Province in the Solomon Islands, is the third case study discussed in *Lore*. This paper, written by Graham Baines and Edvara Hviding, describes the research reciprocity which occurs within the context of information exchange rather than formal interviewing. While investigators apply their expertise to the project, they simultaneously take a hands-on approach in learning traditional knowledge, which in turn promotes feedback from local informants. In their conclusion, the authors provide a helpful description of the investigators' obligatory research "returns" to both the community and government. These include interim and final written and verbal reports, seminars, workshops, and copies of any published academic articles arising from information gained throughout the research.

In an abbreviated paper on documenting oral history in the African Sahel, Rhiannon Barker and Nigel Cross describe how traditional knowledge regarding past agricultural practices, conservation techniques, and ecological change are imperative for the success of development projects. Here the authors provide a good look at the interviewing methodology, selection and training of interviewers, interview problems and the process of recording, translating, and transcribing information. In a frank discussion of the constraints involved in documenting indigenous knowledge, the authors uniquely prompt the reader to analyze how such constraints could be hereafter overcome.

The two final papers in *Lore,* written by Lio Alting von Gesau, Sanit Wongprasert, and Prasert Trakansupakon, examine Northern Thailand and the project efforts of the Mountain People's Culture and Development Educational Programme (MPCDE). The first paper examines traditional environmental knowledge and its adaptation to social change. The second describes efforts to document and apply the traditional environmental knowledge of the highlanders of northern Thailand to projects involving animal husbandry, agriculture, water resources, forestry management, nutrition, medicine, and handicrafts.

The style of the book is straight-forward. It is unpretentious, easy to read, and clear in its approach. With its honest revelations regarding TEK research, *Lore* offers the reader a wealth of experience to draw upon and gives solid advice for investigative advances.

Judith D. Mitchell
Environmental Studies Program
University of Victoria
Victoria, B.C.
V8W 2Y2

Pharmacotheon. Entheogenic Drugs, their Plant Sources, and History. Jonathan Ott. Kennewick, Washington: Natural Products Co., 1993. Pp. 639. $70.00 (hardcover), $40.00 (softcover) plus $4.00 shipping and handling. ISBN 0-9614234-2-0 (hardcover), 0-9614234-3-9 (softcover) (Distributed by agAccess, 603 Fourth Street, Davis, California 95616).

Pharmacotheon is actually at least two books that have been rather puzzlingly bound into one—an ultimately quite useful guide to both plant and fungal sources of a number of important "entheogenic" (psychoactive) drugs, and a popularist treatment of North American drug culture. It begins with a note that defines the author's own neologisms (including *entheogenic*) and explains his justification for his use of terms such as *psychonaut* and even his spelling of *Gaia.* This is followed by the 85-page Proemium in which the author argues the case for the legalization of entheogens, on scientific, ecological, medical, economic, and practical grounds. However, this reveals little if anything about the nature of entheogenic drugs, their plant sources, or their history.

The greater part of the book is subsequently organized into three parts each of which discusses the history and modern usage of one group of psychoactive natural chemicals. Part 1: Beta-phenethylamines, concentrates primarily on plant sources of mescaline, while Part 2: Indole derivatives, discusses sources of LSD and DMT, the alkaloids of the Amazonian shamans' *ayahuasca,* and fungal metabolites of religious importance in Mesoamerica. Part 3: Isoxazole derivatives, finally considers the active chemicals of the fungus *Amanita muscaria* and related species. Each chapter begins with an account of the psychoactive effects of the plants as described by westerners such as Albert Hoffman and Aldous Huxley.

This is followed by some comments on the chemistry and natural history of the organisms concerned, and finally a discussion of the past and present use of the plants, though much of this concerns their role in nonindigenous cultures.

Further important drug types are discussed in Appendix A of Part 4: Appendices, Bibliography, Index, Acknowledgements. Appendix A: "Sundry" visionary compounds, includes sections on the tropane alkaloids, nicotine and tetrahydrocannabinols, while Appendix B: Putative entheogenic species, consists of three annotated lists of "probable," "possible," and "doubtful" plant (and some animal) sources. Appendix C: Index of entheogen chemistry and pharmacology, presents chemical information on 50 psychoactive compounds, and is followed by indices and bibliographic details.

While there is undoubtably a great deal of useful information within this text, the structure of the book often makes it rather difficult to find—not least since the botanical and subject indices are separated by 124 pages of bibliographic detail. Also, much of the book is rather difficult to read, which is due partly to the large number of references cited, but also to the author's style, and his organization of the material—subheadings within the text are not always helpful, while chapters lack any general introduction to their content or aims. Perhaps more importantly, neither the botanical, nor the subject index (44 pages in total) employ any method of subcategorization or cross-referencing—a significant feature when trying to navigate through a text of this size.

Without doubt, one of the most useful features of the book is its bibliography, which is both extensive and up-to-date, and with over 2,440 sources cited, can direct the patient reader to a vast wealth of primary information on the botany, chemistry, pharmacology, and ethnology of many biologically active plant chemicals.

Cath Cotton
Biological Sciences
Whiteland's College
Roehampton Institute, West Hill
London SW15 3SN
United Kingdom

Natural Rubber: Biology, Cultivation, and Technology. M. R. Sethuraj and N. M. Mathew (Editors). Developments in Crop Science 23. Amsterdam, The Netherlands: Elsevier. $231.00 (Dfl. 370.00). Pp. xii; 610.

There has been an ever increasing interest in research on sources of natural rubber since the Second World War when the British and Dutch plantations in Southeast Asia were overrun and occupied by the Japanese and the world's major source of this unique commodity was interrupted. It was in this period that the free world began to realize the essentiality of this product of a tropical tree.

Numerous excellent books on plantation rubber have appeared during the last few decades, an indication of how dependent the world has become on this product of a single tropical tree. This new book, edited by two Indian rubber scientists, has contributions from 38 specialists from 10 countries. It is unique in its coverage and will long hold a place on the shelves of a wide variety of individuals interested in many aspects of the story of rubber in science, history, production, commerce, and other fields.

The editors correctly state: "We consider a single book covering all the important aspects of natural rubber from its history, production, processing to sophisticated engineering applications may not be out of place, and hence this book . . ." They have admirably fulfilled their aim.

It is impossible to single out several of the 38 contributed chapters as the most outstanding. Each of the chapters is a monograph in itself and has a bibliography of the major publications of pertinent articles and books. Together, they comprise a valuable and one of the most complete lists of publications available.

The amount of labor involved in obtaining and editing such a collection of expert contributions must have been extraordinary. The two editors are to be congratulated for putting together such a complete interdisciplinary series of outstanding contributions. And Elsevier deserves great credit in publishing this book, one of the finest in its series "Developments in Crop Science."

This book is available in the United States and Canada from Elsevier Science Publishing Co., Inc., P.O. Box 882, Madison Square Station, New York, N.Y. 10159; and from P.O. Box 1991, 1000 BZ Amsterdam, The Netherlands.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138

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The *Journal of Ethnobiology* has published "Guidelines for Authors" in Volume 10, Number 2 (Winter 1990). Many authors will be able to prepare their manuscripts by consulting recent issues of the *Journal*. If you need a copy of the "Guidelines for Authors" please consult the issue of the *Journal* in which it was first published or write to the Editor requesting a copy.

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CONTENTS

Journal of Ethnobiology

VOLUME 15, NUMBER 1 SUMMER 1995

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Journal of Ethnobiology

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CONTENTS

With this issue I end my tenure as editor of the *Journal of Ethnobiology*. It was an enjoyable four years, but when the opportunity to take a year's research leave came up, well . . . I'm sure you all understand.

The most satisfying aspect of doing a job like this one is interacting with all the fine researchers who work in our field. The high quality of the submissions I've had the opportunity to read is an indicator of the strength of ethnobiology today. My thanks to all the authors who sent their work here. I'd also like to thank one last time the members of the Editorial Board, our many volunteer reviewers, the Associate Editors, the officers of the Society, our typesetter and printer—everyone who helped bring the *Journal* together twice a year.

It is my pleasure to introduce the new editor, Eugene Hunn.

DMP

Dear *Journal of Ethnobiology* reader,

I look forward to this opportunity to serve you as the next editor of the *Journal of Ethnobiology*. I will attend closely to the examples set by my predecessors, Willard Van Asdall and Deborah Pearsall, whose efforts over the past fifteen years have helped establish ethnobiology as an essential anthropological and ecological perspective. I have no revolutionary redirection in mind. Rather, I see my first task as maintaining the present standard of quality and relevance of the articles we publish and keeping strictly to the schedule of publication. I plan to centralize journal production at the University of Washington, a change of convenience that I hope may save both time and money. I will retain the traditional format while investigating the advisability of a somewhat more eye-catching cover.

Once I get up to speed I plan to pursue aggressively "keynote" articles that will give a high profile to the *Journal* and that will at the same time capture the full range and impact of contemporary ethnobiological research. Ethnobiology has become almost a household word during the past decade, yet I sense the *Journal* has not fully capitalized on that popular interest. We can and should be leading the pack. We can and should be the place to turn for the most challenging and current research findings and theoretical insights with respect to the critical intersection of the lives of humans, animals, and plants. I welcome your advice on how we might gain our rightful place at the center of the ethnobiological vortex.

Meanwhile, keep those articles coming.

Gene Hunn

J. Ethnobiol. 15(1):1–44 Summer 1995

WHY IS TAXONOMY UTILITARIAN?

DANIEL CLÉMENT
Canadian Ethnology Service
Canadian Museum of Civilization
Hull, Quebec
Canada J8X 4H2

ABSTRACT.—Cognitive and utilitarian explanations of taxonomy have often been opposed in ethnobiological studies. In this paper, data from Montagnais and Cree taxonomies show a relation between taxonomic structure and uses of plants and animals. This relation operates through partons (parts of the entities that are classified). Traditional societies are not the only ones to show such taxonomic features. Linnean taxonomy was also based on a very specific historical context in which there were direct relations between utility and taxonomic development. On the other hand, the relation between taxonomy and utilization through parts of the entities classified can further help us to understand taxonomic anomalies or why an entity can be classified in more than one category.

RESUMEN.—En los estudios etnobiológicos se contraponen a menudo las explicaciones cognitivas y utilitarias de la taxonomía. En este artículo, los datos provenientes de las taxonomías Montagnais y Cree muestran una relación entre la estructura taxonómica y los usos de plantas y animales. Esta relación opera a través de los partònes (partes de las entidades que son clasificadas). Las sociedades tradicionales no son las únicas que muestran tales características taxonómicas. La taxonomía lineana estuvo basada también en un contexto histórico muy específico en el que había relaciones directas entre la utilidad y el desarrollo taxonómico. Por otro lado, la relación entre taxonomía y utilización, a través de las partes de las entidades clasificadas, puede ayudarnos a comprender mejor las anomalías taxonómicas, o por qué una entidad puede ser clasificada en más de una categoría.

RÉSUMÉ.—Les explications cognitives et utilitaires de la fonction taxonomique apparaissent souvent opposées dans les études ethnobiologiques. Dans cet article, des données provenant des Montagnais et des Cris démontrent qu'il existe une relation étroite entre la structure taxonomique et l'utilisation des plantes et des animaux. Cette relation opère à partir de partons (ou parties des entités qui sont classées). Les sociétés dites traditionnelles ne sont pas les seules à montrer un tel fonctionnement taxonomique. La taxonomie linnéenne tire également son origine d'un contexte historique spécifique où des relations entre l'utilisation et le développement taxonomique peuvent être mises en évidence. D'un autre côté, la relation entre la taxonomie, l'utilisation et la partonomie peut nous aider à mieux comprendre les anomalies taxonomiques ou pourquoi une entité peut être classée dans plus d'une catégorie à la fois.

INTRODUCTION

Cognitive and utilitarian explanations of taxonomy have often been opposed in ethnobiological studies. While the advocates of the first position believe that the purpose of classification is purely intellectual, geared by a compulsion to put order in a chaotic world (Tyler 1969:6), or by simple curiosity (Berlin 1992:290), the defenders of the second argue that people classify entities most likely because they use them (Diamond 1966), and that classification as cultural knowledge is adaptative in essence (Hunn 1982:844). This debate in ethnobiology is but an episode of a much larger debate in anthropology between intellectualism and materialism. One is not surprised to see supporters of the cognitive interpretation in ethnobiology rely on Lévi-Strauss's statement about the intellectual need for human beings to classify without any practical purpose (Berlin 1992:8) and the supporters of the utilitarian approach evoke evolutionary theory (Hunn 1982:844), or even oppose Malinowski to Lévi-Strauss in their initial statement in an attempt to relativize the latter's position and show how pragmatics has been ignored in folk classification studies (Morris 1984:45).

On the other hand, certain authors—mostly advocates of the utilitarian approach—have tried to move ethnobiological studies out of the impasse created by these two drastic positions. New interpretations have been suggested. Posey (1984:123), for example, has proposed to distinguish between "*process* of classification and *purpose* for classification," relating the former to cognitive phenomena and the latter to a utilitarian or adaptionist approach. In the end, however, Posey argues for a utilitarian basis of taxonomy in the broadest sense (practical and symbolic), not resolving the issue of knowledge per se as an explanation for the existence of taxonomy. Hays (1982), Hunn (1982), and Morris (1984) have also proposed solutions. These solutions have some elements in common. They suggest that taxonomy be viewed in relation to numerous factors, such as "utilitarian, ecological, and cultural concerns" (Morris 1984:58), "biological discontinuities in nature, chance historical events, 'utilitarian' human concerns, human cultural concerns in a broader sense, intellectual curiosity, and constraints deriving from the nature of human perception and cognition" (Hays 1982:93), or that it might be better analysed through a study that would combine "cognitive, linguistic, ecological, and evolutionary theory to define a dynamic ethnoecology" (Hunn 1982:844). Two of these authors also share the belief that taxonomy is constituted of what Hunn (1982:830) calls a "natural taxonomic core" that serves a general purpose, "artificial peripheral taxa" serving a special purpose, and what Morris (1984:57) defines as prototypical taxa, around which the Chewa classification he studies focuses. The general and special purpose of Hunn are both utilitarian, since the first one is concerned with acting upon entities and the second one with "collectively represent[ing] a nonresource" (Hunn 1982:835) which is, in other words, a negative utility. As regards prototypicality, Randall (1976;1987; Randall and Hunn 1984) has elaborated original methods to determine the focal range of higher categories in the taxonomy and, in doing so, has insisted on a contextual approach in studying classification. Moreover, his approach has generated evidence that classification involves functional attributes besides only perceptual ones.

In this paper, the two approaches in classification studies, the intellectual and the utilitarian, will be taken into account, using certain concepts of Hunn (1982), Morris (1984), and Brown (1976), mainly, in an attempt to show in what ways taxonomy is utilitarian and in what ways it is not. With Montagnais and Cree data, I will show how taxonomy is based on prototypical[1] taxa and how peripheral taxa are related to these taxa, having been included in the taxonomy most likely over time. Prototypical taxa are the core of the taxonomy and include the main categories of the taxonomy. They are based on uses of the entities that are classified. Other taxa that are peripheral are defined negatively (as nonresource) and can even form categories of their own in the taxonomic structure. The *basis* of the taxonomy, through the core taxa, is utilitarian, but the final *purpose* of the classification is also intellectual, since peripheral taxa or categories respond to the need for human beings to include in their world view most of the entities with which they interact, whether directly through use, negatively through non-use, or out of simple curiosity. Furthermore, I will demonstrate how the relation between taxonomic structure and uses of plants and animals operates through partons. The term parton is borrowed from Brown (1976:401), although in the present article its definition involves slightly different attributes. A parton will still be considered as a part (botanical, anatomical) of an entity that is classified, but the inclusive aspect or hierarchical ("part *of*") relationship implied in Brown's usage of the word will not be taken into account. In the context of my study, a parton is meant strictly as a *useful part* of a plant or an animal since it appeared as such in the discourse and practices of my informants as well as through the analysis of the same discourse and practices. In fact, the activity of partons underlies classification and accounts for it. The same activity also helps us to understand anomalies or why an entity is classified in more than one category.

Traditional societies are not the only ones to show such taxonomic features. Linnean taxonomy was also based on a very specific historical context in which there were direct relations between utility and taxonomic development. Since Linnaeus, taxonomy has evolved to include all entities in such a manner that its utilitarian basis is now not so easily perceptible as it was at the time this worldwide taxonomy was created. The same evolution could probably apply to traditional societies.

The conclusion reached in this paper, which is based on the analysis of empirical data, appears as a new development in the area of the study of intellectual and utilitarian aspects of classification. It shows clearly how the relation between utilitarian factors and perceptual ones operates in the higher inclusive categories. Certainly, as Berlin (1992:181–190) has pointed out, these categories (i.e., life-forms) are striking perceptually and "*appear* to be based on a small number of biological characters" (emphasis added). But they have also evolved from (or originated from) uses of the parts of the entities classified in these categories. In fact, what Berlin denies (utilitarian prominence over a cognitive basis) and what Hunn and Randall consider on the same level (i.e., cognitive and utilitarian factors) are shown here to be aspects of the same process but on two separate levels, with the utilitarian factors in the end forming the basis for the actual operation of classification.

CONTEXT OF STUDY

The data come from three different studies conducted among the Montagnais and Cree peoples, two Native groups from the Eastern Subarctic. Montagnais and Cree are part of the Algonquian language family. A first study was conducted in

1981 in Mingan, on the north shore of the Gulf of St. Lawrence in Quebec, Canada. During the summer, 269 specimens of plants were collected by the Montagnais and myself and deposited at the Department of Botany at Laval University in Quebec for identification. For every specimen, different questions were asked during collection or on the same day to four different informants (two men and two women) between 65 and 74 years of age. The questions were asked in Montagnais and translated through an interpreter, and included such aspects as the name of the plant, its etymology, its gender (animate or inanimate[2]), its classification, the semantic features of the categories, the plant's utilization, and its relation to animals. Identification of the specimens by professional Western botanists yielded 200 species: 165 vascular plants of 600 estimated by botanists in the area, 16 mosses and hepaticae of an estimated 150, 15 lichens out of 100, 3 mushrooms out of 1,000 and 1 alga out of 100. Attention in collecting was given mostly to the plants that my informants as well as other members of the community named and used, that is, the plants were selected for study mostly by the Montagnais themselves, in an attempt to cover and represent the major areas (bush, marsh, muskeg, mountain, coast, and so on) traditionally occupied by these people. This explains why the biggest proportion consists of vascular plants, reflecting the latter's importance in a society traditionally oriented towards hunting and fishing more than gathering. The sample is deemed satisfactory: from 1981 to today, no other new plant has been named or is said to be used by the members of this community, although research is still being conducted on the relations between these people and their environment. The study revealed 137 ethnobotanical lexemes organized in 119 terminal taxa and 18 higher categories that will be discussed below[3].

A second study was conducted between 1982 and 1988, also among the Montagnais people. In 1982–1983, information on 172 animal species was collected from eight Montagnais elders (between 59 and 78 years old) from two communities, Mingan and Natashquan. These animals had been selected by my interpreters as the less ambiguous ones from Bouchard's (1973) study of Montagnais zoological taxonomy. That taxonomy is comprised of 229 terms, of which the many synonyms, sex and age variations, unidentified taxa, and other variations were disregarded. Starting with Montagnais zoological nomenclature, questions were asked on different aspects of the knowledge of these animals, including anatomy, behavior (sounds, senses, and locomotion), ecology (habitat and food, relations between animals, and seasonal phenomena), reproduction, and traditional identification, nomenclature, and taxonomy. In 1988, a complementary study of the identification, nomenclature, and classification aspects was done in an attempt to grasp the whole system. Illustrations for 567 taxa—mostly in color—were presented to two of the eight elders approached in 1982–1983. These illustrations covered the majority of species present in the area traditionally occupied by the Montagnais (for a discussion of these taxa and all the sources used to identify them, see Clément 1995, chapter 7). For each illustration, several questions on nomenclature, synonymy, reproductive habits, and classification were asked. The study yielded 227 lexemes (excluding synonyms and other lexemes referring to distinctions based on age, sex, and so on). Out of these, 212 referred to terminal taxa and 15 to larger categories[4].

Finally, the Cree data was gathered in 1990. The study[5] was done in Chisasibi, on the east coast of James Bay in Quebec. It focused on fish species and ichtyological knowledge, but I also gathered information on the complete ethnozoological taxonomy. Three main informants (56, 57, and 66 years old) and their family participated in the study, which yielded data on Cree fish nomenclature, taxonomy, anatomical knowledge, ecology (habitat, food, migrations), reproduction, fish diseases, and utilizations. The study was conducted both with color illustrations of species and real specimens. I first established a list of fish in Cree territory utilizing Scott and Crossman (1973) and Morin and Dodson (1986).

MONTAGNAIS BOTANICAL TAXONOMY

Botanical partonomy.—The Montagnais people believe in an order in the creation of their universe. Informants usually agree that earth came first, the animals second, and human beings third. This corresponds to three native categories : ***ashtshî***[6] (earth), ***aueshîshat*** (animals), and ***innu*** (human being). When questioned further, the Montagnais place the bulk of the botanical entities known to them right after the category *earth,* even though some of the plants, like mosses and lichens, are labelled ***ashtshî*** (earth). The category between *earth* and *animals* is unlabelled but generally referred to as ***ashtshît nte kânîtâutshîht*** or ***kânîtâutshîki,*** literally "in the earth, the ones that grow." This category forms a continuum attested by the categorization of "algae" ***(shâshâpina),*** which are situated right next to the category *animals* since they "live like animals but they always stay at the same place."

According to my informants, the key element to distinguish plants that are said "to grow in the earth" and plants that are considered as "earth" from the *animals* and the *human being* is the fact that the elements comprised in the first two categories cannot move by themselves. Further on, the main element that distinguishes one plant category (those plants "that grow in the earth") from the other (those that form the "earth" itself) is ***ushkâtiâpî*** (root).

Only the former are said to possess such an organ. Roots are also believed to be the main mode of reproduction for these entities, which is the case for certain important plants in the environment. In fact, in some places, propagation by means of layers is the only means of reproduction for trees such as black spruce (Hosie 1975:72). ***Ushkâtiâpî*** means etymologically "the filiform leg." There are other botanical partons that denote this anthropomorphic view of plants, such as ***uâukanâkanâtuk***^{u}, the "backbone of the wood," which is the heart of the tree; ***pitshu-atshuk***^{u}, balsam fir gum, which comes from ***atshuk***^{u} (sperm or snot); and ***mînapâkuna,*** the "hairy covering," which covers several kinds of old-man's beard. For each of these partons, there is a story related to its human nature: for example, the "heart of the tree" is said to be called upon by the shaman to obey him (Speck 1977:200); the "gum" is believed to have originated from human testes thrown in a balsam fir (Savard 1979:35); and the old-man's beard is said to come from the hair of the father and mother of a young hero called Tshakâpesh (Lefebvre 1974).

Montagnais botanical knowledge comprises many other partons. Some are general like ***mishtuk***^{u} (wood), ***mîn*** (fruit), ***nîpîsh*** (leaf), ***uâpukun*** (flower), and ***uânâtsheshk***^{u} (bark); others are very specific such as ***tshishtâpâkuanat*** (branches

TABLE 1.—Principal Montagnais partons.

Partons	Definitions
mîn (fruit)	a part originating from a plant as the "product of the flower" according to one informant, as "growing on leaves" according to another; in general, the terms corresponds to what is known in Western botany as the reproductive body of a seed plant
mishtuk[u] (wood)	internal part originating from *trees, shrubs,* and *small shrubs;* in Montagnais, there is no common word for trunk and ***mishtuk***[u] is used for wood, trunk, and as a category for trees
nîpîsh (leaf)	a part that comes from a plant and grows on a stem; according to one informant, the word can be used to designate a sepal of a flower; no word for needles of conifers was recorded; some plants are said to be ***nîpîsh*** only due to their lack of a prominent stem
uânâtsheshk[u] (bark)	general term for the part originating from a stem and a root and which constitutes its cover; two layers are distinguished, the outer and the inner; in one case (white birch), the outer layer (***uâshkuai***) is named differently from the inner layer (***uânâtsheshk***[u])
uâpukun (flower)	group of floral leaves originating from a plant; some plants are said to be ***uâpukun*** because of the prominence of this part
ushkâtiâpî (root)	in general, an underground part originating from a plant; the word means also other parts which are considered in Western botany to belong to the stem (i.e. crown of plants; stem base of trees); the word is used for a category of plants marked by the prominence of this part; specific terms (e.g. ***uatapî,*** conifer root) are also used

of conifers), ***ûtîkuana*** (branches of deciduous trees), and ***atamusat*** (willow catkin); and most of these partons play a role in the development of the taxonomy.

Table 1 gives the Montagnais features associated with the principal partons noted above. Montagnais informants consider the relation between these different botanical parts and the plants as one of origin (***utshipanu,*** "it comes from"). Brown (1976:422, note 7) does not mention this possibility while discussing the kinds of "part of" relationship explicit in different languages: he reports only "part of" or possessive ("x belongs to y") relations. When viewed through Montagnais eyes, all botanical parts that could have caused logical difficulties in their interpretation (e.g., can wood be considered a part of a tree in the same sense as a leaf is?) disappear. All "parts" *originate from* (i.e., they are not seen as part of or possessed by a plant) a plant, be they wood, berries, roots, or flowers. Moreover, as I will demonstrate below, this relation also implies the fact that these parts originate from plants as useful or useless products and is thus functional in essence.

Botanical taxonomy.—As noted above, plants are classified either in the category ***ashtshît nte kânîtâutshîht,*** or ***kânîtâutshîki,*** literally "in the earth, the ones that grow" or in the category ***ashtshî*** (earth). The first category includes ***mishtukuat*** (trees), ***shakâua*** (shrubs), ***atishîa*** (small shrubs), ***mashkushua*** (herbaceous plants),

- ***mishtukuat*** ('trees')
  - (covert category)
    - ***ashtshîuâshîshk***^{u} (ground hemlock)
      - ***tshîtshue ashtshîuâshîshk***^{u} ('real ground hemlock')
    - ***innâsht*** (balsam fir)
    - ***mâshtshîshk*** (eastern white cedar)
    - ***minaik***^{u} (white spruce)
    - ***uâtshinâkan*** (tamarack)
    - ***ushkâtuk***^{u} (black spruce)
    - ***ushtshishk*** (jack pine)
  - (covert category)
    - ***uâshkuai*** (white birch)
      - ***uâshkuai*** (white birch)
      - ***innîkuai*** ('real white birch')
      - ***nipî-uâshkuai*** ('white birch of the water')
    - ***mîtûsh*** (poplar)
      - ***mîtûsh*** (trembling aspen)
      - ***mâshi-mîtûsh*** (balsam poplar)
    - ***mashkuminânakashî*** (showy mountain ash)

FIG. 1.—*Mishtukuat*, 'trees'.

and a few unaffiliated taxa. ***Ashtshî*** (earth) comprises mosses, lichens, and even types of mud, a fact that argues in favor of a continuum in this category also.

In Montagnais, ***mishtuk***^{u} has two meanings: "wood" when used with inanimate gender, and "tree" when animate. Taxa belonging to the category *tree* are said (a) to possess a trunk, (b) to have a large diameter, and (c) to grow relatively high. Trees (Fig. 1) are first classified as evergreens and deciduous. These two categories are usually covert, though some informants name the second ***uâshkuai***, which is the prototype of this category (white birch). The reality of these covert categories is further attested by specific nomenclature for branches of conifers and deciduous trees (see above), as well as a name ***(cikopi)*** for evergreens in Atikamekw, a closely related Algonquian language. Only one taxon (ground hemlock) classified in the category *trees* by my four informants, two men and two women[7], does not correspond to either the botanical[8] or Montagnais definition of a tree: in fact, ground hemlock is a shrub, and as such has many stems. Informants say that "real ground hemlock" ***(tshîtshue ashtshîuâshîshk***^{u}***)*** grows with balsam fir; they also name the branches of the plant the same way they name the branches of all conifers. Ground hemlock hence seems to have become a tree more by association with other trees (e.g., through having the same kind of branches) than by virtue of its own features, since contrary to the Montagnais definition of a tree, ground hemlock has many stems, the diameter of each stem is small, and it is not tall. Only one taxon appearing in Fig. 1 was classified differently by women and men: ***mashkuminânakashî***, showy mountain ash, which was classified by the former as a tree because of its great height but by the latter as a shrub (see Fig. 2). The case is similar to that of ***uâpineu-mîtshima***, willow, which is generally classified as a shrub but sometimes, with hesitation, said to also be a tree because it can grow very high. These two taxa are denoted in Montagnais by inanimate lexemes. In Montagnais, all the other trees, including the ground hemlock, are denoted by animate lexemes. At first glance, the reasons why these two taxa, showy mountain ash—which is a tree botanically—and willow—which can be a tree botani-

shakâua ('shrubs') —
- ***apueminânakashî*** (pin cherry)
- ***atîkupemuk***^{u} (glandular birch)
- ***atûminânakashî*** (Bartram's shadbush)
- ***atûshpî*** (speckled alder)
- ***innîtshîminânakashî*** (fetid currant)
- ***kâmatshakâshit shakâu*** (wild holly)
- ***mashkuminânakashî*** (showy mountain ash)
- ***mîkuâpemuk***^{u} (red-osier dogwood)
- ***mishtukusha*** (red-berried elder)
- ***mûshuminânakashî*** (edible cranberry-tree)
- ***tshîtshue shakâu*** (green alder)
- ***uâpineu-mîtshima*** (willow)

FIG. 2.—***Shakâua***, 'shrubs'.

cally depending on the species—are classified in more than one category are not too clear. It seems as if informants were hesitating between different features (height of the plant, animate gender, one or multiple stems) to classify them. The real reasons for this multiple classification will appear as my analysis develops.

Most of the taxa included in the category ***shakâua*** (Fig. 2) are botanically shrubs, that is, multiple-stemmed and woody plants. There are four exceptions to this rule: willow, which can be a tree but is classified with the shrubs because of similar height; showy mountain ash, which is a tree but is considered sometimes as a ***shakâu;*** and speckled alder and pin cherry, which are small trees but considered as ***shakâua*** because they are too high to be in the next category, ***atishîa*** (small shrubs). For three of the last four cases, relative height appears to be a fundamental feature of differentiation. Besides this trait, informants also characterized ***shakâua*** as having (a) large stems, (b) larger leaves than ***atishîa,*** and (c) a double bark (one inside and one outside). In fact, to understand the apparent process of classification, one must view all the main categories as a continuum mostly defined by features of the stem (height and diameter) and the leaves (width). On the other hand, women and men only classified one other plant in this category besides showy mountain ash and willow differently: ***innîtshîminânakashî,*** fetid currant, which was a ***shakâu*** for the former and an ***atishî*** for the latter. Again, the reason given by the women was that the plant is "high."

Fifteen of the 21 terminal taxa considered as ***atishîa*** (Fig. 3) are botanically small shrubs, that is, small woody plants with several stems. The six others have woody stumps (raspberry, cloudberry), a woody part as the base (bunch-berry), strong rhizomes (beach pea, strawberry), which informants possibly associate with wood, or dense trunks (club-moss), perhaps also associated with wood, and therefore related to the ***atishî.*** Three taxa out of these six ambiguous ones have been classified differently by women and men: bunch-berry, a herbaceous plant classified as ***atishî*** by the women and ***mashkushu*** (herbaceous plant) by the men; strawberry, another herbaceous plant considered similarly (***atishî*** by women and ***mashkushu*** by men); and club-moss, primitive vascular plants categorized as ***atishî*** by men but as kinds of ***ushkâtiâpî*** (root) by women (Fig. 5). Other general features of the category ***atishîa*** include (a) relative height (approximately 60 cm), (b) regular diameter of the stem, and (c) presence of small fruits (a feature

atishîa ('small shrubs')
- ***anûshkaniminânakashî*** (raspberry)
- ***ashtshîminânakashî*** (black crowberry)
- ***atikuminânakashî*** (bearberry)
- ***atitshîminânakashî*** (beach pea)
- ***îkûta*** (Labrador tea)
- ***inniminânakashî*** (blueberry)
- ***kâkakânuâshkuâk atishî*** (sweet gale)
- ***kâupemukua*** ('prickly or hairy wooden plants')
  - ***kâkuminânakashî*** (swamp currant)
  - ***shâpuminânakashî*** (hairy gooseberry)
  - ***innîtshîminânakashî*** (fetid currant)
- ***mashtshekuminânakashî*** (small cranberry)
- ***matshikîsha*** (possibly leather leaf)
- ***nishtshiminânakashî*** (bog bilberry)
- ***nitshukuminânakashî*** (sour-top blueberry)
- ***pâshitshinâkuana*** (club-moss)
- ***pitshikîsha*** (possibly swamp laurel)
- ***shakuteuminânakashî*** (cloudberry)
- ***shâshâkuminânakashî*** (bunch-berry)
- ***uîshatshiminânakashî*** (mountain cranberry)
- ***uîshatshipukua*** (sheep laurel)
- ***utaiminânakashî*** (strawberry)

FIG. 3.—***Atishîa***, 'small shrubs'.

deduced from the fact that this category alone comprises 15 taxa out of 23 denoted by lexemes that are formed by a morpheme referring to small fruits). Finally, other taxa in the category are also classified differently by women and men: small cranberry, a tiny shrub, which is ***atishî*** for women but ***mashkushu*** (herbaceous plant) for men, probably because of its small height; mountain cranberry, considered by men only as a ***mînakashîâshk***^{u} (fruit plant) without any affiliation to the main categories; and ***innîtshîminânakashî***, fetid currant, discussed above, which is considered a ***shakâu*** (shrub) by women but, because of a special feature, as a ***kâupemuk***^{u} (prickly or hairy wooden plant) and ***atishî*** (small shrub) by men.

Montagnais classification of ***mashkushua,*** *herbaceous plants,* is the most complex of their botanical taxonomy. Botanically, these plants are characterized by soft stems (absence of woody tissue) or even absence of stem. In the latter case, another part of the plant develops so much (for example, the leaves) that it becomes the main feature of the categorization (for example, the plant becomes a ***nîpîsh,*** literally "leaf"). Fig. 4 presents all the plants classified in one of the three main categories of nonwoody plants: ***mashkushua,*** *herbaceous plants,* which are characterized by (1) their relative height (they can be as high as an ***atishî***), (2) their softness (not hard like wood), (3) their long leaves, and (4) their color, green; ***nîpîsha,*** *leaves,* characterized mainly by their leaves; and ***uâpukuna,*** *flowers,* which have big flowers compared with other plants. Certain plants in Fig. 4 were classified differently by men and women. Three cases have already been mentioned (***mashtshekuminânakashî,*** small cranberry, ***utaiminânakashî,*** strawberry, and ***shâshâkuminânakashî,*** bunch-berry). Besides these, there is also ***pineuminânakashî,*** snowberry, which is a kind of leaf for the women but without any category for the men; and ***ûshpuâkanîssat,*** sporophytes of mosses, which were classified by the women as a kind of earth instead of a kind of herbaceous plant as they were by the men. While the first of these cases is difficult to interpret, the second shows how classification operates through partons and subjective reasoning: ***ûshpuâkanîssat*** look like soft stems and can thus be classified as herbaceous plants; on the other hand, they are part of mosses, which from the Montagnais point of view are kinds of earth. A last comment can be made on Fig. 4. The complexity of the classification of these plants can best be evaluated when one looks at the many categories in which a particular plant can be placed. This again has to do with the part of the plant looked at when it is classified. For example, my informants classified a plant named ***uîshakâtshâkuat,*** fern, as a ***mashkushu*** (herbaceous plant) while its fronds were not completely developed; later in the season, a fully developed specimen of the same species was classified as a ***nîpîsh*** (leaf). The complexity of this type of categorization is shown in Fig. 4 by the multiple use of categories at different levels of the taxonomy.

The Montagnais botanical category ***ashtshît nte kânîtaûtshîht*** or ***kânîtâutshîki*** (in the earth, the ones that grow) also includes ambiguous taxa. According to Berlin (1976:387), these taxa can be defined as those:

> [. . .] which encompass a group of organisms, most of which are highly polymorphic usually in stem habit. In some contexts of identification, a specimen which is said to be a member of a particular generic may be classified as a member of one life form; in others, a different specimen of the same generic class may be regarded as a member of another life form, or placed in no life form at all.

Tshishtâpâkuanat (branches of conifers) and ***ushkâtiâpîa*** (roots) are examples of such taxa. They include plants that can be classified in one of the main categories discussed above (for example, ***ashtshîuâshîshk^{u},*** ground hemlock, which is a kind of ***mishtuk^{u},*** tree) and at the same time are said to be part of these categories which include plants not classified elsewhere (for example, ***ashtshîuâshîshk^{u}*** is also part of the category ***tshishtâpâkuanat,*** branches of conifers, which includes other unaffiliated taxa such as ***kâkâtshiminânakashî,*** common juniper). Fig. 5 illustrates this classification. Here again there are differences between women's and men's classifications. For example, ***pâshitshinâkuana*** is an ***atishî*** for the men because of its woody part and a kind of root for the women because of its crawling stems. Fig. 5 also includes unaffiliated taxa classified as such only by the women (***pineuminânakashî,*** classified by men as leaves) or known only to women ***(anîtshikâta)***.

Besides the general category *plants that grow in the earth*, the Montagnais have another category, ***ashtshî*** (earth), in which are classified plants such as lichens and mosses, as well as kinds of mud and rotten wood. One of the main characteristics of these taxa is that they do not grow into the earth, but are the earth themselves, which grows. While this applies to mosses and lichens, it is not the case for kinds of mud or kinds of rotten wood, which informants seem to include in this category because earth is also constituted of elements that do not necessarily grow. In fact, this entire geovegetal category can be seen as a continuum of

- ***mashkushua*** ('herbaceous plants')
  - ***anukutshâuminânakashî*** (dwarf red blackberry)
  - ***kâianakâshkâti mashkushua*** ('large herbs')
  - ***kâiapishâshiti mashkushua*** ('small herbs')
  - ***kâkakânuâpekâki mashkushua*** ('long and filiform herbs')
  - ***kâmânitanishipîuâshiti mashkushua*** (cotton-grass)
  - ***kânûtamashkuâshiti mashkushua*** ('small hard rounded herbs')
  - ***kâtakuâshiti mashkushua*** ('small short herbs')
  - ***mashtshekuminânakashî*** (small cranberry)
  - ***mîtishat*** (field sorrel)
  - ***nishtshimîtshima*** ('food of the goose')
  - ***ûshpuâkanîssat*** ('sporophytes of mosses')
  - ***utaiminânakashî*** (strawberry)
  - ***utshâshku-mîtshima*** ('food of the muskrat')
  - ***uâpukuna*** ('flowers')
    - ***âmuâpukun*** ('colored flower')
    - ***kâmînauâshiti uâpukuna*** (neodioecious antennaria)
    - ***kâuâpâshiti uâpukuna*** ('small white flowers')
    - ***kâuâpishtukuâniâshiti uâpukuna*** ('small white-head flowers')
    - ***kâuîshâuâshiti uâpukuna*** ('small yellow flowers')
  - ***uâpukuna*** / ***nîpîsha***
    - ***âmu-nîpîsha*** (sea rocket)
    - ***nishtshikâta*** (bristly sarsaparilla; American great burnet)
  - ***nîpîsha*** ('leaves')
    - ***pâshpâshtshu-nîpîsha*** (twin-flower)
    - ***shâshâkuminânakashî*** (bunch-berry)
    - ***tshishiteu-nîpîsha*** ('leaves that warm up')
      - ***kâuâpishtukuâniâshiti tshishiteu-nîpîsha*** (yarrow)
      - ***kâuîpâpinamânapukâshiti nîpîsha*** (American mint)
    - ***uâpush-ushkâtiâpîa*** (wild sarsaparilla)
    - ***uîshakâtshâkuat*** (fern)
- ***nîpîsha*** ('leaves')
  - ***atâpukuat*** (yellow clintonia)
    - ***tshîtshue atâpukuat*** ('real yellow clintonia')
  - ***kâneupemakâht*** (red clover)
  - ***matshi-nîpîsha*** (common hemp-nettle)
  - ***pineuminânakashî*** (snowberry)
- ***uâpukuna*** ('flowers')
  - ***uîpîtakâshkua*** ('hollow stem plants')
    - ***tshîtshûe uîpîtakâshk***[u] (cow parsnip)
- ***atishîa*** ('small shrubs')
  - ***nîpîsha*** ('leaves')
    - ***uîshakâshkamuk***[u] (goldthread)

FIG. 4.—***Mashkushua***, 'herbaceous plants'.

entities that is denoted in the lexemes of the taxa themselves. From those lexemes composed of ***ashtshî*** (earth), such as ***ashâshtshu*** (mud), to those formed with ***-shkamuk***[u] (ground, surface) as in the names for mosses and lichens, to rotten wood again marked by morphemes such as ***ashtshî***, one can see a stratified vision of the earth's crust. This was also pointed out by two of my informants:

tshishtâpâkuanat ('branches of conifers')	***innâshtâpâkuan*** ('balsam fir branch') (...) ***ashtshîuâshîshk***^{u} (ground hemlock) ***kâkâtshiminânakashî*** (common juniper) ***pishkuâshîshk***^{u} (witches'-broom)	***tshîtshue ashtshîuâshîshk***^{u} ('real ground hemlock')
ushkâtiâpîa ('roots')	***pâshitshinâkuana*** (club-moss) ***uatapîa*** ('spruce roots') (...)	
	pineuminânakashî (snowberry)	
	anîtshikâta (pitcher-plant)	

FIG. 5.—Ambiguous and unaffiliated taxa (abridged).

> At the beginning, there is always sand. After the earth grows on it. After, it's ***uâpitsheuâshkamuk***^{u} (reindeer moss). That's the last one, there is nothing after. ***Nîtautshin ashtshî,*** the earth grows. (Barthélémie Lafontaine and Michel Astamajo, Mingan, 18.06.1981)

According to the Montagnais, sand and stone do not belong to the category ***ashtshî*** (earth). While it is not my purpose to describe this entire domain, it can still be said that botanical entities classified as such can be considered as prototypical as the other elements inasmuch as we recognize that the morpheme (***-shkamuk***^{u} 'ground, surface') composing *all* the lexemes of these taxa (mosses and lichens) refers to the name of the category itself ***(ashtshî).***

Fig. 6 illustrates the classification of taxa included in ***ashtshî.*** The figure includes only one taxon ***(ûshpuâkanîssat)*** that my two groups of informants classified differently. This was dealt with in the preceding section. Finally, Montagnais botanical taxonomy comprises a few taxa that could be affiliated with the category ***ashtshî*** inasmuch as these taxa do not have any roots, which is a feature of all the taxa classified as earth. Fig. 7 shows these taxa, about which I recorded no divergence on classification by women and men. The figure illustrates the importance of partons as means of classification (for example, rhizomes, cones, and tumor), a feature that is consistent with the use of other parts such as leaves, flowers, and roots, as classifiers of taxa in other sections of the taxonomy.

Use of plants.—The Montagnais use plants mostly for technical, medical, and nutritional purposes. There are a few ritual uses of plants, but considering their limited importance (only five species), these uses will not be taken into account in the following analysis.

Use of plants for technical purposes includes construction of objects such as canoes, snowshoes, sleds, permanent or temporary shelters, instruments such as rattles and drums, utensils, games, and many articles traditionally used on a daily basis in the bush, such as dyes, diapers, and an equivalent of toilet paper. All of these elements are generally made out of either ***mishtukuat*** (trees) or ***ashtshî*** (earth), and it is with the help of these two notions that I will present the

- ***ashtshî*** ('earth')
  - ( )
    - ***ashâshtshu*** ('mud')
      - ***ashâshtshu*** ('dark mud')
      - ***uâpâtunishtsh*** ('whitish mud')
    - ***ashtâtshîpek***ᵘ ('green microscopic algae')
  - ( )
    - ***ashâtshîuâshkamuk***ᵘ ('plant growing in the mud')
    - ***mashtshekuâshkamuk***ᵘ (sphagnum)
      - ***anîk-ashtshî*** ('long sphagnum')
      - ***kâmîkuât mashtshekuâshkamuk***ᵘ ('red sphagnum')
      - ***kâshîkâshkamâkâshit mashtshekuâshkamuk***ᵘ ('small dense sphagnum')
      - ***kâshîpekushkamâkât mashtshekuâshkamuk***ᵘ ('green sphagnum')
      - ***kâuîshâuâshkamâkâshit mashtshekuâshkamuk***ᵘ ('yellow sphagnum')
    - ***pinâshteshkamuk***ᵘ ('kind of liverwort')
    - ***uâpitsheuâshkamuk***ᵘ (reindeer moss)
      - ***kâiapishâshit uâpitsheuâshkamuk***ᵘ ('small and delicate reindeer moss')
      - ***kâkakânuâpekâk uâpitsheuâshkamuk***ᵘ ('long and filiform reindeer moss')
      - ***kâkâuâshit uâpitsheuâshkamuk***ᵘ ('kind of lichen')
    - ***ûshpuâkanîssat*** ('sporophytes of mosses')
  - ***pashkuâtshîtuk***ᵘ ('rotten wood')
    - ***innashtshî*** ('dark rotten wood')
    - ***kâpmînâu-ashtshî*** ('yellowish rotten wood')
    - ***kâshkâtshutuk***ᵘ ('small cubical rotten wood')
    - ***uâpushutuk***ᵘ ('white rotten wood')

FIG. 6.—*Ashtshî*, 'earth'.

- ***anîk-apâkuai*** ('cortical foliose lichen')
- ***kâpîputepishiti*** (puffball)
- ***mînapâkuna*** (old-man's beard)
  - ***kâshîpekuti mînapâkuna*** ('green old-man's beard')
  - ***kâuînipâti mînapâkuna*** ('black old-man's beard')
- ***pishkuâkâtinân*** ('woody tumor on trees')
- ***shâshâpina*** (algae)
- ***uâkuanâpishk***ᵘ (rock tripe)
- ***uâshkatamuî*** ('rhizome')
  - ***nanamishtshîu-ushkâtiâpî*** ('water arum's rhizome')
  - ***uâshkatamuî*** ('pond-lily's rhizome')
- ***uâshkuetuî*** ('cone and mushroom')
  - ***anukutshâsh-nekâutu*** ('big mushroom')
  - ***pûshûan*** (conk of *Fomes* spp.)

FIG. 7.—Unaffiliated and ambiguous taxa related to *ashtshî* (abridged).

technical uses of plants. In Montagnais, the word ***mishtuk***[u] has two meanings, as noted earlier: when animate it signifies a "tree," but when inanimate it refers to a part of the tree, the "wood." The free form of the notion wood is ***mishtuk***[u]***,*** as in ***mishtuku-emîkuan,*** "wooden spoon." The bound forms are more numerous, and it is through their analysis that one can discover the links between taxonomy (***mishtukuat,*** trees) and partonomy, or uses through a parton (***mishtuk***[u]***,*** wood). The main bound form for wood is ***-âshk***[u]. This morpheme is generally found in those words that refer to most of the objects (or parts of objects) constructed with ligneous species, mainly from wood (***mishtuk***[u]***,*** inanimate) and therefore from trees (***mishtuk***[u]***,*** animate). A partial list of these objects would include toboggans ***(utâpânâshk***[u]***)*** made out of tamarack, white spruce, white birch, and black spruce; one kind of sled ***(utatshinâkanâshk***[u]***)*** made out of the same species; bows ***(akâshk***[u]***),*** which were traditionally made out of black spruce or tamarack; frames of snowshoes ***(ashâmâshk***[u]***)*** made out of white birch, tamarack, and black spruce; salmon spears ***(anituiâshk***[u]***)*** fabricated mainly with black spruce, white spruce, or balsam fir; axe handles ***(ushtâshkuâshk***[u]***)*** made mainly with showy mountain ash; and tent stakes ***(tshîtâshkâtshikana),*** which can be made out of black spruce, white spruce, white birch, trembling aspen, speckled alder, green alder, or even dry balsam fir. Other bound forms for wood are ***-îshk***[u]***,*** which also has the meaning of branch, ***-pemuk***[u]***,*** which refers also to the leafy nature of woody plants, and ***-tuk***[u]***,*** which also conveys the notion of dry or useful. Except for ***-tuk***[u]***,*** these bound forms are not used as frequently as ***-âshk***[u] in lexemes denoting objects made out of ligneous material. Nevertheless, the notion of wood establishes a link between taxonomy and uses of plants. It is also a notion that defines many categories in the taxonomy: wood is a key element to differentiate ***mishtukuat*** (trees), ***shakâua*** (shrubs) and ***atishîa*** (small shrubs) from ***mashkushua*** (herbaceous plants); and it is finally a notion that appears in two subdivisions of the taxonomy (***kâupemukua,*** "hairy wooden plants," and ***uîpîtakâshkua,*** "hollow stem plants") and in a nontaxonomic category used to group fruit plants ***(mînakashîâshkua).*** Woody plants other than ***mishtukuat*** (trees) are used by the Montagnais for technical purposes, but these are very few in number: only two ***shakâua,*** "shrubs," as pelt dryers; branches of two other ***shakâua,*** as a means to whip the dew off trees while walking in the bush; one ***atishî,*** "small shrub," for tanning hides; and one ***mashkushu,*** "herbaceous plant," to construct an animal call. In the last case, the plant is the only one among herbaceous plants to be named by a word formed of a morpheme referring to wood ***(uîpîtakâshk***[u]***).*** This is consistent with the relation between technical purposes and the woody nature of the plants used, even if this plant constitutes an anomaly (it is classified with herbaceous plants that are normally nonwoody plants).

The only other plants that are used technically as much as ***mishtukuat*** (trees) are those included in the main category ***ashtshî*** (earth). One of the divisions of ***ashtshî*** is even named with a morpheme referring to wood (***-tuk***[u]***,*** dry wood, useful wood), linking the main category ***ashtshî*** to ***mishtukuat,*** from which comes ***mishtuk***[u] (wood). ***Mishtuk***[u] dries up to give different kinds of dry wood (for example, ***innâshtshituk***[u]***,*** dry balsam fir, and ***uâshkuaituk***[u]***,*** dry white birch) or rotten wood ***(pashkuâtshîtuk***[u]***),*** as recorded in Fig. 6. The latter category, *rotten wood,* comprises elements mostly used as diapers or to smoke hides. As was the case for ***mishtuk***[u], ***ashtshî*** appears in both free and bound forms. The main bound form is ***-shkamuk***[u], "ground, surface," which appears in many words referring to plants (for example, all the ***mashtshekuâshkamuk***[u], sphagnum) used as diapers, toilet paper, and filling material in log cabins.

Medical use of plants operates in a similar manner as that described for technical use. The main notion of wood, governing the development of one general category of plants (***mishtukuat,*** trees) used for technical purposes, is echoed here by many notions (for example, bark and leaves) linked to either nomenclature or taxonomy of medicinal plants. Description of these parts of plants and their uses will first reveal the most apparent relations between uses and classification.

The bark ***(uânâtsheshk***[u]***)*** of 14 species is used as medication. All these species are ligneous, hence classified as ***mishtukuat*** (trees), ***shakâua*** (shrubs), and ***atishîa*** (small shrubs). Moreover, in most cases, it is the "internal" bark (phloem) that serves to prepare the medication. Branches of 11 species are also used. In Montagnais, *branch* can take many forms: a free form for *branch of conifer* (***tshishtâpâkuan,*** which is the name of a category; see Fig. 5); a free form for *branch of deciduous tree* ***(ûtîkuan);*** and a bound form, ***-îshk***[u], which concerns both evergreen and deciduous trees and which is found in lexemes denoting plants specifically used as medication (for example, ***tshîtshue ashtshîuâshîshk***[u], "real ground hemlock"). Medicinal branches come from the same categories as medicinal barks, that is, trees and shrubs. The leaves ***(nîpîsha)*** of ten species are also prepared for medical purposes. In Montagnais, the notion of *leaf* appears mainly in the free form ***nîpîsha.*** This free form is a main category in the taxonomy (Fig. 4); it is again present in such lexemes as ***tshishiteu-nîpîsha,*** "leaves that warm up," a class of specifically medicinal plants, or in other lexemes such as ***pâshpâshtshu-nîpîsha*** (twin-flower), which is used for chest illness. Taxonomically, these *leaves* are found mostly among the ***mashkushua*** (herbaceous plants), but there are a few cases reported in ligneous plants. In ten cases, the plants used as medication are so small that no parts can be differentiated as to usefulness. These plants are found all over the taxonomy. In five other cases, one ***atishî*** (small shrub) and four ***mashkushua*** (herbaceous plants), it is the root ***(ushkâtiâpî)*** that is used as medication. For my female informants, *roots* form a category per se (Fig. 5). The notion also appears mainly in a free form in such lexemes as ***uâpush-ushkâtiâpîa,*** wild sarsaparilla. Finally, there are some other parts of plants that serve a medical purpose, but much less frequently. These parts still show a relation either with nomenclature or taxonomy: for example, four kinds of cones (***uâshkuetuî,*** which is again the name of a category; see Fig. 7); four kinds of gum (***pitshu*** includes all the different sorts of gum); two kind of berries, ***mînakashîâshkua*** (from ***mîn-,*** "berry") being the name of a general category containing all *fruit plants;* and two kinds of wood.

In Montagnais there are very few words for medications; it is mostly the names of the plants that act as the names of the medications. Therefore, compared with the technical uses of plants, where one can find in the names of the objects constructed a relation with the parton *wood* and the category ***mishtuk***[u] (tree), the relation operates a little differently in the medical domain. Here it is in the actual lexemes of the plants, used instead of names for the medications, that one can find a link with partonomy and taxonomy. There are many examples to illustrate this kind of relation, which has to do with the "doctrine of signatures." A few can be found in Clement 1990. I will cite only three here. In Montagnais the same morpheme, ***uîshatsh- (uîshak-)*** is used in a description of throat illness ***(nuîshatshiku ukûtâkan)*** and in three of the plants used to treat the illness ***(uîshatshiminânakashî, uîshakâshkamuk^u,*** and ***uîshatshipukua).*** The treatment of fever shows similar relations: three of the plants used can be classified as ***tshishiteu-nîpîsha,*** "leaves that warm up," and the symptons of fever are qualified in Montagnais as ***tshishinauâshu,*** a word derived from ***tshishin,*** "it is cold," describing a state exactly opposite to the one implied in the names of the plants used. Finally, among the plants used to treat skin diseases, seven out of ten refer explicitly or implicitly to the color red (for example, ***mîkuâpemuk^u,*** red-osier dogwood, from ***mîku-,*** "red;" ***atûshpî,*** speckled alder, whose bark yields a red liquid when boiled), which can be used to define most symptoms of these diseases.

Considering only the number of taxa, use of plants as food comes in third position after their medical (41 taxa) and technical (34 taxa) uses. Only 25 species were traditionally—and in some cases still are—consumed by the Montagnais, of which 19 are ***mînakashîâshkua,*** *fruit plants.* The others were mostly plants eaten in case of famine (for example, all kinds of reindeer moss). The word ***mînakashîâshkua*** contains three morphemes, two of which establish a relation between a parton (***mîn-,*** "berry") and taxonomy (***-âshku*** refers to wood and hence to a category of ligneous plants). Furthermore, the third morpheme, ***-akashî-,*** "fruit plant," associates the latter two notions (*plant* conveys here the notion of woody), and with the first morpheme ***(mîn-)*** is found in *all* the lexemes denoting a fruit plant (for example, ***mashkuminânakashî, atûminânakashî,*** and ***uîshatshiminânakashî***). These plants, as noted before, are mostly classified as ***atishîa*** (small shrubs). This category contains no less than 15 kinds of ***mînakashîâshkua*** (Fig. 3).[9]

Structure of relations.—To summarize Montagnais botanical knowledge, the fundamental structure of the relations between these people and their plants comprises two main aspects that can explain the taxonomy. These aspects are plant morphology (partons) and utilization. I will detail how this structure operates below, then demonstrate its manifestations in taxonomy. In fact, it is as if taxonomy was but an effect on the language level of a deeper core constituted by a complex utilitarian relation between a people and a domain of its environment.

The Montagnais classify plants in two major categories on the basis of the presence or absence of a single part, the "root": plants that possess this organ "grow in the earth" ***(ashtshît nte kânîtâutshîht*** or ***kânîtâutshîki)*** and plants that do not have any "roots" are considered "earth" ***(ashtshî)*** itself[10]. The first of these two large categories is further divided in two on the basis of the presence or absence of an internal part, the "wood": ***mishtukuat*** (trees), ***shakâua*** (shrubs), and ***atishîa*** (small shrubs) are all ligneous, while ***mashkushua*** (herbaceous plants) by definition are not. The technical uses of plants by the Montagnais are related to the formation or existence of the two main categories: "wood" and its uses for technical purposes are present in most of the divisions of the first major category, and technical uses were also reported as the main uses of the plants comprised in the second main category. Why then are there some categories that define themselves in a positive way and others in a negative way? This state of affairs is not peculiar to the Montagnais. The origin of some of the categories in our own botanical system shows the same development:

> Study of de Jusieu's classification illuminates a peculiar problem which must have intrigued many students of Angiosperm classification. There are, broadly, two kinds of families, which one might call the 'definable' and the 'indefinable', well illustrated by the *Umbelliferae* and the *Rosaceae,* both 'old' families in the sense that the concept roughly representating the modern family is visible in eighteenth-century works. A remark by de Jussieu in his introduction to the *Rosaceae* is worth quoting: 'Tournefort gave the name *Rosaceae* to all those plants with regular polypetalous flowers which were not *Umbelliferae* nor *Cruciferae,* nor resembled Lilies nor Dianthi in their flowers'. In other words, a certain length of the chain of linked genera is conveniently dealt with, leaving as a mid-point link the type genus *Rosa.*
>
> Why is the rose chosen? The answer is clear. This was happening in seventeenth-century Europe, where for centuries previously art and literature had been full of certain symbolic flowers. How could any other choice have been made? The 'indefinable' families, then, are associative; the type genus is an important European plant; and the shape of the family is a product of this thought-process. Furthermore, the more powerful the symbol in medieval writing, the earlier the 'recognition' and the larger the family; thus *Rosaceae* and *Liliaceae* in contrast with (say) *Hamamelidaceae* and *Amoryllidaceae.* (Walters 1961:77–78)

These remarks by a botanist on the negative reasons presiding over the creation of a family of plants are most interesting for the present demonstration. The development of a very complex Montagnais category, the ***mashkushua*** (herbaceous plants), could therefore have originated negatively and, in fact, this is how they were defined by my informants—as plants that have no woody tissue. Why then has this category of plants become as important as ***mishtukuat,*** "trees," for example? Again, Walters (1961:76–77) offers an answer to this question when he talks about the relation between the uses and importance of a category:

> Had there been few Umbelliferous plants in Europe, and had they been of no importance for their edible, medicinal or poisonous properties, *Umbella* might well have been a genus, or at most a few genera, of the *Araliaceae.*

Indeed, it is the great number of taxa and, in a way, the medical uses of the plants classified as ***mashkushua,*** that played a role in the formation of this important category[11].

To pursue my reasoning, "wood" as a central notion in the three categories "trees," "shrubs," and "small shrubs" becomes a key feature in only one of these, the ***mishtukuat,*** "trees". It is in fact among "trees" that the use of wood for technical purposes is the most developed. The notion of "fruit, berry" is at the origin of another class of plants: the ***atishîa,*** "small shrubs." In reality, it is in this category that most of the ***mînakashîâshkua*** (fruit plants) are found, which on the one hand form the essential part of food plants for the Montagnais, and on the other contains, as a lexeme, an explicit reference to the woody nature of these plants (***-âshku,*** "wood"). There remains a final category of plants, ***shakâua*** (shrubs), for which there seems to be no a priori relation between uses and the taxonomic existence of the class. When the analysis is pushed a little further, one notices that the majority of the ***shakâua*** have in common a bark that is used as medication (eight out of twelve taxa) and in most of these cases, it is the "internal" bark that is used. My informants had also stated that a secondary feature of this class was a double bark. This feature becomes a key one when considered in light of the fundamental structure behind the morphological taxonomy. For nonligneous species, the medical uses of certain parts also seem to govern the formation of the class: nine out of 13 plants are used as medications. These 13 plants are the only ones used in this class. Compared with other classes, ***mashkushua*** (herbaceous plants) comprises a high number of residual plants (i.e., plants that are not used): 17 out of 30 taxa compared with 28 plants not used out of 119 in the whole taxonomy. The essence of the ***mashkushua*** could therefore be a residual class, which would account for its complexity and its structure not being as clear as the other classes.

Once the main classes were formed in the development of this botanical taxonomy, one could have found common elements in one class (for example, height of plants, size of stem) that would seem to have been factors in the incorporation of other plants that appear now as residuals compared with the prototypes defined by the use of a special part. This would explain the general appearance of the taxonomy. Again, this state of affairs is not peculiar to the Montagnais. The existence and development of classes in the Linnean taxonomy follow the same pattern. Walters (1961:81) talks about the reasons behind the development of particular classes of plants:

> Under what conditions, then, can a large genus 'arise'? Broadly, I think there are two kinds of situation, which might be exemplified by the very large genera *Carex* and *Euphorbia*. *Carex,* the largest European genus according to Nyman (1878) with 163 species, has by recent estimates well over 1000 species in the world. In the *Species Plantarum* the total of known species of *Carex* was twenty-nine! *Carex,* in fact, represents relative taxonomic ignorance at the time of Linnaeus. This fact becomes more evident when we contrast the generic size and number of the *Gramineae* with that of the *Cyperaceae*. In each case the inconspicuous wind-pollinated flowers present similar difficulties of interpretation; yet the economic importance of the grasses in Europe had ensured that by the time of Linnaeus forty-six genera were named and described, as against five of the present-day *Cyperaceae*.

To understand this citation, one should know that *Carex* are part of the family Cyperaceae, and as they were not used during the time of Linnaeus, they were practically ignored in the taxonomy; the opposite is true for the Gramineae: because of their economic importance, the Gramineae were much more developed.

Montagnais taxonomy revised.—Table 2 illustrates the relations between partonomy, uses, and taxonomic importance. In each main category of the taxonomy, there are certain uses of plants that are more quantitatively developed than others. The

TABLE 2.—Partonomy, uses and taxonomy.

Partons	Uses	Number of Taxa	Categories
-âshk[u] (wood)	technical	8 *mishtukuat* 1 *shakâu/mishtuk[u]*	*MISHTUK[U]* (useful wood)
uânâtheshk[u] (bark)	medical	5 *mishtukuat* 1 *mishtuk[u]/shakâu;* 1 *shakâu/mishtuk[u]* 6 *shakâua*	*SHAKÂU* (double bark)
mîn (fruit)	food	1 *shakâu/mishtuk[u]* 2 *shakâua* 1 *shakâu/atishî* 8 *atishîa* 1 *atishî/nîpîsh* 1 *atishî/mashkushu* 1 *atishî/mînakashîâshk[u]* 1 *mashkushu* 1 *nîpîsh* / unaffiliated	*ATISHÎ* (fruit plant)
nîpîsh (leaf)	medical	1 *nîpîsh/atishî* 1 *atishî; 1 nîpîsh* 3 *nîpîsha/mashkushua* 1 *nîpîsh/atishî/mashkushu*	*NÎPÎSHA* (medical leaves)
ushkâtiâpî (root)	medical	1 *atishî* 1 *atishî/ushkâtiâpî* 1 *nîpîsh/uâpukun/mashkushu* 1 *nîpîsh/mashkushu* 1 *nîpîsh/atishî* 1 *uâpukun/mashkushu*	
uâpukun (flower)	not used	5 *uâpukuna/mashkushua* 1 *uâpukun/nîpîsh/mashkushu*	*UÂPUKUNA* (flowers)
tshishtâpâkuan (branch of conifer)	medical	7 *mishtukuat/tshishtâpâkuanat* 1 *tshishtâpâkuan*	*TSHISHTÂPÂKUANAT* (medicinal branches)
ûtîkuan (branch of deciduous)	medical	1 *atishî*	---
-shkamuk[u] (ground, surface)	technical	6 *ashtshî*	*ASHTSHÎ* (earth)
pashkuâtshîtuk[u] (rotton wood)	technical	3 *ashtshî*	
uâshkuetuî (cone, mushroom)	medical	4 *mishtukuat*	*UÂSHKUETUÎA* (medical cones)
pitshu (gum)	medical	4 *mishtukuat*	*PITSHU* (medical gum)

relation between the number of taxa used for a particular purpose and the category to which these taxa belong is constant in every main category. It corresponds also to what was found as being the structure of the Montagnais's relations with their plants. In each category, there is therefore a core constituted of what one could call prototypes. The reality of these cores is further attested by the fact that taxonomic anomalies[12] can be explained by their presence. For example, there were two taxa, ***mashkuminânakashî,*** showy mountain ash, and ***uâpineu-mîtshima,*** willow, about which my informants were hesitant: the first one was classified most of the time as a ***mishtuk***^{u} (tree) and sometimes as a ***shakâu*** (shrub); the second sometimes as a tree, but more often as a shrub. These two cases are very interesting and can help us to understand in what ways taxonomy is utilitarian and in what ways it is not. This explanation follows.

The core of the class ***shakâua*** (shrubs) is constituted of six taxa named, classified as ***shakâu,*** and known for their medicinal internal bark by one or both groups of informants. These plants are the following: ***atûshpî,*** speckled alder; ***atûminânakashî,*** Bartram's shadbush; ***tshîtshue shakâu,*** green alder; ***apueminânakashî,*** pin cherry; ***mîkuâpemuk***^{u}***,*** red-osier dogwood; and ***kâmatshakâshit shakâu,*** wild holly. Two anomalies, ***mashkuminânakashî,*** showy mountain ash, and ***uâpineu-mîtshima,*** willow, could also be considered part of the core since their bark is used as medication, but they will be dealt with later in more detail. The other four plants (see Fig. 2) left in the ***shakâua*** have the following uses: ***mûshuminânakashî,*** edible cranberry-tree, and ***innîtshîminânakashî,*** fetid currant, are fruit plants that are eaten; ***atîkupemuk***^{u}***,*** glandular birch, is not used; and ***mishtukusha,*** red-berried elder, has a stem which is used to prepare a medication for headaches. All four of these species have multiple stems, a feature that defines the class morphologically. Hence, the general process operates like this: medicinal double bark defines the prototypes of the class ***shakâua***[13] (shrubs). The majority of the prototypes also have the common feature of multiple stems; this secondary feature, as opposed to secondary features that will emerge in the formation of other classes, helps to classify the residual plants that do not conform to the prototypes but still possess this secondary feature. The last four plants mentioned would constitute such residual plants in the taxonomy.

The two anomalies still have to be explained. ***Mashkuminânakashî,*** showy mountain ash, possesses a medicinal bark and therefore is considered sometimes as a ***shakâu.*** However, ***mashkuminânakashî*** is the only plant among the ***shakâua*** to *also* possess wood that is used for a technical purpose: ***ushtâshkuâshk***^{u} (axe handle), which is composed of the morpheme ***-âshk***^{u}***,*** "wood." This taxon can therefore be considered also as a ***mishtuk***^{u} (tree) since the prototypes of this category have in common wood, which is used for technical purposes. Furthermore, ***mashkuminânakashî*** is the *only* lexeme among the ***mishtukuat*** (trees) to be marked by the inanimate gender, a fact that argues in favor of its classification as a ***shakâu*** rather than a ***mishtuk***^{u}***,*** all the ***shakâua*** being inanimate and the ***mishtukuat*** animate. Similar reasons explain the taxonomic ambiguity of ***uâpineu-mîtshima,*** willow. Willow is used only as medication and has no technical purpose. The main medical use is made of its bark as medication; the plant is therefore classified more often as a ***shakâu*** than is ***mashkuminânakashî,*** showy mountain ash, which also has *wood* used for a technical purpose. ***Uâpineumîtshima*** is also inanimate, which leaves no doubt as to its taxonomic category. However, the same plant is sometimes classified as a ***mishtuk***^{u}, "tree." This time, the apparent features (height of trees compared with shrubs, one stem instead of multiple stems) affect the taxonomic choice of the informants. They hesitate and sometimes considered the plant as a ***mishtuk***^{u} (tree).

Other cases of anomalies could be cited to support this interpretation. For example, three plants ***(shâshâkuminânakashî, utaiminânakashî,*** and ***mashtshekuminânakashî)*** were systematically considered ***atishîa*** (small shrubs) by women and ***mashkushua*** (herbaceous plants) by men. All these plants are fruit plants, and in Montagnais society, it is the role of the women to pick berries (there is even a proverb saying that if a man picks berries, he will only have girls as progeny). The plants are therefore classified by women as ***atishîa,*** whose fundamental feature is edible berries. On the other hand, in Montagnais society men are the ones responsible for the transformation of wood into objects. Consequently they have considered these three plants as unusable and have classified them according to their most apparent features. The first two are nonligneous plants and the third grows very near to the ground, hence their classification as ***mashkushua*** (herbaceous plants), which comprise herbs, small plants, and many residuals.

The relation between partonomy and taxonomy just presented in Montagnais botanical thought can also be found in other world views. Feit (1978:105) has reported the existence of the same relation among the Cree of Waswanipi in the province of Quebec. The Cree are of the same linguistic family as the Montagnais:

> The diversity and types of upper level classifications that have been discovered indicate that there often are cross-links to other classificatory structures—including technological utilization, dietary status, economic and ritual significance [. . .]. For example, the term for 'tree', an ethnobotanical category, may serve as well as a resource category, as 'timber' or 'firewood' [. . .].

When one also learns that the English word *wood* is related to the old Irish word *fid,* which means tree, and that the English word *tree* is related to the Sanskrit *dāru,* which means wood, the conclusion is evident: in ethnoscientific terms establishing a clear link between taxonomy and partonomy, a taxon can be a *kind of* simply because its wood is a *part of*[14]. The following section expands this generalization to Montagnais zoological taxonomy, rendering the conclusions attained even more convincing.

MONTAGNAIS ZOOLOGICAL TAXONOMY

Relation between taxonomy and utilization: a hypothesis.—Study of Montagnais zoological taxonomy was initiated by Bouchard (1973) and Bouchard and Mailhot (1973). Six main categories were elicited: ***aueshîshat, missipat, pineshîshat, manitûshat,*** and ***shâtshimeuat.*** The translation of these terms by Bouchard and Mailhot, as well as some translations found in dictionaries from the seventeenth century to today, are recorded in Table 3. In spite of the fact that some of these translations are not accurate (for example, the category ***namesh*** includes aquatic animals other than fish, such as sea mammals, lobster, shrimp, crab, and all

TABLE 3.—Main Montagnais zoological categories.

	aueshîsh	*namesh*	*missip*	*pineshîsh*	*manitûsh*	*shâtshimeu*
Fabvre (1970) [1695]	animal, terrestrial beast	fish	kind of bird, big duck	small bird	small bugs, worms (*manit8-chich*)[1]	mosquito, gnat, midge (*sakime8*)[1]
Laure (1988) [1726]	animal in general, beast	fish	duck, wild fowl (*irini-chichip*)	bird	insect, worm (*mani-tuchich*)	mosquito, gnat, midge
Bouchard and Mailhot (1973)	animal, four-legged animal	fish	water-fowl	bird	animal with maleficent power	insect
Mailhot and Lescop (1977)	animal, four-legged animal	fish	moyak (eider)	bird	maleficent animal (*manitûshîss:* insect, bug)	insect
McNulty and Basile (1981)	wild or do-mestic animal	fish	feathered water-fowl	small bird	insect, rep-tile, malefi-cent animal	mosquito, biting insect

[1]The symbol 8 signifies the ancient recording of the /u/ sound.

shellfish), these translations of Montagnais zoological categories can suggest which apparent features define them: mainly morphological (four-legged, feathered, small, big); habitat (land, water); and miscellaneous (wild, tame, biting, maleficent power). During my own fieldwork on the identification, nomenclature, and classification of 567 taxa, Montagnais informants gave many reasons why an animal was classified in one or another of these main categories. These features, whether mentioned for only one or many taxa, appear in Table 4. The table shows a number of paradigms that operate in the apparent choices informants make when assigning a particular category to a taxon. These paradigms include those used by certain authors as compiled in Table 3, but also largely exceed them. Taxonomic classification seems therefore to be a very complex operation, and any attempt to grasp it in simple terms is unlikely to succeed.

However, there are indications that simple keys exist for interpreting this complex and detailed system. These indications come from the analysis just presented on the relation between taxonomy and partonomy in Montagnais botanical knowledge. They also originate in Feit's (1978:214) observation of the relation his own Cree informants established between the ordering of their animals and their use as food:

> Among the explanations given there were a number that referred to what the 'animals' being rated themselves ate. It will be remembered that what

> and where an 'animal' eats were the predominant criteria for the grouping made in the picture sortings, and that a secondary criterion, quality of the 'animal' as food for humans, suggested a link between the ordering of the domain 'animals' and the domain 'food'.

A relation between food and biological classification has also been found in Navaho, as Feit (1978:105) reports from a study by Perchonock and Werner: "Perchonock and Werner, using a card-sorting method of elicitation, found with Navaho that taxonomies of food terms intersect extensively with folk biological classifications." This quotation follows Feit's statement about the relation between *tree* and *wood* that I referred to earlier. If uses and taxonomy are related, one can expect to discover these relations everywhere and not in a single domain. The Montagnais zoological system shows such a relation. Among the features given by my informants to explain why a taxon was classified in a given category (Table 4), there is one that corresponds to the one revealed by Feit and Perchonock and Werner. This feature is based on the utilization of animals, and revolves around the central theme of edibility and inedibility. There are also two partons involved, ***uiâsh*** (meat) and ***namesh*** (flesh), which are used to differentiate types of meat, from ***aueshîsh*** or ***namesh.*** My presentation of Montagnais zoological taxonomy will follow this lead, and I will attempt to explain certain anomalies in this taxonomy (for example, ***amishk***^{u}, beaver, is classified as ***aueshîsh*** but also sometimes as ***namesh,*** with fish). The explanation of these anomalies can further validate my interpretation of the relation between the taxonomy, the partonomy, and the uses of the biological entities.

General zoological taxonomy and structure of relations.—According to my own data, there is no single term in Montagnais that would be equivalent to what is considered in scientific terms the animal kingdom. Bouchard and Mailhot (1973) suggest that the term ***aueshîsh,*** in the general sense of "animal", covers the entire zoological domain, including reptiles, amphibians, and invertebrates. In the words of one of my informants, this is an impossibility: "***Enuk***^{u} (spider and ant), ***kuâkuâpishîsh*** (butterfly), ***sheuekâtshu*** (dragonfly, damselfly), ***umâtshashkûk*** (frog), and ***shâtshimeu*** (diptera) are not ***aueshîsh. Aueshîsh*** is ***namesh, missip, pineshîsh, maikan*** (wolf), all that" (Jérôme Napish, Mingan, 13.12.1988). Furthermore, another informant explains why all these animals cannot be classified together in one labelled category[15]: "We can't name all that: the insects, the shells, and the rabbit together. We must rather name the groups separately: ***eshat*** (shellfish), ***manitûshat, pineuat*** (partridges), . . . Because, when we say ***aueshîshat,*** we think immediately of those animals that are edible" (Abraham Mestokosho, Mingan, 01.12.1988). These statements seem to imply the existence of two domains in Montagnais zoological taxonomy: edible animals and inedible animals, corresponding respectively to ***aueshîshat*** and ***manitûshat.*** In a critique of Bouchard and Mailhot's study, Brunel (1975) pointed out that the taxa belonging to the category ***manitûshat*** should be considered as unaffiliated taxa and not as a main category, since the feature defining these taxa was not morphological but associated with maleficent power, which is not a taxonomic criterion. While Brunel is surely right in his criticism regarding taxonomic criteria, my data strongly supports the fact that the taxa

TABLE 4.—Features of Montagnais zoological categories.

	AUESHÎSH	*NAMESH*	*MISSIP*	*PINE-SHÎSH*	*MANI-TÛSH*	*SHÂT-SHIMEU*
ANAT./MORPH.	fur; internal morphology; size; quadruped		size; feathers; big feathers	size	small; general morphology	wings
					no wings; like a worm, a serpent	
HABITAT -general	earth; forest	water; sea; can't get out of the water	water	tree	water; amphibious	
-shelter	burrow			nest		
LOCO-MOTION	walks; doesn't fly		flies		crawls	flies
FOOD HABITS	generalist	fish	fish; shell	generalist	leaf; toad; meat; skin	
RELATIONS BETWEEN SPECIES	lives with other ***aueshîshat***; independent	lives with other ***nameshat***	lives with other ***missipat***	lives with other ***pineshîshat***; doesn't live with ***missipat***	lives with other ***manitûshat***; nocturnal	
MISC. HABITS			social; migrating			
UTILIZATION	***uiâsh***	***namesh;*** eaten on Fridays	***uiâsh***	***uiâsh*** not eaten	inedible	
MISC.					ugly; rare; animal of the devil; bites; stings; can kill; causes pain; etc.	

categorized as ***manitûshat*** can be accorded the same taxonomic status as the other categories. First, the reasons why my informants classified these taxa as ***manitûshat*** included, but were not limited to, maleficent power and the like; other reasons were morphological (small, no wings, like a worm), habitat (water, amphibious), and locomotion (crawls), all biological criteria that are pertinent in a taxonomy. Second, 32 out of 38 terminal taxa (Fig. 8) classified as ***manitûshat*** in my own study are invertebrates, the other 6 being reptiles and amphibians. The category ***manitûshat*** is therefore relatively homogeneous and can be opposed as a category to all other vertebrates apart from reptiles and amphibians, even on a strictly morphological or biological basis. My informants stated that they had never examined the anatomy of the reptiles and amphibians in their environment, and accordingly no bones were named among the amphibians, and only a name for the jaws was elicited for reptiles. This fact could imply that reptiles and amphibians are associated with invertebrates because, in the minds of my informants, these animals seem to have no bones, whereas all other animals were attributed a skeleton. A simple division between ***aueshîshat*** and ***manitûshat*** based on the morphological feature of the presence or absence of vertebrae is therefore the more pertinent in that it is supported by another underlying feature—the edibility or inedibility of the species:

> When we say ***manitûsh,*** it is only to indicate to be careful not to eat it. (Jérôme Napish, Mingan, 12.12.1988)

or, in religious terms:

> Those are all the animals of the Devil. Our Lord, he has created all the animals of the forest. The Devil, he was jealous and he started making his own animals. He made ***anîk*** (American toad), which is not a beauty, ***umâtshashkûk*** (mink frog), also not beautiful, and ***shâshâku-anukutshâsh*** (eastern chipmunk). That one, he looks like the fur animals, but he is not good to eat. What God made is all good. But the Devil, he has always tried to play tricks. We can't eat that, the serpents and the toads. (Abraham Mestokosho, Mingan, 30.11.1988)

The case of ***shâshâku-anukutshâsh,*** eastern chipmunk, illustrates how the taxonomy operates. ***Shâshâku-anukutshâsh*** constitutes a taxonomic anomaly since the taxon was classified as ***aueshîsh*** *and* ***manitûsh.*** The main reason given for its classification as an ***aueshîsh*** was the fur of the animal, a secondary or apparent feature of this class. On the other hand, the reasons given for classification of the same taxon as a ***manitûsh*** were that the animal's fur was striped, it was rare in the region, it lived with reptiles, it had nocturnal habits or a certain general appearance, and finally, as noted in the citation above, because it was not good to eat. The last reason fits perfectly with the proposed interpretation, and since it fundamentally defines the ***manitûshat,*** it could well be the main reason for its categorization as such. The same explanation can also support the fact that other animals are classified as ***manitûshat*** *and* in another category. This is the case with ***mûkamishu,*** American bittern, which is not eaten and which is classified with the other waterfowl ***(missipat),*** besides being a ***manitûsh;*** and with ***nânâshpâtinishtsheshu,*** star-nosed mole, which is not eaten and is said to be an ***aueshîsh*** as well as a ***manitûsh***[16].

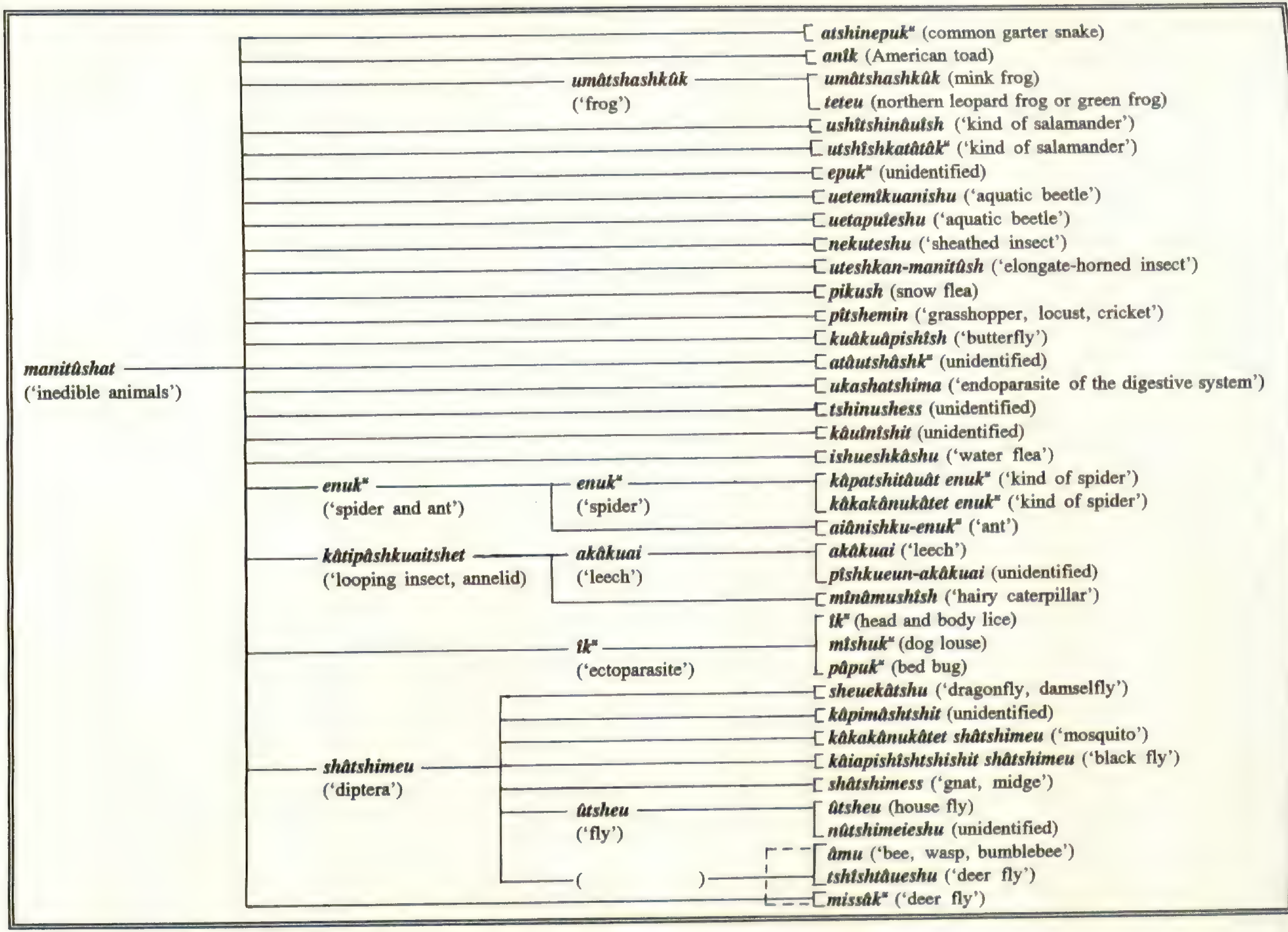

FIG. 8.—***Manitûshat*** (inedible animals or invertebrates, reptiles and amphibians).

Once a division is made between edible and inedible animals, called, respectively, ***aueshîshat*** and ***manitûshat,*** another division can be seen between ***aueshîshat*** (edible animals) that possess ***uiâsh*** (meat) and those that have ***namesh*** (flesh). That this division exists can be proven in many ways. First, Bouchard and Mailhot (1973:63) report the same division between ***uiâsh*** and ***namesh,*** "the latter being used to designate, it seems, the flesh of the animals that, from the Montagnais point of view, the Church permits everybody to eat on Fridays." Second, during my own fieldwork, I asked two of my informants to distinguish systematically those animals that had ***uiâsh*** from those that had ***namesh.*** Of course, no ***manitûsh*** was said to possess either ***uiâsh*** or ***namesh.*** Only mammals and birds were said to possess ***uiâsh,*** while ***namesh*** was attributed to all fish, shellfish, lobster, crab, shrimp, and the like. On the other hand, the category ***aueshîshat,*** discussed above, includes all mammals and birds known to the Montagnais, except the cetaceans. The ***nameshat*** (Fig. 9), as a taxonomic category, comprises all fish, cetaceans, shellfish, lobster, crab, shrimp, and the like. ***Namesh*** has therefore two meanings: it can refer to the "flesh" of a certain category of animal as opposed to the "meat" ***(uiâsh)*** of another category, and it is also used to label the category itself (aquatic animals). Generally speaking, the Montagnais also consider ***namesh*** (flesh) to be a characteristic of the ***nameshat,*** and ***uiâsh*** (meat) to be one of the ***aueshîshat.*** There is only one exception to this rule: the cetaceans. While these aquatic animals are classified as ***nameshat*** (aquatic animals), they are the only ones in this category to be said to possess ***uiâsh*** (meat) instead of ***namesh*** (flesh). This case is anomalous in terms of the criterion of flesh, but it can be explained. Cetaceans have never been very important in Montagnais culture; the anthropologist Speck (1977:78) even believed that the absence of cetaceans in Montagnais legends could indicate that the Montagnais had arrived only recently on the shore of the Gulf of St. Lawrence and the Atlantic Ocean. Cetaceans could therefore have been incorporated in the taxonomy only recently, and it is their most apparent features, their aquatic habits and fish-like form, that would have motivated their classification as ***nameshat*** (aquatic animals), on the basis that all the taxa in this category show such secondary features. Had cetaceans been eaten, most likely their ***uiâsh*** (meat) would have served to classify them as ***aueshîshat*** as well, or as ***aueshîshat*** only.

There are other taxonomic cases even more anomalous. The ***aueshîshat*** proper (Fig. 10) comprises all the quadrupeds known to the Montagnais, but a few of them that show semi-aquatic habits are sometimes also classified as ***nameshat*** (aquatic animals). One informant made the following statement about these animals, which is quite similar to the religious reason given by Bouchard and Mailhot for the Montagnais differentiation between ***uiâsh*** and ***namesh:***

> To know if it is ***namesh,*** one would say formerly that the ***nameshat*** were those that could be eaten on Fridays. We were hence allowed to eat beaver: beaver is ***uiâsh*** but it resembles ***namesh,*** like crab and shrimps. We ate also seal, otter . . . but muskrat, I don't know. Finally, we ate all the other kinds of ***namesh*** like shellfish, cod, etc. (Abraham Mestokosho, Mingan, 30.11.1988)

While there seems to be a religious idea behind this division, there is some reason to believe the division is very old and traditional. During my field work I elicited

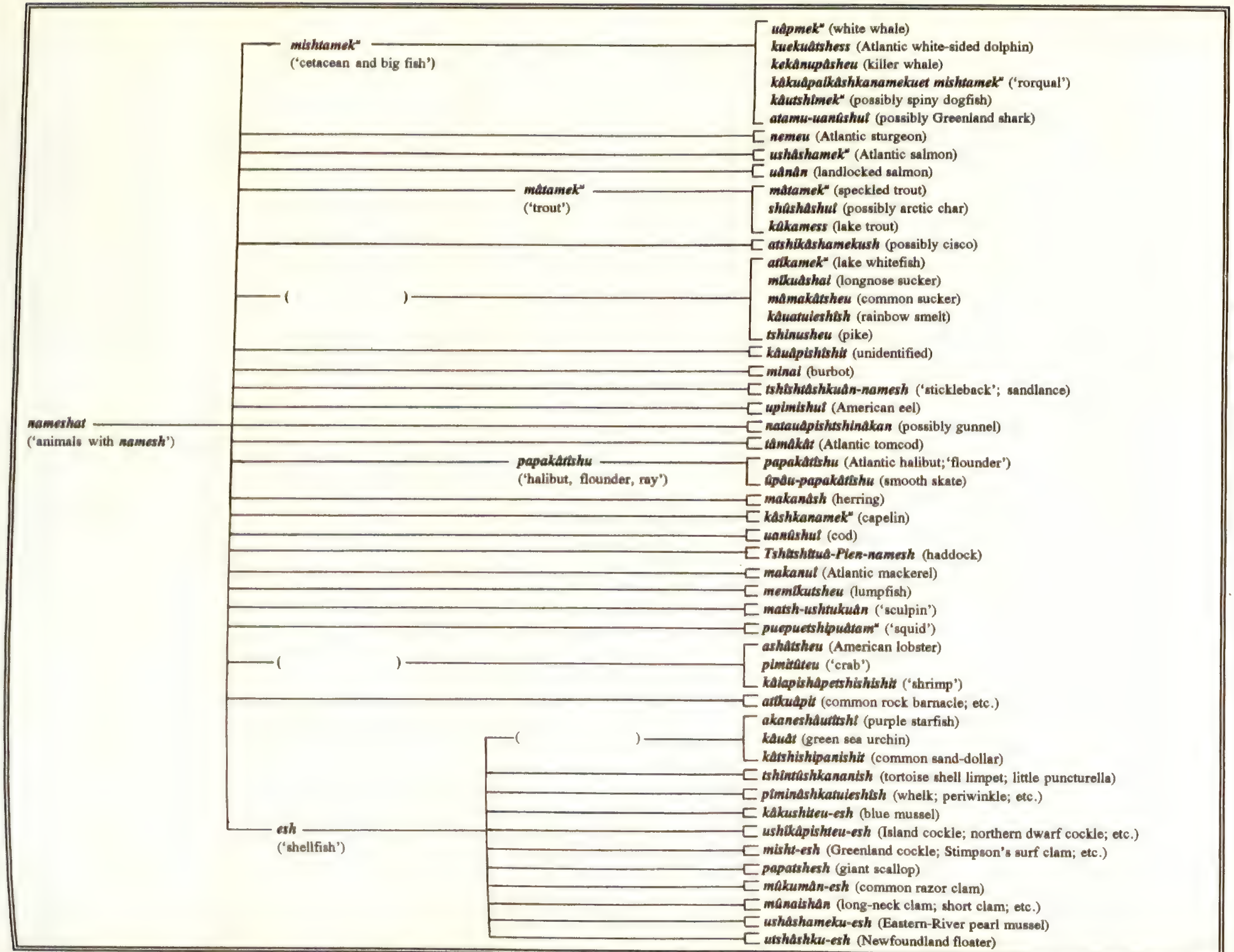

FIG. 9.—*Nameshat* (animals with *namesh* or aquatic animals).

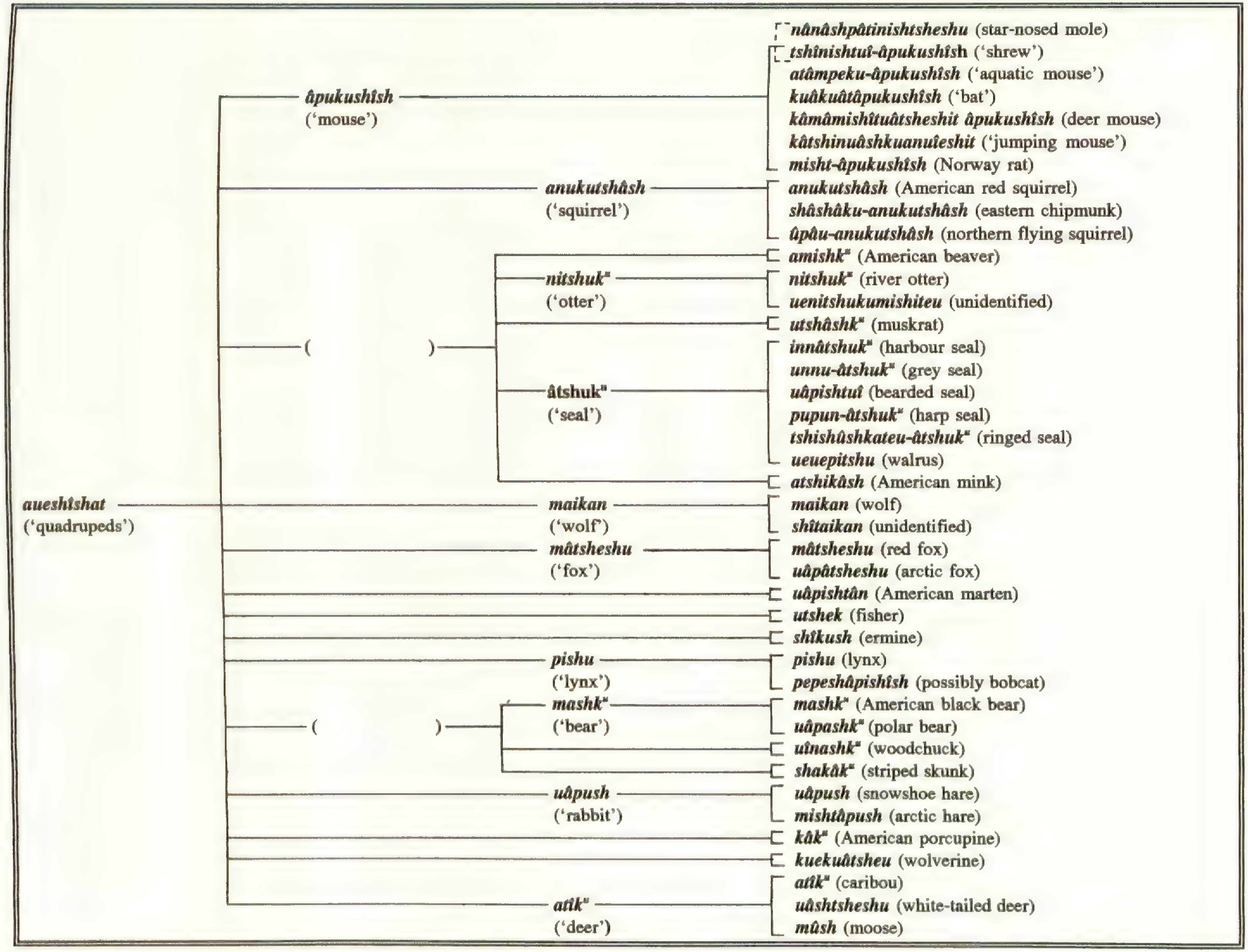

FIG. 10.—*Aueshîshat,* 'quadrupeds'.

the division while studying anatomy, independently of taxonomy. There also exists in the traditional Montagnais religious system another division that parallels the one between ***uiâsh*** and ***namesh.*** The Montagnais believed—and many still do—in masters who govern from the spirit world the destiny of the species under their leadership. In this system, there is a general master, ***Papakashtshîshk***[u]***,*** who is said to control land animals in general, and another one, ***Mishtinâk***[u]***,*** who has jurisdiction over aquatic animals. This distinction is thus quite similar to that made between ***aueshîshat*** (quadrupeds and birds) and ***nameshat*** (aquatic animals), since the first master controls only species that possess ***uiâsh*** (meat) and the second mostly species that have ***namesh*** (flesh). The only exceptions are again cetaceans and semi-aquatic mammals (beaver, seal, and the like); the former are always, and the latter sometimes, classified as ***nameshat*** (aquatic animals). Since the anomalous cases (cetaceans and semi-aquatic animals) are found both in the taxonomic and the religious systems, one suspects this is a very old state of affairs. Another reason given below will definitely prove the antiquity of the system.

After the differentiation between animals with ***uiâsh*** and animals with ***namesh,*** there exists a final minor division in the taxonomy based on edibility: between those animals with ***uiâsh*** that are not consumed, ***pineshîshat*** (small birds); and those that are, ***aweshîshat*** proper (quadrupeds), ***missipat*** (waterfowl), ***pineuat,*** (partridges), and an unlabelled category comprising all the birds of prey. On this taxonomic level, I have not found any other differences made between the categories on the basis of type of food or use as a food. It seems here that, as one advances lower and lower in the taxonomy, its operation is based more and more on intellectual criteria rather than mainly on utilization. The morphological or behavioral characters become the main features of classification (for example, quadrupeds, birds of prey, waterfowl). A similar pattern emerged in the analysis of the Montagnais botanical system, in which residuals appeared more often in the lowest level of the taxonomy.

Fig. 11 summarizes the main features and categories of the zoological taxonomy of the Montagnais. I will not discuss the ***missipat*** (waterfowl), birds of prey, ***pineuat*** (partridges), and ***pineshîshat*** (small birds) any further; all the taxa comprised in these categories are presented in Clément (1995). Similarly, other lower categories appearing in the different zoological figures (i.e., ***enuk***[u]***,*** "spider and ant," ***mishtamek***[u]***,*** "cetacean and big fish," ***âpukushîsh*** "mouse,") will not be examined in more detail since the purpose here is to present an overview of the way the major inclusive categories operate. On the other hand, the category ***shâtshimeu,*** referred to at the beginning of this section, appears in Fig. 8. One of my informants classified it as a subdivision of the ***manitûshat*** (invertebrates, reptiles, and amphibians), but another treated it as an unaffiliated category. Either way it does not interfere with the general demonstration.

The Cree case: further corroboration.—My fieldwork among the Cree of Chisasibi in 1990 yielded a zoological taxonomic structure quite similar to the one just presented for the Montagnais. The Cree are part of the same linguistic family as the Montagnais, and it is not surprising to find similar systems. While one might say that my study could have been biased by the earlier findings on the Montagnais taxonomy, there is at least one excellent argument against this: my study among the Cree has

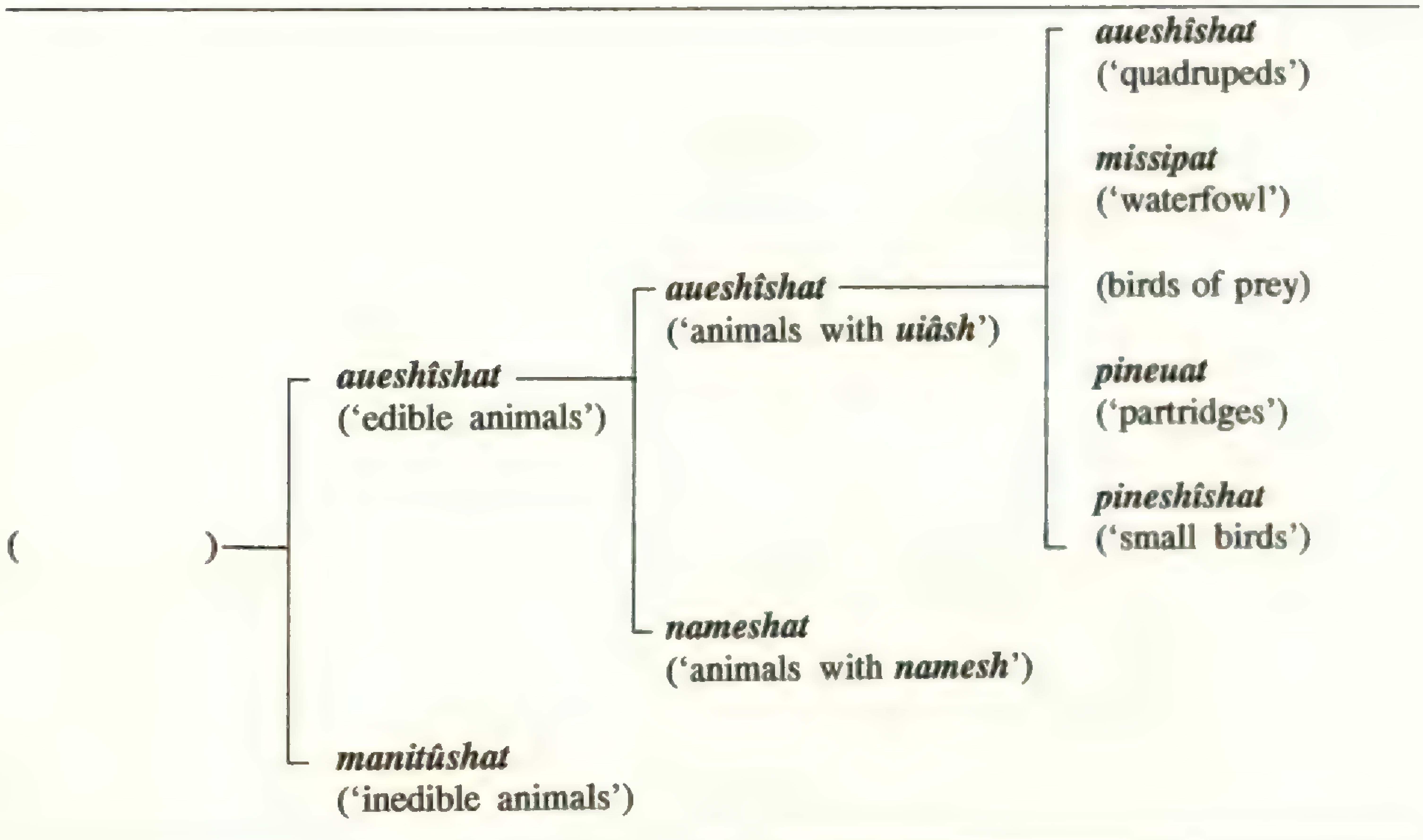

FIG. 11.—Schema of Montagnais zoological taxonomy.

permitted me to discover an unexpected corroboration of my hypothesis, which might not have been revealed without adopting the premise of the existence of a taxonomic structure based on utilization as food. I present this corroboration below.

The Chisasibi Cree schematic zoological taxonomy presented in Fig. 12 is even more basic than the Montagnais one (Fig. 11). It could include other categories—for example, Feit (1978:180–181) points out that the Cree from Waswanipi, distinguish between large birds and small birds—but exhaustiveness is not my purpose. My study was limited, and here I simply wish to highlight how the zoological taxonomy operates. Thus, the Cree—at least those of Chisasibi with whom I worked—do not have a single term to designate animals as a whole, or fauna as opposed to flora. Feit (1978:180–181) has also observed this: only the most educated Cree among his informants used ***awesiisuch***[17] at this level.

As in Montagnais zoological taxonomy, a distinction is made between ***uuhkaanch*** (edible animals) and ***minichuushuch*** (inedible animals). The distinction became evident when I asked, for example, why such and such fish was not considered as a ***minichuuch***. My informants invariably told me: "Because we eat it." For my informants, ***minichuushuch*** comprised most invertebrates, amphibians, and reptiles, that is, all animals "that we don't eat." On the other hand, ***uuhkaanch*** was used specifically for fur-bearing animals as well as, at least for one informant, all animals that were not ***minichuushuch***. The edible animals[18] were further divided into two major categories: ***uuhkaanch*** and ***nimaasich***. The category ***nimaasich*** was equivalent to the Montagnais ***nameshat***: it included all aquatic species whether whales, fish, or shellfish, except for marine mammals with "fur," such as seals, and semi-aquatic animals like the beaver or muskrat. One feature associated with these categories was the use of a specific term to designate the *flesh* of the aquatic animals, a feature absent in the Montagnais system, where one finds a case of homonymy: ***namesh*** is at the same time a parton

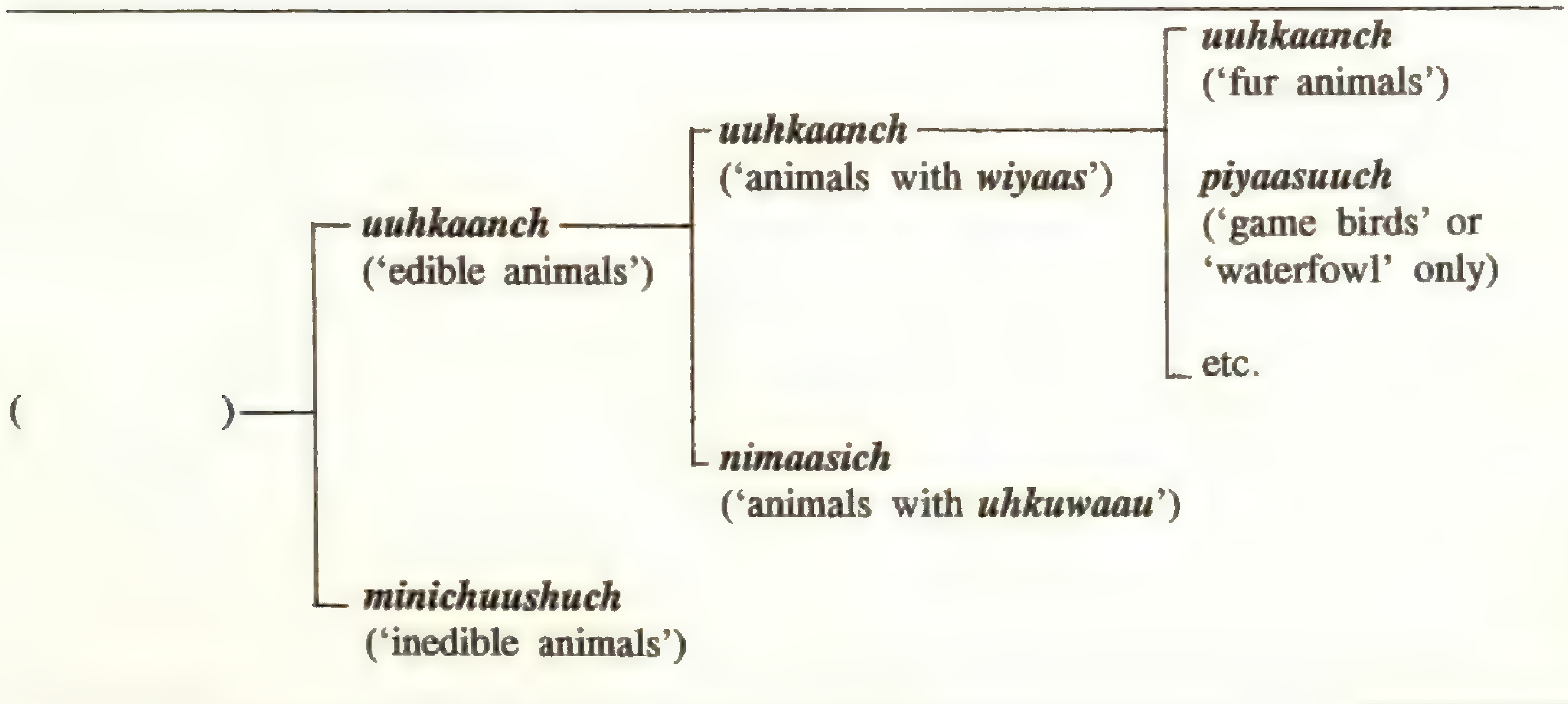

FIG. 12.—Schema of Cree zoological taxonomy.

(flesh) and a name of a category (aquatic animals). This most unexpected term ***(uhkuwaau)*** was but a confirmation of my hypothesis. Fishing is at present much more important in Cree communities than it is among the Montagnais. In such conditions, the Cree seem to have retained a word to distinguish the flesh ***(uhkuwaau)*** of fish from the meat (always ***wiyaas***) of mammals and birds. The word has apparently disappeared from the Montagnais language, but the system has persisted through time.

CONCLUSION

While the limited scope of this paper did not permit me to examine the Montagnais zoological system thoroughly (the relations between prototypes and residuals were not discussed in detail as they were with the botanical data), both zoological and botanical systems show the same pattern. A clear relation exists between taxa, utilization, and partons. Furthermore, there are operating principles governing the same relation. In the formation of main categories in any taxonomy, the union of prototypical taxa leads to a definition of the principal feature of the category. This definition is based on the use of a part of the taxa: in the botanical system, it corresponds mainly to the technical use of *wood,* the medical use of *internal bark,* and the use of *berries* as food, which lead respectively to the creation of ***mishtukuat, shakâua,*** and ***atishîa.*** In the zoological system, it corresponds to the edibility of animals, and more specifically, to the presence of either *meat* or *flesh* of animals and aquatic species, which accounts for the formation of the categories ***aueshîshat*** and ***nameshat.*** Simultaneously, counterparts of these definitions appear in the taxonomy, leading also to the formation of main categories that, functionally, are designed to assemble the residual elements in the environment: in the botanical system, the ***mashkushua,*** and in the zoological system, the ***manitûshat.***

Once formed around prototypical taxa, each category appears to have certain striking common elements. In turn, these elements by themselves or interacting with the fundamental features help to incorporate other leftovers and to account for the diversity present in nature. This last activity can help us to understand taxonomic anomalies. In the botanical system, ***mishtukuat, shakâua, atishîa,*** and ***mashkushua*** correspond visibly to *trees, shrubs, small shrubs,* and *herbaceous plants.* Interaction between the first two categories, for example, can account for the fact that two plants, ***mashkuminânakashî,*** showy mountain ash, and ***uâpineu-mît-shima,*** willow, are classified in both of them. In the zoological system, similar examples are found: on one level, the relationship between ***aueshîshat*** and ***manitûshat,*** which correspond to *edible* and *inedible animals* on the one hand and to *quadrupeds* and *invertebrates, reptiles, and amphibians* on the other, explains why a taxon such as ***shâshâku-anukutshâsh,*** eastern chipmunk, is classified both as *quadruped* (or even *animal with* ***uiâsh***) and *inedible animal.* On another level, the relationship between ***aueshîshat*** and ***nameshat,*** which refer to *quadrupeds* and *aquatic animals* as well as to *animals with* ***uiâsh*** *(meat)* and *animals with* ***namesh*** *(flesh),* helps to explain why ***amishk^u,*** beaver, is classified in both categories: it has ***uiâsh*** but also aquatic habits, besides being eaten as a ***namesh.***

The discovery of these detailed relationships between taxa, utilization, and partons is important for ethnobiological studies. Moreover, their existence is supported by similar discoveries in Linnean taxonomy. In the ongoing debate between supporters of the cognitive explanation of taxonomy (Berlin 1992) and some of their critics (Hunn 1982; Randall 1976, 1987; Randall and Hunn 1984), who favor an approach that tries to integrate both cognitive and utilitarian factors in the analysis of taxonomy, the approach sustained in this paper can be best evaluated through its method. It is only through minute analysis of uses of plant and animal products alongside study of the classification of the same plants and animals in a taxonomic system which is *apparently* morphological or behavioral that one can discover the relation between cognitive and utilitarian factors. By minute analysis, I mean not only reporting or assessing uses but above all studying these uses in their context, such as the material used or the linguistic manifestation of the uses in the nomenclature of the products themselves. Among other places, it is there, hidden in that nomenclature, that one can expect to find the morphemes that will indicate how the relation between use and cognition operates through the useful parts of the plants and animals classified. What some call higher inclusive categories and others life-forms will then prove to be linked to uses of products, and the study of taxonomy will extend to include other domains of interaction between human beings and their environment.

NOTES

[1]At the time of this study, Randall's methods (e.g., Randall 1987:143) to determine focal taxa (which can be considered prototypical taxa) were unknown to me. However, I believe Randall's methods (list of "kinds of" highly inclusive categories asked of a sample of informants and list of good examples and reasons for the choices) would yield results similar to those reached in this paper by other means, mainly through analysis of multiple data. In this sense, my conclusion and that of Randall (and Randall and Hunn 1984) on the majority of higher categories are convergent in certain respects (e.g., importance of utilitarian factors).

[2]In Algonquian languages, there are two gender classes, which linguists have labelled animate and inanimate. Animate most often includes "all persons, animals, spirits, and

large trees, and some other objects" (Bloomfield 1946:94). The attribution of the animate gender can be an indication of cultural importance, since most objects that are animate are so because in legends or elsewhere they have the capacity of acting as human beings (Vaillancourt 1980:38).

[3]The complete study—which was used as partial fulfilment for a master's degree in anthropology—has been published (Clément 1990).

[4]This study, which was presented at Laval University as a doctoral dissertation, will also be published (Clément 1995).

[5]This study was part of a project concerned with the economic and social-cultural consequences of exposure of the Cree of Northern Quebec to methyl mercury. My report (Clément 1992) was prepared under contract with Castonguay, Dandenault, and Asso. Inc. for the Cree Board of Health and Social Services of James Bay, the supervisor of the study on behalf of the James Bay Mercury Committee.

[6]For Montagnais, I generally follow the standard orthography as defined by linguists and Native people (Drapeau and Mailhot 1989). Seven vowels are used, four long ***(e, â, î, û)*** and three short ***(a, i, u)***. The eight consonants are ***m, n, p, t, k, h, tsh*** and ***sh***. ***M*** and ***k*** can be labialized when they terminate a word; this is noted with a superscripted u, as in ***atîk***^{u}.

[7]During fieldwork, I worked with women and men separately, always two by two. This approach was designed to study sexual differences in knowledge about plants. In the original study, taxonomic classification made by the two women appeared separately from taxonomic classification made by the two men. In this article, because of spatial limitation and specific objectives, taxonomies of both men and women appear together in the figures.

[8]The botanical definitions of tree, shrub, and herbaceous plants used in this paper are those on which the best known flora for this region (Marie-Victorin 1964) is based. A tree is a woody plant consisting of a single trunk bare at its base and having branches and leaves. A shrub is a ligneous plant with several stems at its base. Herbaceous plants are characterized by absence of woody tissue (i.e., having soft stems) or even absence of stems.

[9]The Montagnais system of classification comprises several types of classification that intersect with the taxonomy, which in appearance is based on morphological criteria (presence or absence of wood, height, size of diameter of stem, and so on). ***Mînakashîashk***^{u}, *fruit plant*, is an example; fruit plant names with the suffix ***-minânakashî*** (***-min(ân)-:*** berry, fruit + ***-akashî:*** fruit plant) occur in most of the taxonomical categories. But there are others that are not discussed in this paper, such as ***tshîshiteu-nîpîsha*** *(leaves that warm up)*, which includes other plants than the one noted in Fig. 4; classification of trees according to the hardness of their wood, and so on (see Clément 1990:43–44). In this article I am concentrating only on the explanation of the relation between higher inclusive taxonomical categories and the use of the parts of the entities classified in these categories.

[10]This division also corresponds roughly to the scientific division of plants into vascular plants and lower vascular plants.

[11]Other authors have tried to explain the development of Linnean taxonomy. Foucault (1970:125–165), for instance, treats the question historically. He relates the development to the importance of language and the apparent premise of that period that life does not exist, only living beings exist that can be named and organized. Atran (1990), who also analyses

this taxonomy historically, denies that classification is tied to practices or utilitarian factors in both Linnean and ethnobiological systems (Atran 1990:20 and 276, note 4; also 1986:152, note 3). In the original French version of his book, Atran (1986:152, note 3) disputes Walters' (1961) view, although in the English version (Atran 1990) this challenge has been withdrawn. To my knowledge, Walters (1961) remains one of the few botanists who has demonstrated an evident relation between Linnean taxonomy and utilitarian factors.

[12]Several attempts have been made to explain anomalies in different systems of classification (e.g., Douglas 1957, 1966; Sperber 1975). Most of them conclude that anomalies are due to the presence of mixed schemes used to classify natural entities. I propose here a more utilitarian explanation based on the presence in all higher inclusive categories of a core of useful prototypes.

[13]Note that one taxon of this class, green alder, is labelled ***tshîtshue shakâu,*** which means literally the "real ***shakâu***." The fact that a prototype of this category bears the same name as the category itself also supports the present interpretation.

[14]Witkowski et al. (1981:8) explain in greater detail the relation between *tree* and *wood* in English. Their article on the origin of both terms in 66 different languages also supports the present interpretation: these authors believe that *wood* was encoded before *tree* in the world's languages, that "'wood' in the extended sense of 'tree' constituted the principal way in which most languages first encoded 'tree'" and that the antiquity of the concept 'wood' is related to its use as "a raw material."

[15]The reality of a covert category equivalent to the animal kingdom is, however, easy to demonstrate. All the lexemes denoting the taxa of this domain are animate and the zoological species have certain elements in common (for example, it is believed that most of them can move by themselves, compared with the botanical species, which cannot).

[16]As will appear later on, the classification of these last three animals (eastern chipmunk, American bittern, star-nosed mole) is also based on the presence of an anatomical part. All three have ***uiâsh*** (meat) and this explains why they are considered on another level (see Fig. 11), ***aueshîshat,*** which this time refers to "animals with ***uiâsh***." But they are also ***manitûshat*** (inedible animals) because they are not eaten, besides the fact that on a morphological/perceptual level they are not beautiful, look like reptiles, or share the same habitat. This case is similar to that of the willow. Willow has a medicinal bark that constitutes the useful feature of the prototypes of the category ***shakâu*** (shrubs), but it is sometimes classified also as a ***mishtuk***^{u} (tree) on the basis of secondary (i.e., morphological) features of the latter category (i.e., height, single stem). My interpretation is that plants and animals are classified, first, on the basis of a main usefulness (or the opposite), and second, on the basis of another kind of usefulness *or* on secondary features (morphological mainly, but also ideological) that have arisen as common to another category whose prototypes are based on another main usefulness.

[17]The system used here for transcribing Cree terms is the Roman script as it appears in one of the most recent Cree dictionaries that I am aware of, the *Cree Lexicon* by MacKenzie et al. (1987). Long vowels are distinguished from short vowels ***(a, e, i, u, y)*** by a repetition of the vowel ***(aa, uu, ii)***. The consonants used are ***j, l, m, n, p, t, k, w, ch, s*** and ***sh.***

[18]The informant who helped me most to establish the taxonomic diagram used the term ***uuhkaanch*** to designate the edible animals, and specifically fur-bearing animals. For other Cree, ***uuhkaanch*** signifies domestic animals and ***awesiisuch*** or ***awaasiisuch*** is then

used to mean wild animals (Feit 1978:180–181). But this interchangeability of terms does not affect the food basis of the taxonomy.

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APPENDIX 1. Montagnais, English and scientific names of plant species mentioned in this paper (in alphabetical order of Montagnais names)

âmu-nîpîsha	sea rocket	*Cakile edentula* (Bigel.) Hook.
âmuâpukun	"colored flower"	many species such as: *Trifolium repens* L.; *Iris versico-lor* L.; *Hieracium floribundum* Wimm. & Graebn.
anîk-apâkuai	"cortical foliose lichen"	many species such as: *Lobaria scrobiculata* (Scop.) DC.; *Parmelia squarrosa* Hale; *Hypogymnia physodes* (L.) Nyl.
anîk-ashtshî	"long sphagnum"	*Sphagnum* spp.
anîtshikâta	pitcher-plant	*Sarracenia purpurea* L.
anukutshâuminânakashî	dwarf red blackberry	*Rubus pubescens* Raf. var. *pubescens*
anûshkaniminânakashî	raspberry	*Rubus idaeus* L.
apueminânakashî	pin cherry	*Prunus pensylvanica* L.f.
ashâtshîuâshkamuk[u]	"plant growing in the mud"	many species of lichens and mosses such as: *Stereocolon saxatile* Magn.
ashtâtshîpek[u]	"green microscopic algae"	many species
ashtshîminânakashî	black crowberry	*Empetrum nigrum* L. var. *purpureum* (Raf.) DC.
ashtshîuâshîshk[u]	ground hemlock	*Taxus canadensis* Marsh.
atâpukuat	yellow clintonia	*Clintonia borealis* (Ait.) Raf.
atikuminânakashî	bearberry	*Arctostaphylos uva-ursi* (L.) Spreng.
atîkupemuk[u]	glandular birch	*Betula glandulosa* Mx.
atitshîminânakashî	beach pea	*Lathyrus japonicus* W.
atûminânakashî	Bartram's shadbush	*Amelanchier bartramiana* (Tausch) Roemer
atûshpî	speckled alder	*Alnus incana* (L.) Moench var. *incana*
îkûta	Labrador tea	*Ledum groenlandicum* Retz.
innâsht	balsam fir	*Abies balsamea* (L.) Mill.
innîkuai	"kind of white birch" or "real white birch"	*Betula papyrifera* Marsh. var. *cordifolia*

APPENDIX 1. (continued)

inniminânakashî	blueberry	*Vaccinium angustifolium* Ait.
innîtshîminânakashî	fetid currant	*Ribes glandulosum* Grauer.
kâianakâshkâti mashkushua	"large herbs"	many species such as: *Carex rostrata* Stokes; *Calamagrostis canadensis* (Michx.) Nutt.
kâiapishâshit uâpitsheuâshkamuk[u]	"small and delicate reindeer moss"	*Cladonia uncialis* (L.) Wigg.
kâiapishâshiti mashkushua	"small herbs"	many species such as: *Equisetum arvense* L.; *Deschampsia cespitosa* (L.) Beauv.
kâkakânuâpekâk uâpitsheuâshkamuk[u]	"long and filiform reindeer moss"	*Cladina stellaris* (Opiz) Brodo
kâkakânuâpekâki mashkushua	"long and filiform herbs"	many species such as: *Elymus arenarius* L. var. *villosus* Mey.
kâkakânuâshkuâk atishî	sweet gale	*Myrica gale* L.
kâkâtshiminânakashî	common juniper	*Juniperus communis* L.
kâkâuâshit uâpitsheuâshkamuk[u]	"kind of lichen"	*Cetraria nivalis* (L.) Ach.
kâkuminânakashî	swamp currant	*Ribes lacustre* (Pers.) Poir.
kâmânitanishipîuâshiti mashkushua	cotton-grass	*Eriophorum* spp.
kâmatshakâshit shakâu	wild holly	*Nemopanthus mucronatus* (L.) Trel.
kâmîkuât mashtshekuâshkamuk[u]	"red sphagnum"	*Sphagnum* spp.
kâmînauâshiti uâpukuna	neodioecious antennaria	*Antennaria neodioica* Grenne var. *neodioica*
kâneupemakâht	red clover	*Trifolium pratense* L.
kânûtamashkuâshiti mashkushua	"small hard rounded herbs"	many species such as: *Elymus arenarius* L. var. *villosus* E. Meyer; *Carex argyrantha* Tuck. var. *aenea* (Fern.) Boivin
kâpîputepishiti	puffball	*Lycoperdon* spp.
kâshîkâshkamâkâshit mashtshekuâshkamuk[u]	"small dense sphagnum"	*Sphagnum* spp.
kâshîpekushkamâkât mashtshekuâshkamuk[u]	"green sphagnum"	*Sphagnum* spp.
kâshîpekuti mînapâkuna	"green old-man's beard"	*Usnea subfloridana* Stirt.

APPENDIX 1. (continued)

kâtakuâshiti mashkushua	"small short herbs"	many species such as: *Triglochin maritimum* L.
kâuâpâshiti uâpukuna	"small white flowers"	many species such as: *Equisetum sylvaticum* L.; *Cerastium arvense* L.
kâuâpishtukuâniâshiti tshishiteu-nîpîsha	yarrow	*Achillea nigrescens* (E. Mey.) Rydb.
kâuâpishtukuâniâshiti uâpukuna	"small white-head flowers"	many species such as: *Cerastium arvense* L.; *Anaphalis margaritacea* (L.) Benth. & Hook.
kâuînipâti mînapâkuna	"black old-man's beard"	*Bryoria trichodes* (Michx.) Brodo & D. Hawskw. ssp. *americana* (Mot.) Brodo & D. Hawskw.
kâuîpâpinamânapukâshiti nîpîsha	American mint	*Mentha arvensis* L.
kâuîshâuâshiti uâpukuna	"small yellow flowers"	many species such as: *Taraxacum officinale* Weber; *Leontodon automnalis* L.; *Ranunculus acris* L.
kâuîshâuâshkamâkâshit mashtshekuâshkamuk[u]	"yellow sphagnum"	*Sphagnum tenellum* (Brid.) Brid.
mâshi-mîtûsh	balsam poplar	*Populus balsamifera* L.
mashkuminânakashî	showy mountain ash	*Sorbus decora* (Sarg.) Schneider
mashtshekuminânakashî	small cranberry	*Vaccinium oxycoccos* L.
mâshtshîshk	eastern white cedar	*Thuya occidentalis* L.
matshi-nîpîsha	common hemp-nettle	*Galeopsis tetrahit* L.
matshikîsha	possibly leather leaf	*Chamaedaphne calyculata* (L.) Moench.
mîkuâpemuk[u]	red-osier dogwood	*Cornus alba* L. var. *alba*
minaik[u]	white spruce	*Picea glauca* (Moench.) Voss
mishtukusha	red-berried elder	*Sambucus pubens* Michx.
mîtishat	field sorrel	*Rumex acetosella* L.
mîtûsh	trembling aspen	*Populus tremuloides* Michx.
mûshuminânakashî	edible cranberry-tree	*Viburnum edule* Raf.
nanamishtshîu-ushkâtiâpî	"water arum's rhizome"	rhizome of *Calla palustris* L.
nipî-uâshkuai	"white birch of the water"	*Betula papyrifera* var. *papyrifera*

APPENDIX 1. (continued)

nishtshikâta	bristly sarsaparilla; American great burnet	*Aralia hispida* Vent. *Sanguisorba canadensis* L.
nishtshiminânakashî	bog bilberry	*Vaccinium uliginosum* L.
nishtshimîtshima	"food of the goose"	many species such as: *Callitriche hetero-phylla* Pursh.; *Arenaria peploides* L.
nitshukuminânakashî	sour-top blueberry	*Vaccinium myrtilloides* Michx.
pâshitshinâkuana	club-moss	*Lycopodium* spp.
pâshpâshtshu-nîpîsha	twin-flower	*Linnaea borealis* L.
pinâshteshkamuk[u]	"kind of liverwort"	*Ptilium crista-castrensis* (Hedw.) De Not.
pineuminânakashî	snowberry	*Gaultheria hispidula* (L.) Bigel
pitshikîsha	possibly swamp laurel	*Kalmia polifolia* Wang.
pûshûan	conk of *Fomes* spp.	
shakuteuminânakashî	cloudberry	*Rubus chamaemorus* L.
shâpuminânakashî	hairy gooseberry	*Ribes hirtellum* Michx.
shâshâkuminânakashî	bunch-berry	*Cornus canadensis* L.
tshîtshue ashtshîuâshîshk[u]	"ground hemlock associated with balsam fir" or 'real ground hemlock"	*Taxus canadensis* Marsh. associated with *Abies balsamea* (L.) *Mill.*
tshîtshue atâpukuat	"yellow clintonia propagating by means of layers" or 'real yellow clintonia"	*Clintonia borealis* (Ait.) *Raf.* propagating by means of layers
tshîtshue shakâu	green alder or 'real ***shakâu***'	*Alnus viri* (Chaix) DC. var. *sinuata* Regel
tshîtshue uîpîtakâshk[u]	cow parsnip or 'real hollow stem plant"	*Heracleum lanatum* (=*H. maximum* Bart.)
uâkuanâpishk[u]	rock tripe	*Lasallia papulosa* (Ach.) Llano
uâpineu-mîtshima	willow	*Salix* spp.
uâpush-ushkâtiâpîa	wild sarsaparilla	*Aralia nudicaulis* L.
uâshkatamuî	"pond-lily's rhizome"	rhizome of *Nuphar* spp.
uâshkuai	white birch	*Betula papyrifera* Marsh. var. *cordifolia* (Regel) Fern.
uâtshinâkan	tamarack	*Larix laricina* (Du Roi) K. Koch.
uîshakâshkamuk[u]	goldthread	*Coptis groenlandica* (Deder) Fern.
uîshakâtshâkuat	fern	*Dryopteris* spp.
uîshatshiminânakashî	mountain cranberry	*Vaccinium vitis-idaea* L.
uîshatshipukua	sheep laurel	*Kalmia angustifolia* L.

APPENDIX 1. (continued)

ushkâtuk^u	black spruce	*Picea mariana* (Mill.) BSP.
ûshpuâkanîssat	"sporophytes of mosses"	sporophytes of mosses such as *Polytrichum commune* Hedw.
ushtshishk	jack pine	*Pinus divaricata* (Ait.) Dumont
utaiminânakashî	strawberry	*Fragaria virginiana* Duchesne
utshâshku-mîtshima	"food of the muskrat"	many species such as: *Carex* spp.; *Eriocaulon septangulare* With.; *Eriophorum* spp.

APPENDIX 2. Montagnais, English and scientific names of animal species mentioned in this paper (in alphabetical order of Montagnais names)

akaneshâutîtshî	purple starfish	*Asterias vulgaris*
amishk[u]	American beaver	*Castor canadensis*
anîk	American toad	*Bufo americanus*
anukutshâsh	American red squirrel	*Tamiasciurus hudsonicus*
ashâtsheu	American lobster	*Homarus americanus*
atâmpeku-âpukushîsh	"aquatic mouse"	many species
atamu-uanûshuî	possibly Greenland shark	*Somniosus microcephalus*
atîkamek[u]	lake whitefish	*Coregonus clupeaformis*
atîk[u]	caribou	*Rangifer tarandus*
atîkuâpit	common rock barnacle	*Balanus balanoides*
	northern coil worm	*Spirorbis borealis*
	common serpula	*Serpula vermicularis*
atshikâsh	American mink	*Mustela vison*
atshikâshamekush	possibly cisco	*Coregonus artedii*
atshinepuk[u]	common garter snake	*Thamnophis sirtalis*
îk[u]	head and body lice	*Pediculus humanus*
innâtshuk[u]	harbour seal	*Phoca vitulina*
kâk[u]	American porcupine	*Erethizon dorsatum*
kâkuâpaikâshkanamekuet mishtamek[u]	"rorqual"	
	humpback whale	*Megaptera novaeangliae*
	minke whale	*Balaenoptera acutorostrata*
	fin whale	*B. physalus*
kâkushiteu-esh	blue mussel	*Mytilus edulis*
kâmâmishîtuâtsheshit âpukushîsh	deer mouse	*Peromyscus maniculatus*
kâshkanamek[u]	capelin	*Mallotus villosus*
kâtshinuâshkuanuîeshit âpukushîsh	meadow jumping mouse	*Zapus hudsonius*
	woodland jumping mouse	*Napaeozapus insignis*
kâtshishipanishit	common sand-dollar	*Echinarachnius parma*
kâuât	green sea urchin	*Strongylocentrotus dröbachiensis*
kâuatuieshîsh	rainbow smelt	*Osmerus mordax*
kâutshîmek[u]	possibly spiny dogfish	*Squalus acanthias*

APPENDIX 2. (continued)

kekânupâsheu	killer whale	*Orcinus orca*
kuâkuâtâpukushîsh	"bat"	
	little brown bat	*Myotis lucifugus*
	Keen's bat	*M. keenii*
kuekuâtshess	Atlantic white-sided dolphin	*Lagenorhynchus acutus*
kuekuâtsheu	wolverine	*Gulo gulo*
kûkamess	lake trout	*Salvelinus namaycush*
maikan	wolf	*Canis lupus*
makanâsh	herring	*Clupea harengus harengus*
makanuî	Atlantic mackerel	*Scomber scombrus*
mâmakâtsheu	common sucker	*Catostomus commersoni*
mashk^u	American black bear	*Ursus americanus*
mâtamek^u	speckled trout	*Salvelinus fontinalis*
matsh-ushtukuân	"sculpin"	
	staghorn sculpin	*Gymnocanthus tricuspis*
mâtsheshu	red fox	*Vulpes vulpes*
memîkutsheu	lumpfish	*Cyclopterus lumpus*
mîkuâshai	longnose sucker	*Catostomus catostomus*
minai	burbot	*Lota lota*
misht-âpukushîsh	Norway rat	*Rattus norvegicus*
misht-esh	Greenland cockle	*Serripes groenlandicus*
	Stimpson's surf clam	*Spisula polynyma*
	etc.	
mishtâpush	arctic hare	*Lepus arcticus*
mîshuk^u	dog louse	*Trichodectes canis*
mûkumân-esh	common razor clam	*Ensis directus*
mûnaishân	long-neck clam	*Mya arenaria*
	short clam	*M. truncata*
	etc.	
mûsh	moose	*Alces alces*
nânâshpâtinishtsheshu	star-nosed mole	*Condylura cristata*
natauâpishtshinâkan	possibly gunnel	*Pholis gunnellus*
nemeu	Atlantic sturgeon	*Acipenser oxyrhynchus*
nitshuk^u	river otter	*Lontra canadensis*
papakâtîshu	"flounder"	
	Atlantic halibut	*Hippoglossus hippoglossus*
	smooth flounder	*Liopsetta putnami*
	winter flounder	*Pseudopleuronectes americanus*
papatshesh	giant scallop	*Placopecten magellanicus*
pâpuk^u	bed bug	*Cimex lectularius*
pepeshâpishîsh	possibly bobcat	*Lynx rufus*
pikush	snow flea	*Achorutes nivicolus*
pîminâshkatuieshîsh	smooth periwinkle	*Littorina obtusata*
	American pelican's foot	*Aporrhais occidentalis*
	common northern whelk	*Buccinum undatum*
	etc.	
pimitûteu	"crab"	
	common rock crab	*Cancer irroratus*
pishu	lynx	*Lynx lynx*
puepuetshipuâtam^u	"squid"	

APPENDIX 2. (continued)

	Atlantic long-finned squid	*Loligo paelei*
***pupun-âtshuk**[u]*	harp seal	*Phoca groenlandica*
***shakâk**[u]*	striped skunk	*Mephitis mephitis*
shâshâku-anukutshâsh	eastern chipmunk	*Tamias striatus*
shîkush	ermine	*Mustela erminea*
	possibly also least weasel	*M. nivalis*
shûshâshuî	possibly arctic char	*Salvelinus alpinus*
tâmâkât	Atlantic tomcod	*Microgadus tomcod*
teteu	northern leopard frog	*Rana pipiens*
	or green frog	*R. clamitans*
tshînishtuî-âpukushîsh	"shrew"	
	masked shrew	*Sorex cinereus*
	arctic shrew	*S. arcticus*
	etc.	
tshîntûshkananish	tortoise shell limpet	*Acmaea testudinalis*
	little puncturella	*Puncturella noachina*
tshinusheu	pike	*Esox lucius*
tshîshtâshkuân-namesh	"stickleback"	*Gasterosteus aculeatus*
	threespine stickleback	*Apeltes quadracus*
	bloody stickleback	
	etc.	
	also sandlance	*Ammodytes americanus*
***tshishûshkateu-âtshuk**[u]*	ringed seal	*Phoca hispida*
Tshîtshîtuâ-Pien-namesh	haddock	*Melanogrammus aeglefinus*
uânân	landlocked salmon	*Salmo salar*
uanûshuî	cod	*Gadus morhua*
***uâpashk**[u]*	polar bear	*Ursus maritimus*
uâpâtsheshu	arctic fox	*Alopex lagopus*
uâpishtân	American marten	*Martes americana*
uâpishtuî	bearded seal	*Erignathus barbatus*
***uâpmek**[u]*	white whale	*Delphinapterus leucas*
uâpush	snowshoe hare	*Lepus americanus*
uâshtsheshu	white-tailed deer	*Odocoileus virginianus*
ueuepitshu	walrus	*Odobenus rosmarus*
***uînashk**[u]*	woodchuck	*Marmota monax*
umâtshashkûk	mink frog	*Rana septentrionalis*
***unnu-âtshuk**[u]*	grey seal	*Halichoerus grypus*
ûpâu-anukutshâsh	northern flying squirrel	*Glaucomys sabrinus*
ûpâu-papakâtîshu	smooth skate	*Raja senta*
upimishuî	American eel	*Anguilla rostrata*
***ushâshamek**[u]*	Atlantic salmon	*Salmo salar*
ushâshameku-esh	Eastern-River pearl mussel	*Margaritifera margaritifera*
ushîkâpishteu-esh	Island cockle	*Clinocardium ciliatum*
	northern dwarf cockle	*Cerastoderma pinnulatum*
	etc.	
***utshâshk**[u]*	muskrat	*Ondatra zibethicus*
utshâshku-esh	Newfoundland floater	*Anodonta cataracta*
utshek	fisher	*Martes pennanti*
ûtsheu	house fly	*Musca domestica*

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ETHNOZOOLOGICAL CLASSIFICATION AND CLASSIFICATORY LANGUAGE AMONG THE NAGE OF EASTERN INDONESIA

GREGORY FORTH
Department of Anthropology
University of Alberta
Edmonton, Alberta
Canada T6G 2H4

ABSTRACT.—Categories of natural kinds recognized by the Nage people of the eastern Indonesian island of Flores admit both taxonomic and nontaxonomic forms of classification. The latter consist of two modes of lexical pairing associated respectively with mundane discourse and the formal idiom of ceremonial speech. Within Nage ethnozoological nomenclature, taxonomic relations are most thoroughly exemplified by their classification of snakes (***nipa***). In distinguishing taxonomic from other forms of classification, relations of class inclusion are considered with regard to ways in which the Nage language might identify something as a "kind of" another thing. In this connection, taxonomy (in some contexts associated with polysemous nomenclature) is distinguished from "encompassment," an implicitly polysemous relationship which pertains to resemblance rather than inclusion. The paper thus initiates a discussion of ways in which ethnobiological classification articulates with forms of dualistic symbolic classification so prevalent in eastern Indonesia, and of how the classification of natural kinds compares with the conceptual ordering of other entities, including spiritual beings.

RESUMEN.—Las categorías de clases naturales reconocidas por el pueblo Nage de la isla de Flores en Indonesia oriental admiten formas de clasificación tanto taxonómicas como no taxonómicas. Estas últimas consisten de dos modos de apareamiento léxico asociados respectivamente con el discurso mundano y las expresiones formales del lenguaje ceremonial. Dentro de la nomenclatura etnozoológica Nage, las relaciones taxonómicas son ejemplificadas en forma más completa por su clasificación de las víboras (***nipa***). Al distinguir las formas taxonómicas de otras formas de clasificiación, las relaciones de inclusión de clase se consideran en relación a las formas como la lengua Nage puede identificar a algo como una "clase de" otra cosa. A este respecto, la taxonomía (asociada en algunos contextos con la nomenclatura polisémica) es distinguida del abarcamiento ("encompassment"), una relación implicitamente polisémica que tiene que ver con la semejanza más que con la inclusión. El trabajo inicia así una discusión de las maneras en que la clasificación etnobiológica se articula con las formas de clasificación simbólica dualística, tan común en Indonesia oriental, y sobre la manera en que la clasificación de clases naturales se compara con el ordenamiento conceptual e otras entidades, incluyendo los seres espirituales.

RÉSUMÉ.—Les catégories d'espèces naturelles reconnues par le peuple Nage de l'île de Flores dans l'Indonésie orientale comprennent les deux formes de classification: taxonomique et non-taxonomique. Celle-çi consiste en deux formes d'accouplement lexique, associées respectivement au discours vulgaire et à l'idiome formel due langage cérémonial. Dans la nomenclature éthnozoologique, les relations taxonomiques sont mieux démontrées avec la classification des serpents (***nipa***). La distinction entre la classification taxonomique et autres formes de classification rends possible le concept de classes d'inclusion, d'après lesquelles, dans la langue Nage, il est possible d'identifier quelque chose comme étant "une espèce" de quelque chose d'autre. En établissant cette relation, la taxomomie (dans des contextes associés avec la nomenclature polysémique) se différencie de 'groupement', celui-ci constituant une relation polysémique qui est d'avantage liée à la ressemblance qu'à l'inclusion. Cet article engage donc une discussion sur les formes par lesquelles la classification éthnozoologique s'articule avec des formes de classification symbolique dualistes, très commune dans l'Indonésie. Nous faisons également la comparaison entre la classification des espèces naturelles et l'organisation d'autres identités, y compris les êtres spirituels.

In this paper I describe features of the classification of biological species among the Nage of eastern Indonesia. My focus is on their classification of snakes. One objective is to demonstrate the existence, in limited areas of Nage ethnozoology, of conceptual relations corresponding more closely to the model of scientific taxonomy than is usual in folk classification. Another is to discuss ways class inclusion is expressed in Nage. Using the Nage case as an illustration, I suggest that ethnobiologists could benefit from more attention to features of language in deciding issues such as whether folk classifications correspond to the taxonomic model of scientific biology, and the grounds on which these issues may be decided. More specifically, I argue that while relations that constitute a taxonomy may not be directly or unequivocally expressible in local languages, taxonomic order can be discerned in patterns of naming. While taxonomy need not be a fully conscious or explicit method of connecting biological categories, in the Nage case neither is it something imposed on the data by the western observer (cf. Berlin 1992, addressing critics Gardner 1976, Hunn 1976, Ellen 1986 and others). At the same time, ethnobiological classification, particularly insofar as it corresponds to scientific taxonomy, is to be distinguished from other instances of Nage classification involving biological categories. Of particular interest here are forms of lexical pairing. By comparing ethnobiological classification with other ways in which its component categories are connected conceptually and linguistically, I initiate a discussion of ways in which the former relates to patterns of dualistic symbolic classification so prevalent in eastern Indonesia.

THE NAGE AND THEIR CLASSIFICATION OF LIVING THINGS

The Nage are a group of some 50,000 cultivators who speak an Austronesian, and more specifically Central-Malayo-Polynesian, language. They reside to the north and west of the large, active Ebu Lobo volcano in the central part of the eastern Indonesian island of Flores. Nage are an interior people, living mostly from dry field horticulture and stock raising supplemented by limited hunting and fishing. However, irrigated rice cultivation has been practiced in selected areas since the 1930s. While Nage territory includes areas of primary and secondary forest, savannah, and riverine environments, their familiarity with coastal and marine biota is limited. Ethnobiological fieldwork has mostly been conducted in the western part of the Nage region, in the vicinity of the main Nage village of Bo'a Wae. All indigenous terms given below are from the Bo'a Wae dialect. Apart from publications by the author, very little has been published on the Nage, and a dictionary or word list of the Nage language has yet to appear.

These notes are offered as an introduction to selected areas of Nage ethnozoology. Not only are my own ethnographic researches still in progress, but a specifically ethnobiological study of the region, involving extensive and directed interviewing and systematic use of live or preserved specimens, has yet to be conducted. Information on zoological kinds derives mostly from investigations of local religion, ritual, and cosmology, including especially Nage representations of spiritual beings. In identifying species I have relied on opportunistic observation of local animals and plants, supplemented by informants' descriptions, data contained in zoological publications, and ethnobiological studies concerning related languages and peoples of western Flores (see Table 1). My knowledge of animal kinds was partly gained from open-ended conversations with numerous interlocutors, and partly from directed questioning of a dozen regular informants ranging in age between 30 and 60. All but one were men. Like the great majority of Nage nowadays, all informants had some formal education, though only three had more than six years of schooling. It was not possible to employ photographs or other illustrations in identifying zoological (and particularly herpetological) species because none of sufficient quality was available at the time of my fieldwork.

Despite these limitations, several general features of ethnobiological nomenclature are firmly established. Like most languages, Nage has no word that corresponds to *plant*, though there are general terms for *tree* (***lo kaju***), *grass* (***ku***), and *vines* (***koba tali*** or ***tali koba***).[1] On the other hand, Nage do have a word comparable to English *animal*. This is ***ana wa***, a term which can be understood to mean "children, people (***ana***) of the wind (***wa***)." Although ***ana wa*** corresponds mostly to the folk sense of English *animal* (cf. Indonesian *binatang*), it also resembles the scientific sense of the English word insofar as it includes birds, reptiles, insects, and fish as well as mammals. In fact, Nage often specified ***ana wa*** as a reference to all living things that moved. By either comparison, Nage would appear to be unusual in marking this most inclusive of biological taxa—a *kingdom* or *unique beginner* in Berlin's terminology—since in most languages, *animal*, like *plant*, exists only as a covert category (Berlin et al. 1973; Berlin 1992:15, 17).

According to a local interpretation, animals are called ***ana wa*** because like the wind (***wa***), their behaviour, in contrast to that of human beings, is unconstrained and unpredictable (see Forth 1989:93). In the first instance, the term denotes larger, four-legged animals rather than, for example, birds and snakes, and is applied more often to domestic mammals than to wild species. In other words, large mammals, especially domesticated ones, are the prototype or focus—the "best example" in the language of fuzzy sets—of the category ***ana wa***. Yet while some Nage expressed reservations about including fish (***ika***) and snakes (***nipa***) among the ***ana wa***, the general consensus was that creatures other than mammals were also correctly placed under this rubric.[2] There was complete agreement, even among educated Nage, that human beings (***kita ata***) were not ***ana wa***. Small children are regularly spoken of as ***ana wa***, especially with reference to their lack of knowledge and social skills. As one man put it, children are "like animals because they do not (yet) know anything." Further questioning, however, established that this identification of children as "animals" is metaphorical, and that Nage do not regard their offspring as ***ana wa*** in the same way they regard their horses, for example, as belonging to this class.

The existence of *animal* as a discrete taxon is further attested by the application of the numeral classifier ***éko*** (tail) to all living things that would be counted as animals even in the extended definition of the English folk category. Thus one says ***emu sa éko***, "one mosquito;" ***pake éko dhua***, "two frogs;" ***goka éko telu***, "three pythons;" ***feni éko wutu***, "four parrots;" and ***bhada éko lima***, "five water buffalo." Humans, by contrast, including even the smallest—and least socialized—of children are counted with ***ga'e***, e.g. ***ana ga'e lima***, five children, while plants and inanimate objects take separate classifiers.

The majority of Nage terms for members of the class of *animals* are terminal taxa denoting basic kinds that do not belong to any intervening named category. These basic kinds—or *folk generics* in Berlin's terminology—mostly correspond to biological species. The palm civet (***bheku***) and giant Flores rat (***bétu***, *Papagomys armandvillei*), for example, are ***ana wa*** (animals), and nothing more. In a minority of instances, below ***ana wa*** one encounters named taxa further divided into two or more kinds (or varieties). Thus subordinate to ***metu***, "ant, red ant," are ***metu ladhe*** (a light red ant), ***metu ma'u*** (coast ant, a dark red kind), and others, while ***hale***, "flies," includes ***hale éno*** (small fly, the common housefly), ***hale mite*** (black fly, a bluebottle), ***hale ja*** (horse fly), and ***hale bhada*** (buffalo fly). In some instances, the superordinate taxon is identically named at the subordinate level. ***Jata***, for example, includes ***jata*** (occasionally specified as ***jata ulu bha***, white-headed ***jata***), the Brahminy kite (*Haliastur indus*), and ***jata jawa***, designating one or more large raptors of the genus *Accipiter*. Other Nage examples of this widespread pattern of folk biological nomenclature are discussed below.

The only named taxa designating a level intermediate between *animal* and basic kinds, and thus corresponding to *life-forms* (see Brown 1977, 1979), are ***nipa***, "snakes," and ***ika***, "fish." The Nage classification thus appears consistent with Brown's thesis (1979:792) that if a language contains between one and three life-form terms, these will be one, or some combination, of *fish*, *snake*, or *bird*. Nage possesses no monolexemic taxa corresponding to *bird*, *mammal*, or *insect* (cf. Brown's neologism *wug*, ibid.:793). Nor is there an equivalent of *reptile*, since, unlike snakes, various kinds of lizards and turtles are each named with folk generics included immediately under ***ana wa*** (animal). At the same time, the Nage language includes numerous expressions comprising two juxtaposed terms denoting basic kinds that refer to a more comprehensive group of animals. An example is ***peti kolo***. This consists of ***peti***, a term applied to several species of Munia (*Lonchura*) and other small passerine birds that are more completely known as ***ana peti***, and ***kolo***, the name of one or more species of small doves (including *Streptopelia* and *Geopelia*). When thus conjoined, the terms refer not just to doves and Munias but to a variety of relatively small birds. (As regards plants, pairing is exemplified by the phrase ***bheto pezi***, conjoining the names of two varieties of bamboo and serving as a term for bamboo in general, which includes three other named varieties and for which there is no single lexeme.)

There are nevertheless strong indications that such juxtapositions do not label intermediate taxa, or form part of any systematic taxonomy. In contrast to a taxon like ***nipa*** (snakes), the class of birds designated as ***peti kolo*** is highly indeterminate, both in regard to contextual variability and insofar as informants disagree as to which birds it should include. Also noteworthy is the circumstance that some birds classified as ***peti***, or ***ana peti*** (itself a variably defined grouping), are not referred to as ***peti kolo***. Pertinent here is the functional or utilitarian character of the latter category, which primarily refers to birds that damage cereal crops; and not all birds classified as ***ana peti*** are crop pests. On the other hand, there are birds that regularly consume crops, such as crows and cockatoos, which Nage reject as instances of ***peti kolo***. In fact, while observed use of the term reveals a more inclusive reference, Nage often deny that the pairing refers to anything other than the two sorts of birds explicitly named. Put another way, ***peti kolo***, and other formally identical expressions to be discussed below, are (as one informant explicitly noted) collective designations subsuming neither subcategories nor individual members. In no case, therefore, can the referent be ennumerated, or modified with a numeral classifier, so that whereas one can speak of "one snake" (***nipa sa éko***), one cannot speak of one (or two or more) ***peti kolo***.

The nontaxonomic status of such expressions is further apparent from the existence of pairings conjoining quite diverse biological kinds (or different life-forms), for example ***piko dhéke***, "quails (and) rats," another reference to crop pests, and thus another indication of the functional definition of such classes. Here it is also noteworthy that ***kolo*** (dove) further pairs with ***piko*** to form ***piko kolo***, referring to birds like Columbiformes and Galliformes that are regularly hunted as food, and hence to a utilitarian category of another sort.

The importance of functional criteria in various instances of folk biological classification has been forcefully argued by a number of authors (see Hunn 1982; Morris 1984:57; Randall and Hunn 1984; Turner 1987). Yet there are obvious formal differences between binary expressions like ***peti kolo*** and a term like ***nipa*** (snake), which, as I show just below, designates a well-defined taxon readily distinguishable on the basis of perceptual characteristics alone. Other examples of lexical pairing involving ethnobiological categories are discussed toward the end of the paper, where the significance of this pattern of naming is considered further.

NAMING, IDENTIFICATION, AND TAXONOMY

During the last two decades much attention has been given to questions of whether, or to what extent, folk classifications are organized according to the taxonomic principle encountered in scientific biology (see Atran 1990; Berlin 1992; Bulmer 1979; Ellen 1986; Hunn 1976; Hunn and French 1984; Randall 1976, 1987; Taylor 1990:60–83; Wierzbicka 1984). Although *taxonomy* is sometimes used synonymously with *classification*, or is equated with any classification organized in part by relations of inclusion, taxonomy as a systematic feature of classification is most clearly in evidence where class inclusion admits at least three levels (two or more kinds are conceived as members of a more inclusive category that in turn instances a still more inclusive class) and where this is combined with transitive relations (if 'a' is a member of 'b,' and 'b' of 'c,' than 'a' should also be recognized

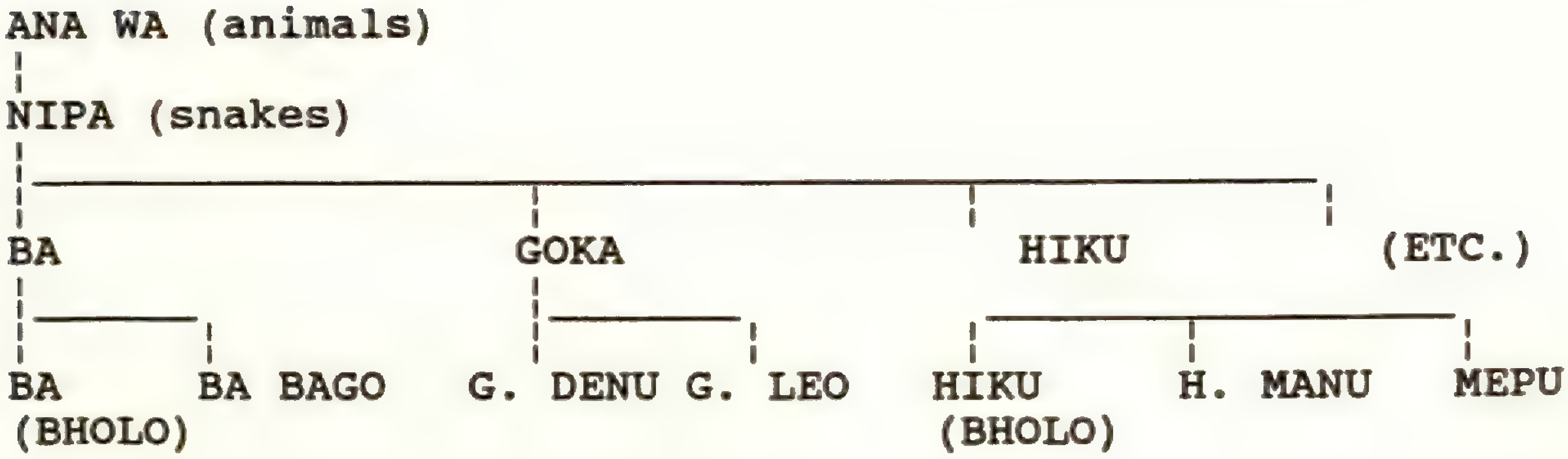

FIG. 1—Nage classification of snakes arranged in a tree diagram.

as a member of 'c'). Later on I discuss features of their language that indicate that Nage do not distinguish class inclusion from other sorts of association which I call resemblance. Even so, particulars of biological nomenclature reveal that in limited areas, Nage classification of living things does admit true taxonomic relations comprising more than two levels of named taxa. In order to illustrate such a taxonomic ordering I describe the Nage classification of snakes (***nipa***; see Table 1 and Fig. 1).

Nage ethnoherpetological classification comprises four levels, and displays not only inclusion but also transitivity (a snake is an animal, thus any particular named kind of snake is also an animal). These levels are indicated by ***ana wa*** (animal), ***nipa*** (snake), a series of 10 terms denoting zoological species or genera, and a series of further terms referring to varieties of several more inclusive kinds. These are listed in Table 1(a).

In the absence of a comprehensive ethnozoological investigation, the herpetological identifications given in Table 1 must be considered provisional. Nevertheless, the scientific referents of ***ba***, ***gala***, ***goka*** (***goka denu*** and ***goka leo***), ***hiku***, and ***pupu zupi***, all of which designate quite distinctive species, are beyond reasonable doubt. Following van Hoesel (1958:33–34), ***ulu pali***, the "two-headed" snake, is a cylinder snake (*Cylindrophis opisthorhodus* Boulenger). The term ***goko***, designating what Nage describe as a "flying snake," names a species of *Chrysopelea*, probably *C. ornata* (Loveridge 1946:133–134; Reinhard and Vogel 1971:412). Although the species is found in the Indonesian archipelago as far east as Sulawesi (Celebes), it does not appear in de Rooij's (1917:304) list nor, so far as I can discover, in other lists of Flores species. Even so, informants' detailed descriptions leave little doubt of its presence in central Flores.

In contrast to the foregoing categories, ***sawa*** and ***nipa 'e'e*** each appear to denote two or more different species. ***Sawa*** (not to be confused with Indonesian 'sawa' or the same word as used in the Ende and Lio regions of Flores for pythons) is applied to a rat snake (probably *Elaphe subradiata*); but may refer as well to another large snake (perhaps *Dipsadomorphus cynodon*; see de Rooij 1917:200). Employing de Rooij's and other lists, elimination alone would suggest an association of ***nipa 'e'e*** with *Psammodynastes pulverulentus* (de Rooij 1917:202; cf. Verheijen 1982), and perhaps one or more wolf snakes (*Lycodon* spp.). In fact, ***nipa 'e'e***, which literally means "ugly snake" (***'e'e***, ugly, unattractive, deteriorated), names a rather

TABLE 1.—Kinds of ***nipa*** *(snakes).*

BA	Russell's viper, *Vipera russelli limitis*
BA (BA BHOLO)	Common Russell's viper
BA BAGO	"Hurling" Russell's viper
GALA	Slender, dark blue arboreal snake, *Dendrelaphis pictus*
GOKA	Python, *Python* spp.
GOKA DENU	Reticulated python, *P. reticulatus*
GOKA LEO	Timor python, *P. timorensis*
GOKO	Flying snake, *Chrysopelea* sp.
HIKU	Green tree viper, *Trimeresurus albolabris*
HIKU (HIKU BHOLO)	Common ***hiku***
HIKU MANU	Smallest and least dangerous variety of ***hiku***
MEPU	Largest and most poisonous variety of ***hiku***, also called ***hiku éko to***, "red-tailed hiku"
LOLA BA	Small, nonpoisonous snake resembling Russell's viper ***(ba)*** in coloration, possibly the Indian Wolf Snake, *Lycodon aulicus*, or *L. subcinctus* [van Hoesel 1958:35]
NIPA 'E'E	"Ugly snake," two or more species of small, nonpoisonous snakes, probably including *Psammodynastes pulverulentus* and *Lycodon* sp.
NIPA KELA	"Variegated snake," sometimes classified as a variety of ***nipa 'e'e***, perhaps *Psammodynastes pulverulentus.*
PUPU ZUPI	Spitting cobra, *Naja naja* (***zupi***, to blow, exhale)
SAWA	Large, nonpoisonous snake, *Elaphe subradiata* or *Dipsadomorphus cynodon*
SAWA PIPI TO	Red cheeked ***sawa***, not distinguished by association with a particular species from other snakes designated as ***sawa***
ULU PALI	"Two-headed" snake, *Cylindrophis opisthorhodus* Boulenger (***ulu***, head; ***pali***, at both ends)

Sources of information on Florenese snakes: Grzimek et al. 1971, Gruber 1971, van Hoesel 1958, Loveridge 1946, Petzold 1971, Reinhard and Vogel 1971, de Rooij 1917, van Suchtelen 1921, Verheijen 1967, 1982.

general category comprising several harmless, mostly small, and otherwise undistinguished species that can further be designated with descriptive expressions referring to coloration (e.g., ***nipa 'e'e mite***, black, dark nipa 'e'e; ***nipa 'e'e deto deto***, flecked, speckled nipa 'e'e).

With regard to the descriptive quality of the term, also included among these may be a snake Nage call ***nipa kéla*** (variegated, multicolored snake). Indeed, the statements of two informants indicated that this category could be subsumed by ***nipa 'e'e***, with one man rendering the name as ***nipa 'e'e kéla***, while descriptions provided by others contrasted ***nipa 'e'e*** and ***nipa kéla***. Similar disagreement concerns ***lola ba***, denoting a small, harmless snake named with reference to its resemblance to the deadly Russell's viper (***ba***; whether ***lola*** has another relevant sense is unclear), which some Nage also described as a "kind of" ***nipa 'e'e***.

In view of their highland territory, it is not surprising that I encountered no special terms for the eight or so species of sea and freshwater snakes reported for Flores (see de Rooij 1917:304). In fact only a minority of people are familiar with aquatic snakes that live entirely in water (or ***nipa ae***, water snakes, as they are simply described). While one man claimed that ***nipa kéla*** referred to such a snake, others denied this. From direct questioning, Nage appeared to be unfamiliar as well with blind snakes (genus *Typhlops*), of which at least two Flores species are reported (de Rooij 1917). Two informants described "earth snakes" (***nipa awu***) living in cavities some distance underground; but their descriptions did not accord with distinctive features of *Typhlops*. That blind snakes do not figure clearly in the classification of ***nipa*** is consistent with their subterranean habitat and secretive behavior (Loveridge 1946:110). Nage unfamiliarity with "water snakes" and "earth snakes" justifies the omission of both from Table 1.

It is worth noting that the number of named taxa in Table 1 is comparable to those reported from other parts of Flores (see van Suchtelen 1921:60, who reports nine named varities for the Ende region, and Verheijen 1982:164, who gives a list of 11 for Komodo). While not all herpetological species present in central Flores are included in their classification of snakes, all evidence suggests that Nage apply ***nipa*** only to true snakes. Questioning thus revealed that neither eels (***tuna***) nor centipedes (***héte te'e***), for example, are classified as ***nipa*** (cf. Arndt 1961:359, 1933:295, whose dictionaries indicate that centipedes may be so classified in the neighboring languages of Ngadha and Lio).

Since all ***nipa*** are *animals* (***ana wa***), the information presented in Table 1 reveals a taxonomy comprising at least three levels for any terminal taxon (see Fig. 1). Several usages indicate a fourth level. The two species of python (***goka***) are distinguished as ***goka denu*** and ***goka leo***. ***Leo***, the name of the black-naped oriole (*Oriolus chinensis*), refers to the resemblance between the coloration of one kind of ***goka*** (*P. timorensis*) and the bird's brilliant yellow and black plumage. The other modifier, ***denu***, which is applied to the less colorful (though reportedly more aggressive) kind of python (*P. reticulatus*), has no further meaning that could illuminate its use in this context. At the same time ***goka denu*** specifies a kind that is often designated simply as ***goka***, or ***goka bholo*** (common python). It is thus clearly the unmarked member of the pair.

The categories ***ba*** and ***hiku*** provide examples of the same pattern. Nage distinguish ***ba bago***, a variety of Russell's viper that characteristically hurls (***bago***) itself at victims, from a more usual variety, ***ba***, or ***ba bholo*** (common ba), which does not. The hurling viper is sometimes also described as smaller and possessing a less pointed tail than the other sort.[3] Similarly, in addition to the usual and unmarked variety of ***hiku*** (or ***hiku bholo***, the green tree viper), Nage distinguish a smaller and less dangerous sort called ***hiku manu*** (***manu*** is "domestic fowl," alluding perhaps to the fact that fowls are able to kill it) and a larger, more aggressive and especially venomous sort distinguished as ***mépu*** or occasionally, as ***hiku éko to***, "red-tailed hiku."[4] Not only do Nage speak of ***mépu, hiku bholo***, and ***hiku manu*** as variants of a single kind, however; several informants described them as possible growth stages of one and the same snake. While no such claim was made with regard to the two varieties of ***ba***, the herpetological literature indicates that the hurling behavior attributed exclusively to ***ba bago***—the snake's ability to project itself towards a victim with such force that its tail leaves the ground—is characteristic of Russell's vipers in general (Loveridge 1946:176). It seems that, here as well, one may be dealing with a single species, or even subspecies.

Nage were similarly unsure whether ***sawa pipi to***, "red cheeked sawa," designated a kind of snake distinct from those simply designated as ***sawa*** (see Table 1). Most thought there was just one sort, and that the longer name referred to the fact that some ***sawa*** have red cheeks, indicating a more aggressive temperament. In no case then do lexical distinctions pertaining to the categories ***ba, hiku***, or ***sawa*** unequivocally refer to distinct natural species, or what the Nage, employing an Indonesian term, describe as a difference of *jenis* (kind, type, species). In this regard, the classification of these three kinds of snakes appears to differ from that of pythons (***goka***), in which the two named varieties are associated with two separate herpetological species. Yet even here there is a question of how far Nage themselves regard the latter as differing in kind. Some informants indeed described them as constituting a single kind (*jenis*). One man even claimed that ***goka leo*** (*Python timorensis*) were nothing other than pythons with fresh skins, and ***goka denu*** (*P. reticulatus*) animals with old skins that had become dull and rough. What this suggests is that in spite of lexical distinctions composing a fourth level of Nage snake classification, all *basic* or *generic* terms occupy the third level. By the same token, none of the taxa in this level was spoken of as constituting a single kind with one or more others, although ***lola ba*** and ***nipa kéla*** appear to be more closely associated with ***nipa 'e'e*** than with other categories, if they are not to be treated as components of a fourth level immediately below ***nipa 'e'e***.

Among the snake taxa listed in Table 1, only ***nipa 'e'e*** (ugly snake) and ***nipa kéla*** (variegated snake) incorporate ***nipa*** as a necessary component of the names. ***Nipa*** is frequently, though not mandatorily, included in the names of several others, including ***nipa ba, nipa sawa***, and ***nipa ulu pali***. In contrast, the remaining kinds (***gala, goka, hiku, lola ba, pupu zupi***) are less usually, if ever, expressly designated as ***nipa***. Whatever the reason for this contrast (see Taylor 1990:58–59), there is nothing to suggest that the latter five are considered any less representative of the category ***nipa*** than are the others.

This circumstance raises the wider issue of focality. While certain categories located at the fourth, and least inclusive, level of Nage snake classification are evidently focal or prototypical (e.g., ***goka denu*** or ***goka bholo***, in relation to ***goka*** in the more inclusive sense), there is no evidence that one or more of the third level categories are more closely identified with the term ***nipa*** than are the others. The fact that certain snakes, most notably pythons, are represented by Nage as exceptional in regard to size or behavioral peculiarities does not render them peripheral to the category ***nipa***. On the contrary, pythons (***goka***, but also occasionally ***nipa goka***), considered as embodiments of leaders of groups of earth spirits (***nitu***) whose lesser members are manifest as other kinds of snakes, are in at least one respect central to the category. Following Randall and Hunn (1984), genuine life-form taxa as defined by Brown may be a rarity in folk classifications. However, the evidence of Nage usage indicates that ***nipa*** is subject to none of the restrictions associated with supposed life-form terms encountered in some other languages, such as Samal or Sahaptin (ibid.).

This absence of a hierarchy of central and peripheral members signals an important difference between Nage classification of snakes and other animals (***ana wa***). It is also consistent with the degree to which the former accords with a scientific model of taxonomy. It may be noted, for example, that while *bird* arguably exists as a covert category of Nage ethnozoology, certain less inclusive named categories, and particularly the one labelled ***ana peti*** (small passerine birds, especially *Lonchura*), are demonstrably more focal, or more closely associated with the concept of *bird*, than are others. (Pertinent here is the fact that Nage usage sometimes equates ***ana peti*** with birds in general, while in other contexts the term is applied to a far more restricted class of avifauna.)

POLYSEMY AND CLASS INCLUSION

Terms like ***ba*** and ***hiku***, denoting common, unexceptional, prototypical, or unmarked varieties at the least inclusive taxonomic level, can be called polysemous, since they refer both to more inclusive and included taxa. In folk classification, this pattern is so widespread as to be characteristic (e.g., Berlin et al. 1973; Hage and Miller 1976; Berlin 1992:110, citing Wyman and Harris 1941). As indicated above, it also occurs in other areas of Nage ethnobiological nomenclature. Apart from distinctions among two or more wild species, the same pattern is encountered when undomesticated varieties are marked with the modifiers ***witu*** (undergrowth, brush) and ***bene*** (wild) and thus distinguished from domesticated counterparts designated only with the basic term (e.g., ***wawi***, domestic pig, and ***wawi witu*** or ***wawi bene***, wild pig). In contrast, other examples of the same formal pattern are unproductive in the sense that the marked term is not regarded as an instance of a category designated by the unmarked. Thus while various uncultivated plants are named by terms incorporating the name of a cultivated plant plus the modifier ***nitu*** (spirit; see Balee 1989, who describes a similar nomenclatural practice among the Ka'apor of Brazil), "spirit rice" (***pae nitu***) or "spirit millet" (***wete nitu***) are not considered as members of the categories labelled ***pae*** (rice) or ***wete*** (millet). In a similar vein, Nage do not regard the papaya, in one dialect named ***muku jawa*** (Javanese banana), or the resin plant (probably *Ricinus communis*, see Verheijen 1984:17), in Bo'a Wae called ***padu goa*** (Goanese papaya), as types of banana or papaya, respectively.[5]

Understood simply as a pattern in which more inclusive and exclusive meanings of a single term are analytically distinguishable, polysemy in Nage naming practices is not in every case clearly associated with taxonomic relations in the strict sense. A taxonomic model is attested where the exclusive (or included) sense can be linguistically specified with the use either of an alternative name or, more usually, by a modifier meaning "common," "typical," "real, true," or "original" (see Berlin 1992:34). The language of scientific biology uses this device, as for example when herpetologists speak of "true snakes." As regards both zoological and botanical nomenclature, polysemy in Nage classification articulates taxonomic relations with the modifier ***bholo***, as seen in the case of the classification of snakes. ***Bholo*** otherwise translates as "just, merely; only, alone; empty;" thus an expression like ***hiku bholo*** might be translated as "(it is) just a hiku" (i.e., not a ***hiku manu*** or ***mépu***). Nowadays, bilingual Nage often use instead the Indonesian word *biasa*, "common, ordinary, usual" for this purpose; hence unexceptional ***hiku*** are also specified as ***hiku** biasa*.[6]

Since this device appears as a general feature of Nage biological nomenclature, the distinction between taxonomic and nontaxonomic polysemy pertains not so much to a difference between their classification of snakes and other animals (***ana wa***) as to one between biological and nonbiological objects. In this respect, the Nage case supports the view that natural species are everywhere classified differently from artifacts and other cultural things (see Atran 1990). Nevertheless, the Nage treatment of snakes (***nipa***) is sufficiently different from their classification of most other zoological kinds (which in turn more closely resembles the classification of artifacts) as to raise a query. The perceptual salience of snakes, in respect of their physical form, method of locomotion, and so on, does not provide an adequate explanation. Thus some other Indonesian peoples, for whom snakes would appear to be just as salient, do not possess a single term that includes all named ophidians. The eastern Sumbanese (Forth, unpublished field notes) and the Nuaulu of Seram (Ellen 1979) provide examples. In view of the same comparison, neither utilitarian factors nor general cultural complexity, on which Brown's (1977, 1979) quasi-evolutionary argument relies in accounting for the emergence of life-form categories, can account for the appearance of a single term for *snake* in some eastern Indonesian societies but not in others.

The systematic taxonomic ordering of snakes obviously relies to a large degree on the presence in Nage of a term denoting animals (***ana wa***) that unequivocally includes snakes, as well as a nonpolysemic life-form term (***nipa***) designating a well-defined taxon subordinate to ***ana wa*** that facilitates transitive relations (i.e., all specific kinds of ***nipa*** are simultaneously recognized as ***ana wa***). As regards ethnozoology, the only other area of the classification revealing a similar degree of taxonomic rigor concerns fish. As a gloss of Nage ***ika***, *fish* is the only other apparent life-form taxon designated with a single lexeme. This characterization, however, requires qualification. Nage do not apply ***ika*** to several species of freshwater fish described as having scales only on the head and as remaining at the bottom of streambeds or attaching themselves to rocks. Nor are eels (***tuna***) included in the category. On the other hand, sharks (***iu***), dolphins (***lobhu***), and whales (known only as ***ika méze***, big fish) are counted as ***ika***. In the last regard, it appears significant that as an interior people, Nage are quite unfamiliar with sea creatures, and are likely to know of whales, dolphins, and sharks only indirectly and simply as aquatic animals resembling large "fish" (***ika***). Thus ***ika*** provides a less straightforward example of an ethnozoological category corresponding to a unit of scientific taxonomy than does ***nipa***.

Opposed to writers who see ethnozoological classification as reflecting a natural order of perceptually salient, physical (morphological or behavioral) difference and resemblance are those who consider such classifications as grounded largely in functional or practical, and therefore social and cultural, considerations (e.g. Hunn 1982; Ellen 1993; Randall 1987; Randall and Hunn 1984; Wierzbicka 1984, 1985). That practical factors play little part in the Nage classification of snakes follows from several particulars. First, snakes have virtually no economic importance, figuring neither as a source of food (unlike fish) nor as stealers of domestic fowls (unlike diurnal raptors and monitor lizards, for example) or as crop pests (unlike various birds and insects).[7] Several species are venomous and dangerous to humans. This is not a significant factor for the Nage classification of snakes, however, since there is no term denoting a separate class of poisonous snakes, nor any word readily translateable as "venomous."[8] The use of ***hiku ba***, a phrase conjoining the names of two species of viper, to denote dangerous snakes in general, does not contradict this characterization; for as shown earlier, such expressions do not denote discrete taxa. On the other hand, creatures that similarly deliver painful and injurious bites, such as scorpions (called ***éko teko***, striking tail) and centipedes (***héte te'e***), are not classified as ***nipa***.

Finally, while snakes in general are identified with spiritual beings, and in some contexts particular kinds of snakes with particular spirits, there is no formal correspondence between ethnoherpetological and spirit classification. Although spirit leaders are commonly thought to assume the form of pythons, other, lesser spirits can manifest as any sort of snake. What is more, some such beings take the form of fish and eels rather than snakes, while some named varieties of spirits (e.g., ***noa***) never appear in snake guise. For Nage, the possibility of snakes being an embodiment of spiritual beings, most of which are capable of causing mystical harm, is no less a matter of practical, or functional, concern than is the possession by some snakes of poisonous bites. Despite the close association of spirits with snakes, the Nage classification of spirits provides a good example of a nonbiological classification in which polysemy does not articulate scientific taxonomy. I will return to this topic after reviewing several other issues of classificatory language.

CLASS INCLUSION AND LANGUAGE

Because taxonomic relations are systematically revealed in certain areas of their ethnozoological classification, one cannot simply assume that the Nage language possesses special means of explicating class (or hierarchical) inclusion. In modern scientific biology, inclusion, the fundamental principle of taxonomy, is unequivocally expressed with terms like *genus* and *species*. Almost by definition, traditional societies lack special terms that exactly translate these concepts. Sometimes, folk biological classes are described with general terms meaning "kind, type," "group, grouping," or even "lineage, clan." Nage uses no words of these sorts for this purpose (cf. Ellen 1993:61). Nor is there a word that corresponds to English "member." The inclusion of one category by another is indicated by first identifying a creature as a python (***goka***) and then as ***nipa mogha***, "also a snake."

This statement, however, does not reveal which is the inclusive category; nor does it necessarily imply that all members of one category will belong to the other.

There are two other ways of expressing inclusion, as for example when one wants to say "the python is a kind of snake."[9] The first is exemplified by ***goka (ke) ko'o nipa*** (python (the) [is] of snakes; ***ke***, functioning either as a demonstrative pronoun or definite article, is optional). As a preposition, ***ko'o*** generally indicates possession, participation, or containment. Class inclusion is one sort of relationship thus denoted, yet it is not the only one, possession of property and anatomical relations between whole and part being others (e.g., ***ko'o nga'o***, of me, mine). Moreover, the form of words indicating the inclusion of one class in another (such as *pythons* in *snakes*) does equal service in expressing the inclusion of an individual within a class. The sample statement ***goka ke ko'o nipa*** is therefore reversible; one can also say ***nipa ke ko'o goka***, "that (particular) snake is a python." In other words, the form pertains as much to identification of single specimens as to classification, or the articulation of relations between categories. More generally, statements like ***X (ke) ko'o Y*** are expressions of identity comparable to "X is Y," with ***ko'o*** possessing some of the functions of the English copula.

The other form of statement capable of conveying the idea that pythons, for example, are a kind of snake is ***goka (ke) bhia ko'o nipa***. This differs from the first only by the appearance of ***bhia*** (dialectal ***bhila***). While often translateable as "like, resembling," ***bhia*** is most accurately glossed as "(to possess the) manner, way, form, shape, or appearance of something" (cf. Ellen 1993:61 s.v. Nuaulu ***nita***, way). As a substantive it also has the sense of "appearance of a thing" (see ***bhia nge'e ko'o goka***, "this shape belongs to pythons," i.e., "this looks like a python;" ***bhia nge'e*** can also mean "like this, in this way"). Consistent with the foregoing, Nage pointed out that ***bhia*** referred not to just any similarity, but to a particularly close resemblance between two things. ***Goka bhia ko'o nipa*** is therefore more accurately translated as "(the) python has the form of a snake" than as "pythons are similar to snakes."

In any language to say that an item has the form of something can imply that it is an instance of that thing.[10] Yet, in response to questioning, Nage sometimes rejected ***goka bhia ko'o nipa*** as an expression of the python's inclusion in the category of snakes, claiming that the phrase should be understood as stating that pythons resemble snakes. Some informants then further pointed out that this cannot be correct, since pythons are not "like" snakes—they "are" snakes. Statements of this kind were nevertheless elicited or observed with sufficient regularity as expressions of relations between, for example, individual kinds of snakes and the category ***nipa***, as to confirm that ***bhia ko'o*** (to have the form of) refers to inclusion in certain contexts. That the same form of Nage words can express either inclusion or resemblance is perhaps not surprising, for the same is true of English. In colloquial speech to say that "X is a kind of Y" does not always entail that X is, in any strict sense, a member of class Y. It can also mean that X is "something like Y" or "is of a kind with Y" (e.g., "a ukelele is a kind of guitar;" "a mug is a kind of cup," cf. Kempton 1978; "a bat is a kind of flying mouse"). In this respect, the main difference between the two languages may be that, whereas English "kind of" primarily expresses inclusion, Nage ***bhia ko'o*** has resemblance as its principal sense.

Also relevant in this connection is the modern Nage use of Indonesian words like *macam* and *jenis*, two terms they now regularly employ when talking—in the national language, but sometimes in Nage as well—about classificatory relations. In standard Indonesian, *macam* (kind, sort, type), expresses both inclusion and resemblance, rather like colloquial uses of English "kind." According to the dictionaries (e.g., Echols and Shadily 1963), *jenis*—a word deriving ultimately from Latin *genus* (kin) via Arabic (cf. Ellen 1993:61)—has more the sense of "species," and should express class inclusion exclusively. Yet Nage tend to use *macam* and *jenis* interchangeably for resemblance and inclusion. In their use of the Indonesian words, therefore, they do not consistently distinguish between the two sorts of relations, just as they do not always do so in their use of ***bhia ko'o***. It is also noteworthy that both *jenis* and *macam* refer to exclusive classes in Indonesian language statements like *delapan jenis ular*, "eight kinds of snakes," whereas Nage ***bhia*** is not used in this way. In addition, by using the Indonesian words, Nage are able to specify two things, or even two categories (e.g., ***goka denu*** and ***goka leo***), as being of, or constituting, a "single kind" (*satu jenis saja*).[11]

In any language ambiguity of this sort is bound up with polysemy insofar as statements interpretable as expressions of inclusion as well as resemblance can be seen to involve two senses of the more inclusive term (e.g., *table* in "a desk is a kind of table"). Where this distinction is expressible in language—as in the case of Nage snake classification, where the more specific sense of ***hiku*** can be marked with the modifier ***bholo***—then polysemy entails inclusion and hence taxonomy. Yet such is not always the case. The Nage classification of spirits provides a good illustration in this regard, as well as an apt comparison with their ethnoherpetological taxonomy. While reputedly manifest as biological kinds, and especially as snakes, spirits do not exist like animals as empirical beings with attributes independent of the mind. In this sense, then, they are human creations to the same extent as are tools and other material artifacts, and owing to their immateriality are more easily modified.

Of all named categories of Nage free spirits, the most often mentioned is ***nitu***. This term is applied to earth spirits manifest as snakes, as well as to a broader class to which this and other, distinctly named, varieties (e.g., ***bapu, noa, logo lia, manu ke'o***) belong. Yet while Nage often depict the separately named spirits as instances of ***nitu*** in the more inclusive sense, and designate specific spirit images sometimes with ***nitu*** and sometimes with one of the other terms, they will typically deny inclusion when questioned directly, stressing instead differences between separately named spirits and the unmarked variety of ***nitu***. Things are quite different with snake classification, where ***ba bago***, for example, is clearly regarded as denoting a kind of ***ba*** (Russell's viper), the other kind then being specifiable as ***ba bholo***. Accordingly, as I confirmed in direct questioning, there is no expression ***nitu bholo*** (common, true nitu) that could distinguish the unmarked variety from the broader class.

Patterns of this sort, wherein a discernible polysemy does not effect taxonomic relations, are better described as instances of encompassment rather than inclusion. Encompassment is adopted from Dumont (1986), who uses it to refer to a situation in which a term subsumes its contrary, the defining feature of relations he calls "hierarchical classification" or "hierarchical opposition." Since Dumont

(1986:227) characterizes the relation between the zoological categories *animal* and *vertebrate* as an instance of hierarchical opposition, I depart from his scheme in separating encompassment from taxonomy, in part by associating the two principles with two distinct contexts of polysemy. To do so, however, is not to suggest that taxonomy and encompassment are completely opposed principles of classification. Indeed, they are closely linked by what appears to be an inherent cognitive difficulty in conceiving of a class completely abstractly, or separately from one or more of its members: its prototypical or focal instances. With taxonomy, the relation between central and peripheral members recalls encompassment insofar as the peripheral instances are subsumed as parts of a conceptual whole that, to some degree, is identified (by name or otherwise) with their contrary, which is to say the central member or members.

Since taxonomic contraries may be expected to share one or more features in common, their relationship is also based upon resemblance. Indeed, taxonomy may develop—ontogenetically if not phylogenetically—from resemblance, that is from a perception of similarities to the formulation of abstract classes (see Berlin 1992, Ch. 2, especially pp. 63–64). Consistent with this, while class inclusion always entails resemblance—between most if not all members of the same class—resemblance need not entail inclusion. At most, from a resemblance between things it might be inferred that they belong to a single kind. Yet this kind need not be definitely conceptualized.

While resemblance is a property of both taxonomy and encompassment, the two relations differ in that taxonomic resemblance concerns only terms at the same level of contrast. (Thus, logically, a viper cannot be said to resemble a snake.) Encompassment, on the other hand, entails an additional resemblance, tending towards an identity, of terms at the superordinate and subordinate levels, inasmuch as these are not consciously distinguished. In this respect, encompassment is a fundamentally binary relationship, whereas taxonomy, requiring a superordinate term plus contrasting terms at the subordinate level, is minimally ternary. At the same time, the fact that encompassment links comparable terms that, owing to the ambiguity of the relation, exist simultaneously at the same and at different levels, recalls the equivocal nature of Nage ***bhia ko'o*** (to have the form of). That this phrase expresses both resemblance and inclusion underlines the fact that taxonomy and encompassment are not always easily distinguished. Encompassment is also comparable to what Hunn and French (1984) call *coordination*; a biological category is named as X plus a modifier, and thus contrasted with unmodified X without the latter being further identified as the name of a class superordinate to both. I differ from these authors, however, in regard to their identification of coordination with polysemy in general, or their claim that construing X as the common name of distinct superordinate and subordinate taxa always imposes an alien taxonomic form on ethnobiological naming patterns.

PARALLELISM AND LEXICAL PAIRING OF BIOLOGICAL NAMES

In characterizing the Nage classification of snakes (and, in a lesser degree, of other animals) as taxonomic, and their classification of spirits as nontaxonomic, I distinguish *classification*, as the more general term denoting ways in which categories are conceptually connected, from *taxonomy*, referring to a particular classificatory principle. While inclusion is essential only to taxonomy, any form of classification entails the perception of resemblance. Yet members of a class may share one or more features in common with all other members or they may not. In the first case, one is dealing with monothetic classification, and in the second with polythetic classification—a pattern of Wittgensteinian "family resemblances" wherein any member shares different features with different other members (Needham 1975).

Taxonomy is distinguished from other forms of classification not on the basis of the monothetic nature of component classes, but by the abstract character of the superordinate class: the fact that it is conceptually distinct from all of its members. With other forms of classification, by contrast, items can be grouped together on the basis of resemblance alone, that is, on the basis of some purely horizontal, or cognatic, conception of relatedness—as for example, when two or more entities are spoken of as being related to one another in a kinship idiom (cf. Berlin 1992:19–20). In order to distinguish other forms of conceptual order from taxonomic classification, some of the former have sometimes been characterized as symbolic classification (Needham 1980:45). How useful it might be to characterize all nontaxonomic classification as symbolic is a matter that need not concern us here. It may however be remarked that forms of classification encountered in cosmology and ritual, for example, appear on the whole not to involve taxonomic relations.

As regards animal categories, one instance of a nontaxonomic classification based solely on resemblance is the previously mentioned practice of lexical pairing. Binary expressions conjoining a particular pair of ethnobiological names operate as a sort of dualistic synecdoche since they refer to a class of things larger than the two kinds named. As demonstrated with reference to ***peti kolo***, munia-dove, however, such classes do not participate in taxonomic relations owing to their indeterminate nature, internal variety, and collective reference (or indivisibility).

Bound up with these factors is the functional, or practical, import of the class. Further instances of the idiom, all of which exemplify this quality, are given in Table 2, which includes pairs of names referring to crop pests, wild animals used as food, bothersome creatures, particularly valuable domestic animals, and so on. A similar form of binary classification is reported for the Melpa of New Guinea, who also pair biological kinds on the basis of "functional similarities," some pairs then "standing for the whole class" that they exemplify (Lancy and Strathern 1981:782; see also Ellen 1986:90–91).[12] It is important to note, however, that Nage lexical pairing does not concern ethnobiological categories alone, but applies as well to nonbiological things that, as several authors (van Esterik 1982; Stanlaw and Bencha 1985) have convincingly shown, are not classified in accordance with a consistently taxonomic model. Examples of such pairings include ***nitu bapu***, comprising the name of two kinds of spirits and referring to a larger class of spiritual beings; ***ebu kajo***, "grandparent" and "great-grandparent," in combination designating ancestors in general; ***uta tua***, "green vegetables" and "palm wine," a reference to food and especially simple foods; and ***kita ata***, an expression combining the first person plural inclusive pronoun with a word specifying humans dissociated from the speaker, and referring to human beings in general.

TABLE 2.—Instances of lexical pairings applied to more inclusive classes of animals.

BIRDS:	
peti kolo	munia, dove; birds that destroy crops (see text)
piko kolo	quail, dove; game birds (see text)
iki jata	small falcon, Brahminy kite; diurnal raptors, especially ones that regularly steal domestic fowls
jata kua	***kua*** names two or more kinds of eagle; the reference of this expression is the same as the ***iki jata***
INSECTS:	
emu hale	mosquito, fly; bothersome flying insects
maju méla	bedbug, dog flea; tiny biting insects (also a reference to undesirable qualities removed from houses in an annual rite of cleansing)
metu mule	ant or red ant, black ant; ants in general, conceived as small insects that deliver a painful sting
REPTILES:	
hiku ba	green tree adder, Russell's viper; poisonous snakes
iu ngebu	shark, saltwater crocodile; dangerous animals inhabiting the sea. (Note: This expression pairs a reptile with a nonreptile.)
MAMMALS:	
kogha wawi	deer, (wild) pig; major and most valued game animals. (See also ***kogha wawi, kuza tuna***, referring to wild foods in general, derived from both land and water; ***kuza***, crustacean (e.g. crayfish); ***tuna***, eel.)
bheku meo	palm civet, (wild) cat; small animals occasionally taken as food, though particularly in the context of the annual ***ngobu*** ritual.
kutu bétu	porcupine, giant rat; smaller animals occasionally hunted; sometimes paired with ***bheku meo*** (see above).
bhada ja	water buffalo, horse; largest and most valuable domestic animals, all animals used as bridewealth (cf. ***bhada wea***, buffalo, gold; major animate and inanimate components of wealth, including bridewealth; thus a reference to wealth in general).

Another example provides a particularly revealing illustration of the functional and cultural, as opposed to physical or perceptual, basis of this form of dualistic classification as it concerns natural kinds. Nage indicate the nocturnal presence of spiritual danger with the double pairing ***po ko, uci meci***. ***Po*** and ***ko*** both refer to owls and owl vocalizations. ***Meci*** denotes both a kind of cricket and the insect's characteristic sound, while ***uci*** is a nocturnal vocalization not linked exclusively with any zoological species. Since Nage regard all four sounds as auditory manifestations of witches and malevolent spirits, and thus as inauspicious omens, it is clearly this common mystical association rather than any morphological or behavioral similarities that links together the implicated zoological kinds.

While the motivation for such pairings is resemblance relating to the functional value—or cultural significance—of named kinds, the fact that it is always two kinds, or sometimes two pairs, that are named together cannot be explained in practical terms. This reflects instead a pervasive dualism, a general principle of Nage culture evidenced in a wide variety of social, cosmological, and ritual forms. Lexical pairing is not simply a common form of naming objects, but a general feature of Nage syntax. Thus, words with verbal senses are also regularly juxtaposed (e.g., ***tana ngale***, "to enquire, request," compromising two words that by themselves mean "to ask"), as are terms denoting types of social groups, territorial units, social persons or statuses, spiritual beings, and kin (see Forth 1993:117–119).

As some of these applications may suggest, lexical pairings do not always designate classes of things more inclusive than the pair actually named. In many cases the component terms are roughly synonymous (as in the example of ***tana ngale***). In this instance, moreover, the main function of the idiom is disambiguation rather than class designation. (Thus ***tana*** means not only "to ask," but also "land, earth," and so when similarly conjoined with ***watu***, "stone," figures in another pairing, ***tana watu***, as a reference to "territory.") Disambiguation is also operative in the zoological pairings ***kogha wawi*** and ***bheku meo*** (see Table 2) insofar as it is immediately clear, from the complementary terms, that the referents are specifically wild pigs (***wawi witu***) and wild cats (***meo witu***), rather than their domestic counterparts. Nevertheless, whether they are synonyms or words with quite distinct referents, conjoined terms always have significances that are in some way comparable or figure as complementary components of unitary meanings, so that one can accurately speak here of parallelism (cf. Jakobson 1973).

In addition to the mundane lexical pairing illustrated above, the Nage tendency "to speak in pairs" (cf. Fox 1988) is extensively evidenced in the canonical parallelism of Nage ritual speech, which requires that elements (words, phrases) always be combined with specific other elements. Certain pairings from everyday speech also appear in this formal idiom, which is largely reserved for ceremonies (addresses to spirits, invocations, prayers). In this case they are typically elaborated by the addition of other words or phrases (verbs, modifiers) separating the paired elements. For example, the phrases ***kogha poma, wawi jola*** (deer bathe, wild pigs wallow) refer in palm-tapping ritual to people enjoying an abundant yield of the Arenga palm (***tua***). Similarly, the pairing ***piko kolo*** (quail [and] dove), referring to game birds, is elaborated in the ritual idiom as ***piko ta'a wito io, kolo***

ta'a 'isi moko (quail that takes along others, dove that urges on friends), a reference to a person who desires the company of others, or seeks companions in an endeavour.

By no means do all ritual speech pairs correspond to the lexical juxtapositions encountered in more mundane speech, however. For example, in contrast to the mundane pairings ***metu mule, kogha wawi***, and ***peti kolọ*** (see Table 2), in the ceremonial idiom one finds the pairings ***mule//ipu*** (black ant//immature form of riverine fish), ***wawi//manu*** (domestic pig//domestic fowl), and ***kata//piko*** (junglefowl//quail). Denoting creatures that occur in large numbers or bear many offspring, these names are thus paired in expressions referring hopefully to human fecundity and reproductive success, viz., ***woso bhia mule wolo, kapa bhia ipu lau nanga*** (be many like black ants in the uplands, many like fish fry in the estuary); ***dhadhi bhia wawi, mesa bhia manu*** (give birth like pigs, hatch like domestic fowls); and ***bi ala bhia kata mala, liwo bhia piko wigho*** (reproduce like junglefowl in the plains, cluster together like quail [+ unidentified adjective]). As these examples show, many such ritual speech pairs include quite varied zoological kinds (e.g., insects and fish; mammals and birds), comparable only in regard to very specific attributes (e.g., swarming habits, multiple births). One even encounters animals paired with plants, as when ***kata mala***, "junglefowl of the plain," is paired with ***mako ae***, a flowering plant (*Ipomoea* sp., cf. Verheijen 1990:31, 51, 69) that grows prolifically near bodies of water (***ae***). In contrast, mundane lexical pairings typically denote animals that share a more general resemblance and are more closely related biologically (black ants and other ants, buffalo and horses, Munia birds and doves, civets and wild cats). A number of parallelistic expressions, including many appearing in song and aphoristic speech, conjoin the names of two kinds of birds. Yet these are mostly ones whose similarity lies precisely in the augural value of their calls rather than in their physical appearance.

Names of snakes, the most taxonomically ordered of animals, rarely appear as components of binary expressions in either mundane or ceremonial speech. In the latter idiom I have discovered only one pairing, and this comprises ethnoherpetological terms occupying different classificatory levels. The expression is ***nipa lia, gala bha*** (snake in a cave, white ***gala*** snake), and refers to something that is rarely seen. (The ***gala*** is normally a dark-colored snake.) That snakes should provide the one instance of a life-form term paired with the name of an included terminal taxon is hardly surprising. The relative absence of ethnoherpetological names from all forms of binary expression is less readily accounted for. One possibility, however, is that all named snakes—in contrast to birds or mammals, for example—are so alike that individual kinds lack special metaphorical value. Recalling that mundane ethnozoological pairings mostly designate functional classes, another factor may be that particular snakes, again by comparison to other animals, are relatively devoid of functional or utilitarian value. (As regards practical significance, while not all snakes deliver a painful or dangerous bite, all are regarded as possible manifestations of potentially malevolent beings.)

CONCLUDING REMARKS

Although no speech form unequivocally denotes class inclusion, taxonomic relations involving both inclusion and transitivity are present in Nage ethnozoological classification, while absent from other areas of classification, for example, that of spiritual beings. Taxonomic ordering, best exemplified by their classification of snakes, is not equally developed in all areas of Nage zoological nomenclature. It is not an external framework arbitrarily imposed on selected data; it is a property of certain forms of language use and so discernible as the product of their analysis. As an examination of Nage snake classification has shown, ethnoherpetological categories cannot be interpreted in any way but as components of a taxonomic order. No evidence indicates that any named kind is more focal, exemplary, or prototypical of the category ***nipa*** than any other. Polysemy is evidenced at lower levels, but neither polysemy nor prototypicality is inconsistent with taxonomy either in Nage or scientific zoology, where a polysemous use of terms designating both genera and species or species and subspecies (see e.g., ***Naja naja naja***, the spitting cobra) is a standard and common practice.

Various instances of Nage classification reveal a nontaxonomic relationship between categories that can be called encompassment. With encompassment, inclusion is implied by linguistic usage yet usually contradicted by informants' statements. A category encompasses another when there is no regular distinction, lexical or otherwise, between a superordinate conceptual entity and one existing at the same level of contrast with a distinctly named encompassed term. While encompassment is thus formally similar to taxonomic polysemy, in which the same name is applied to taxa occupying superordinate and subordinate levels (e.g., a word denotes both a group of biological kinds and a particular kind included in the group), the latter is distinguished by a recognition by users of two distinct senses of the polysemous term. This is the formal difference. In practice it may not always be apparent whether what the analyst would recognize as polysemy articulates encompassment or taxonomy. Related to this, insofar as the Nage language does not entirely distinguish resemblance and inclusion, both classificatory relations can be expressed by the same form of words.

Using *classification* in a broad sense, a major outcome of the present study is the discovery that the Nage possess three distinct classifications of biological entities. One, which may be called ethnobiological, does admit taxonomic relations and order categories primarily on the basis of morphological and other physical resemblances between natural kinds. The other two modes of classification can both be described as parallelistic. One occurs in ritual speech, where two terms are conjoined owing to their symbolic or metaphoric similarity—the fact that the natural kinds to which they refer both serve as metaphorical references to the same things. Although ritual speech pairings are sometimes the same as those encountered in everyday language, there are numerous distinct mundane pairings that designate functional or utilitarian classes. These binary expressions operate quite differently from taxonomic names. Mundane pairings do not name categories that comprise numerable individuals, and so for this reason alone cannot participate in taxonomic relations. Nor do they serve as figurative references, for example to qualities or powers of humans or anthropomorphous beings, as do the pairings of ritual language.

In this last regard, the two instances of binary speech contrast in a way reminiscent of the standard distinctions of metaphor (connecting semantically contrasting wholes) and metonymy (connecting parts with wholes) and of symbol and sign (cf. Leach 1976). The two applications of the pair ***piko*** (quail) and ***kolo*** (dove) exemplify these contrasts. Their elaborated combination in ceremonial contexts links the bird categories with human reproductive power, while their simple juxtaposition in mundane speech produces a form of synecdoche whose reference remains ornithological. The contrasts of whole to whole and whole to part relations, often used to characterize the distinction of metaphor and metonymy, also bear upon the contrast of resemblance and inclusion as it pertains to different forms of classification. Not constituting true taxa, expressions like ***piko kolo*** (game birds) do not fully accommodate relations of inclusion. Nevertheless, they do rely on inclusion—the use of two included parts to name a larger whole—to the extent that the binary expression is employed to refer to a large group of birds.

Inasmuch as Nage, when questioned directly, often deny that binary expressions like ***piko kolo*** comprise more than the two kinds specified by name (while observed usage indicates that they do), such expressions can alternatively be seen to involve encompassment. That is, ***piko kolo*** can be understood in two undistinguished senses, as a reference to all game birds and as a subsumed category denoting only quails (***piko***) and doves (***kolo***). The second sense would then contrast with an unnamed category of other game birds, similarly subsumed by ***piko kolo*** in the first, encompassing sense, in a way completely comparable to the relation between the spirit categories ***nitu*** and ***bapu***. Being identifiable with encompassment, expressions like ***piko kolo*** are therefore dissociated from taxonomic relations in yet another respect.

Since the components of some mundane juxtapositions are identical to paired terms in ritual language, one may infer that functional resemblance is more readily converted into symbolic association than is taxonomic linkage. However that may be, it is clear that Nage connect animal categories in several ways, and only one of these is taxonomic. In this eastern Indonesian society, systematic taxonomy co-exists with nontaxonomic forms of classification, even when these concern identically named biological kinds. By the same token, identical categories form part of both hierarchical and symbolic classifications (Needham 1980). Writing on the Melpa of New Guinea, who similarly combine taxonomy and pairing, Lancy and Strathern (1981:788) suggest that the binary mode of expression may "interfere with" or "block" the taxonomic ordering of biological categories. I have no evidence that this occurs among Nage, and there is good reason to suppose it does not. For in the eastern Indonesian case, pairing and taxonomy evidently relate to forms of conceptual order effected for quite different purposes.

NOTES

[1]Nage words are written with the following orthographic conventions. The /bh/ and /dh/ are implosives; /c/ approximates English 'ch'; /gh/ represents a voiceless fricative (cf.

Dutch 'g'); while /w/ is often closer to English 'v'. Glottal stops are indicated with /'/. These have phonemic value initially and medially but not terminally. In initial positions in disyllabic words (e.g., ***fega***, kingfisher), /e/ (without an accent) represents the schwa. Where the /e/ is long in this position, it is marked with an acute accent (see e.g., ***féga***, to regain consciousness). In monosyllabic words and in the last syllable of longer words, the /e/ is always long, as it is when followed by another vowel or a glottal stop (see e.g., ***meo***, cat; ***te'e***, mat); hence in these positions, in the interests of economy, the /e/ is not marked with an accent. All other letters represent sounds roughly similar to their common English referents. Whenever I mention the Indonesian language below, I refer to Bahasa Indonesia, the Malay-based national language.

[2]Wierzbicka (1985:157; see also 1984) argues that many speakers of "ordinary English" would not regard snakes as a kind of animal. From my own experience as an English-speaker, I would characterize such speakers as extraordinary. Wierzbicka apparently refers here to snakes being excluded from the prototype of "animal," which basically comprises large, four-footed mammals in English and in Nage as well. For all the attention Wierzbicka gives to the notion of "kind of," it is curious that she never remarks on the ambiguity of this term in ordinary English, where it can express both resemblance and inclusion. Nor does she consider whether other languages may differ from English in the way they express notions of class inclusion.

[3]It may also be considered less dangerous, in respect of the curious notion that if a hurling viper manages to strike its victim, the latter will be unharmed, whereas if the viper misses, the victim will become ill, as if bitten, but not seriously.

[4]Interestingly, ***manu*** is similarly employed to mark the smaller of two varieties of monitor lizard, ***ghoa manu*** and ***ghoa ba'o***.

[5]As Goa (the Makassarese centre in southwestern Sulawesi) and Jawa (the island of Java) compose a standard pair designating all places outside of Flores, in this context the names mean "foreign" rather than specifically "Goanese" or "Javanese" (cf. Barrau 1979 regarding methods of naming exotic plants in Indonesia and Oceania).

[6]The pattern also occurs in the naming of cultivated and other useful plants. For example, the taxon labelled ***uwi***, tuber, includes a subordinate taxon also named ***uwi*** but specificable as ***uwi bholo*** (or ***uwi biasa***), as well as ***uwi kaju***, cassava. Interestingly, both of the latter subsume further named varieties, so that ***uwi bholo*** includes ***uwi boko***, while ***uwi kaju*** includes ***uwi kaju boa***. This would appear unusual, as other plants and animals classified in this way do not include unmarked (or "common") kinds that are further divided into named varieties.

[7]Although pythons are able to swallow small domestic animals, such occurrences are rare and hence of little practical concern. Python skin is an export commodity today, and some Nage have begun to eat python flesh, a practice formerly prohibited. But these are recent developments, and pythons are not economically significant as a source of skins or food.

[8]Some snakes are said to "bite"*(**kiki**)* or "strike" *(**kedho**)*. As Nage recognize, however, these behaviors are not exclusive to venomous species.

[9]Sample statements presented to informants for translation were in Indonesian, with "kind" being rendered with the Indonesian word *jenis*. Questioning of this sort was supplemented by observation of Nage speech.

[10]Cf. Gould (1983:363, cited in Lakoff 1987:120) who, in criticizing the cladistic approach to biological classification, states that "a ceolocanth looks like a fish, tastes like a fish, acts like a fish, and therefore...*is* a fish."

[11]Nage also use Indonesian *sebangsa*, "of the same kind," when classifying an entity by reference to another, similar entity. In this respect, *bangsa* (nation, race, group, category, kind) functions identically to *macam* and *jenis* in referring indiscriminately to resemblance or inclusion.

[12]Especially in myth and formal speech, eastern Sumbanese pair animal names when designating a single kind. ***Buti meo rumba***, monkey–wild cat, for example, refers simply to monkeys, and ***ringu tanoma***, dugong-turtle, to dugongs (Forth 1988:221). Since the words for monkey and dugong both have other meanings, disambiguation may be a function here. I have yet to encounter any usage completely comparable to these among Nage, who tend to use biological pairings to denote more, rather than less, inclusive classes.

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BOOK REVIEW

The Ethnobotany of Southern Balochistan, Pakistan, with Particular Reference to Medicinal Plants. Steven M. Goodman and Abdul Ghafoor. Chicago, Illinois: Field Museum of Natural History. Fieldiana, Botany, New Series, No. 31, 1992. Pp. v; 84. ($20.00) (paperbound). ISSN 0015-0746.

This book is a compendium of ethnobotanical and medicinal knowledge of the Baloch people of the Balochistan Province of southwestern Pakistan. Steven Goodman, a field biologist at the Field Museum of Natural History, and Abdul Ghafoor, a botany professor at the University of Karachi in Pakistan, travelled around this arid expanse of desert and mountains, by foot and by four-wheel-drive vehicle for four months to undertake this study. They interviewed nomads and villagers about their ethnobotanical knowledge, and traditional healers about all aspects of their application of herbal medicines, following Unani and Ayurvedic medicine systems. Despite the inevitable influences of "modernization," healing traditions in the region remain viable.

Following a brief introductory section, describing the project, the state of ethnobotanical knowledge, the settings of the study, and the general format, the book is divided into two major parts. Part 1, Ethnobotanical Uses of Wild Plants, includes a total of 114 plants in 43 families having local usage. For each species, the family and scientific names, voucher specimen number, locality, and vernacular name are provided, along with notes on use, treatment (for medicine) and, often, comments relating to the plant and its history. Part 2, The Pharmcopoeia of Balochistan Herbalists, begins with a brief summary of the Unani and Ayurvedic Systems of medicine, followed by a description of the herbalists and herbal doctors consulted, and the interviewing methodology. It then comprises a systematic list of herbal medicine plants, totalling 56 plant species in 33 families, in a similar format to the plant of Part 1.

This is a useful compendium of information, and it will serve as a good foundation for comparative research, as well as representing a valuable reference for the ethnobotany of a little known area. The index of local names will make the information accessible to local botanists, healers and others as well, as long as they can read English. The book contains a number of excellent black and white photographs of the places and people, and a few of the plants; more illustrations would have made it more useable for local people. Perhaps it can serve as a basic source of information for a more "user-friendly" local ethnobotanical guide.

Nancy J. Turner
Environmental Studies Program
University of Victoria
Victoria, British Columbia
Canada V8W 2Y2

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BIOLOGICAL DIVERSITY AND COMMUNITY LORE IN NORTHEASTERN THAILAND

LYNDON WESTER
Department of Geography
University of Hawai'i
and
SEKSON YONGVANIT
Faculty of Humanities and Social Science,
Khon Kaen University

ABSTRACT.—As communities experience economic development the value of traditional resources is typically reassessed. How much people currently know about particular indigenous food plants, and the attitudes they express about them, are seen a means to predict whether or not the plants will remain a part of the local diet and if they will persist as cultivated, tended, or wild species in a landscape transformed by modernization. To address this subject, populations in four villages, and two educational institutions in the Northeastern region of Thailand, were asked to identify certain food plants from photographs and supply some information about each species. High school students scored significantly better than university students. People comparable in age to the students, but not receiving formal education, did best. People from farms and villages consistently knew more than urban dwellers, and those from the most remote and undeveloped provinces scored highest. Ownership of transport vehicles and travel experience were inversely related to performance in the knowledge test. The results suggest that as more opportunities become available for education, and as migration to urban centers continues, knowledge and use of traditional food plants will decrease. More recognition of these as resources is needed in the formal education system.

RESUMEN.—Conforme las comunidades se desarrollan economicamente, se reevalúa por lo general el valor de los recursos tradicionales. La medida en que la gente conoce actualmente particulares plantas alimenticias indígenas, y las actitudes que expresan acerca de ellas, son vistas como una forma de predecir si las plantas seguirán siendo parte de la dieta local, y si persistirán como especies cultivadas, protegidas o silvestres en un paisaje transformado por la modernización. Para abordar esta cuestión, se pidió a la población de cuatro pueblos y dos instituciones educativas de la región nordeste de Tailandia que identificaran ciertas plantas alimenticias en fotografía y que proporcionaran alguna información sobre cada especie. Los estudiantes a nivel medio lograron puntuaciones significativamente mejores que los estudiantes universitarios, si bien personas de edad comparable que no habían recibido educación formal obtuvieron los mejores resultados. Las personas del campo y las aldeas sabían consistentemente más que los habitantes urbanos, y aquéllas que venían de las provincias más remotas y subdesarrolladas lograron las puntuaciones más altas. La posesión de vehículos de transporte y la experiencia de viaje estuvieron inversamente relacionados con los resultados del examen de conocimiento. Los resultados sugieren que, a medida que se abren más oportunidades para educación y continúa la migración a los centros urbanos, el conocimiento y uso de las plantas alimenticias tradicionales disminuye. En el sistema de educación formal se requiere major reconocimiento de estas plantas como recursos.

RÉSUMÉ.—Alors que les communautés connaissent un développement économique, la valeur des ressources traditionnelles est typiquement réévalué. Les connaissances des plantes indigènes vivrière particulières et les attitudes envers ces plantes sont vues comme moyen de prédire si ces plantes feront ou non partie de l'alimentation locale et si elles continueront à être cultivēes, entretēnues ou resteront à l'état sauvage dans un environnement transformé par la modernité. Afin d'élaborer ce sujet, il e été demander à la population de quatre villages et à qux membres de deux institutions éducationnelles de la région du Nord-est de Thaïlande d'identifier, d'après des photographies, certaines plantes vivrières et de donner des informations sur chaque espèce. Les élèves de lycées ont nettement mieux réussi que les étudiants d'universités, encore que les personnes d'un âge similaire mais n'ayant reçu aucune éducation scolaire ont eu plus de succès. Fermiers et villageois en savaient constamment plus que les habitants des villes; de plus ceux des provinces les plus reculées et les moins développées se sont avérés les meilleurs. La possession d'un moyen de transport ainsi que l'expérience des voyages étaient inversement reliées aux résultats de l'épreuve de connaissance. Les résultats suggèrent qu'avec davantage d'opportunités d'études devenant accessibles et avec la migration vers les centres urbains continuant, la connaissance et l'utilisation des plantes vivrières traditionnelles diminueront. Il est nécessaire que dans le système d'études conventionnelles celles-ci soit plus reconnues comme ressources.

INTRODUCTION

What people know about the plants they eat or see growing around them reflects the relationship between themselves and their physical and cultural environment. Economic development in parts of Southeast Asia is making dramatic material improvement in the circumstances of large segments of the population. However, social and cultural traditions that were once characterized by great geographical variability, are being profoundly altered by new, typically urban, tastes and values. This is producing both cultural homogenization and a reduction in biological diversity as local varieties and even species are no longer tended or cultivated or their habitat is lost as a result of changes in land use. Villages beyond the end of the road, where former traditions may persist, are also often refugia for germplasm upon which modern commercial agricultural systems may ultimately depend (Soemarwoto et al. 1985). Thus the prosperity of the broader national or world economy will suffer unless genetic raw material is protected to allow development of new commercial crops, or advanced varieties of existing ones. Seed banks and botanical gardens have a crucial role to play in the preservation of taxa recognized by plant scientists, but there is more to biological diversity than this. The fullest range of genetic diversity can be perpetuated where cultural traditions and practices associated with these plants are maintained as well.

The objective of this research is to investigate the current levels of knowledge about traditional food plants in Northeast Thailand, where the population is experiencing rapid social and economic change, in order to help guide conservation planning.

Loss of traditional knowledge among agricultural communities in many parts of the developing world has been noted. In Northern Thailand Anderson (1993) has expressed concern about the perpetuation of such information among the Hill Tribes. Works (1990) has recorded that elders in a Peruvian community frequently lament that the young are no longer interested in plants or gardens. Maikhuri and Gangwar (1993) observed that among the Khasi and Garo tribes of Northeastern India, knowledge about plants by the young was judged to be poor. It is commonly believed that children learn to recognize species, and the skills for collecting and cultivating plants, as they assist their parents and grandparents with field work (Brierley 1985). When this does not occur an important unifying bond for the community is weakened and the biological heritage reduced as some plant taxa are no longer cultivated, collected, or even recognized as resources.

Ironically, communities that have moved further along the path of economic development discover that traditions relating to the growing and the consumption of traditional plant foods—valuable means of fostering cultural pride and ethnic identity—have diminished in the process of modernization. Unfortunately this may only occur after many negative aspects of economic transition have manifested themselves and many plant taxa have already been lost. In Hawai'i taro (*Colocasia esculenta* [L.] Schott) was the staple food for indigenous people, but the amount under cultivation has declined since the nineteenth century. However, at present among native Hawaiians there is a reawakening to the value of the plant both for its nutritional qualities and as a focus for ethnic pride. In the 1930s 342 names of taro varieties were recorded, but only 67 existing taxa could be found by the 1980s, suggesting that significant losses had already taken place (Abbott 1992).

In the face of degradation of traditional knowledge, one approach is to record and archive as much material and information as possible from a decreasing number of informants who still retain such knowledge. However, there is much that can not be recorded in written form, especially in a language and culture different from the one in which the culture evolved and developed (Sarukhán 1985). An alternative procedure is to focus on maintaining the integrity of the encompassing human-ecological system. Referred to as *in situ* conservation, some see this as a more effective way to protect genetic resources, since the aim is to conserve plant species within their established physical and cultural environmental setting. *In situ* conservation has the added advantage of also preserving those organisms whose value or ecological role is not yet appreciated by any culture (Altieri and Merrick 1987).

For such a contextual approach to biotic conservation and cultural continuity to be successful, the focus must be on the character and function of the community as a whole. It is important to understand how and when information is acquired and passed between members of the community. It is often not clear, for example, whether most information on a particular subject is shared by all mature adults or known only by particular individuals, who have a special role as conservers and depositories of knowledge (Padoch and de Jong 1991). Considering how perpetuation of this knowledge is affected by new external forces now shaping traditional societies, such as enhanced opportunity for formal education and geographical mobility, is of vital importance.

STUDY SITE

The foothills of the Himalayas in mainland Southeast Asia have long been recognized as an important center of diversity for cultivated plants (DeCandolle 1883; Vavilov 1926; Sauer 1952). Archaeological discoveries in Thailand have confirmed that its inhabitants were lively experimenters with indigenous plant resources by 10,000 BP (Gorman 1969; Glover 1977; Solheim 1970, 1972). The legacy of an ancient Southeast Asian agricultural system survives in many parts of rural Thailand. Upland swidden agriculture and traditional kitchen gardens contain a diverse assemblage of crops and animals raised together in a complex structurally and functionally similar to a natural ecosystem in which one component supports another (Fernandes and Nair 1986; Soemarwoto et al. 1985). On the basis of the large number of cultivated varieties found in this general area, Vavilov (1926) suggested it was a likely hearth of agriculture.

Today, within Thailand, the Northeast region is known for the many food plants that are cultivated, casually tended, or collected directly from the wild. Scholars often attribute the variety of organisms consumed as food to the economic poverty of a region where every possible source of sustenance must be utilized. Although urbanized Central Thais view some of the typical foods in the Northeast with some distaste, in fact the Northeast has contributed much to the richness and diversity of Thai cuisine (Van Esterick 1992; Wester and Chuensanguansat 1994).

Because old traditions remain generally strong in Northeastern Thailand, we selected this region as the main site for this research. The 16 provinces that make up the Northeast region, referred to as Isaan, extend over an area of slightly elevated sandstone known as the Korat Plateau (Fig. 1). This area has historically been more impoverished than other regions of the county, partly due to the generally poor quality of the sandstone-derived soil, and also because the area is ringed by mountains that extract moisture from rain-bearing monsoon airstreams. This makes the plateau more susceptible to drought than any other part of mainland Southeast Asia. Isaan has its own distinctive language and culture within Thailand akin to that of neighboring Laos (Rambo 1991). Rural people, particularly in the northern part of Isaan, identify themselves as "Lao." The Lao language is more commonly spoken in villages than standard Thai, which is learned in school. Historically, the area has been under the control of Khmer, Mon, Thai, and Lao kingdoms, but the majority of the population today is ethnically Lao.

The staple food of the region is glutinous rice. Protein in diets comes mainly from fish, insects, crustaceans, amphibians, reptiles, and mammals and is complemented by a wide variety of plants that serve as the main sources of vitamins and minerals (Somnasang et al. 1986). People collect a multitude of wild plants from the forests and often transplant useful species to more convenient locations,

FIG. 1—Location of study sites in Northeast Thailand.

such as home gardens (Moreno-Black 1991). Many plants are identified as either a domesticated (*baan*) or a wild or forest (*paa*) variety. Plants and seeds from gardens are traded actively, or given as gifts, within and between villages, and with contacts far afield. To a very limited extent, villagers sell these to provide a small cash income for a household (Yongvanit et al. 1990). Although most of the volume of plant materials offered for sale in markets is commercially produced, there are

TABLE 1.—Plant species richness in Thai markets.

		Total species
Northeast Region	Khon Kaen	106
	Sakon Nakhon 2	93
	Tha Bo 3	92
	Nong Khai	90
	Khon Kaen 2	85
	Loei, Night Market	82
	Nakhon Pathom	80
	Korat	78
	Sawang Daen Din	77
	Chiang Khan	76
	Loei, Day Market	74
	Sakon Nakhon	73
	Udon Thani	69
	Si Chiang Mai	69
	Tha Bo 4	69
	Tha Bo 1	65
	Tha Bo 2	65
	Kranuan	54
	Kham Perm	35
Other	Aw Dtaw Gaw, Bangkok	115
	Pak Khlong, Bangkok	107
	Aw Dtaw Gaw, Bangkok	101
	Bangkeng, Bangkok	98
	Aw Dtaw Gaw, Bangkok	91
	Khlong Thoey, Bangkok	89
	Kuala Lumpur, Malaysia	72
	Narathiwat, Southern Region	57
AVERAGE		80.0

typically several traders who specialize in the fruits, roots, flowers, and leaf vegetables which reflect the variety and character of the former subsistence agriculture.

METHODS

In the absence of other statistical information, observing the composition of merchandise offered for sale in a market is an indirect way of determining what kinds of food are available or preferred in an area (Ishige and Ruddle 1986). Accordingly, we surveyed fresh plant foods in 20 produce markets, mostly in the Northeastern region (Table 1). Some markets in Bangkok and elsewhere were included for comparison. We prepared a list of expected species for rapid recording of those identified by sight in markets. Rarer species were of special interest. We recorded local names and collected voucher specimens whenever possible for later identification. As plants were often represented only by juvenile leaves, which typically lack crucial diagnostic characters, a number of species have yet to be

TABLE 2.—Plant species used in identification test.

Botanical name (Family)	Common name	Percent correct indent	Frequency in markets
Marsilea crenata (Marsileaceae)	*phak waen*	75.2	7
Cratoxylum spp. (Guttiferae)	*phak tiu*	62.6	15
Barringtonia subangulata (Barringtoniaceae)	*kra don, chik*	61.7	3
Trapa incisa (Trapaceae)	*kra chap*	46.5	2
Caesalpinia mimosoides (Leguminosae)	*khayaa, chalueat*	40.6	8
Cissus hastata (Vitidaceae)	*hop hep, poun*	23.3	1
Hydrocharis morsus-ranae (Hydrocharitaceae)	*nong ma, pae, tao*	21.8	4
Garcinia spp. (Guttiferae)	*som mong*	19.8	3
Momordica charantia (Cucurbitaceae)[1]	*mara, phak hai*	19.2	1
Perilla frutescens (Labiatae)	*ngaa khee mon*	0.0	2

[1] This was not the common weedy plant whose leaves are found in most markets or the domesticated bitter melon cultivated for its fruits but a variety with sharply ribbed fruit possibly collected from the wild. The ripe fruit of this species is known to be toxic, but the leaves and immature fruits are eaten in India and the Far East apparently without ill effect (Purseglove 1968).

satisfactorily identified. Markets were surveyed during the wet season in the months of July and August as early in the morning as possible. We surveyed some markets more than once to assess variation from day to day and at various times of day.

To obtain an objective measure of the degree to which information about traditional subsistence food plants is being transferred to the younger generation, we conducted a total of 795 interviews among six populations. These populations were: university students at Khon Kaen University, high school students at a rural high school in Sawang Daen Din (a district center within Sakon Nakhon Province), and villagers in four rural settlements; Kok Khon and Na Bon (Nong Khai Province); Sai Thong (Kalasin Province); and Sawang Daen Din district (Sakon Nakhon Province) (Fig. 1). The last named population consisted of two subpopulations, one from the village of Nong Phai and the second from several villages nearby. In some cases we treated these subpopulations separately, as will be discussed below.

As a basis for an objective test of plant knowledge, a set of high quality color photographs of 10 selected plants was prepared. The photographs depicted leaves, young shoots, or fruits of food plants that we observed for sale in produce markets (Table 2). All plants used for the identification test are found in other parts of Thailand, where distinctive regional names are sometimes applied to them (Smitinand 1980). We did not include very common species, but selected a range of plants found moderately commonly to rarely in markets. Plants not believed to be part of the indigenous agricultural system were excluded, as were species produced by large scale commercial agriculture. The presence of diagnostic visual characters of species influenced the choice of plants for the test procedure. We selected two species very similar in appearance to test whether subjects could differentiate them from photographs.

Each subject was asked to identify each plant, and provide some information about it. The ability to supply a commonly used name for a plant was assumed to be a measure of a person's familiarity with it. We also asked subjects for some personal information, such as age, place of birth, educational level, and whether their home was rural (a village or farm) or urban (a town or city). In an effort to obtain some measure of mobility, and so determine experience beyond their homes, subjects were asked what transport vehicles their family owned (bicycle, motor bike, car, or truck) and whether they had ever visited the main cities of the Northeastern region (Nakhon Ratchasima or Korat) and the neighboring Northern region (Chiang Mai), the national capital (Bangkok), or a foreign country. Field assistants who were native Thai speakers conducted all interviews in that language. The high school students were asked to complete information in a classroom setting by a teacher as part of a course in environmental studies. Hired assistants conducted all other interviews individually. Assistants included students from Khon Kaen University already trained in interview techniques, and others trained specifically for this project. The university students surveyed were selected randomly on the university campus. In each of the villages surveyed, we mapped the location of all houses and selected a predetermined number of houses. In most cases only one person from each household was interviewed.

A list of plant names was compiled from the responses given at interviews and compared with published records (Smitinand 1980; Bunkerd et al. 1982; Vidal 1959). We asked four local authorities—two professional botanists at Khon Kaen University and two local informants with post-graduate degrees in biology or agriculture—to consider the full list of names given for each plant and to indicate which names were appropriately applied. These experts generally agreed on which names were correctly used for each plant. Other names supplied usually referred to other species. In a small number of cases, subjects used names that did not appear in any reference source or were unknown to the authorities we consulted.

RESULTS AND DISCUSSION

The market surveys yielded a total of 233 species, including 65 that were found in only one of the markets. Total numbers of species per market ranged from 115 to 35, with an average of 80 (Table 1). This compares to about 70 fresh produce species typically found in a large supermarket in the United States. The markets richest in species tended to be those in Bangkok that catered to foreigners or Thais with more cosmopolitan tastes and where certain temperate fruits and vegetables were being offered for sale in addition to traditional Thai foods. A considerable number of subsistence food plants was found especially in Klong Thoey and Aw Daw Gaw markets of Bangkok, which are close to areas where recent immigrants from country areas have settled. Levin (1992) has observed that "country foods" are popular in the rural areas of Southern Thailand, but in Bangkok are usually regarded as unsophisticated fare. However, she also found instances where such plants were considered exotic luxury items in Bangkok.

There was some variation in markets surveyed on different days. Those visited later in the day usually yielded lower counts. The bulk of produce in markets comes from large-scale commercial growers, so a predictable set of plants is

TABLE 3.—Variation in score with gender.

	Male		Female	
Age	Number	Average score	Number	Average score
10–19	121	2.4	219	2.8
20–29	118	2.7	148	2.9
30–39	21	6.5	37	6.8
40–41	19	6.9	32	7.1
50–59	16	7.4	34	7.4
60–69	8	7.4	9	7.2
70–79	3	5.3	4	7.8
80–89	0		0	
90–99	1	0.0	0	
Total[1]	307		483	

[1] age or gender was not recorded for five subjects.

available in most markets. The species encountered less frequently are typically those supplied by local farmers on an informal basis. We surveyed Tha Bo market, in Nong Khai Province, several times at approximately 8:00 am and consistently found between 65 and 70 species. When it was surveyed at 6:00 am, however, an additional 20 species were observed, including five we did not see during any other survey. Moreno-Black (1991) has observed that less common commodities are typically brought to the market early in the day (4:00 or 5:00 am), when producers can obtain cheapest transport from village to town. These are sold or traded off very quickly, an indication of the demand for the commodities.

In the interview survey, which included a photo-recognition test of ten plants, the most frequently recognized species was the very distinctive fern *Marsilea crenata*. It was correctly identified by 75.2% of the subjects (Table 2). The relationship between the frequency with which a species was found in markets, and ability of subjects to recognize it, was not strong. The patterns of response were similar in all populations, however. Two species selected because of their similarity (*Cratoxylon* and *Barringtonia*) were among the most readily recognized out of the set of ten. *Barringtonia* was mistaken for *Cratoxylon* only 2% of the time. The reverse occurred in only two instances out of 795. This suggests that people, at least within these populations, were able to interpret photographs of plants with some facility.

In almost all age groups women scored slightly higher than men (Table 3). There was a general tendency for score to increase with subject age until about 70 years, when scores of men showed a sharp decline. One possible explanation is that men lose their faculties earlier than women. Alternatively, perhaps in the past there was a dichotomy in the knowledge learned by men and women, which is now only evident in the older age classes. However, since we only interviewed eight people in this age group, a larger sample is desirable to verify the pattern of declining male knowledge. It is clear, however, that the elderly are particularly

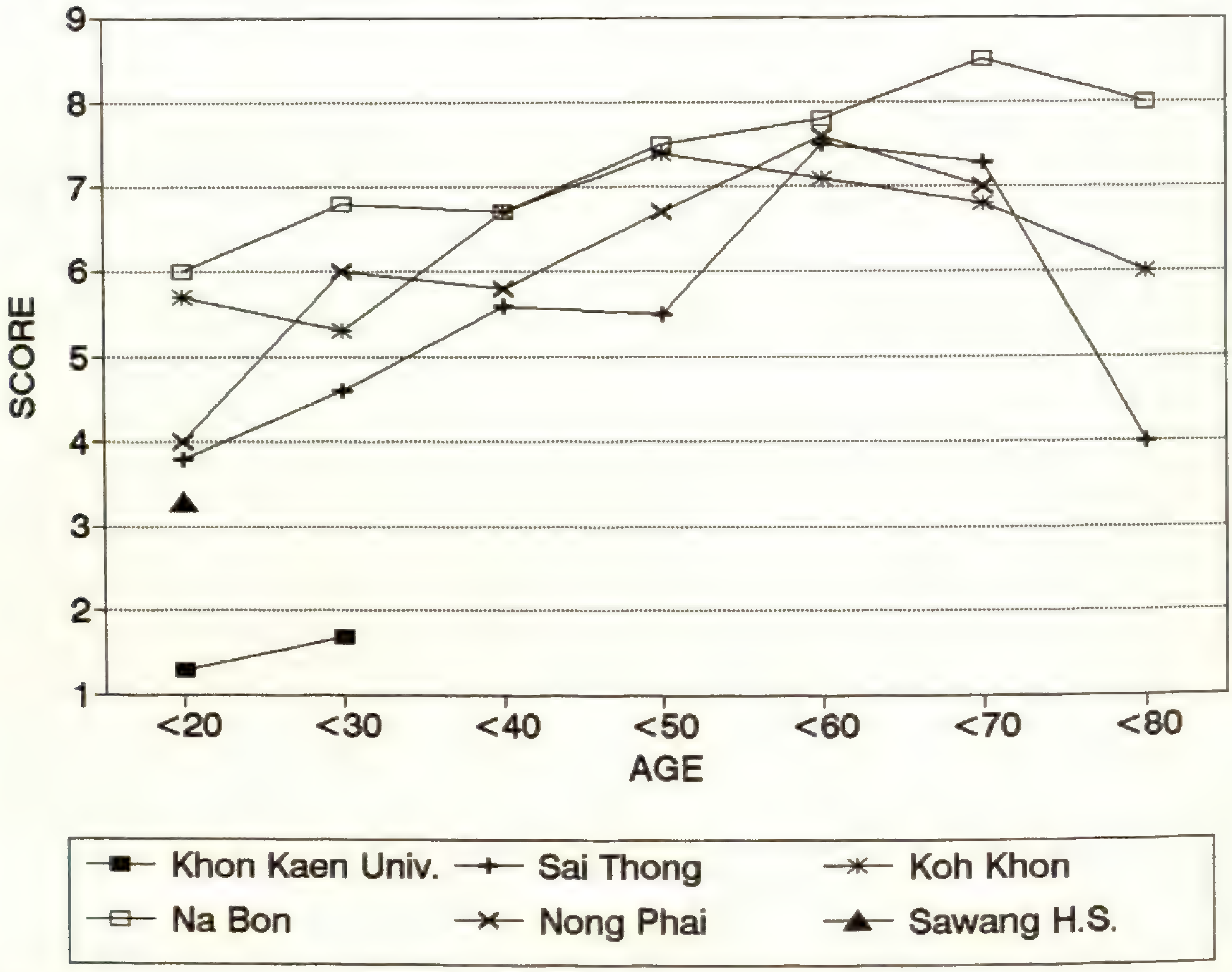

FIG. 2—Variation in scores attained in plant identification test with age.

important as depositories of information. This is supported by informants who assert that they had learned much about plants from their grandmothers.

In marked contrast to the scores of village populations were those of the two populations of students, all of whom were less than 30 years old (Fig. 2). Although scores in both student populations showed an increase with age (Table 4), those of university students were extremely low even compared to the younger high school students from the Sawang Daen Din. About 44% of the university students came from farms and village homes, so the background of this subgroup is most directly comparable to that of the high school students. However, even the university students from rural homes did not score as high as high school students who remained in the less urban environment of a small town as opposed to a city (Table 5). This would imply either that university-bound students from rural areas do not acquire traditional knowledge readily, or that they forget it when they leave the rural setting.

Variations in scores are also apparent among students from different geographical origins. Of the students surveyed at Khon Kaen University, 76% were born in the Northeast, but all regions of Thailand were represented in the sample. Those from the Northeast did better than students from other regions. Students from Bangkok and the South had the least number of correct identifications (Table 6). The higher scores of students from the Northeast may in part reflect familiarity with the local environment and food plants that are most popular in that region. It

TABLE 4.—Variation of score with age among student populations.

	Sawang Daen Din High School		Khon Kaen University	
Age	No. subjects	Average score	No. subjects	Average score
13	10	2.8		
14	40	3.1		
15	4	3.8		
16	13	3.4		
17	19	3.9		
18	14	3.6	78	1.3
19			80	1.4
20			84	1.4
21			73	2.1
22			24	1.8
23			10	1.8
Other	0		19	
Total	100		368	

TABLE 5.—Variation in score with type of home.

	Sawang Daen Din High School		Khon Kaen University	
Nature of home	No. subjects	Average score	No. subjects	Average score
Rural	61	3.7	160	2.1
Urban	36	2.7	202	1.0
No reply	3		6	
Total	100		368	

is worth noting that students from rural homes in the Northern region scored almost as well as the rural Northeasterners, perhaps reflecting the cultural and ecological similarity between the regions (Table 6). Average scores of groups from different provinces within the Northeast were highest among students from provinces that are regarded as the poorest and least developed—for example, Kalasin, Yasothon, Mukdahan, and Loei. (Table 7). It is notable that from whatever part of the country students came, those from rural homes almost invariably scored higher than those who indicated their families lived in towns or cities.

For three of the village populations, subjects were asked what level of schooling they had attained. Very few of the subjects had any high school education. In all of the village populations, subjects who had four or fewer years of elementary school education scored higher than those who completed elementary school or

TABLE 6.—Comparison of scores attained by students at Khon Kaen University according to region of origin.

Region of origin	Rural: No. subjects	Rural: Average score	Urban: No. subjects	Urban: Average score
Northeast	133	2.3	142	1.2
North	9	1.8	13	0.6
Central	7	1.0	12	0.8
Bangkok	1	1.0	26	0.9
South	10	1.0	9	0.2
Total[1]	202		160	

[1] Six students did not indicate whether they were from rural or urban homes.

TABLE 7.—Average scores of students at Khon Kaen University from Northeastern Provinces.

Province	Rural: No. of subjects	Rural: Average score	Urban: No. of subjects	Urban: Average score
Kalasin	4	3.8	7	1.4
Yasothon	5	3.6	2	2.0
Loei	2	3.5	0	–
Mukdahan	2	3.0	1	3.0
Sisaket	7	2.7	3	2.7
Roiet	9	2.5	3	1.3
Buriram	6	2.3	6	2.0
Khon Kaen	21	2.3	40	0.9
Mahasarakham	6	2.3	4	1.8
Nakhon Phanom	3	2.3	3	1.0
Sakon Nakhon	8	2.1	6	1.7
Nakhon Ratchasima	12	2.2	19	0.9
Udon Thani	23	2.2	23	1.0
Ubon Ratchthani	8	2.0	11	1.2
Chaiyaphum	5	1.6	1	0.0
Surin	7	1.6	9	1.7
Nong Khai	5	0.6	4	2.0
Total	133		142	
Average		2.2		1.2

who attended high school (Table 8). It would appear that the pursuit of formal education takes students away from agricultural pursuits where they are most likely to learn traditional plant lore. Studing takes time that might otherwise be spent producing or collecting food. Furthermore, a formal education is an urban-

TABLE 8.—Educational Attainment and Scores.

	Khon Kaen U.		Sawang H.S.		Kok Khon		Nong Phai		Sai Thong	
Education	No.	Score	No.	Score	No.	Score	No.	Score	No.	Score
0–4 years elementary					37	6.8	15	6.3	31	5.7
5–7 years elementary					10	6.1	5	6.0	17	4.6
1–6 years high school			100	3.3	7	6.1	1	6.0		
1–5 years university	368	1.5								
No record									2	
Total	368		100		54		21		50	

izing process, since the student must often live away from home in a town or city for long periods.

As a measure of economic prosperity, we asked subjects what types of vehicles their families owned (bicycle, motorcycle, truck, or car). Those with no or fewest vehicles (usually bicycles or motorcycles) had higher average scores (Fig. 3). Mobility was also measured by the number of selected places each subject had visited. The high degree of mobility of all populations was surprising. For example, more than 50% of the high school students had been to Bangkok, 1,000 km away, and many subjects had been to several foreign countries, mostly for work. In general, the people who knew the largest number of plants were those who had travelled least (Fig. 4), although the relationship did not appear as strong as with vehicle ownership. This finding may reflect the fact that the common response of the poorest people to bad times is to migrate temporarily for work.

CONCLUSIONS

An inventory of plant species present in produce markets provided information about the relative abundance and availability of fresh plant foods in a variety of communities, from major cities to small towns. Typically there are more species found in Thai markets than in the produce section of supermarkets in culturally diverse cities in the United States. Other surveys have also demonstrated the richness of available food plants and their variation from place to place in Thailand (Jacquat 1990; Moreno-Black 1991; Yongvanit et al. 1990 and Pei 1987). The largest numbers of species are found in the markets of Bangkok. Bangkok markets offered temperate fruits and vegetables relatively new to Thai cuisine, as well as some "country foods." The latter suggests that immigrants from rural areas retain a taste for plants from their homes. The high mobility of all populations studied explains why a selection of these minor food plants are found in parts of Bangkok frequented by recent immigrants.

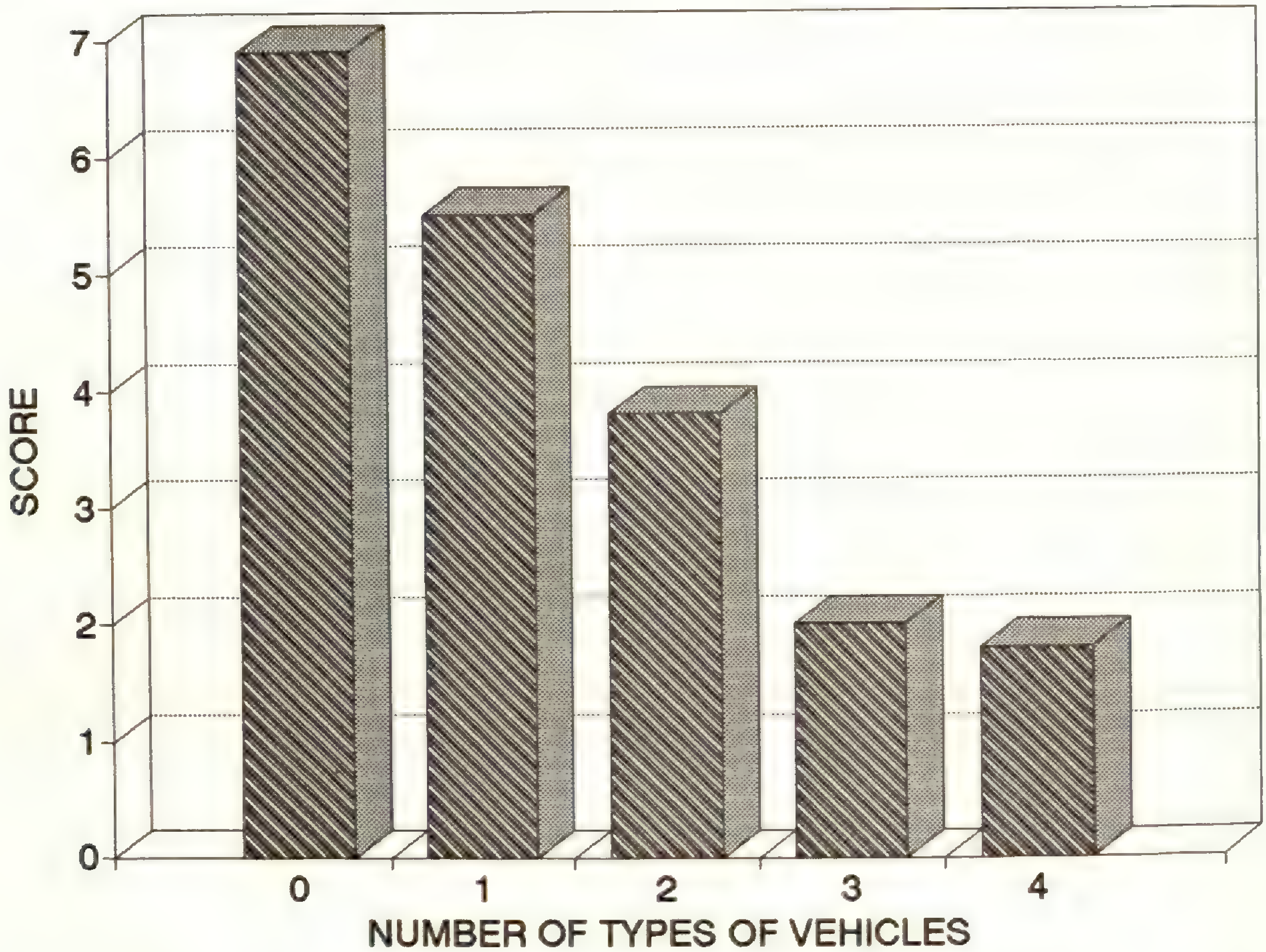

FIG. 3—Variation in scores attained in plant identification test with types of vehicles owned. A maximum of four was possible if the family owned a bicycle, a motorcycle, a car, and a truck.

Knowledge of traditional food plants, as measured by a plant identification test, was almost the exact opposite of results of most standardized tests. People who scored the highest had the least formal education. Those who did poorest were the most mobile or urbanized of the subjects and had the largest number of middle class credentials. Within each population, knowledge increased with age, but the future educated elites (present day university students) knew least of all. These results suggest that knowledge continues to be transmitted in poorest and most rural households.

In many instances the abandonment of traditional practices is not a conscious choice but the incidental result of new patterns of living. For example, as formal education occupies a larger proportion of the day for children, or as young adults migrate for extended periods to the metropolis and beyond for work or advanced education, the amount of time during which people of different generations spend together is greatly reduced, and hence the opportunities for transfer of traditional cultural information are fewer. It would appear that people still value traditional ways. For example, they return to their villages of origin on a frequent basis and often prefer to resettle there in retirement. However, it seems that the traditional connection between land and life has been significantly altered as a result of the adoption of urban values and goals and simply because individuals are absent from the locale during crucial periods of their life.

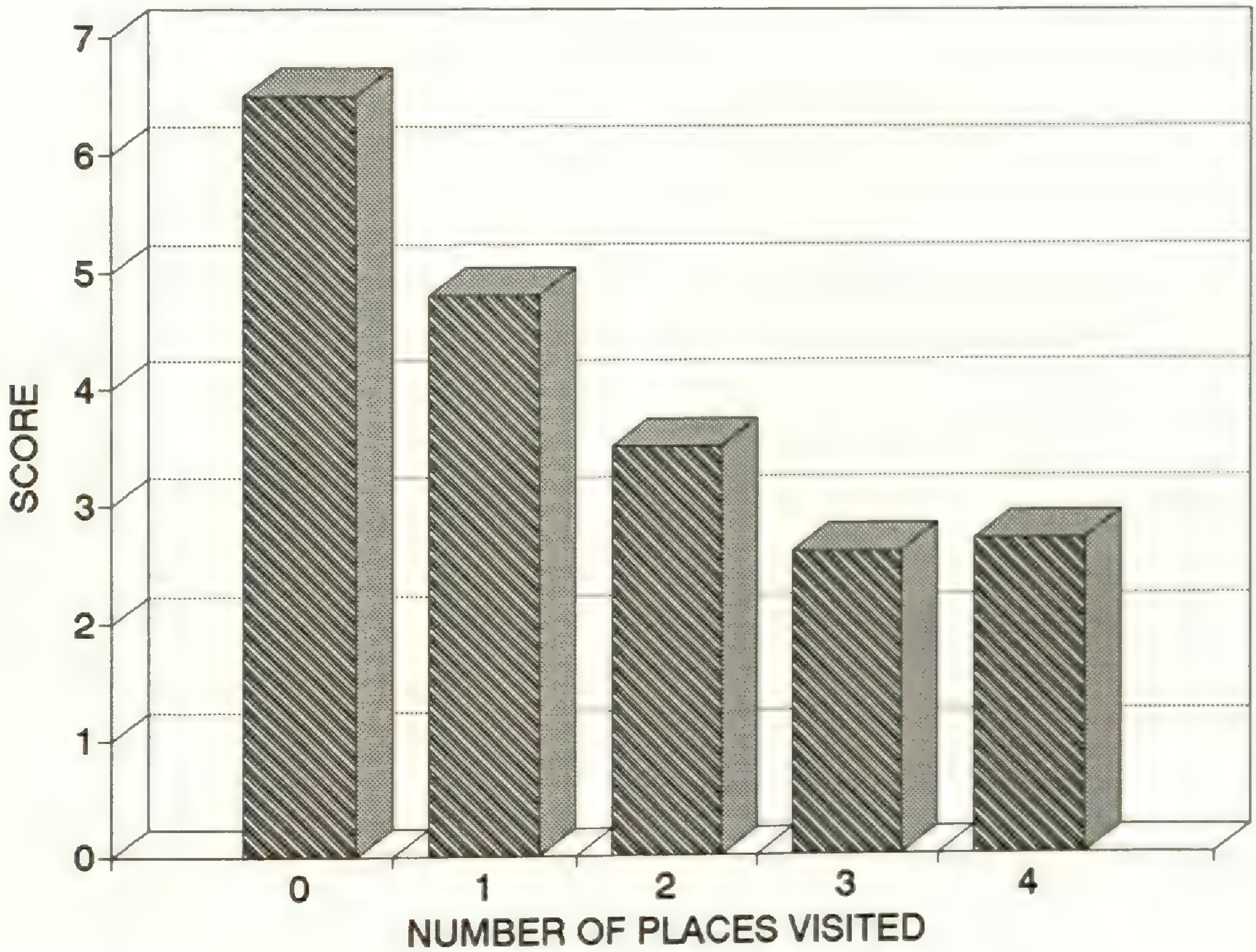

FIG. 4—Variation in scores attained in plant identification test with mobility. Mobility was measured by the number of specified places each subject had visited. A maximum of four on the scale was possible if the subject had visited Bangkok, Nakhon Ratchasima (Korat), Chiang Mai, and a foreign county.

Continued expansion of educational opportunities and increased availability of cheap transport to allow people to migrate for work to Bangkok or beyond will help to break the ties with the land and impede the transmission of knowledge about indigenous plant use. Furthermore, those likely to be responsible for the design and implementation of any official conservation program will be increasingly drawn from a generation that has acquired little appreciation of this traditional lore. In addition, some Thais make a conscious effort to distance themselves from their materially poor rural origins and the associated low social status. However, loss of traditional plant knowledge is no doubt also an unintended by-product of the strongly felt urge to modernize. If the richness of rural Thai culture, including a cuisine characterized by great variety, is to be maintained, the cultural base from which it stems must be supported, and the physical environment on which it depends protected.

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BOOK REVIEW

Edible Wild Plants of Sub-Saharan Africa: An Annotated Checklist, Emphasizing the Woodland and Savanna Floras of Eastern and Southern Africa, Including Plants Utilized for Food by Chimpanzees and Baboons. Charles R. Peters, Eileen M. O'Brien, and Robert B. Drummond. Kew, England: The Royal Botanic Gardens, 1992. Pp. 239. £15.00 (paperback). ISBN 0-947643-51-6.

As its title reveals, this is not a book, but a check list of wild edible plants—and a very specialized one at that, drawn from an unsystematically narrow literature that reflects more the life experiences of the authors than a guided intellectual inquiry (with some exceptions).

The 3-page introduction outlines the broad history of the authors' study of wild plants since its inception in the 1970s. The 200-page list of plants follows, and is divided into the major plant groupings: I. Pteridophyta, II. Spermatophyta, A. Gymnospermae, B. Angiospermae, 1. Monocotyledons, 2. Dicotyledons. Families and genera are arranged alphabetically within these groups. A short list of references is followed by an index to families and genera.

Building on their initial goal to synthesize information on indigenous wild flood plants of Africa, Peters, O'Brien, and Drummond later broadened their perspective to embrace ecological and conservation issues, and eventually were drawn to other consumers of these foods—most prominently nonhuman primates. Finally, they fixed on chimpanzees and baboons in southern and eastern Africa since these primates eat some of the same plants that local peoples do and so are regarded as "pests" and "competitors" (p. 1).

The authors emphasize eastern and southern Africa, and for humans, consult some West African references as well. Each entry in the plant list contains updated botanical nomenclature, and synonyms when those appeared in the cited reference(s). Annotation is generally limited to noting what plant part is used, and who consumes it—H, C, and B denote the reported consumption by humans, chimpanzees, and baboons, respectively. In this context it is interesting to call attention to a growing body of related, and more sophisticated studies that reveal that some of what used to be regarded as primate "feeding" behaviors are instead intentionally medicinal, cosmetic, and otherwise different from food acquisition. I mention this here to encourage a broader sphere of inquiry, not to diminish the list, which still serves its purpose as a document of "consumption."

In addition to nomenclature and use, a few additional remarks are scattered among the entries—e.g., directions to use a young plant, or to consume a plant raw, and qualifiers such as "slightly toxic," "famine food," "pepper substitute." Whether an entry is so embellished depends entirely on whether the reference(s) cited contained such detail. The result is that the individual plant records are uneven, a fact that distracts but also does not diminish the list.

The authors caution that, although "the identity of plants was checked as far as possible" (p. 3), botanical identification cannot be certain for records not backed up by voucher specimens. This statement reveals a sensitivity to the critical importance of vouchers for all studies involving plants (these preserve the identity of the plant in question and provide the only irrefutable link between local knowledge and bioscientific paradigms). Paradoxically, the statement also compounds whatever problems may be embedded in the references that lack vouchers. This problem is by no means unique to these authors, and I believe that it seriously compromises their work. Further, they (as others commonly do) miss the related problem that many researchers do not pay attention to the variability of common names for the same botanical species. Instead, they rely on the vernacular used in one village to identify plants by the vouchers that were collected in another location, where at least some of the common names are likely to be different: variability in local names occurs across space—even within villages and households—and over time.

That many of the references consulted are more than 20 years old raises an important issue. What has this to do with *contemporary* plant use, especially since the authors identify as one potential audience of this book "those whose job it is to set priorities for genetic preservation" (p. 1). Finally, scholars of human-plant relations in Africa, and generally, will note serious omissions among the references cited.

Overall, one could say that the authors achieved their goal—a synthesis, but one bearing some of the blemishes of the literature it cites. The list serves a rather specialized audience; researchers who work with these plants, and in these parts of Africa, will want to consult it for insights they may garner as they reflect on their own work, and should urge their institutional library to order a copy.

The production quality of the book is very good, and is reflected in its cost.

Nina L. Etkin
Department of Anthropology
University of Hawaii
Honolulu, Hawaii 96822

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"GHOST'S EARS" (*Exobasidium* sp. affin. *vaccinii*) AND FOOL'S HUCKLEBERRIES (*Menziesia ferruginea* Smith): A UNIQUE REPORT OF MYCOPHAGY ON THE CENTRAL AND NORTH COASTS OF BRITISH COLUMBIA

BRIAN D. COMPTON
Department of Botany
The University of British Columbia
Vancouver, B.C., Canada V6T 1Z4

ABSTRACT.—The cultural roles of mycocecidia (fungal galls) of the fungus *Exobasidium* sp. affin. *vaccinii* on *Menziesia ferruginea* Smith (false azalea, or fool's huckleberry) among various Pacific northwest coast cultures are identified and discussed. As many as nine distinct coastal groups named and ate these mycocecidia. Among at least three coastal groups, the Henaaksiala, Heiltsuk, and Tsimshian, the mycocecidia had mythological importance.

RESUMEN.—Se identifica y discute el papel cultural de las agallas producidas por el hongo *Exobasidium* sp. affin. *vaccinii* al crecer sobre *Menziesia ferruginea* (cuyos nombres vernáculos en inglés se traducen como "azalea falsa" y "arándano de tontos") entre las culturas de la costa noroccidental de Norteamérica. Nueve diferentes grupos de la costa nombraban y comían estas agallas. Entre al menos tres grupos costeros, los Henaaksiala, Heiltsuk y Tsimshian, las agallas fungosas tenían importancia mitológica.

RÉSUMÉ.—Le champignon *Exobasidium* sp. affin. *vaccinii* produit des galles sur *Menziesia ferruginea* Smith ("fausse azalée"). Le rôle de ces galles dans la culture de différents peuples ou groupes autochtones de la côte nord-ouest du Pacifique est identitié et discuté ici. Jusqu'à neuf de ces peuples ont nommé, et utilisé les galles d'*Exobasidium* comme nourriture. Chez au moins trois groupes, les Henaaksiala, les Heiltsuk et les Tsimshian, les galles avaient une importance mythologique.

The Heiltsuk are one of several Indigenous Peoples whose traditional territory embraces part of the central coast of British Columbia. In one of their myths, "Raven and Squirrel," Squirrel invited all the people, with the exception of their chief, Raven, to feast on berries at his house. Feeling slighted, Raven retaliated by producing talking excrements that lured Squirrel's guests from the house long enough to allow Raven to sneak in and eat the berries (Boas 1928:34–35, 1932:19; cf. Boas 1977:233). The following paper represents an attempt to clarify the nature of this unidentified "berry" and its associated indigenous terminology.[1]

In one version of the tale involving Raven and Squirrel these "berries" are referred to by the Heiltsuk name ***Lî´nxwas*** (or ƛɪnx^{ω}***as***)[2] but their botanical identity is unspecified (Boas 1928:35). Boas also recorded the comparable Heiltsuk term *L!Enq!was* (or ƛ̓ŋq̓^{ω}***as***), which he interpreted as referring to "a berry" (Boas 1928:287). These terms correspond to other terms in the Upper North Wakashan isolects, i.e., Henaaksiala, Haisla, Heiltsuk, and Oowekyala, that were previously regarded as separate and apparently related, yet ambiguously defined, viz., Henaaksiala/Haisla ***ƛ̓n̓k̓ʷas***, Heiltsuk ***ƛ̓ń̓k̓ʷás***, and Oowekyala ***ƛ̓n̓k̓ʷas***; and, in contrast, Henaaksiala/Haisla ***ƛ̓ǹ̓q̓ʷas***, ***ƛ̓n̓q̓ʷàs***, Heiltsuk ***ƛ̓ń̓q̓ʷás***, and Oowekyala ***ƛ̓n̓q̓ʷas*** (Lincoln and Rath 1980:184, 1986:346; Rath 1981:601). All of these terms have been translated as referring to some type of plant either with or without "berries." In addition, Lincoln and Rath (1986:492) have questioned the legitimacy of the linguistic root (√***ƛnkʷ-***) that was originally interpreted as the basis for the first three of the preceding series of Upper North Wakashan terms.

As a result of recent transcriptional revisions utilizing the testimony of the late Henaaksiala elder Gordon Robertson, a Henaaksiala speaker, the dubious Upper North Wakashan root, RL985 (i.e., root list #985), √***ƛnkʷ-*** (Lincoln and Rath 1980:184, 1986:492) and its derivates (Henaaksiala/Haisla ***ƛ̓ǹ̓k̓ʷas***, Heiltsuk ***ƛ̓ń̓k̓ʷás***, and Oowekyala ***ƛ̓n̓k̓ʷas***) have been rejected (John Rath, personal communication, 1988) in favor of RL986, √***ƛnqʷ-*** (Lincoln and Rath 1980:184, 1986:492). However, the terms derived from this latter root, i.e., Henaaksiala/Haisla ***ƛ̓ǹ̓k̓ʷas*** or ***ƛ̓n̓q̓ʷàs*** (Gordon Robertson and John Rath, personal communications, 1988; cf. Lincoln and Rath 1986:346), Heiltsuk ***ƛ̓ń̓q̓ʷás*** and Oowekyala ***ƛ̓n̓q̓ʷas***, have emerged with conflicting definitions: plant (unidentified) without berries (Lincoln and Rath 1980:184); plant (unidentified) with either red or purplish edible berries (Lincoln and Rath 1986:346, 1980:184; Rath 1981:601); red or blue kind of huckleberry (Lincoln and Rath 1986:492); or something associated with one's nose as well as a "berry" which shares the physical characteristics of the contents of one's nose (Lincoln and Rath 1986:346).

From additional testimony provided by Gordon Robertson and several other Native elders of coastal British Columbia it may now be seen that each of the definitions associated with Henaaksiala ***ƛ̓ǹ̓q̓ʷas***, Heiltsuk ***ƛ̓ń̓q̓ʷás***, and Oowekyala ***ƛ̓n̓q̓ʷas*** describes aspects of the botanical referents of these terms. Evidence related to these referents was obtained when Gordon Robertson and Heiltsuk-speakers Mary Hunt, and the late Annie M. Wilson and Maggie Windsor identified Henaaksiala/Haisla ***ƛ̓ǹ̓q̓ʷas*** and Heiltsuk ***ƛ̓ń̓q̓ʷás*** as referring, at least in part, to *Menziesia ferruginea* Smith, an ericaceous plant known as fool's huckleberry,[3] mock azalea, rusty-leaf, rusty menziesia and, more commonly, false azalea (Hitchcock and Cronquist 1973:345). Annie Wilson also indicated that the Heiltsuk name ***ƛ̓ń̓q̓ʷás***, said to mean "sad plant," can be used to refer to an unidentified plant with droopy branches, possibly some type of willow (*Salix* sp.) (cf. Lincoln and Rath 1980:184). According to Gordon Robertson, the name for *M. ferruginea* in the Henaaksiala and Haisla languages derives from the development of reportedly mucous "berries" (cf. Lincoln and Rath 1986:346) on the leaves, flowers, and stems. These "berries" have been noted by Mary Hunt and Annie Wilson, who refer to them in Heiltsuk as ***p̓sp̓iy̓ú yis‿luáł***, literally, 'ear of ghost'.[4]

A gloss equivalent or loan translation for the Heiltsuk term ***p̓sp̓iy̓ú yis‿luáł*** in the Southern Tsimshian language (Sküüxs) was verified by Kitasoo elder Violet Neasloss and the late Haihais elder Louisa Hall, both of Klemtu, one of two Native communities in which Southern Tsimshian is still spoken. This term is Sküüxs ***ts'ɪmú·kinɔ́·nk*** (also, Sküüxs ***ts'im mú·ki nánəq̓*** or Sküüxs ***ts'ɪmu·xinɔ·nk***, literally, 'in ear-ghost,' or "ghost ear") (John Dunn, personal communication, 1990; Marie-Lucie Tarpent, personal communication, 1990). The aforementioned Heiltsuk and Southern Tsimshian terms are all essentially semantically equivalent.

Although he referred to the edible structures emanating from Henaaksiala/ Haisla ***ƛŋ̀q̓ʷas*** as "berries," Gordon Robertson described these structures in a way that suggested they may actually represent a plant structure parasitized by a fungus. *Exobasidium vaccinii* (Fuckel) Woronin, a fungal parasite of *M. ferruginea*, seemed a likely candidate (Robert Bandoni, personal communication, 1988; Ginns 1986:135). Research in Canada by Drs. Nancy Nickerson (personal communication, 1990) and Savile (cf. Savile 1959:648) and in Sweden by Nannfeldt (cf. Nannfeldt 1981:6–10, 63–64) indicates, however that the fungus on *M. ferruginea* is probably a species distinct from *E. vaccinii* (J. A. Parmelee, personal communication, 1990) that has a very restricted host range. D. Savile (personal communication, 1990) recommends that this fungus be referred to as *Exobasidium* sp. affin. *vaccinii* until it can be further studied, properly described, and named.

The botanical Latin identity of the "berries" growing on *M. ferruginea* was confirmed in 1990. Gordon Robertson examined fresh specimens of *Exobasidium* sp. affin. *vaccinii* parasitic on *M. ferruginea*, obtained from Prince Rupert, British Columbia (Compton #187, 6 June 1990, UBC #F13569) and near Vancouver (Wells & Hiebert #1762, 28 July 1990, UBC #F13570).[5] He confirmed that these fungi were the "berries"[6] of the plant named ***ƛŋ̀q̓ʷas*** in Henaaksiala and Haisla. This leads to the conclusion that these "berries" are equivalent to the "***ghost ears***" described by Mary Hunt, Annie Wilson, Violet Neasloss, and Louisa Hall. Furthermore, Mildred Wilson of Hartley Bay verified the Coast Tsimshian (Sm'algyax) term ***tsmuu'no:'nax̱*** in reference to a photograph of *E.* sp. affin. *vaccinii* on false azalea (see Fig. 1). This term, said to mean "ear ghost," is reported to be derived etymologically from Sm'algyax ***tsmuu'm b'aa'lx***, literally, 'in-ear-modifier clitic-ghost.' Mildred Wilson also referred to the fungus as Sm'algyax ***tse'a̱x***, said to mean 'ear wax' or 'deaf,' although the proper term for 'deaf' is Sm'algyax ***sqawk***. The former term, Sm'algyax ***tse'a̱x***, "running ear," more correctly refers to an ear discharge (Margaret Seguin, personal communication, 1991). People in Hartley Bay refer to the shrub on which this "berry" grows as Sm'algyax ***sqan tse'a̱x***, a term that incorporates the Coast Tsimshian word for shrub (Mildred Wilson).

Exobasidium species are parasites lacking a distinct fruiting body that usually confine their host range to members of Ericaceae (Frankland et al. 1982:11; Smith 1908:422). *Exobasidium* spores may infect the leaves, stems, and flowers of false azalea, resulting in organ deformation and hypertrophic growth that accompanies fungal development (cf. Rae 1922:725; Savile 1959:648; Sinclair et al. 1987:26–27). Eventually the fungus sporulates on the surface of mycocecidia (fungal galls) that range from 1–2 cm in size and are indeed somewhat berry-like (i.e., they are globular, somewhat sweet, and crisp). Although the mycocecidium produces a whitish bloom when sporulating (Sinclair et al. 1987:26–27; Smith 1908: 423; Annie Wilson), the immature structure may be pale rose (Smith 1908:423), as observed in a recent collection (Wells & Hiebert #1762, 28 July 1990, UBC). When pale-rose colored, the "berries" are considered ripe (Gordon Robertson). Further, Smith (1908:423) has noted that "red or purple patches occur on the upper surface of the leaves (which are infected by *Exobasidium*), opposite to the portion occupied by the fungus below." The claims that Henaaksiala/Haisla ***ƛŋ̀q̓ʷas***/Heiltsuk

FIG. 1.—The "berries" of fool's huckleberry: *Exobasidium* sp. affin. *vaccinii* infection resulting in deformation and hypertrophy of leaves and flowers of *Menziesia ferruginea* (photo by Brian D. Compton).

ƛn̓̓q̓ʷás/Oowekyala ***ƛn̓q̓ʷas*** has red or purplish berries can thus be attributed to the morphological characteristics of *E.* sp. affin. *vaccinii* and the host response to its infection.

Because false azalea does not produce true berries, claims by some Native individuals that Henaaksiala ***ƛǹ̓q̓ʷas***/Heiltsuk ***ƛń̓q̓ʷás***/Oowekyala ***ƛn̓q̓ʷas*** lacks berries are alsǫ explained (cf. Lincoln and Rath 1980:184). The fungal structures are prominent only during the summer, particularly in July (Gordon Robertson). This fungus is not uncommon in the Pacific Northwest but it may be sporadic in occurrence (possibly due to climatic factors) or simply frequently overlooked.[7]

Although the mycocecidia have been described by Gordon Robertson as resembling "snot," he, Mary Hunt, Annie Wilson, and Maggie Windsor all attested to their edibility. Mildred Wilson said that children in Hartley Bay enjoy eating the "crunchy" fungus but that it was too sweet for her.[8] Because the fruits of false azalea are unpalatable capsules, the possibility exists that the "berries" of Squirrel's feast are *E.* sp. affin. *vaccinii.*

Both *Exobasidium* sp. affin. *vaccinii* and *Menziesia ferruginea* are further involved in Henaaksiala and Tsimshian mythology. As a child, Gordon Robertson learned from his Tsimshian grandfather and various Henaaksiala elders the story of Henaaksiala ***c̓ə̀l̓gikl̓a***, a creature known to steal corpses (cf. Olson 1940:195–196): "That ***c̓ə̀l̓gikl̓a*** blew [its] nose and threw it and it hit those little bushes and that's why it grows there [i.e., on the leaves of *M. ferruginea*]." Elsewhere in the area comparable creatures are known for undesirable actions, such as kidnapping children. Thus the ***c̓ḷgikḷa*** is remembered among the Henaaksiala not only for its heinous acts, but also for causing ***ƛṇ̀q̓ʷas*** (or ***ƛṇq̓ʷàs***) to have its own "berries."

This paper represents the first report for British Columbia in which *Exobasidium* sp. affin. *vaccinii* has been identified as a culturally recognized associate of *M. ferruginea*. It corroborates and clarifies Gorman's (1896:76) observation that the Haida are fond of and eat apparently comparable structures raw. Gorman, however, erroneously attributed the edible portion to a gall-forming insect. Outside British Columbia, the use of *E.* sp. affin. *vaccinii* as food has been reported among Eskimo peoples of Cordova on Prince William Sound and in Port Graham on the lower Kenai Peninsula, Alaska. In the Sugpiak language spoken at Prince William Sound this fungal gall is known as ***piugtem cuutii***; in Sugpiak spoken at Port Graham it is known as ***cuuteruaq***, literally, 'dog ears' (Alix Wennekens, personal communication, 1990).

The use of *E.* sp. affin. *vaccinii* is perhaps not limited in British Columbia to the area encompassed by the Haida, Haihais, Henaaksiala, Heiltsuk, Coast Tsimshian, and Southern Tsimshian cultures (see Fig. 2). The existence of the Oowekyala term ***ƛṇk̓ʷas*** implies that the Oweekeno may have eaten this fungus. Furthermore, Boas (1947:130) referred to the Kwak'wala term ***pō'x̣was (*puxʷas)***[9], which was said to refer to the "fruit of *Menziesia ferruginea* Smith," indicating that the Kwakwaka'wakw also recognized and possibly ate this fungus (cf. Boas 1921:1402, 1455, 1910:222–23). The reference to Kwak'wala ***pō'x̣was*** as a "fruit," in conjunction with Gordon Robertson's comments that these are "berries," provide evidence that Native people recognize the berry-like appearance of *M. ferruginea* infected by *E.* sp. affin. *vaccinii.* [10] Note, however, that Kwak'wala ****puxʷas*** was said by Boas to refer to "willow tree" (Lincoln and Rath 1980:63; Neville Lincoln, personal communication, 1990), although this Kwak'wala word was not known to contemporary Kwak'wala speakers who were consulted (Neville Lincoln, personal communication, 1990).

There is further suggestive evidence among the Haida that these fungal galls represent "berries." *Menziesia ferruginea* is known as 'raven's berry bush' (Turner and Levine 1971:83), although the reason for this name is unclear. There is evidence that either *E.* sp. affin. *vaccinii* or *M. ferruginea* has been regarded by speakers of North Wakashan tongues, Tsimshianic languages, and the Haida language as a "berry." Specifically, Gordon Robertson has indicated that *E.* sp. affin. *vaccinii* mycocecidia are regarded as true "berries" (referred to in Henaaksiala and Haisla as ***màmḷk̓imas***) in the Henaaksiala sense[11] and Mildred Wilson also regards them as "berries." However, it is currently unclear whether Heiltsuk ***p̓sp̓iy̓ú yis‿luáƚ*** Heiltsuk ***ƛṇ́q̓ʷás*** and Oowekyala ***ƛṇq̓ʷas*** can be referred to the Heiltsuk and Oowekyala *berry* folk botanical classes (Heiltsuk ***ǧúláli/ǧúǧʷḷímás*** and Oowekyala ***ǧúlali***) or whether the comparable Coast Tsimshian and Southern Tsimshian taxa may be regarded as *berries.* With the exception of Turner and Levine's (1971) work, no previous studies of Pacific Northwest Native ethnobotany and folk biological classification systems indicate such a likelihood. On the other hand, Gordon Robertson's comments imply that this fungus would traditionally be regarded as a *berry* throughout Upper North Wakashan folk

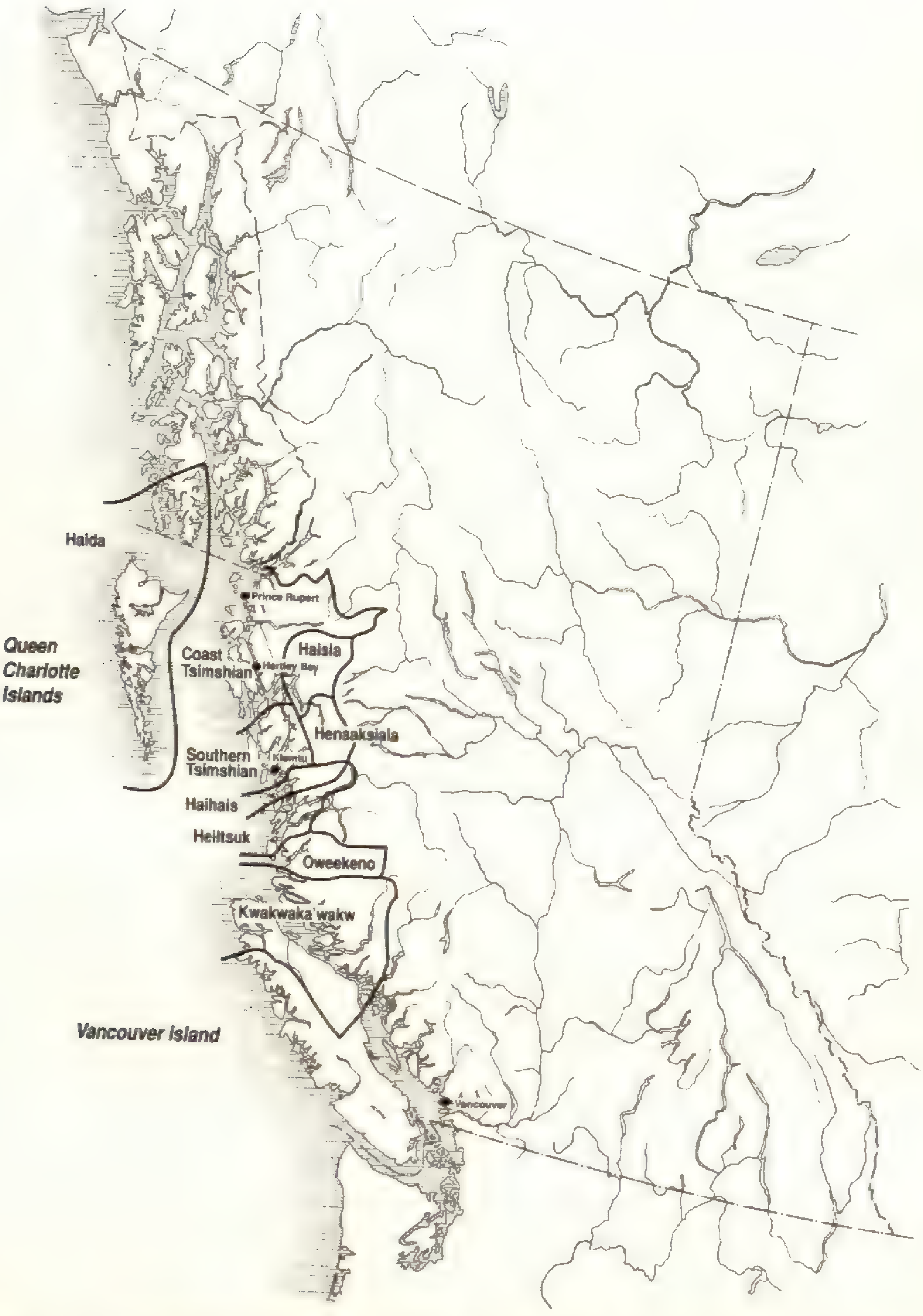

FIG. 2.—Approximate locations of British Columbian ethnolinguistic groups discussed in the text.

botanical classification. Additional ethnobotanical research among other Indigenous Peoples of British Columbia and Alaska may result in the documentation of more widespread recognition and use of *E.* sp. affin. *vaccinii* and Native perception that this fungus is a type of *berry.*

Evidently neither *M. ferruginea* nor *E.* sp. affin. *vaccinii* has great significance in terms of their relative contributions to the nutritional and technological pursuits of the North Wakashan, Coast Tsimshian, and Southern Tsimshian peoples and their neighbors. These species are significant, however, because of the evidence they offer for Native recognition of an understudied host-pathogen relationship as well as for a rare instance of mycophagy among coastal peoples of British Columbia. The research reported here is significant for illustrating the importance of making cross-cultural folk biological comparisons within the North Wakashan and Tsimshian ethnolinguistic areas. Specifically, I have identified an intriguing distinction between the manner in which speakers of Henaaksiala, Heiltsuk, and Southern Tsimshian relate *E.* sp. affin. *vaccinii* to other folk taxa. In addition, I have documented previously ignored Heiltsuk, Henaaksiala, and Tsimshian mythological roles for one or, possibly, both of these species. This study illustrates the importance of continuing ethnobiological research on North American organisms or biological associations that are distinguished by, and significant to, the Native people who share their environment. It also indicates why otherwise seemingly insignificant or obscure botanical organisms such as *Exobasidium* sp. affin. *vaccinii* should not be overlooked in ethnobiological studies because they may be integral to the understanding of interesting and unique cultural relationships to native plants and fungi.

NOTES

[1]The indigenous isolects and languages significant to this research are classed in the Wakashan and Tsimshianic language families. The term "isolect" refers to Upper North Wakashan tongues of undefined scope (Nater 1987:239, footnote 2). Within Upper North Wakashan, Heiltsuk (with two dialects, Bella Bella and Klemtu) and Oowekyala are regarded as isolects, although Henaaksiala and Haisla are treated as separate languages (Neville J. Lincoln, personal communication, 1992). The phonemic inventory used in the transcription of terms from the North Wakashan tongues (Henaaksiala, Haisla, Heiltsuk, Oowekyala, and Kwak'wala, spoken by the Kwakwaka'wakw) cited in this paper is after Lincoln and Rath (1980, 1986) and Rath (1981). The phonemic inventory is as follows: consonants - ***b, d, z, λ, g,*** g^{ω}, ***ğ,*** $\check{g}^{\omega}$ (plain plosives); ***p, t, c, ƛ, k,*** k^{ω}, ***q,*** q^{ω} (aspirated plosives); ***p̓, t̓, c̓, ƛ̓, k̓,*** $\acute{k}^{\omega}$, ***q̓,*** $\dot{q}^{\omega}$ (glottalized plosives); ***s, ł, x,*** x^{ω}, ***x̌,*** $\check{x}^{\omega}$ (fricatives); ***m, n, l, y, w, h*** (plain resonants); ***m̓, n̓, l̓, y̓, w̓, h̓*** (glottalized resonants); ***m̩, n̩, l̩*** ("vocalic resonants"); ***m̩̓, n̩̓, l̩̓*** (glottalized "vocalic resonants"); vowels - ***ə, i, u, a*** (plain); ***i̓, u̓, a̓,*** (glottalized); other elements - : (reduplication boundary), : (juncture), ? (glottalizing juncture). The symbol "ω" is used to indicate lip-rounding, an articulatory feature characteristic of those obstruents indicated. Accent, when unpredictable, is indicated by use of the grave (`). In the case of the Heiltsuk tongue the acute (') over a vowel or vocalic resonant indicates high tone, its absence indicates low tone. Generally, slashes (/ . . . /) are used to indicate a phonemic level of transcription, but they are omitted with the understanding that all Upper North Wakashan terms are in phonemic transcription.

Southern Tsimshian terms presented in this paper are from field notes and tape recordings I made in Klemtu. Terms were transcribed by John A. Dunn. The phonemic inventory used is essentially that of Halpin and Seguin (1990:267) for Coast Tsimshian. It was used in transcribing Coast Tsimshian forms communicated to me by Dr. Seguin, with some minor orthographic variations. The Coast Tsimshian phonemes are: (plain stops and affricate) ***p, t, c, k,*** k^{ω}, ***q, ʔ;*** (glottalized stops and affricate) ***p̓, t̓, c̓, k̓,*** $\acute{k}^{\omega}$, ***q̓;*** (continuants) ***s, ł, x, h;*** (plain sonorants) ***m, n, l, w, u, ÿ,*** (an unrounded velar glide); (glottalized sonorants) ***m̓, n̓, l̓, w̓, y̓, ÿ̓;*** (short vowels) ***i, e, a, o, u;*** (long vowels) ***i·, e·,*** ([ɛ·]) ***a·, o·, u·, ł·;*** (stress) ***v́***. The plain nonglottal stops and affricates are contextually voiced to [***b***], [***d***], [***ʔ***], [***g***], [g^{ω}], [***ǵ***], the velars are palatalized to [k^{y}, g^{y}] and [$\acute{k}^{y}$] before ***o(·)*** or ***u(·)*** and optionally before other vowels. It may be possible to analyze the vowel system as having only three phonemic short vowels, with what are here written as i and e as allophones of i, and u and o as allophones of u. The Sugpiak term reported in the paper is presented in the form communicated to me by A. Wennekens.

[2]The forms in parentheses here and in the following sentence were written by Neville J. Lincoln using the contemporary orthography presented by Lincoln and Rath (1980, 1986).

[3]This common name is probably based on the failure of *M. ferruginea* to produce berries (it produces capsules) although it is similar in appearance and related to other berry-producing species in the Ericaceae, (i.e., huckleberries).

[4]Single quotation marks are used to denote literal translations of non-English terms. Double quotation marks indicate approximate English glosses, terms quoted by one or more Native consultants, or items cited verbatim from a published source.

[5]These specimens were identified by J. A. Parmelee, Economic Fungi Project, Agriculture Canada Biosystematics Research Centre, Ottawa, Ontario. They are deposited at the Herbarium of the Department of Botany at The University of British Columbia in Vancouver (UBC).

[6]This is how Mr. Robertson referred to these fungi in English, although they are not berries in the botanical sense.

[7]Tom C. Wells (personal communication, 1990) has monitored several Pacific Northwest populations of *M. ferruginea* over the last several years, but has not found this fungus to be common among those populations.

[8]I have not noted excessive sweetness in the specimens I have tasted.

[9]This word, as indicated by the preceding asterisk, derives from a Kwak'wala root attested by Boas that was found impossible to re-elicit by Lincoln and Rath (1980:viii).

[10]Additional evidence of Kwakwaka'wakw knowledge of the "berries" of *M. ferruginea* has been presented by Grubb (1977:69), who recorded that "eating berries [of false azalea] renders one dumb and is potentially poisonous." This belief may refer to uninfected leaves rather than the mycocecidia, however, as Turner and Bell (1973:283) have documented that Kwakwaka'wakw report that chewing the leaves causes loss of speech. It should also be noted that false azalea reportedly contains toxic compounds common to several members of the Ericaceae (Turner and Szczawinski 1991:82).

[11]The concept of real or true *berries* as defined by Gordon Robertson includes several true native berries, several berry-like fruits, as well as the small round reproductive structures (strobili) of some gymnosperms. Although this concept may correspond to the common nontechnical English folk concept of *berries*, it differs significantly from the botanical definition of a berry as a fruit in which much or all of the ovary wall becomes enlarged and juicy, and which contans seeds within their own hard seed coats (Little and Jones 1980:53).

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SOME NOTES ON ETHNOGRAPHIC SUBSISTENCE SYSTEMS IN MOJAVEAN ENVIRONMENTS IN THE GREAT BASIN

CATHERINE S. FOWLER
Department of Anthropology
University of Nevada, Reno
Reno, NV 89557

ABSTRACT.—Subsistence resources utilized by Southern Paiute and Shoshone peoples in the Mojave Desert of western North America near the time of extensive contact and disruption of their lifeways in the 1840s have been little discussed in the ethnographic literature. In the 1930s, Isabel Kelly worked with a number of Southern Paiute groups in this desert, and her unpublished field notes, as well as some additional data, help to outline their subsistence systems. Recent studies among the Timbisha or Death Valley Shoshone also elucidate aspects of their subsistence cycles. Although these groups share a number of subsistence aspects with their linguistic kinsmen in the Great Basin Desert to the north, they also developed some unique foci based on certain locally occurring resources such as legumes, agaves, and yuccas, as well as tortoises, and chuckwallas. The spread of garden horticulture into the eastern part of the region prior to the mid-1700s probably added an important margin to the indigenous subsistence systems in this dry area.

RESUMEN.—Los recursos para la subsistencia utilizados por los pueblos Paiute Sureño y Shoshone del Desierto Mojave del occidente de Norteamérica hacia el período de contacto extensivo y perturbación de su forma de vida en los años 1840 han sido poco discutidos en la literatura etnográfica. En los años 1930, Isabel Kelly trabajó con un número de grupos Paiute Sureño en este desierto, y sus notas de campo inéditas, así como algunos datos adicionales, ayudan a esbozar sus sistemas de subsistencia. Estudios recientes entre los Timbisha, o Shoshone del Valle de la Muerte, esclarecen también algunos aspectos de sus ciclos de subsistencia. Si bien estos grupos comparten un buen número de aspectos de la subsistencia con sus parientes lingüísticos en el Desierto de la Gran Cuenca hacia el norte, también desarrollaron algunos focos particulares basados en ciertos recursos de distribución local, como leguminosas, agaves y yucas, así como tortugas y lagartijas. La expansión de la horticultura a la porción oriental de la región antes de mediar el siglo XVIII probablemente agregó un margen importante a los sistemas indígenas de subsistencia en esta área árida.

RÉSUMÉ.—Les ressources utilisées par les peuples Paiute de Sud et Shoshone dans le desert du Mojave d'Amérique du Nord occidentale, aux abords des années 1840, période de contact important et de dérangement de leurs moeurs, figurent peu dans la litérature éthnographique. Pendant les années 1830, Isabel Kelly fit des recherches dans un nombre de groupes Paiute du Sud dans ce desert, et ses notes nonpubliées, ainsi que d'autres données, servent à reconstruire leurs moyens de subsistance. Des études récentes des Timbisha ou Shoshone de Death

Valley servent également à élucider certains aspects de leurs cycles de subsistance. Bien que ces groupes partagent plusieurs aspects de leur subsistance avec leurs parents linguistiques du desert du Great Basin au Nord,ils ont également développé certaines spécialisations d'aprés les ressources locales telles que les féculents, l'agavé et le yucca, ainsi que les tortues et les chuckwallas. Le déploiement de l'horticulure vers l'est de la région avant la moitié du 18[e me] siècle contribua certainement une marge importante aux moyens de subsistance indigènes dans cette région aride.

INTRODUCTION

Ethnographic subsistence systems for the Great Basin of western North America have been defined in the past largely as focused on cold desert resources. This is because much of the published field work deals with groups in the Great Basin Desert, a relatively high, arid, and cold regime (see, for example, Chamberlin 1911; Fowler 1986, 1989, 1992; Kelly 1932, 1964; Smith 1974; Steward 1933, 1938, 1941, 1943; Stewart 1941, 1942; Shimkin 1947; Zigmond 1981). However, a significant number of the native peoples of the Great Basin culture area lived in and depended upon the resources of hot deserts, particularly the Mojave Desert (Fig. 1), a lower, dryer, and warmer regime.[1] In historic times, groups in the Mojave Desert included several subgroups of the Southern Paiute (Las Vegas, Pahrump, Moapa, Shivwits, St. George, Chemehuevi), the Timbisha (Death Valley), Panamint Valley, and Koso Shoshone, and some adjacent Kawaiisu. Non-Great Basin (or non-Numic-speaking) groups also in this desert and with whom Great Basin peoples shared much in terms of subsistence and other features of adaptation included, among others, the Cahuilla, Serrano, Mohave, and some Walapai subgroups. By focusing subsistence around floral and faunal species common to both the Great Basin and the Mojave deserts, but also on certain key Mojavean resources (e.g., legumes, agaves, and yuccas; desert tortoises and chuckwallas), all of these groups learned to cope with the Mojave's seeming harshness. In historic times, some of these groups also supplemented these naturally occurring products with several derived from garden horticulture.

In this paper data on the distribution and character of the subsistence complexes focused on the uniquely Mojavean resources are discussed for the Great Basin groups. What is known of the history and importance of gardening among them is also reviewed. Sources for these data include the extensive unpublished notes of Isabel Kelly (1932–34) for the Southern Paiute,[2] the author's field data for Southern Paiute in the Mojave Desert (Fowler 1968, 1986–1990) and for the Timbisha or Death Valley Shoshone (Fowler 1992–1993), and certain published materials (e.g., Bell and Castetter 1937, 1941; Castetter et al. 1938; Coville 1892; Irwin 1980; Laird 1976; Schroth 1987; Steward 1938; Stuart 1945; Wallace 1980; Zigmond 1981). Unfortunately, since all of these data were gathered long after Mojavean subsistence systems ceased to function in their entirety, the data suggest more of the "what" and "how" than of the "how much" and "how often" of the use of these resources. Statements of consultants regarding these other aspects are occasionally included, but cannot now be verified.

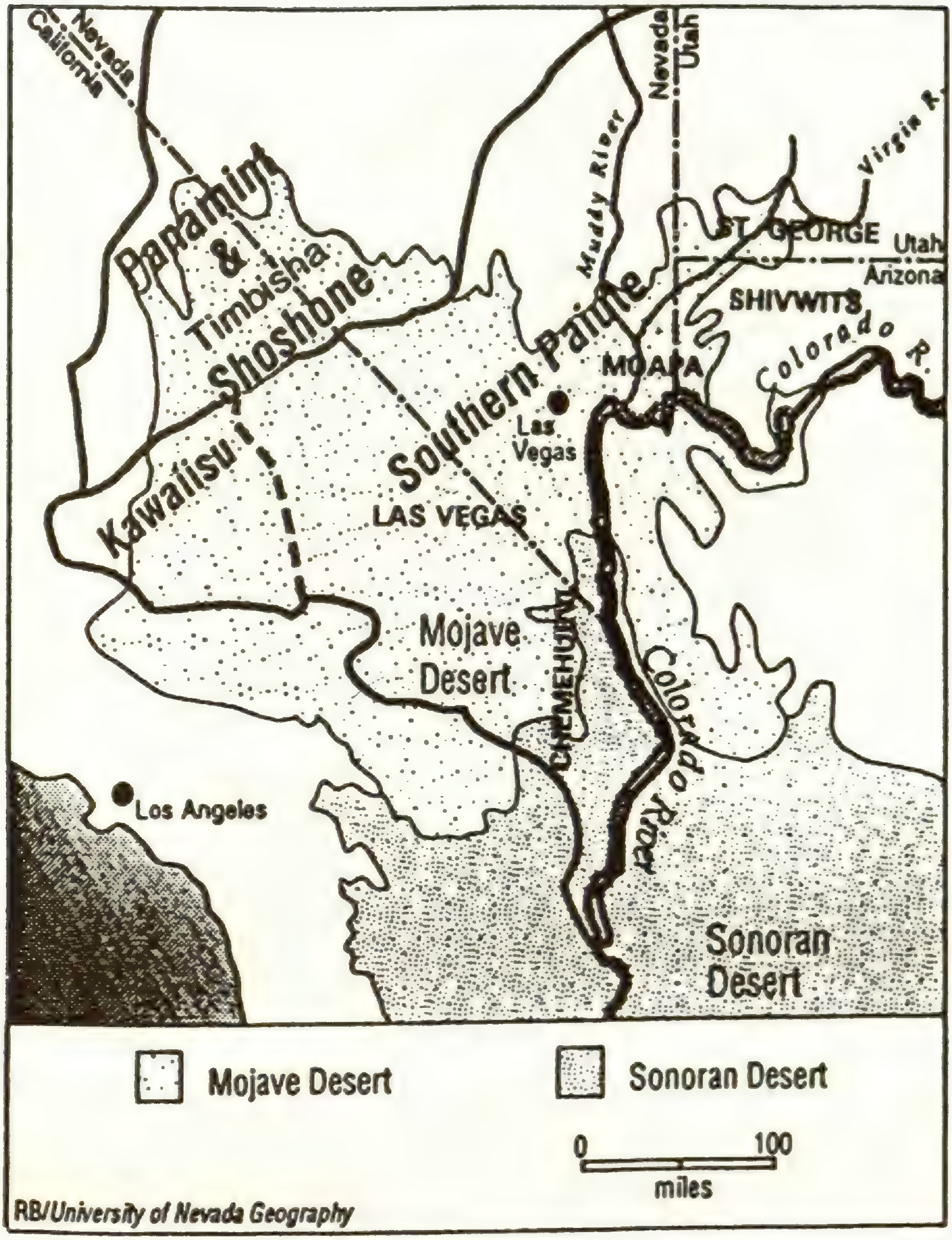

FIG. 1.— Great Basin Tribes in Mojave Desert environments.

FLORAL RESOURCES

The mesquite complex.—The term *mesquite complex* has been previously applied to the series of procedures involved in gathering and making edible certain members of the Fabaceae, including primarily honey mesquite (*Prosopis glandulosa* Torr. var. *torreyana* [L. Benson] M.C. Johnston) and screwbean (*P. pubescens* Benth.; see Bean and Saubel 1972; Fowler 1986:67; Schroth 1987). These, as well as certain other members of the family (e.g., *Acacia* spp.), are important components of the Mojavean flora as well as that of the adjacent Sonoran Desert. They were likewise important in the diets of Southern Paiute and Shoshone peoples (but not Kawaiisu [Zigmond 1981:54]), in some local areas replacing the all-important pinyon and/or acorn, or at least standing equal to them. It is difficult today to judge the former distribution, and especially the density and productivity of mesquite groves properly, as many have succumbed to drought brought on by the tapping of groundwater resources to salve the seemingly insatiable thirst of modern Mojave Desert dwellers. However, their focal distributions seem once to have been most of the drainage patterns throughout the Mojave (Benson and Darrow 1981). Screw beans were of more limited occurrence, but equally favored where found.

Pods of honey mesquite (called *ohbi* in Timbisha Shoshone and *obi* in Southern Paiute) were used slightly differently by Shoshone and Southern Paiute people, with additional differences probably occurring among families. Among the Timbisha Shoshone, a first use was made in the spring when the pods were green but still flat.[3] These pods were pit-roasted on a layer of hot stones, with the result being a tart-tasting product that was not to everyone's liking. Kelly (1932–1934:LVI:99;M:44;CI:40;SG:23) did not report this use among the Southern Paiute. However, the Moapa and Pahrump Southern Paiute as well as the Timbisha Shoshone ate the green pods raw as snacks at a slightly later stage—after the seeds had formed. For this purpose people with several mesquite groves or trees to choose from sampled different trees until they found those with the sweetest pods. They then collected what they wanted from these special trees (Fowler 1986–1990; 1992–1993).

More elaborate processing attended the taking of mesquite later in the season, after the pods had begun to ripen or had dried.[4] Southern Paiute people collected ripened but still green pods from the trees, then pounded them into a pulp in stone mortars with stone pestles. They made a drink from the resulting pulp (Kelly 1932–1934:LVI:99;M:44;CI:40). The Timbisha and Panamint Shoshone people apparently waited a little later, until the pods had turned yellow and had begun to drop from the trees. They pounded the still moist pods in large tree-stump mortars (Fig. 2)[5] with cylindrical stone pestles and also made a juice, squeezing it from the remaining pulp. Old people could drink all of this sweet-tasting juice that they wanted, but young people were cautioned that too much of the mixture would make them drowsy (Fowler 1992–1993).[6]

Shoshone and Southern Paiute peoples both made use of mesquite pod meal made from fully ripened fruit. As a first step, the pods were laid out to dry to remove all remaining moisture. They were then pounded into a fine powder (principally the mesocarp), a process that took considerable time and strength given the toughness of the exocarp and the endocarp surrounding the seed within a pod. The meal was further sifted in an open-twined tray to remove any unground material, especially the endocarp and seeds.[7] The Timbisha Shoshone then set aside both types of material to be used to prepare large meal cakes for storage.

The Timbisha Shoshone apparently prepared their cakes for storage in flat winnowing trays, while at least the Moapa Southern Paiute used conical burden

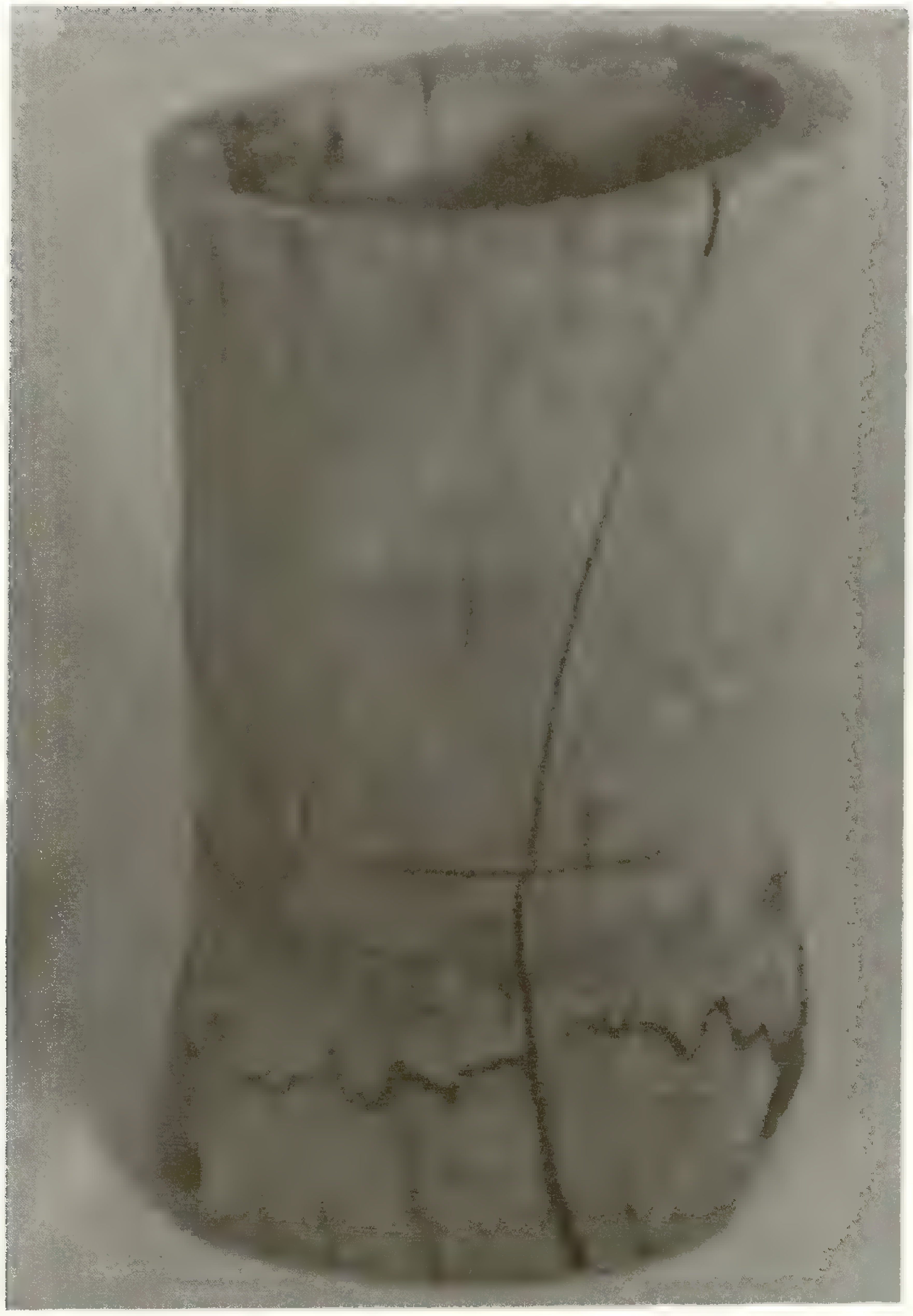

FIG. 2.—Mesquite bean mortar collected in Saline Valley, CA, in 1959 (Eastern California Museum, Independence, A850; 32 cm).

baskets (Stuart 1945). The Timbisha people first lined a winnowing tray with the fiber retained from the pounding process, material called *kahɨmbɨ*. The meal was then formed into a cake on the tray, with water being sprinkled between the layers to help them pack more tightly. The cake, as much as a foot or more high, was then covered with an additional layer of *kahɨmbɨ*, wetted to form a crust. The cake, called *pigibi*, could then be sun-dried, removed from the tray, and cached in a grass-lined pit (Fowler 1992–1993). The Moapa Southern Paiute built their cakes either in conical burden baskets, or in a small hole dug to shape and lined with mesquite pod pulp (Kelly 1932–1934:M:44). Their cakes were as much as 2 feet thick. After a few days, the baskets were inverted and the large cones of meal left to dry further; or the cakes were removed from the pits for the same purpose. The cones and cakes were then stored in grass- or bark-lined pits in rockshelters or caves, or in underground pits on bluffs or ridges (Stuart 1945). Both groups kept a cone or cake in the house and people removed pieces and ate them without further preparation, or added them to water for juice. The Moapa people also stirred dried mesquite meal into cooked agave and made the resulting mixture into small cakes. These were suitable for the trail or for meals in camp (Stuart 1945).

FIG. 3.—Screwbean (*Prosopis pubescens* Benth.) near St. George, UT.

Dried pods were often stored and processed later, although there was considerable danger of insect damage if storage was prolonged. The common predator is bruchid larvae that eat the seed and the mesocarp, and then pupate within the pod (Kingsolver et al. 1977:110f). Processing before the larvae emerge (some overwinter in the pod) was favored by the Timbisha people, who recognized their value as food. They cached mesquite pods in subterranean pits lined with arrowweed (*Pluchea sericea* [Nutt.] Coville) and capped with earth at valley sites near Furnace Creek before moving to the mountains for the summer.[8] A site containing such a cache was excavated in Breakfast Canyon near Furnace Creek in 1992 (Yohe and Valdez 1993). The beans were then processed in the fall upon their return (Fowler 1992–1993).

Kelly (1932–1934:M:44) reports for the Moapa Southern Paiute some family ownership of mesquite groves near cultivated fields. The same is not mentioned for Las Vegas, Pahrump, or Chemehuevi groups, although the latter knew that it was a Mohave custom (Kelly 1932–1934:CI:40). Steward (1938:183) reports family ownership of groves in Ash Meadows, an area jointly occupied by Shoshone and Southern Paiute people. Timbisha people felt more possessive about the mesquite at Furnace Creek, their home district, but were willing to trade their surplus. Kelly (1932–1934:SG:23) was told that mesquite was rare and little utilized at St. George, and absent from the original Shivwits district. Schroth (1987) reviews concepts of ownership as well as other distributions among non-Great Basin Mojave Desert dwellers.

Screwbeans (Fig. 3), although not nearly as common as mesquite, were important and favored by all of the people fortunate enough to have them in their districts. According to Kelly (1932–1934:LVI:100;CI:41), for the Las Vegas and Pahrump Southern Paiute and the Chemehuevi, processing of these involved an additional step—pit ripening. Once the screwbeans had been obtained, they were placed in layers in an arrowweed-lined pit, water being sprinkled between the layers. A man stood in the pit to tamp down the pods. The pit was then covered with more arrowweed and a clay cap and allowed to sit for about a month. When the pit was opened, the screwbeans had changed color—from tan to red. They were then removed and placed in storage granaries or processed into meal using a stone mortar.

Screwbeans have tiny, very hard seeds, most of which are not easily ground except by special attention. According to Kelly (1932–1934:LVI:100), the Las Vegas and Pahrump people removed the seeds from the mortared meal mixture by tapping them to the edge of a winnowing tray. The seeds could then be ground on a metate and made into additional meal. Most people apparently preferred to mix the ground seed with water to make a drink. The pod meal of screwbeans could be eaten prepared as a drink, or made into dried cakes similar to those of mesquite. Ripened screwbeans were widely traded, especially within Southern Paiute territory. Kelly (1932–1934:LVI 100) states: "Many used to trade rabbitskin blanket, sheep hide, eagle feathers, sinew, anything they had, for screwbean."

Although pit-ripening of screwbean is also reported for the Mojave and Yuma (Drucker 1937:47; Kroeber 1925:737; Castetter and Bell 1951:179), it is by no means universal to the area (Bean and Saubel 1972) nor is its function fully understood. Kelly (1932–1934:M:44) does not report it for the Moapa people, and the Timbisha Shoshone have not heard that it was necessary. In the tree-ripened state (usually by fall), screwbeans have a sweet flavor when raw.[9] Perhaps pit-ripening hastens the process or enhances the flavor. It may also cause a slight fermentation, but such is not reported. Whatever the effect, those who had screwbeans within their areas seem to have made good use of them, and, if they had enough to trade, they could exact good prices.

The agave complex.—Like mesquite and screwbean, agaves are primarily confined to the Mojave and Sonoran deserts in the southern Great Basin, but also have broader distributions south of that. Common species in the Mojave Desert include *Agave deserti* Engelm. (Chemehuevi territory only) and *Agave utahensis* Engelm. ssp. *utahensis, A. utahensis* var. *nevadensis* Engelm., and *A. utahensis* ssp. *kaibabensis* (McKelvey) Gentry. *Agave utahensis* varieties are found in scattered distributions at mid-level elevations in the Mojave Desert (principally Southern Paiute territory), with *A. utahensis* ssp. *kaibabensis* occurring at higher elevations and extending along the north rim of the Grand Canyon through the territory of the Kaibab Southern Paiute. The agave complex, where it is found, shares many features with like complexes in the Southwest and Mexico (Castetter et al. 1938).

According to Kelly (1932–1934:LVI:94–5;CI:37–9;SH:30;SG:22), for the Southern Paiute and Chemehuevi, processing of agave (*yantɨ, nantɨ*) began in the early spring (February or March, depending on elevation) with collection of plants just as they were sending up flower stalks. The plants were severed from their roots using a chisel-shaped wooden wedge and a special knife (Fig. 4). The leaves were often trimmed to within 1 or 2 inches of the base with the knife and the agaves returned to a central processing location in special pack frames. A large pit was

FIG. 4.—Agave knife with metal blade, collected at Moapa, NV, in 1929 (National Museum of the American Indian, 16/4059; 29 cm).

dug and a fire built in it. After the fire died down, rocks were added to the pit and each family placed its agaves in a section of the pit. More rocks were added and a fire built on top. The pit was left unopened for 24 to 48 hours, during which time singing and dancing took place. Prohibitions were also in effect to insure good baking. After the pit was opened, the sweet, dark mass, and any still partly intact hearts, was removed by each family and cooled, pounded, and formed into large, flat cakes for drying and storage. Portions were also eaten fresh out of the pit. Agave was mixed with other types of meal or meats and made into stew.

According to Kelly (1932–1934:CI:38;LVI:94;M:34;SH:30), the spring harvesting and cooking of agave, especially by the Shivwits, Moapa, Las Vegas, and Pahrump Southern Paiute and by the Chemehuevi, was under the direction of a male or female specialist (sex depended on area). This person supervised the activities, sometimes lit the fire,[10] and also offered special prayers for the success of the roast. There are no data indicating that agave collecting areas were family owned.

The Timbisha Shoshone apparently did not have agave within their territory, nor did other Panamint Shoshone except perhaps the people in the Koso district (Driver 1937:64). Agaves also seem to have been lacking in Kawaiisu territory (Zigmond 1981).

The yucca complex.—There are several species of yuccas found in the Mojave Desert, one of the most characteristic being the Joshua tree (*Yucca brevifolia* Engelm.). All groups with Joshua trees (Southern Paiute *tsoadɨmpɨ;* Timbisha Shoshone *muupɨ*) in their territories made similar uses of them, especially in the spring. At that time the new growth tips containing what will be the flowering and fruiting heads (Fig. 5) were carefully twisted from the ends of the stalks and pit-roasted in coals (Coville 1892:355). If sharp spines remained, these were cut away and the bud was eaten much like an artichoke. Joshua trees left to flower

FIG. 5.—Joshua tree (*Yucca brevifolia* Engelm.) with growth tips ready to harvest.

had their blossoms harvested as they emerged—these, too, being pit-roasted. Those left to fruit had the fruit collected, although not all people and groups preferred these. The Death Valley Shoshone ate them (called *paki*); the Southern Paiute did not.

Other yuccas, including commonly *Yucca schidigera* Roezl ex Ortgies, *Y. bacatta* Torr. and *Y. whipplei* Torr., were also favored for fruit and stalks. Kelly (1932–1934:LVI:97) reports an interesting process in use among the Las Vegas Southern Paiute to hasten ripening of *Yucca schidigera* (*uwimpɨ*) fruits: the stem containing them was broken but not severed from the plant. Ripening could also be speeded by burying the fruit in a pit covered with earth. Once ripe, the fruits were split and the seeds removed. They were then buried under ashes or roasted on coals. Later, after being in storage, they were boiled and mashed "just like apple sauce."

Yucca bacatta (*uusi*) fruits were split, seeded, and dried, and sometimes formed into balls or pounded into flattened sheets. The resulting product was set out on mats to dry in the sun (Kelly 1932–1934:CI:44;SH:39;SG:21). The sheets were later carefully folded for storage and covered with bark for caching in rockshelters or in juniper trees. The sheets were then ground into flour and made into mush or loaves like agave (Kelly 1932–34). The newly emerging stalks and blossoms of narrow-leafed yucca (*Y. angustissima* Engelm. ex Trel.) were eaten, but not the fruit. It was considered too bitter and dry (Fowler 1986–1990). Zigmond (1981:69) reports that the Kawaiisu treated the "hearts" of *Yucca whipplei* much like other groups treated agave, with ceremony and prohibitions surrounding the pit-roasting of this species in the spring. The Kawaiisu also roasted the split, green flower stalks, but seem not to have used the fruit.

Other floral resources.—Although definitive ethnobotanies are lacking for most Great Basin Mojave Desert dwellers, several combined sources document, in addition to the plants already described, the use among these peoples for food of more than 20 genera that produced seeds (*Sporobolus, Descurainia, Suaeda, Poa, Atriplex, Amaranthus, Salvia, Rumex, Oenothera, Allenrolfea, Oryzopsis, Mentzelia, Dicoria,* etc.), several leafy plants for greens (i.e., *Stanleya pinnata* [Pursh] Britton, *S. elata* M.E. Jones), several fruits (*Lycium, Opuntia,* among others), a few roots/corms (i.e., *Calochortus kennedyi* Porter, *Dichelostemma pulchellum* [Salisb.] Heller, *Allium* spp.), and, where possible, pinyon (*Pinus monophylla* Torr. & Frem., *P. edulis* Engelm.) and scrub oaks (*Quercus turbinella* Greene, *Q. gambelii* Nutt.) (Coville 1892; Fowler 1986–1990; 1992–1993; Irwin 1980; Kelly 1932–1934:LVI:85–9;M:37–9;CI:30–2;SG25–6; Wilke et al. 1979). Zigmond (1981) lists roughly 100 species of plants used for food by the Kawaiisu, including a number of non-Mojave Desert species. Bean and Saubel (1972) list roughly 75 species utilized for food among the adjacent Cahuilla, also people not wholly within the Mojave Desert.[11]

Taken in their entirety, the floral complexes of the Mojave Desert probably allowed for about as varied a subsistence system as those of the more northerly Great Basin Desert; but the presence of agaves, yuccas, and the legumes also provided some unique features. The Timbisha Shoshone rank mesquite as co-equal to pinyon in their plant subsistence system (Fowler 1992–1993). The Moapa Southern Paiute stored as much if not more mesquite and agave than they did pine nuts and berries—which were sometimes hard to get (Fowler 1986–1990; Kelly 1932–1934:M:47). Whole camps of Chemehuevi people went after agave each year, so much so that the river camps were nearly deserted. Kelly (1932–1934:ChI:38) states: "Could tell from great distance when people gathering mescal; could see fires on all the mountains." Thus, the use of these plant groups set the southern groups somewhat apart from their northern kinsmen, giving them additional storable staples upon which to depend in good years. In poor years, all groups looked for alternatives.

FAUNAL RESOURCES

Mammals and reptiles.—Just as with floral resources, the Mojave Desert faunal community fostered certain specializations. According to Kelly (1932–1934: LVI:108) for the Southern Paiute, more of the day-to-day animal protein came from rabbits, wood rats, tortoises, and chuckwallas than it did from deer or bighorn sheep. Of the latter two, desert bighorns (*Ovis canadensis* ssp. *nelsoni* Merriam) were the more common, being found in most Mojavean areas. Some Southern Paiute groups, on the other hand, had to go into the adjacent territory of the Timbisha (Death Valley) Shoshone or Cahuilla in order to take more than an occasional deer (*Odocoileus hemionus* Rafinesque). If they wanted hides, they organized communal hunts to these areas, or went on trading expeditions (Kelly 1932–1934:LVI:108). Even the Timbisha people considered deer rare in mountains surrounding central Death Valley, noting that they were taken only on the west side of the Panamint Range.

Bighorn sheep and deer were more commonly hunted by individuals or by small groups of men under the direction of a dreamer—a different dreamer being required for each type of large game animal (Fowler 1986–1990; 1992–1993; Kelly 1932–1934:LVI:115;M:52;CI:57;SH:48). Dreaming for big game animals in this region is related to the same practices to the south and west, as among the Mojave, Cahuilla, and others (Kroeber 1925).

Rabbits, including cottontails (*Sylvilagus audubonii* Baird) and hares (*Lepus californicus* Merriam), were often hunted and snared individually using bag nets or noose snares set in their trails. They were taken in mesquite thickets and near agricultural fields, once those were established. They were also taken in drives with linear nets on occasion, and in certain areas (Irwin 1980; Steward 1938). In the Las Vegas valley, Kelly (1932–1934:LVI:114) reports that the brush was fired in the spring to take young cottontails and jackrabbits, which reportedly ran about confused in the face of fire. Cottontails could also be extracted from their burrows with hooked sticks twisted into their fur (Fowler 1992–1993; Kelly 1932–1934: LVI:113).

Desert woodrats (*Neotoma lepida* Taylor) were often sought in mesquite thickets where they constructed their large nests. They were extracted from the nests with hooked sticks, or occasionally, by setting fire to the nest (Fowler 1992–1993; Kelly 1932–1934:LVI:121;M:59). Chuckwallas (*Sauromalus obesus* Baird) were similarly extracted from crevices in the rocks with a hooked stick (Wallace 1978).[12] The Timbisha people roasted them in a bed of coals with hot, flat stones on top (Fowler 1992–1993). They were very fond of chuckwalla, so much so that people in northern Death Valley often referred to them as "chuckwalla-eaters." The Chemehuevi, Las Vegas, and Moapa people prepared chuckwallas the same way as the Timbisha people, and also used the hooked stick to extract them from the rocks (Kelly 1932–1934:LVI:116;M:60). The Moapa people held a boy's first game ceremony when he killed his first chuckwalla, suggesting something of the importance of this animal (Kelly 1932–1934:M:53). Prime hunting times varied with elevation, but usually spring and summer were the favored seasons.

Hunting desert tortoises (*Gopherus agassizii* Cooper), reported to have been common to most Mojavean areas, could be risky business, according to what Kelly (1932–1934:LVI:117) was told. They were usually extracted from their burrows with a crooked stick, but first the hunter had to make sure that the hole was not occupied by a rattlesnake. In order to determine if a tortoise were present, a rock was thrown at the hole. The tortoise—or rattlesnake—made a characteristic noise if present, or emerged (see also Schneider and Everson 1989:186 for similar comments). Tortoise meat was cut away from the shell and pit-roasted in the ashes. The carapaces were used as eating utensils and digging tools (Fowler and Matley 1979). Most Southern Paiute (and Chemehuevi) groups in the Mojave Desert ate desert tortoises and their eggs; the Death Valley and Panamint Shoshone apparently did not (Fowler 1992–1993; but see Driver 1937:62 for a different opinion).

There is little information on bird hunting among these groups, although from the brief notes of several authors most groups took at least doves (*Zenaida* spp.) and Gambel's quail (*Callipepla gambelii* Gambel) from blinds near water holes and collected their eggs (Fowler 1992–1993; Irwin 1980:19; Kelly 1932–1934:LVI:118;M:66;CI:70;SG:35; Sh:55). Some groups also had access to a few waterfowl in certain seasons, and also took a few other small birds or their eggs when encountered.

Although animal protein was not all that plentiful in the Mojave Desert, other foods were apparently sufficient to have suggested some animal food taboos. Most groups did not eat members of the dog family except as famine foods. Cats were similarly avoided by most, but bobcats were sometimes taken. The larvae of some insects were eaten (Sutton 1988), but not grasshoppers, most caterpillars, or angleworms (Driver 1937; Kelly 1932–1934; Steward 1941). Racoons, although field-hunted to keep them from eating or ruining agricultural products, were generally not eaten by the Southern Paiute who had them in their districts (Kelly 1932–1934:M:58; CI:71;LVI:126). Southern Paiute people adjacent to the Colorado River were also not keen on fish, eating them only occasionally (Drucker 1937; Kelly 1932–1934:CI:69;M:63;LVI:126; SG:35). The Timbisha Shoshone occasionally ate desert pupfish (*Cyprinodon* spp.; Fowler 1992–1993). Ground squirrels and other small rodents were also taken, often by children looking for a ready meal (Fowler 1992–1993). Adults trapped them with figure-4 traps, but some considered them not worth the trouble unless they were known to be locally plentiful (Fowler 1992–1993). Perhaps certain aspects of this selectivity were brought about by a considerable involvement with gardening, especially among the Southern Paiute, but also historically among the Timbisha and Panamint Valley Shoshone.

HORTICULTURE

There is a great deal that is not known about the practice of garden horticulture among the Southern Paiute and adjacent Shoshone. Although the ultimate origins of the crops—principally corn, beans, squash, sunflowers, and amaranth—are clear enough, it is their more immediate source or sources as well as the source of the planting and irrigation techniques that are in doubt (see Euler 1966 for ethnohistoric references). Elsewhere it has been argued based on linguistic evidence that at least one immediate source of cultigens among the westernmost Southern Paiute was the Lower Colorado River agricultural complex, as practiced by various Yuman groups (Fowler and Fowler 1981). But the Hopi and Pai peoples were probably involved in crop transfers as well. Based on data obtained in the 1930s, Kelly (1964:39) doubted that the practice in the more easterly Southern Paiute areas predated by much the arrival of the Mormons in the 1850s; but in the Mojavean areas, it was certainly well established by at least 75 years earlier (Fowler and Fowler 1981; see also Euler 1966). Timbisha Shoshone practices probably postdate the 1840s (Wallace 1980), while those of the Panamint Valley people may be later (1880s?).

Kelly's (1932–1934:LVI:62–78;CI:18–27;M:26–30;SG:11–20;SH:40–41) unpublished field notes help to document in more detail the nature of Southern Paiute horticultural practices. Her data from the St. George and Moapa areas specify the following: (1) land for gardens had to be level and near a stream with a low bank; (2) the ground was cleared by hand, using a flattened stick, both sexes participating; (3) the main ditch was dug at right angles to the stream and the laterals ran from it parallel to the stream—there was no exit back to the stream; (4) sometimes there was overflow, but there is no indication in Kelly's notes that she asked whether unintentionally watered ground was harvested for wild plants; (5) the ditch was dug with the same flat stick used for clearing (Kelly 1932–1934:SG:12).

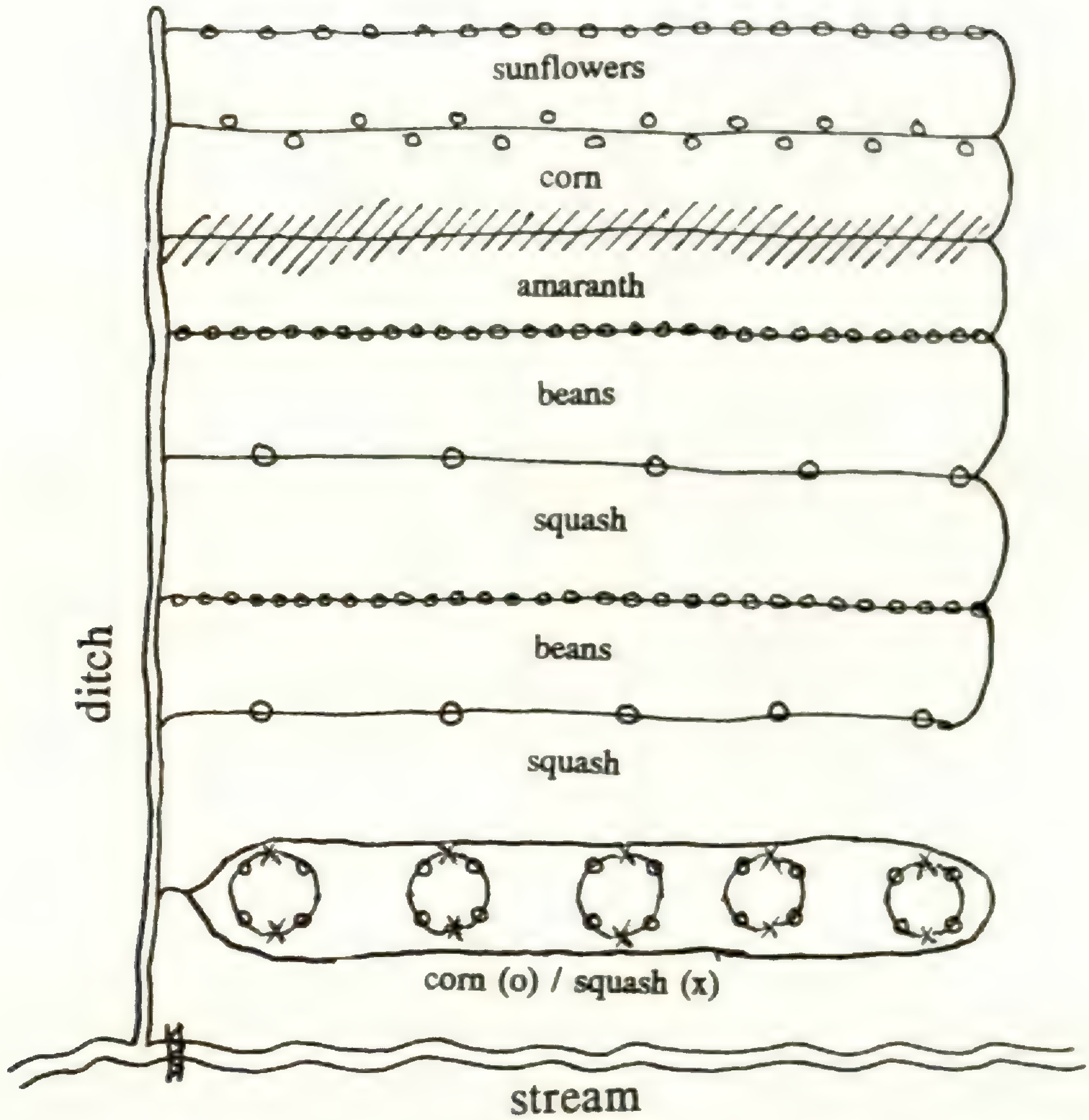

FIG. 6.—St. George Southern Paiute field plan, based on sketch by Isabel Kelly (1932–34).

Before the field was planted, the ground was soaked by means of the feeder ditches. At St. George, the people planted according to a plan in which the first row contained white corn planted in circles the length of the lateral ditch (Fig. 6). On either side of the corn within the circles two squash seeds were planted. The second field row had a soft-shelled squash. The third row contained beans, commonly teparies. The fourth had hard-shelled squash; the fifth, speckled beans; the sixth *kumutɨ* (*Amaranthus hypochondriacus* L.) that had been broadcast sown. The seventh row had red and blue corn alternating on opposite sides of the ditch; and the last had sunflowers (Kelly 1932–1934:SG:13–14).

While Kelly's consultants in other areas disagreed about minor details of the St. George planting plan (not all groups put in the same crops), all agreed that white corn had to be sown in the first row and that it always had to be planted in circles. Red and blue corn were kept some distance away, and might be in separate rows. The white corn was said to be a short, early-maturing variety (ca. 50 days), and the others were taller and matured later (Kelly 1932–1934:LVI:68). The systems were said to be precontact. After Mormon settlement, people said that they merely planted in rows with no set order. All plants went in at the same time. The garden was irrigated when the corn was 2 to 3 inches tall, and again when it was a foot tall. After that, it might be watered anytime, especially if the leaves yellowed or curled. The white corn was the water gauge—if it did not grow well, some other area or system needed to be tried (Kelly 1932–1934:LVI:68).

Other methods of field planting and watering were also recorded by Kelly (1932–1934:LVI:63;M:26). At some sites at Moapa and Las Vegas, some cultigens were planted near springs and either ditches were dug from them to irrigate, or pots of water were carried to them. There were also communal fields with ditches on a grid system in some locations. In addition on the lower Virgin River and along the Colorado, corn was planted on the river margin where it did not need irrigating (Kelly 1932–1934:LVI:66–69). This type of planting is quite like that in use by the Mojave and other river Yumans (Kroeber 1925). These groups likewise contributed Spanish-derived wheat, watermelons, and chick peas to the Southern Paiute systems at some unknown data after the 1780s (Fowler and Fowler 1981).

Timbisha Shoshone gardening seems to have come from the adjacent Southern Paiute, although there is some suggestion that a least one farmer visited the lower Colorado River to obtain some seeds (Jaeger 1941:284). By the 1870s if not before, gardens featuring indigenous crops as well as introduced ones were present at Furnace Creek, Grapevine Springs, Saratoga Springs, Hungry Bill's Ranch, and Warm Springs in Death Valley, and at Warm Springs in Panamint Valley (Fowler 1992–1993; Wallace 1980). All of these featured ditch irrigation. Fruit trees and grapes were also included in some of these locations, and the garden plots sometimes covered more than an acre. Although the Timbisha and Panamint Valley people may have entered farming later than their Southern Paiute neighbors, there is good evidence that they took to it quickly and established quite extensive plots (see for example, Coville 1892).[13]

CONCLUSIONS

The various food-getting complexes just described, whether using indigenous Mojavean resources or introduced ones, seem to have been quite complementary in terms of seasons. Most groups in the Mojave Desert gathered agave during the winter and early spring; Joshua tree buds and yucca buds came in early spring; several greens and seeds were harvested in summer; mesquite was taken in late spring and summer, as were screw beans and yucca fruits. Hunting went on all year, except for prohibitions during the season when animals were mating or bearing and rearing their young.

Although these resources were probably adequate to carry small populations through most years, the addition of garden horticulture to the subsistence system probably provided a healthy margin against tough times, and seemingly also some surplus to trade. The Las Vagas Southern Paiute double cropped corn (February and May plantings, with early summer and fall harvests), thus spreading its availability through much of the year (Kelly 1932–1934:LVI:68). Tepary beans (*Phaseolus acutifolius* Gray), well known for their heat and drought resistance, made it through the hot Mojavean summers probably without a great deal of care. Squashes (including summer as well as winter varieties) also balanced the seasons well, and provided, along with corn and beans, storable products. Amaranth, watermelons, and other plants provided some seasonal resources, but also additional storable reserves. Although this form of horticulture did require people to do some plant tending (watering, field hunting, weeding), it also left time for other subsistence pursuits. It was popular enough that Kelly (1932–1934: LVI:20–34) recorded its occurrence at roughly 70% of the Las Vegas and Pahrump band camp sites she surveyed or about which she learned.

Although we may never be able to reconstruct the subsistence pattern for Great Basin peoples in the Mojave Desert fully (see also Wilke et al. 1977 for a similar comment on the Cahuilla), these notes should help by suggesting that several aspects of subsistence were indeed complementary and probably served the people well. The Mojavean Southern Paiute and Death Valley Shoshone, not unlike their Cahuilla and Colorado River Yuman neighbors, explored this desert to good advantage, and worked out several subsistence solutions.

NOTES

[1]The Great Basin Desert ranges in base elevation from roughly 3,000 ft. to 5,000 ft. in valleys with intervening ranges reaching 5,000 ft. to 11,000 ft. Annual precipitation averages 5 in. to 12 in. in the valleys with increased amounts in adjacent ranges. Temperatures are wide ranging, from –20° F. in winter to 100° + in summer, and often with a diurnal of 50°. The Mojave Desert is lower in base elevation by roughly 2,000 ft., has higher annual temperature averages (below 0° F. to above 125°), and lower annual precipitation (1.4 in. to 5 in.; Bender 1980; Jaeger 1957). Maps of both are provided by Bender (1980), Benson and Darrow (1981) and Jaeger (1957).

[2]Isabel Kelly, whose unpublished notes are cited and used here, spent from June 1932 to March 1934 in nearly continuous field studies among various subgroups of the Southern Paiute under a National Research Council grant to study their ethnogeography. Roughly 1/4 of her data were published (Kaibab, San Juan, Panguitch; Kelly 1964). Several, but not all, of her typescript notes (excerpts from field notebooks) are on microfilm at University Archives, University of California, Berkeley. Copies of all of the excerpts, field notebooks, and other unpublished comparative data (some 3,000 Ms pages) are in the possession of C. Fowler, who is editing and otherwise preparing them for publication with permission of her literary executor. Bands represented in Kelly's notes include: Kaibab, San Juan, Panguitch, Kaiparowits, Beaver, Gunlock, St. George, Shivwits, Moapa, Panaca, Pahranigat, Cedar City, Las Vegas (including Pahrump), and Chemehuevi. Citations in this paper are from the typed exerpts, by page number. Kelly collected roughly 200 botanical (but not zoological) specimens for identification from most groups. These were identified by personnel at the University of California Herbarium and at the California Academy of Sciences, but few were filed. Fowler's field notes and botanical specimens are in her possession.

[3]The use of mesquite pods in this stage is reported only for the Timbisha and not for the Southern Paiute. It is possible that this use was not recorded, but it may also be a matter of differences in preferences among groups or families, as even for sweet mesquite, the flavor is not to everyone's liking.

[4]Timing of harvests for mesquites vary considerably across the Mojave Desert, as flowering and fruiting are tied to temperature and elevation. In Death Valley, the harvest was

usually finished in early June; in Moapa, mid- to late August was the appropriate time to take fully ripened pods.

[5]The Timbisha people say that one never uses stone against stone to pound mesquite; i.e., a stone mortar and a stone pestle. No ultimate reason is given for the prohibition, but the belief is a strong one. Some Southern Paiute groups used wooden mortars and some stone, according to Kelly (1932–1934:LVI:99;M:44;CI:40).

[6]Mesquite pods can be very high in sugars and probably would ferment easily in warm weather. However, there may also be a chemical compound that produces drowsiness.

[7]The Timbisha people discarded the seeds of mesquite, as did some Southern Paiute groups (Las Vegas, Pahrump). The Chemehuevi and Moapa people sometimes ate them, but considered preparation a lot of work. They parched the seeds, pounded them to remove the endocarp, and then ground them to meal on the metate (Kelly 1932–1934: CI:40–41).

[8]In early June after completing the mesquite harvest, the Timbisha people went into the Panamint Range to collect roots, seeds, and later berries and pine nuts. They returned to winter camps in the valley in late October or November.

[9]A Chemehuevi person mentioned to Kelly (1932–1934:CI:41) that this process "sweetened" the screwbeans. Perhaps not all are naturally sweet, just as not all mesquite pods are sweet.

[10]Kelly (1932–1934:CI:38;LVI:94) states that both the Chemehuevi and Las Vegas people believed that a person born in mid-summer (July) should light the fire in order that it burn nice and hot.

[11]None of these lists probably is truly exhaustive of the plant food sources utilized in this region, as all researchers worked in the area after food collecting had been disrupted by non-Native American intrusions or landscapes had been altered by mining and ranching activities.

[12]Hooked sticks, which apparently were used on chuckwallas and on cottontails, are found only in these southern desert areas within the Great Basin. The crooked stick, as was used on tortoises but probably also for other purposes, is also uniquely southern. These implements appear to be specialized tools primarily correlated with southern desert resources. Other types of wooden implements are used in food collection elsewhere in the northern Great Basin (e.g., hooked and plain pine nut poles, pointed sticks for collecting small game).

[13]The whole question of the dating of Death Valley agriculture should probably be reassessed. Although there is apparently no archaeological evidence for it thus far at any time period (except the latest), there also has been little concerted effort to look for its traces in pollen records or by other means from the most likely areas.

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BOOK REVIEW

The Nature of Shamanism: Substance and Function of a Religious Metaphor. Michael Ripinsky-Naxon. Albany: State University of New York Press, 1993. $57.50 (hardcover); $18.95 (softcover). Pp. xii; 292. ISBN 0-7914-1385-3 (hardcover), 0-7914-1361-1 (softcover).

This volume synthesizes a wide-ranging literature in seven languages on shamanism, incorporating with it the author's own experiences and perspectives. It can be read as an introduction to the subject. Two of the seven chapters focus on the ethnobotanical dimension of shamanism, enough coverage to justify a book review for this journal.

Professor Ripinsky-Naxon views shamanism as a manifestation of the universal human quest to make larger sense of the relationship among the humans, natural forces and the unseen world. Ethnographic data, archaeological finds, past events, mythologies of the ancients and Jungian psychology are interwoven into a cultural-historical framework in which consciousness and intentionality are viewed as growing out of the collective unconscious.

Shamans have cross-culturally manifested similar kinds of reactions to outside forces and natural phenomena. An example would be the ability to trigger altered states of consciousness with quartz crystals and gold (which may have led them to become objects of human value in the first place). Also described are phosphenes—luminous images caused by excitation of the retina—that predisposed certain individuals in very different parts of the world to tie them to visionary experiences.

Ripinsky-Naxon is convinced that use of entheogenic substances, which he prefers to call hallucinogens, forms a pattern of great antiquity and centrality. Here he stands at odds with the historian of religions, Mircea Eliade, who for most of his life viewed the use of hallucinogens as an aberrant and recent innovation in culture history. The author avers that psychotropic plants were an early and major vehicle for achieving an altered state of consciousness. Shamanic use of mind-expanding substances can be inferred from cave art as far back as the Upper Paleolithic. Shamanic residues are apparent in complex religious systems as diverse as the Osiris cult of the ancient Egyptians, the animal-headed St.

Christophoros in Greek Orthodoxy, and Sufism. To appreciate how far thinking has developed along these lines, it is instructive to contrast this work with such classic treatises on primitive religion as Lowie (1925) and Radin (1937), neither of whom had a clue that hallucinogens could have broad explanatory significance.

Ripinsky-Naxon's cultural-historical speculations about certain psychotropic plants are as stimulating as some of them are tenuous. He posits the idea that Old World cereal cultivation originated to assure a ready supply of the fungus ergot (*Claviceps* spp.), which sometimes forms on the spike, rather than for the food value of the grain. Ergot in the eastern Mediterranean region was used, in addition to its therapeutic value, to induce visions. Building on Wasson's work on Siberia and India, fly-agaric mushroom *(Amanita muscaria)* is inferred to be a shamanic inebriant in Zoroastrian, Chinese and Ancient Greek traditions as well as in the Americas. On the basis of phytomorphic mushrooms on a Mochica ceramic, the author concludes that fly-agaric was ingested in this pre-Inca culture of Peru. Elsewhere in the Andean realm, mastication of coca (*Erythroxylum* spp.) leaves is said to induce divine trance. If so, it would have occurred through the power of suggestion of a sacred plant, rather than from the biochemical power of the alkaloids in the dried leaf. Curious assertions that coca chewing is of Chibchan origin and that cultivation of this plant started in the Bolivian Yungas are far off the mark both in terms of time and place.

Ethnobotanical details are not the strength of this book. Its forte emerges when the reader moves beyond the factual and verifiable into the dimly perceived origins of religious transcendence. The numinous quality of the writing encourages one to reflect on the deeper meanings of the religious impulse, linkages between nature and culture, and the psychic unity of humankind. One inescapable conclusion derived from this work is relevant to the present dominant mindset in Western, especially North American, society. Is not the war against drugs in reality a war against both the biological nature of human beings and an important aspect of their creativity? Specialists and non-specialists with ethnobotanical interests willing to focus on the big picture will find here much to think about. The clear prose, free of convolutions and abstract logic, facilitates the effort.

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Daniel W. Gade
Department of Geography
University of Vermont
Burlington, Vermont 05405

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PREHISTORIC CERAMIC AGE ADAPTATION TO VARYING DIVERSITY OF ANIMAL RESOURCES ALONG THE WEST INDIAN ARCHIPELAGO

ELIZABETH S. WING
Florida Museum of Natural History
Gainesville, FL 32611
and
STEPHEN R. WING
Division of Environmental Studies
University of California
Davis, CA 95616

ABSTRACT.—We apply island biogeographic principles to the analysis of archaeological faunas from Caribbean Ceramic age sites, and use the results to better understand human adaptations to these island settings. Faunal samples from groups of islands, the Lesser Antilles, Greater Antilles and Virgin Islands, Bahamas, and Turks and Caicos, share characteristics and can be analyzed in these island groups as well as individually. Despite variation within these island groups, they reflect decreased diversity with distance from the mainland and a positive correlation between diversity and island size. Though the colonists were subject to the limitations described by island biogeographic principles, they were also able to exert some control by disproportionately enriching the diversity of species on small islands by introducing animals.

RÉSUMÉ.—Nous appliquons des principes bio-géographiques insulaires à l'analyse des faunes archéologique des sites caraïbes de la période céramique. Nous utilisons les résultats pour mieux comprendre les adaptations humaines à ces environnements insulaires. Des échantillons de faune de groupes d'îles, Les Petites Antilles, les Grandes Antilles avec les Iles Vièrges, et les Bahamas, les Turques et les Caïcos, ont des caractéristiques communes et forment trois groupes. Malgré une certaine variation à l'intérieur de ces groupes, ils reflétent une diversité décroissante en fonction de la distance du continent et une corrélation positive entre la diversité et les dimensions de l'île. Bien que les colons furent subordonnés à des limitations inscrites par les principes bio-géographiques insulaires, ils étaient aussi capables, en introduisant des animaux, d'exercer une influence sur l'enrichissement disproportionné de la diversité des espèces des petites îles.

RESUMEN.—Aplicamos principios de la biogeografíca de islas al análisis de faunas arqueológicas de sitios de la era cerámica en el Caribe, y empleamos los resultados para entender mejor las adaptaciones humanas a estos escenarios isleños. Las muestras de fauna de grupos de islas, las Antillas Menores, las Antillas Mayores y las Islas Vígenes, y las Bahamas, Turcos y Caicos, comparten características y pueden ser analizadas en estas agrupaciones de islas, así como en forma individual. A pesar de la variación dentro de estos grupos de islas, reflejan una disminución de la diversidad a mayor distancia de la tierra firme, y una correlación positiva entre diversidad y tamaño de la isla. Si bien los colonizadores estuvieron sujetos a las limitaciones descritas por los principios biogeográficos de islas, pudieron también ejercer cierto control al enriquecer desproporcionalmente la diversidad de especies en islas pequeñas mediante la introducción de animales.

INTRODUCTION

Native American colonization of the West Indian archipelago was fraught with uncertainties. These early colonists faced distant ocean voyages to islands with unfamiliar plants and animals. They did not know whether they would find resources they were accustomed to using in sufficient quantities to sustain life. All of the resources they required for food, medicine, and the raw materials for construction of tools, equipment, shelter, and clothing had to be met by the plants and animals of the island, its surrounding waters, and whatever was imported. The animals that were used for food and whose remains were incorporated in archaeological deposits are evidence for the ways the colonists coped with the differences they found in island faunas.

Despite the uncertainties Native Americans faced, they did colonize the West Indies, Bahamas, and the Turks and Caicos islands (Fig. 1). Whether they were pushed by population pressures on the mainland or were drawn by the potentials of the islands is still debated. Whatever the force that initiated migration, Amerindians moved into the West Indies from at least two fronts and came in at least three waves of migration (Rouse 1992). The first wave of migration took place around 4000 B.C. and originated in Middle America. These people with Casamiroid culture settled in western Cuba. The second and subsequent waves of migration originated from the northeastern coast of South America. The second migration occurred around 2000 B.C. bringing people with Ortoiroid culture into the Lesser Antilles and the Virgin Islands. The third and largest wave of migration began about 250 B.C. These people, belonging to the Ceramic age, colonized virtually all of the islands of the West Indies and the Bahamas by the time Europeans explored the Caribbean. The adaptation of these Ceramic age people to the island ecosystem is the focus of this paper. The data upon which it is based are samples of animal remains excavated from this third period of settlement.

A better understanding of the kinds and diversity of plants and animals that might be found on islands such as the West Indies is provided by research stimulated by the seminal work on island biogeography by MacArthur and Wilson (1967). The equilibrium theory that stems from this research considers the numbers of species occurring on islands to be the dynamic balance between immigration and extinction (Connor and McCoy 1979:806). As a consequence, the diversity of species on islands decreases with the distance of the island to the mainland source of species (MacArthur and Wilson 1967). Thus, human colonists would encounter ever fewer species the further they ventured from the mainland. The number of species on an island is also related to the area of the island. This relationship, known as the species-area curve, is best described by the power function model, log species/log area. People settling on smaller islands would theoretically find fewer species than those settling on larger islands at equal distance from a source of species. Many studies of the species/area curves of different organisms have found that the slopes of these curves fall within the

FIG. 1.—Map of the West Indies.

range of 0.20 to 0.40 (Connor and McCoy 1979:801). We use this range to evaluate the effects on human exploitation of the decreased diversity of animal resources found on small isolated islands.

Our focus is to apply island biogeographic principles to the analysis of archaeological faunas, and use the results to gain a better understanding of human adaptations to these island settings. Ideally, we would compare the archaeological faunas directly with the modern faunas of the islands. However, introductions of both New and Old World animals, extinctions of endemic species, and landscape modifications for plantation agriculture have so drastically modified the island faunas, as they were found by Amerindians, that direct comparisons are no longer appropriate (Woods 1989, 1990). Instead, we assess an array of faunal assemblages from the perspective of general biogeographic principles derived from many studies of the distribution of plants and animals (Preston 1962; Hamilton et al. 1964; MacArthur and Wilson 1967; Connor and McCoy 1979; Woods 1990). We use individual abundance, generic richness as seen in the slopes of log species/log area curves, diversity and equitability, and similarity indices for this analysis of a series of vertebrate faunal assemblages excavated from archaeological sites in the Caribbean (Table 1). We also divide the faunal samples into habitat specific subsamples and extend our analysis to include the relative contributions of each to the fauna as a whole. The resulting patterns provide a better understanding of the nature of human adaptation to colonization of the West Indian island archipelago.

MATERIALS AND METHODS

Site selection.—We follow three guidelines in the choice of sites for this study. The sites are chosen to represent past resource exploitation throughout the West Indies and as such are located in a broad array along the island chain. Only samples recovered using a fine gauge screen sieving strategy are included in this study. The samples come from midden refuse and, whenever possible, from deposits that accumulated during the early ceramic period. Our choice of archaeological faunal samples are intended to insure both the greatest comparability of recovery methods and archaeological context as well as the widest geographic distribution of the samples.

The faunal samples come from 18 sites located on 13 islands, six in the Lesser Antilles, two in the Virgin Islands, two in the Greater Antilles, and three in the Bahamas, Turks and Caicos (Table 1; Fig. 1). The majority, 16, of the sites are located directly on the coast. Two sites, Hope Estate on St. Martin and Tutu on St. Thomas, are in the higher elevation, interior of these islands, 2 km from the shore.

The samples are all from Ceramic age contexts deposited by people who practiced agriculture (Newsom 1993). The matrix of these deposits is composed of mollusc and crab shell. Three of the samples are features, features 4 and 25 from En Bas Saline and feature 104 from Maisabel. All samples are identified by the excavators as midden refuse. The animal remains in them represent primarily food remains. The vertebrate remains are primarily small- and medium-sized individuals weighing from 100 to 500 gr. Some of their fragmentary remains are

TABLE 1.—The faunal samples analyzed. Their island location, dates of the deposits, and reference are presented. C^{14} dates are listed as the mean and standard deviation BP and the number of the issuing laboratory. In the absence of C^{14} dates, chronological dates spanning the years of the production of dated pottery associated with the faunal remains are given.

Island	Site Name	Date	Reference
Bahamas			
1. Samana Cay	SM-2, SM-7	AD 1000–1500	Watford[1], Hoffman[1]
2. Crooked Is.	CR-8, CR-14	AD 1000–1500	deFrance 1991
Turks and Caicos			
3. Middle Caicos	MC-6, MC-12	AD 750–1500	Wing and Scudder 1983
Greater Antilles			
4. Hispaniola	En Bas Saline (fea. 4 and 25)	AD 1250–1500	Deagan 1988
5. Puerto Rico	Maisabel	AD 200–600	deFrance 1988
Virgin Islands			
6. St. John	Trunk Bay	AD 100–800	Wild[1]
	Calabash Boom	AD 1050 ± 60	Caesar[1]
7. St. Thomas	Tutu (2044 lv.D&F)	1430 ± 90 BP (Beta 62568)	Wing et al. 1993
Lesser Antilles			
8. St, Martin	Hope Estate	2250 ± 45 BP (PITT-0220)	Haviser 1988
9. Saba	Kelbey's Ridge	AD 670–1350	Hofman 1993
	Spring Bay (unit 31)	655 ± 30 BP (GrN -16773)	Hofman 1993
10. Nevis	Hichman's (GE-5)	AD 0–600	Wilson[1]
	Indian Castle (GE-1)	1280 ± 60 BP (Beta-19327)	Wilson[1]
11. Antigua	Mill Reef	AD 500–1150	Wing et al. 1968
12. Barbados	Silver Sands	650 ± 100 BP (I-16,215), 990 ± 80 BP (I-16,215)	Drewett 1991
13. Grenada	Pearls	AD 200	Fandrich 1990, Stokes 1991

[1] personal communication

burned. Associated with the food remains may be the remains of intrusive animals such as the small land snails found in most sites.

Excluded from analysis are contexts with burials. Dogs are usually found with many associated parts of the skeleton and often recovered in association with human burials in the West Indies (Wing 1991). A burial of an agouti, *Dasyprocta* sp., was recovered from the Sugar Factory Pier site on St. Kitts (Goodwin 1975 letter). These burials are of animals that are either known to be domestic or tame and managed. By excluding burials from analysis, we lean on the side of caution to not overstate a case for the practice of manipulating the faunal resources of the islands. It is possible that other animals that had special cultural significance, such as guinea pigs, *Cavia porcellus*, were also occasionally buried rather than disposed of in midden refuse but these have not yet been found.

Though not always possible, these samples come from the early Ceramic age deposits on each island. The migration of people, originating from northern South America, progressed up the island chain reaching the Bahamas late in the prehistory of the Caribbean. The dates, associated with the contexts with which the faunal samples belong, reflect this progress up the island chain, with the Bahaman sites the most recent (Table 1).

One of the most important methods in zooarchaeological research is recovery of animal remains with fine gauge sieves (3 and 1.5 mm) (Payne 1972). Though this is by no means a new method, it has only recently been used in the West Indies. Faunal samples recovered with fine gauge screen give us a new improved view of animal catches in the West Indies. Based on old samples, recovered with large gauge sieves or simply gathered, one would conclude that sea turtles were the primary resource used in the Caribbean. However, with the new recovery methods it is now clear that prehistoric catches included diverse species and the majority were small individuals. The width of vertebral centra of fishes correlates well with the size of the fish in life and can be used as a gauge of the sizes of exploited animals. Most of the measurements of vertebral centra from West Indian samples range from 2 to 6 mm. These come from fishes estimated to weigh between 60 and 569 gms (Wing and Brown 1979). Only samples recovered with a fine gauge sieving strategy that would recover this important component of Caribbean faunas are included.

Identification and quantification.—Identifications are always made by direct comparison of each specimen with modern reference specimens in the collections of the Florida Museum of Natural History. The anatomical position of each fragment is determined first and then each fragment is identified to the lowest possible taxon. Identifications to the level of genus and family are used for this analysis to allow greatest possible comparability among samples. In general preservation is good as these remains are in calcareous deposits that provide alkaline conditions favorable for bone preservation. Therefore, identification of even the smallest and most delicate bones is usually possible.

We use minimum numbers of individuals (MNI) to quantify the animals represented in the samples. This measure is a count of the greatest number of identical elements for each taxon. The size of skeletal elements is taken into account in these calculations. For example, one taxon represented by five right dentaries and two left dentaries would represent at least five individuals (MNI) but, if one of the left dentaries is far larger than any of those on the right, the MNI estimate could be increased from five to six. As Grayson (1984) has correctly pointed out, adding the MNI from successive levels can bias the results by counting one carcass, spread though two levels, twice. This is less likely when the fauna is composed of small individuals. Nevertheless, our calculations of MNI are based on the individual animals from an occupation zone, a discrete feature, or widely separated levels.

We use MNI for this analysis for one important reason. These faunal assemblages are composed of species with different numbers of skeletal elements and if we used the basic method of quantification, a count of identified specimens (NISP), we would bias the results in favor of those species with the largest number of skeletal elements. For example, most fish skulls have approximately ten times the number of elements found in a mammal or bird skull and some animals have unique, abundant, and easily identifiable skeletal elements, such as the spines on the spiny box fish or the dermal bones of an armadillo. These differences bias the results of quantification based on NISP. Samples, composed of species from all vertebrate classes with different numbers of identifiable skeletal elements, need to be quantified in some way that reduces these innate biases. Calculation of minimum numbers of individuals is the best method we know at this time.

Sample size.—Sample size is always a critical issue because samples must be large enough to reflect accurately the nature of the population sampled (Table 2). However, it is not always possible to dictate the sizes of archaeological samples. We include only those that have over 125 MNI and then test the sample sizes to insure that the diversity measures we use in the analysis do not correlate with sample size. The methods we use to test for adequate sample size are the random sampling method and sample size rarefaction.

We use the random sampling method described by Kintigh (1989) and McCartney and Glass (1990) to test whether our samples are random collections from a population. We simulate random samples from the summed generic abundance for all sites together and count the number of genera "collected" for hypothetical sample sizes from 0–3,000. The distribution of these hypothetical samples shows a classic rarefaction curve where accumulation of new genera progresses at an increasingly slow rate with increased sample size. When the data from each site are plotted against this curve, we find that the sites from the two large islands, Hispaniola and Puerto Rico, and the site on the island closest to the mainland, Grenada, fall within the distribution while the cluster of sites from smaller islands falls significantly below the line (Fig. 2). This indicates that sites on large islands and the island close to the mainland are representative of the overall population in terms of sample size and generic richness, but the sites on smaller islands fall well below the expected richness even in the case of the large sample size for the site on Antigua. Species richness in the samples from the two smallest islands, Saba and Samana Cay, fall farthest below the line. This also indicates that island size effect on generic richness is large. Because of this island size effect on expected richness, it is also necessary to view sample size for each island separately.

We employ the method of sample size rarefaction to compare the adequacy of each of the samples (Sanders 1968; Hurlbert 1971; Krebs 1989). This procedure provides an estimate of the number of species that would be expected in a sample of a given size based on the relative abundance of species in the whole sample. We use this technique to produce rarefaction curves for each sample and then scale these curves to 1 for sample size on the x axis and for generic richness on the y

TABLE 2.—Islands, their land area (km2), number of vertebrate genera identified, minimum numbers of individuals (MNI), diversity (H'), and log of the genera. The number of genera for each site or component of a site are listed after the total number of genera for the island.

Island	Area[1]	Number of Genera	MNI	H'	Log of Genera
Bahamas					
1. Samana Cay	39	23: 17 (SM-2), 12 (SM-7)	227	0.79	1.36
2. Crooked Is.	238	20: 11 (CK-8), 20 (CK-14)	196	1.02	1.30
Turks and Caicos					
3. Middle Caicos	190	36: 32 (MC-6), 19 (MC-12)	264	1.12	1.56
Greater Antilles					
4. Hispaniola	76193	48: 34 (fea. 4), 36 (fea. 25)	199	1.42	1.68
5. Puerto Rico	8865	45: 43 (S38W18), 22 (fea. 104)	153	1.43	1.65
Virgin Islands					
6. St. John	49	38: 34 (TB), 24 (KB)	249	1.28	1.58
7. St. Thomas	70	33	202	1.22	1.52
Lesser Antilles					
8. St. Martin	88	21	147	0.97	1.32
9. Saba	13	29: 23 (KR), 26 (SB)	196	1.27	1.46
10. Nevis	130	32: 30 (GE-5), 20 (GE-1)	234	1.22	1.51
11. Antigua	280	36	869	1.15	1.56
12. Barbados	431	27	179	1.18	1.43
13. Grenada	344	31	132	1.33	1.49

[1] Woods 1990

axis. The curves are then plotted for comparison (Fig. 3). The sample from Antigua, number 12, is the largest with 823 MNI and therefore shows a greater degree of saturation than the curves of the other samples, which are similar to one another.

The other critical issue about sample size, in addition to being an adequate representation of the animals that were central to the protein portion of the prehistoric diet, is whether they correlate with the measures used in this analysis, generic richness, diversity, and equitability. To test for correlation we use a Spearman's rank correlation of sample size (total MNI and marine component subsample) with generic richness and diversity. None of these correlations are significant, showing that total sample size is not linked to richness or diversity, nor are the marine subsamples linked to the marine component richness or diversity or the terrestrial subsample linked to terrestrial diversity (Table 3). However, terrestrial generic richness is correlated with terrestrial MNI, indicating that there may be a reduction in the power of our regression analysis for this group. As a conservative measure, we evaluate terrestrial subsamples in a descriptive sense only and focus on the relative importance of terrestrial fauna within the whole. These

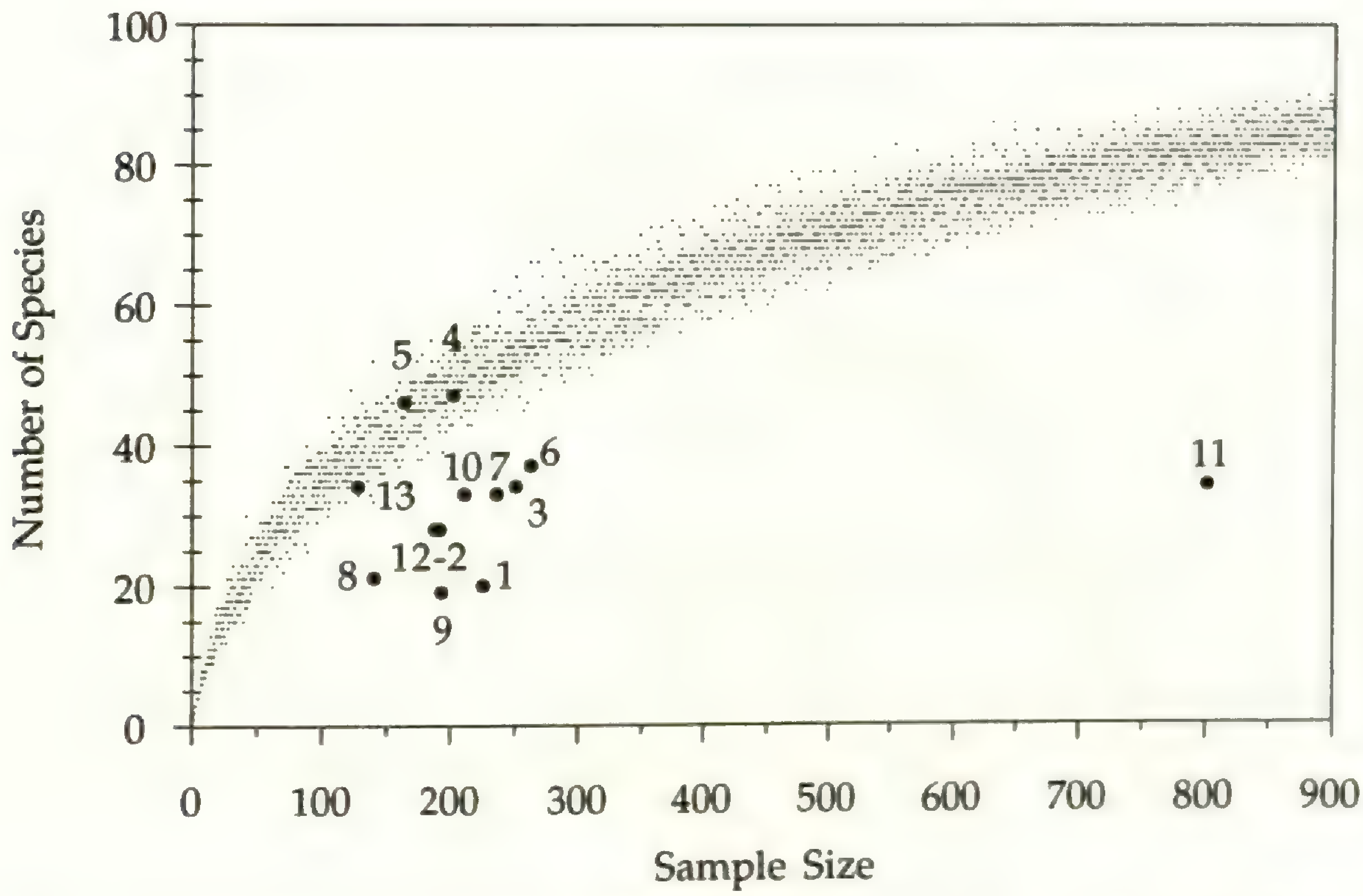

FIG. 2.—Simulated random samples from the summed generic abundance for all sites together, and a count of the number of genera "collected" for hypothetical sample sizes from 0 to 3000. Each point represents a hypothetical sample.

tests indicate that the sizes of the total samples we use adequately represent the animals that were central to the vertebrate animal protein portion of the diet of settlers on each island. Undoubtedly, other rare species were occasionally used and some of these may have had great cultural significance, but as subsistence is based upon the staples these samples fit our analysis requirements.

Diversity and equitability.—Ecologists frequently use measures developed from information theory (Shannon and Weaver 1949; Margalef 1958) to describe the diversity of biological systems (Peet 1974; Cowell 1978; Magurren 1988; Krebs 1989). These measures combine data on numbers of categories (taxa) and abundance within each category to describe the heterogeneity of a system. Diversity by this definition reflects the amount of uncertainty of predicting the identity of an individual picked at random from the community, i.e., the heterogeneity of the sample. For our analysis we use a common measure of heterogeneity, the Shannon-Weaver function (Shannon and Weaver 1949):

$$H' = \sum_{i=1}^{S} p_i \log_{10} (p_i)$$

where;

H' = information content of the sample

S = number of taxonomic categories

p_i = proportion of the total sample composed of individuals in the i^{th} taxon

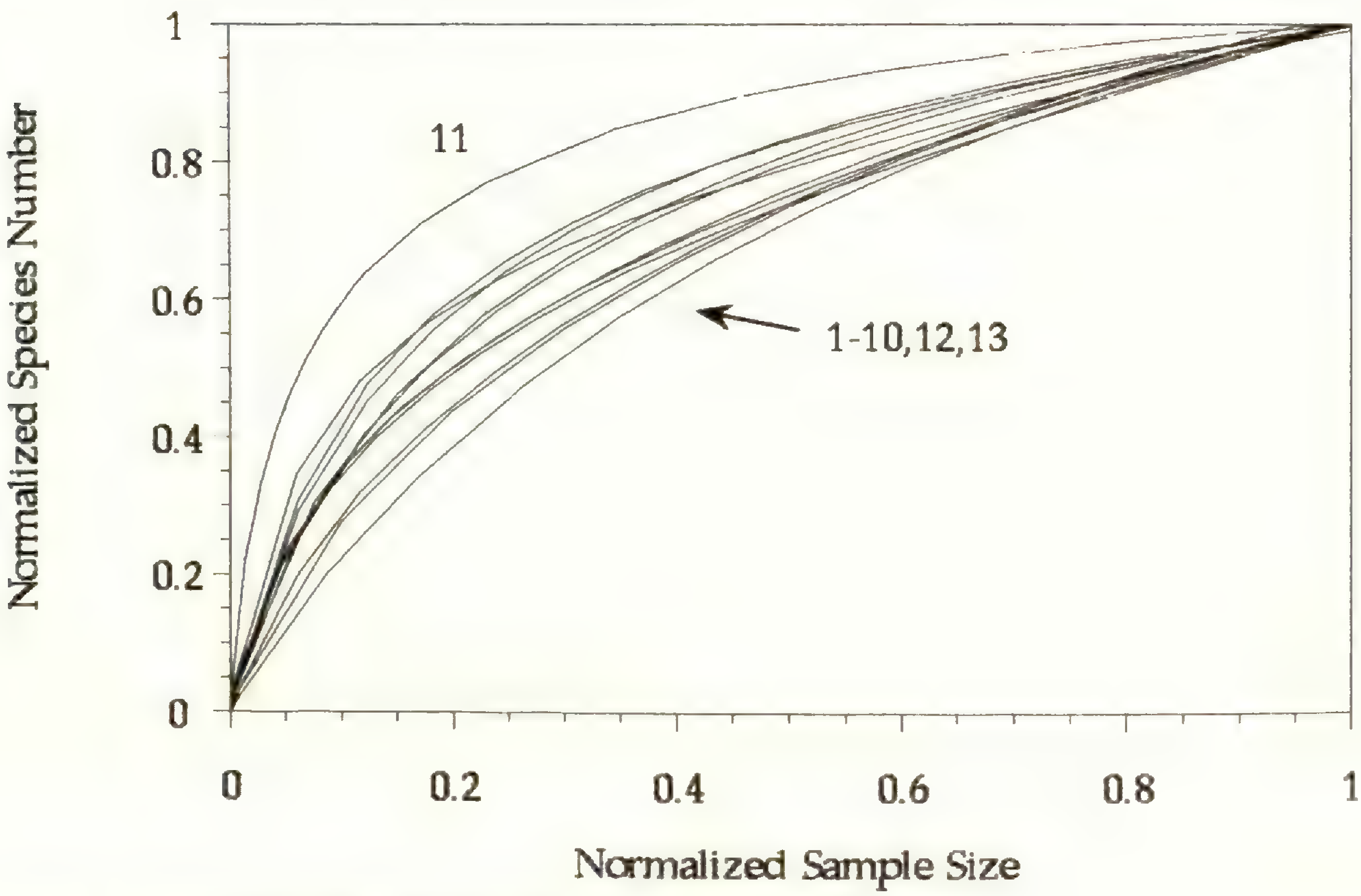

FIG. 3.—Normalized rarefaction curves for each site.

TABLE 3.—The statistical significance of the Spearman's rank correlation of whole sample size and subsample size with generic richness and diversity.

Comparisons		Probability	Significance
MNI	for the total sample vs.:		
	total generic richness	p = .1885	NS
	total diversity	p = .7747	NS
	marine generic richness	p = .3800	NS
	marine diversity	p = .5745	NS
	terrestrial generic richness	p = .3559	NS
	terrestrial diversity	p = .8902	NS
MNI	for the marine component vs.:		
	marine generic richness	p = .2418	NS
	marine diversity	p = .2882	NS
MNI	for terrestrial component vs.:		
	terrestrial generic richness	p = .0256	****
	terrestrial diversity	p = .5908	NS

With this measure of diversity, samples with an even distribution of abundance between taxa have higher diversity than samples with the same number of taxa but with disproportionately high abundance of a few taxa. Alternatively, diversity will reflect the number of taxonomic categories in all samples with equal distributions of abundance. More taxonomic categories lead to greater diversity values when samples show the same degree of equitability in abundance.

Measures of heterogeneity combine two independent concepts, species richness (the number of species) and equitability (the degree to which species are equally abundant). Examination of equitability independent of richness is also of interest. Equitability may be calculated by scaling the heterogeneity measure to its theoretical maximum (Hurlbert 1971; Peet 1974). The theoretical maximum for H' occurs at LogS, so equitability is measured by V'=H'/LogS (Hurlbert 1971). Values close to one suggest even use of resources, while lower values suggest a greater degree of specialization in the use of resources. Low values may occur because of low available diversity of food resources or because of specialized use of a few taxa among a highly diverse sample of food resources.

Similarity indices.—Similarity measures describe the overlap in the use of resources, in other words, the similarity between the faunal assemblages of two sites. We use the simplified Morisita-Horn index (MH) to compute the similarity of the faunal samples from different islands (Horn 1966). The index is a function of the overlap in taxonomic categories and abundance within each category. It is computed as follows for site a and b:

$$MH = 2 \left[\frac{aN_i bN_i}{(da+db)N_a N_b} \right]$$

where;

N_a = total number of individuals in site a
aN_i = number if individuals in the i^{th} species of site a
d_a = sum of aN_i^2 divided by N_a^2

This index is generally insensitive to differences in the richness of taxonomic categories and sample size but sensitive to the abundance of the most numerous taxonomic category (Wolda 1981). Independent studies by Smith (1986) and Wolda (1981) found that the Morisita-Horn index is among the most sensitive and robust of measures available. The insensitivity of the index to differences in sample size makes it particularly appropriate for this analysis.

We use this similarity index to compute the scale of taxonomic overlap for the marine and terrestrial subsamples separately. This is done by plotting all pairwise comparisons between marine and terrestrial subsamples and the distance between each pair of islands from which the subsamples are derived (Fig. 4a and 4b). We expect that the typically large scale of dispersal of organisms in the sea will result in a relatively high degree of overlap in the taxonomic categories within the marine subsamples association between similarity and distance between islands. In contrast, the restricted dispersal of terrestrial organisms within typical island archipelagos will reflect generally low values for similarity and decreasing similarity with increased distance between islands. This pattern

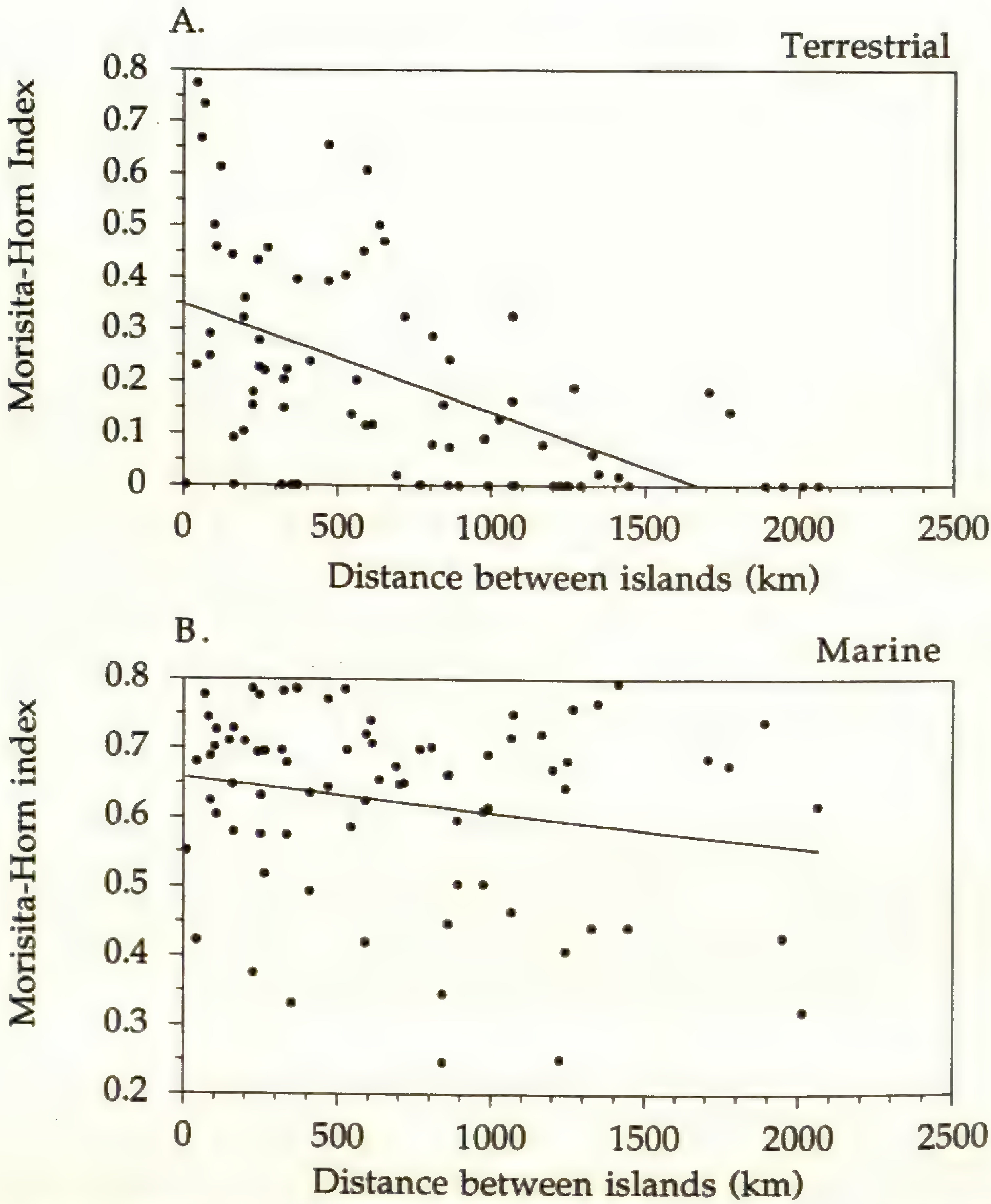

FIG. 4a.—Morisita-Horn index of the similarity between terrestrial components of each site measured against the distance between islands (km). ($y = 0.6572 + -0.00020823x$; $r = 0.53$; $p < .05$). FIG. 4b.—Morisita-Horn index of the similarity between marine components of each site measured against the distance between islands (km). ($y = 0.6572 + -0.0000503x$; $r = 0.19$; $p > .05$ NS).

reflects the fundamental difference between open marine systems (in the sense of Roughgarden et al. 1985) and the subdivided terrestrial systems, islands.

Log species/log area curves.—The animals used by people do not reflect the total island fauna or the relative abundance in which they occurred. Rather, human exploitation may be viewed as a filter retaining the remains of those species that were selected for food and could be caught with the available technology. Though faunal assemblages represented by remains may be modified by a number of other filters, such as the depositional history, preservation, and identifiability of the remains, we do not expect these filters to be sensitive to differences in island size or distance from the mainland between sites. However the first filter, the effect of species diversity and abundance on human foraging patterns, may retain properties consistent with the available resources on each island. That is, we expect the slope of log species/log area curve for the sites to be positive, reflecting the slope of log species/log area curves for most distributions of organisms that fall within relatively narrow limits, a range between 0.2 and 0.4 (Connor and McCoy 1979). However, if there was some differential selectivity or enhancement of resources on small islands, this slope would be reduced.

In the migration into ever more distant and isolated islands, several adjustments may have been made to allow sustainable harvests of animal resources. One modification is to emphasize use of more reliable resources, such as reef fishes. Another made by people who colonized most islands is to enhance the number of terrestrial species through the introduction of domestic and captive animals brought from the mainland or from nearby islands. Such additions to the exploited faunas of small islands would reduce the slope of the total log species/log area curve.

Analysis.—Our strategy is to analyze the total faunal samples for patterns of diversity, equitability, similarity, and the slopes of the log species/log area curves, and then to divide the samples into habitat specific subsamples to determine the pattern of distribution of each subsample in a descriptive sense. We test for trends associated with distance from the mainland and island area with least square linear regression analysis. In the case of diversity and equitability measures, which are not necessarily normally distributed, we use the more conservative approach of rank transforming the index and running a regression on the ranked estimates (Conover 1980).

Subsamples.—For analysis of trends within the fauna, we divide the samples into four habitat specific subsamples, which are composed of endemic and introduced terrestrial species, estuarine, and reef organisms. We investigate trends in generic richness and relative size (MNI) between the subsamples associated with distance along the island chain and island area. Unfortunately, by dividing the total samples into these groups the sample sizes of terrestrial and introduced animals are compromised for regression analysis. We therefore rely on a more descriptive analysis of distribution of these two groups. The endemic terrestrial faunas of the islands were enriched by the animals introduced by Amerindians from both the mainland of South America and the Greater Antilles (Table 4). Though we examine the importance of introduced animals to subsistence, they probably had significance beyond subsistence (Wing 1993a). The estuarine subsample includes; manatee (*Trichechus manatus* Linnaeus), West Indian monk seal [*Monachus tropicalus* (Gray)], crocodile (*Crocodylus* sp.), sea turtle (Cheloniidae), sting ray (*Dasyatis* sp.), ladyfish (*Elops saurus* Linnaeus), tarpon (*Megalops atlanticus* Valenciennes), bonefish [*Albula vulpes* (Linnaeus)], herrings (Clupeidae), needlefishes

TABLE 4.—Introduced animals in the Caribbean during prehistoric times (Olson 1978; Morgan and Woods 1986; Wing 1989).

Source	Destination	Species
Within Island Chain Introductions		
Hispaniola	Puerto Rico, Virgin Islands	extinct insectivore *Nesophontes edithae* Anthony hutia *Isolobodon portoricensis* Allen flightless rail *Nesotrochis debooyi* Wetmore
Greater Antilles	Bahamas, San Salvador Lesser Antilles, Saba	pond turtle *Trachemys* sp.
Large Bahama Is.	remote Bahamas, Samana Cay	? cony *Geocapromys* sp.
Introductions From Mainland		
South America	probably entire Caribbean	domestic dog *Canis familiaris* Linnaeus
South America	Lesser Antilles	opossum *Didelphis marsupialis* Linnaeus armadillo *Dasypus novemcinctus* Linnaeus agouti *Dasyprocta leporina* (Linnaeus) tortoise *Geochelone carbonaria* Spix[1]
South America	Antigua, Puerto Rico Hispaniola	guinea pig *Cavia porcellus* (Linnaeus)

[1] probably an historic period introduction.

(Belonidae), silversides (Atherinidae), snook (*Centropomus* spp.), bigeye scad [*Selar crumenophthalmus* (Bloch)], amberjack (*Seriola* sp.), mojarra (Gerreidae), barred grunt [*Conodon nobilis* (Linnaeus)], pigfish [*Orthopristis chrysoptera* (Linnaeus)] porgies (Sparidae), croacker (Sciaenidae), mullet (Mugilidae), clinids (Clinidae), sleeper (Eleotridae), cutlassfish (*Trichiurus lepturus* Linnaeus), and boxfish (*Lactophrys* spp.) (Randall 1968). Pelagic fishes are a rare component of these faunal assemblages, never constituting more than 7.5% of the fauna. Thus we do not analyze this component separately. The group of fishes inhabiting reefs and the surrounding pelagic waters includes all other marine genera (Randall 1968). The taxa represented in all of the samples are listed in Appendix 1.

RESULTS

Whole Samples.—We apply three methods of analysis to the whole samples representative of each island. These are correlations between diversity indices and generic richness with island area and the measure of equitability with distance

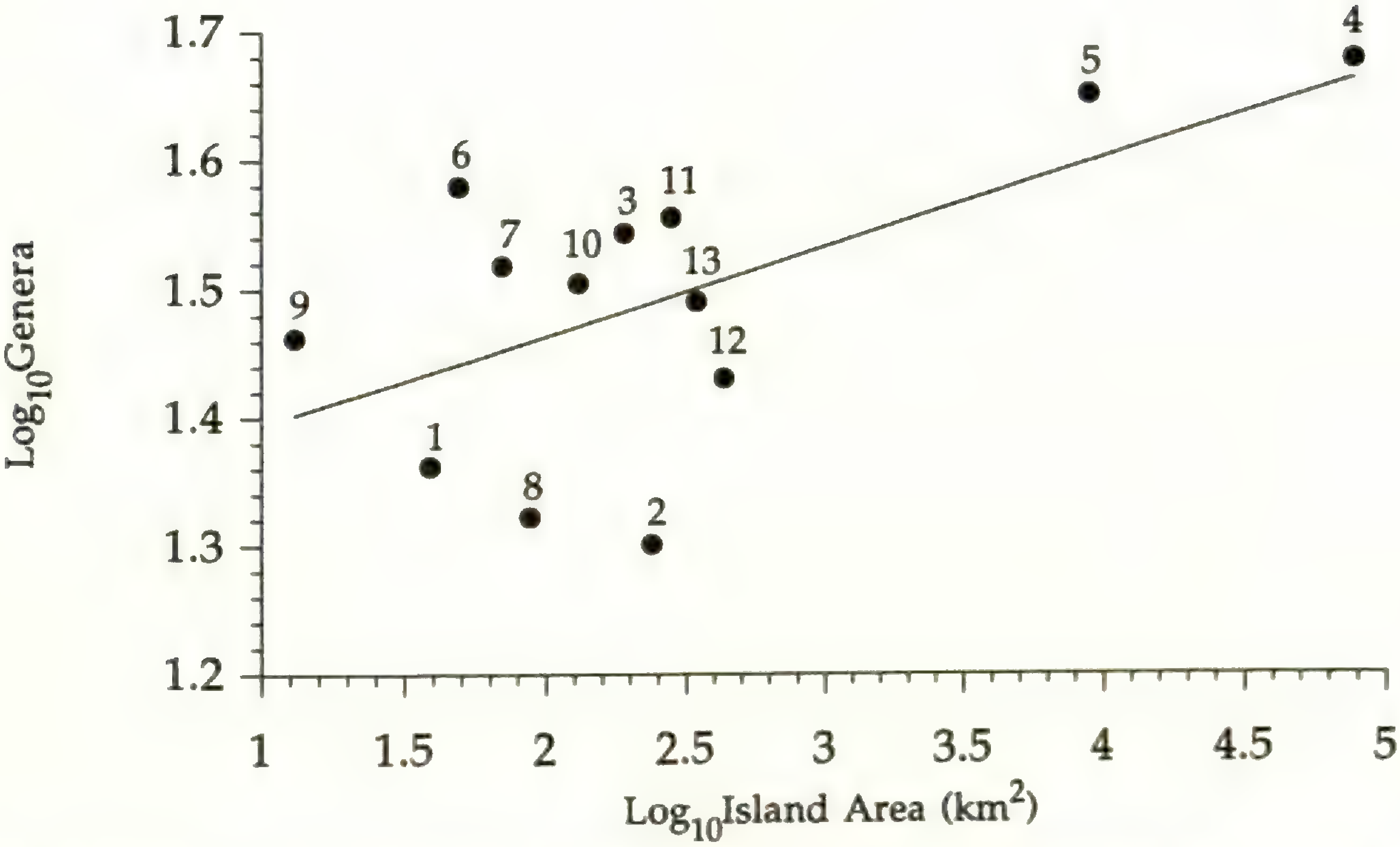

FIG. 5.—Log_{10} of the genera of the whole sample plotted against the Log_{10} of the area of the island. ($y = 1.3234 + 0.07018x$; $r = 0.601$; $r^2 = 0.362$; $p = .0296$).

from the mainland. No significant correlation exists between the total sample size and each of these tests as measured by the Spearman's rank correlation.

We find that the log species/log area curve (Fig. 5) increases with island area. The slope of the curve is 0.07, lower than predicted by data from the underlying distribution of fauna on islands, which ranges between 0.2 and 0.4 (Connor and McCoy 1979). This illustrates the effect of human selection from the underlying distribution of animals on islands of different sizes. The logs of the numbers of taxa fall into groups according to the location of the island rather than strictly by island size (Table 2). The samples from the Bahamas and those from the Lesser Antilles are broadly overlapping, 1.30 to 1.56. The values for the samples from the two Virgin Islands sites, 1.52 and 1.58, are at the upper end of the range, while those from the Greater Antillean sites are well above that range, 1.65 and 1.68.

A similar pattern of increase with island area results from diversity, as measured by the Shannon-Weaver index (Table 2, Fig. 6). Regression analysis of these data produces a line with a positive slope, 0.0809, that is statistically different from zero. The ranked diversity measures and regression produce the same pattern. As with the log species/log area curve, the samples from the Greater Antillean sites (Hispaniola and Puerto Rico) have distinctly more diverse faunas, with diversity values of 1.42 and 1.43, than the cluster of samples from the Lesser Antilles and the Virgin Islands, with values from 0.97 to 1.33. Samples from sites in the Bahamas fall below the regression line, having the lowest diversities, with values from 0.79 to 1.12.

Analysis of the equitability of the whole faunal samples results in a significant pattern of decreased equitability with distance from the mainland (Fig. 7). The equitability indices are high, above 0.8 for the majority of the samples from

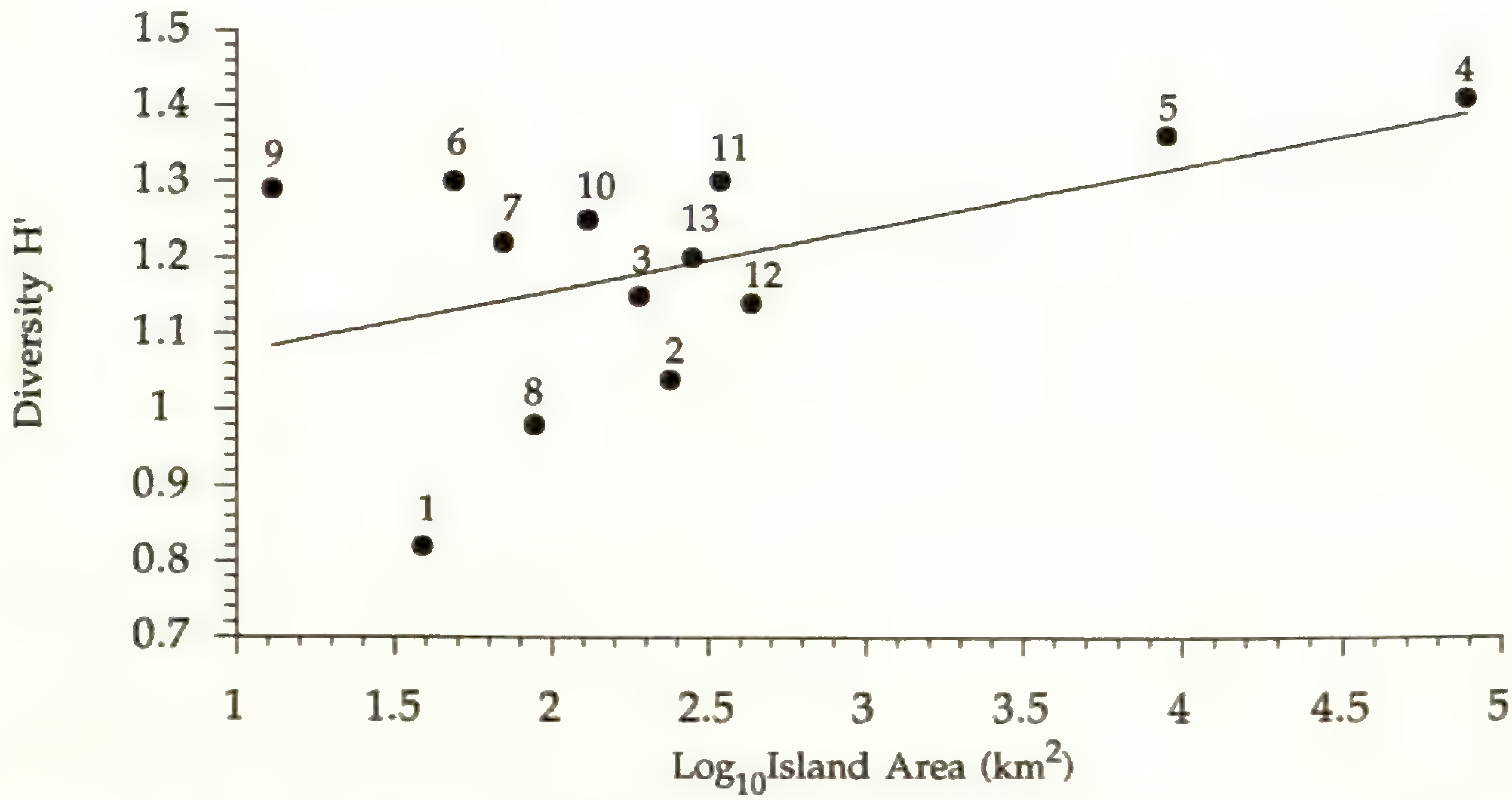

FIG. 6.—Diversity (H') of the total sample plotted against the Log_{10} of the area of the island. ($y = 0.9936 + 0.0809x$; $r = 0.49$; $r^2 = 0.244$; $p = .086$ NS).

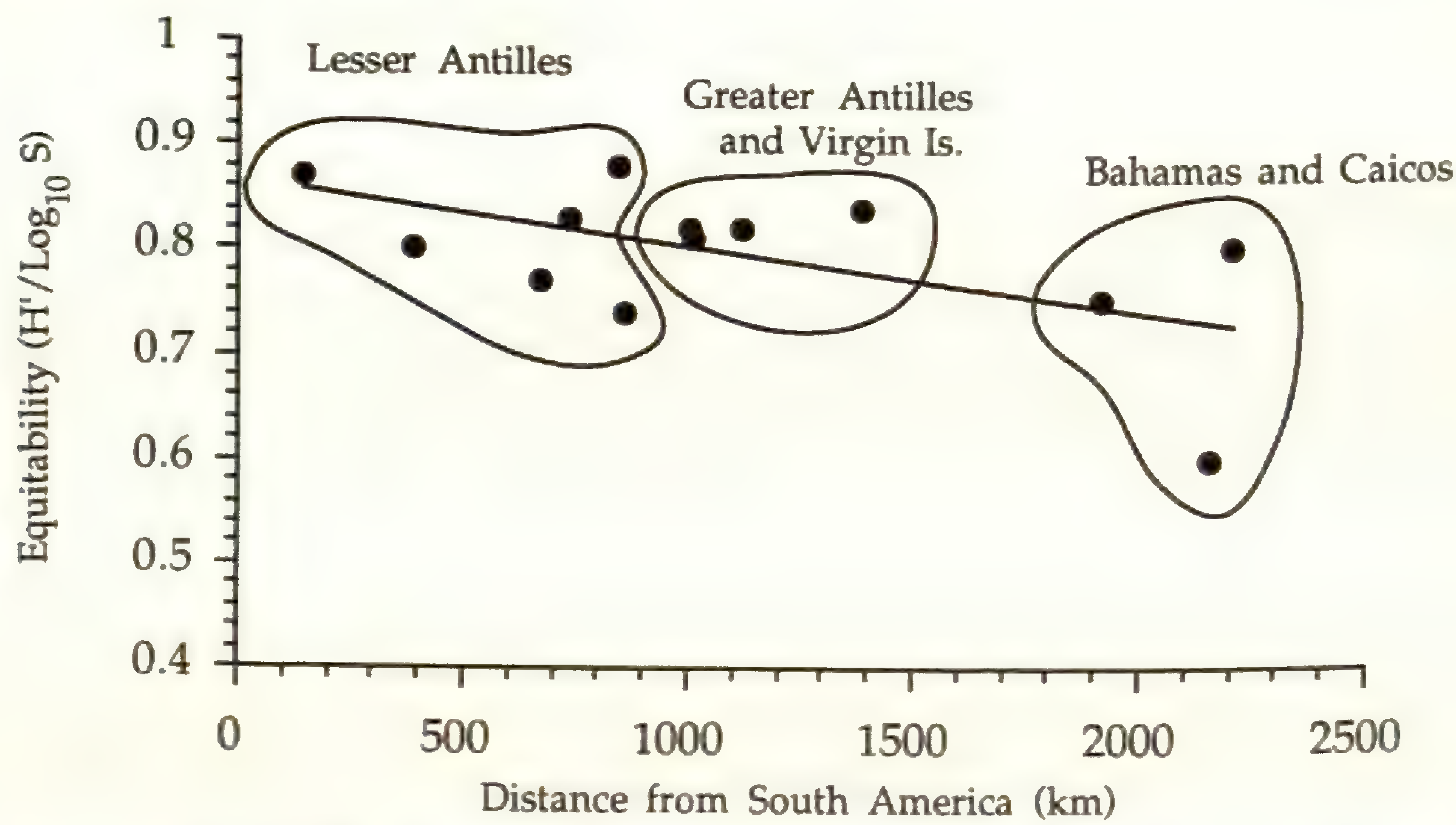

FIG. 7.—Equitability of each whole sample plotted against distance from the mainland of South America. ($y = 0.86 + -0.0000629x$; $r = 0.56$; $r^2 = 0.32$; p .0433).

the Lesser and Greater Antilles and the Virgin Islands, and at 0.8 or substantially below for the samples from the Bahamas and Middle Caicos.

Similarity between island faunas.—The Morisita-Horn similarity indices for the marine and terrestrial components of the samples provide evidence for the differences between these two components in terms of similarity across the island chain. This index of similarity reveals two trends that meet our expectations.

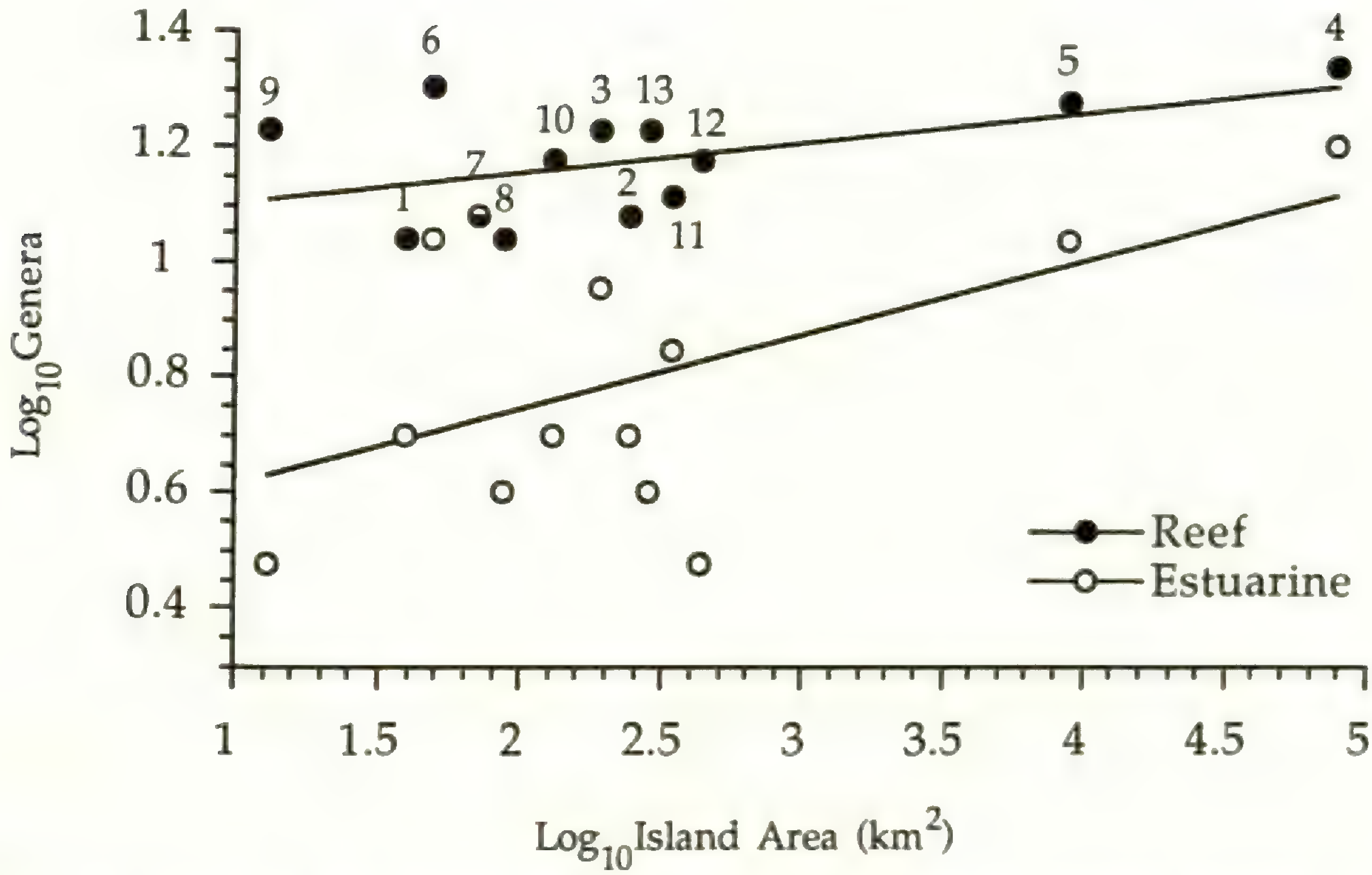

FIG. 8.—Log_{10} of reef genera (a) and estuarine genera (b) plotted against the Log_{10} of the area of the island. a: ($y = 1.053 + 0.0519x$; $r = 0.517$; $r^2 = 0.268$; $p = .069$ NS) b: ($y = 0.486 + 0.130x$; $r = 0.540$; $r^2 = 0.3$; $p = .05$).

Among the terrestrial subsamples, increased distance between islands from which the pairwise subsamples were taken is correlated with decrease in similarity. The resulting regression produces a statistically significant line of negative slope (Fig. 4a). However, among the aquatic subsamples, distance between islands is not correlated with similarity. The resulting regression produces a line with a slope not significantly different from zero (Fig. 4b). The pairwise overlap values are not strictly independent, so confidence limits established by regression must be interpreted cautiously. However, the trends show clearly that the marine component of the faunal samples is more similar across the island chain than the terrestrial component.

Habitat specific subsamples.—Further subdivisions of the faunal samples allow examination of those segments of the faunal assemblage most effected by island size and isolation. The marine component of these samples is subdivided into estuarine, reef, and pelagic animals and each is correlated with island area in a transect from the South American mainland to the Bahamas. Pelagic fish richness and abundance are low in all samples, but highest in the two most oceanic islands, Samana Cay and Barbados. Reef richness and abundance vary little throughout the island chain. The log species/log area curve for the reef fauna alone has a slope that is not significantly different from zero (Fig. 8). In contrast, estuarine generic richness is greatest in the larger islands of the Greater Antilles and their immediate neighbors, the Virgin Islands and Middle Caicos. The log species/log area curve for the estuarine fauna alone has a significant slope of 0.130. This difference in the slope is the direct effect of island size on the richness

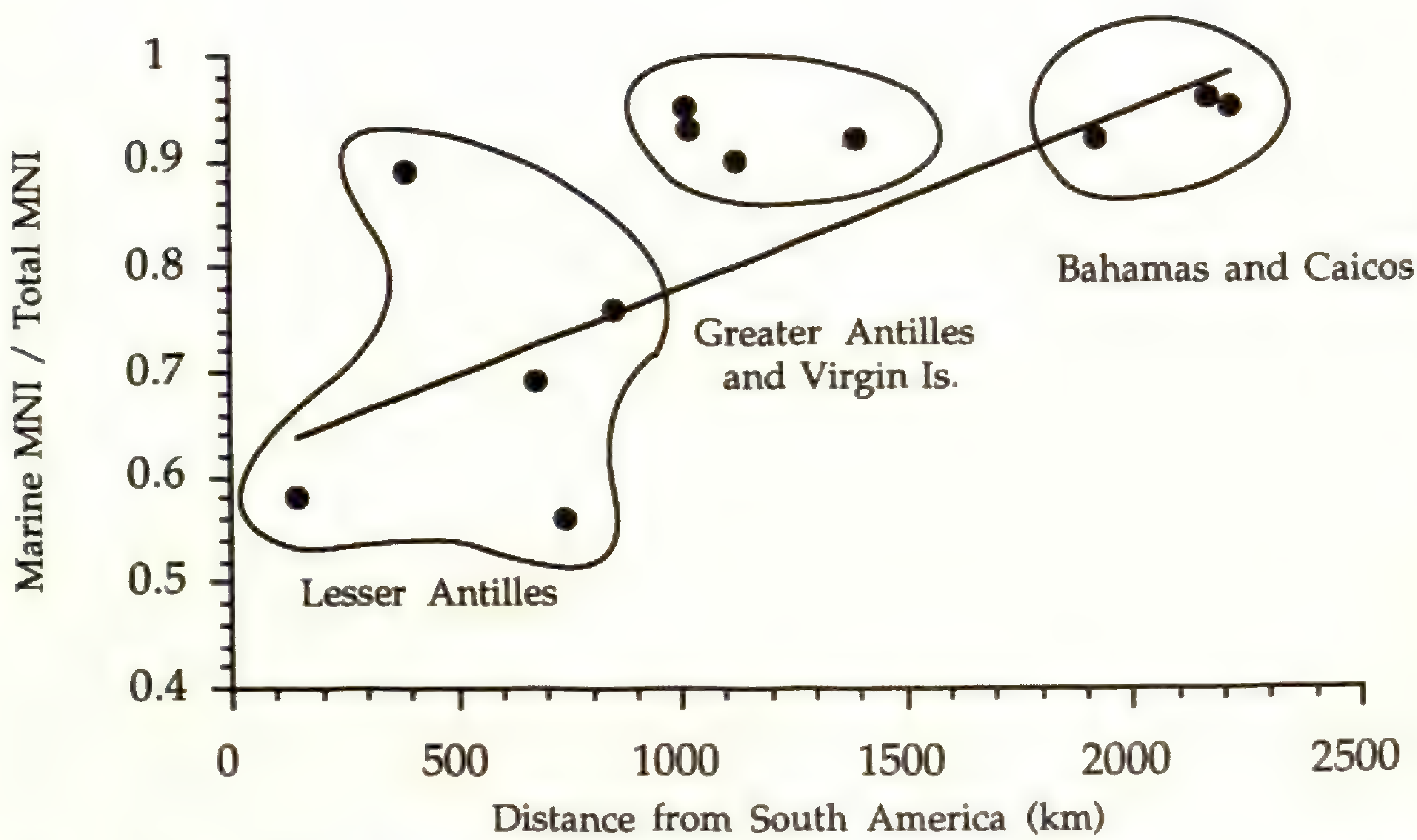

FIG. 9.—The MNI of marine genera divided by the total MNI plotted against the distance from the mainland of South America. ($y = 0.6117 + 0.0001\,68x$; $r = 0.57$; $r^2 = 0.057$; $p = .04$).

of estuarine fauna, which disproportionately enriches the marine subsample on large islands.

Another aspect of the marine component is the equitability of the marine fauna compared with distance from the South American mainland. Equitability of the marine fauna decreases with distance from the mainland. The regression of these equitability measures against distance from South America produces a statistically significant line with negative slope. This does not differ significantly from the equitability of the whole samples. Both patterns reflect a general trend towards specialization on marine resources, particularly in the distant Bahamian islands.

The ratio between marine MNI and total MNI provides evidence for the relative importance of the marine faunal component, and by extension the terrestrial component. The correlation of this ratio with distance from the South American mainland produces a statistically significant regression line with a positive slope of 0.0002 (Fig. 9). The samples from the Lesser Antilles form a group with relatively more terrestrial animals, and therefore a low ratio of marine to total individual animals (0.38 to 0.76, excluding Barbados). The outlier to this group (0.89) is the site on Barbados, which is the most oceanic island in the Antilles. The Greater Antilles have intermediate ratios of marine to terrestrial MNI (0.90 to 0.92). The Virgin Islands and the Bahamas have the highest ratios (0.92 to 0.96) and the ratio for the sample from Middle Caisos (0.92) is within this range. These trends suggest an increase in dependance on marine animals with distance from the mainland, with island size and isolation also playing a part.

The terrestrial faunal component is smaller than the marine component and is composed of endemic species and introduced animals. The results of a log species/log area regression fails to reveal a significant relationship. However, several patterns exist in the richness and abundance of the terrestrial faunal component. The source of introduced animals is from the mainland of South America and from the Greater Antilles (Table 4). Consequently, introductions of the most genera are to Grenada, closest to the mainland, and St. Thomas, closest to the Greater Antillean source. The two smallest islands, Saba and Samana Cay, have more introduced genera than the islands adjacent to them (Fig. 10a). This pattern is also evident from the relative MNI of introduced and endemic animals along the island chain, which shows relatively high numbers of introduced animals near the mainland (Grenada and Barbados) and near the Greater Antilles (St. Thomas and St. John) (Fig. 11).

DISCUSSION

These results indicate that human exploitation of animal resources was not free from the constraints described by island biogeographic models. By every measure the trends are for greatest diversity on larger islands, the Greater Antilles, and the island closest to the mainland, Grenada, with lowest diversity on the smaller and most isolated islands of the Bahamas, Turks and Caicos. As a part of these trends, the relative importance of terrestrial resources diminishes with distance from the mainland, and the numbers of estuarine species increase with the island size. The slope (0.07) of the species/area curve by comparison with the range of slopes (0.2 to 0.4) for the underlying distribution of fauna on islands is below what would be anticipated if nothing were lost from the archaeological record and no human selection of resources took place (Connor and McCoy 1979). However, selection of resources and the fundamental choice of site location have an effect on how well the samples conform to the biogeographic principles.

A general observation is that island groups share characteristics and cluster in these analyses, and these relationships are statistically significant. The clusters we recognize are samples from the Lesser Antilles, the Greater Antilles, and the Bahamas; those from the Virgin Islands and Caicos appear to cluster more closely with the Greater Antilles in some analyses and with the Lesser Antilles and Bahamas in others. Thus, we do not see a trend of decreased diversity between the samples from Grenada and Barbados, close to the mainland, and Saba and St. Martin, farthest from the mainland within the Lesser Antilles. But as a group the samples from the Lesser Antilles are less diverse than those from the Greater Antilles. Least diverse of all are the group of samples from the Bahamas, Turks and Caicos. It is, therefore, more accurate to speak of clusters composed of variable samples, which as clusters conform to biogeographic expectations.

The variation within a cluster seems to relate to the particular choices made in selection of the home site and the complex of resources closest to the site. Choice of the location of the home site was not an arbitrary decision, and the majority of sites in the Caribbean and in our samples are located directly on the coast. Only two of the 18 sites are located inland. The Hope Estate site on St. Martin and the Tutu site on St. Thomas are both located 2 km inland. The Hope Estate sample deviates most from the other Lesser Antillean samples. Probably as a consequence of the inland location, the people at Hope Estate relied more on terrestrial

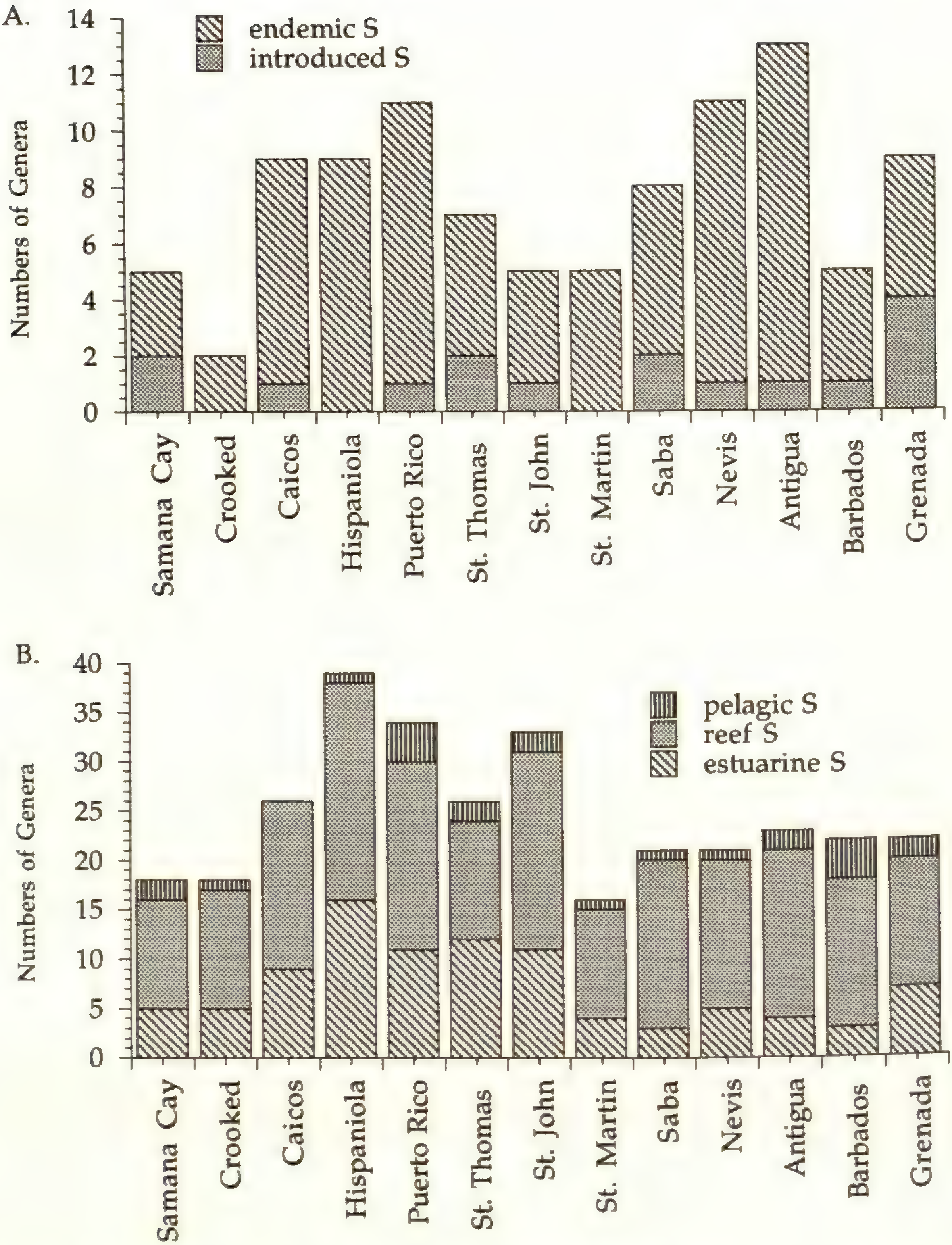

FIG. 10a.—The numbers of genera of introduced and endemic terrestrial animals presented on a gradient from Samana Cay to Grenada. FIG. 10b.—The numbers of genera of pelagic, estuarine, and reef animals presented on a gradient from Samana Cay to Grenada.

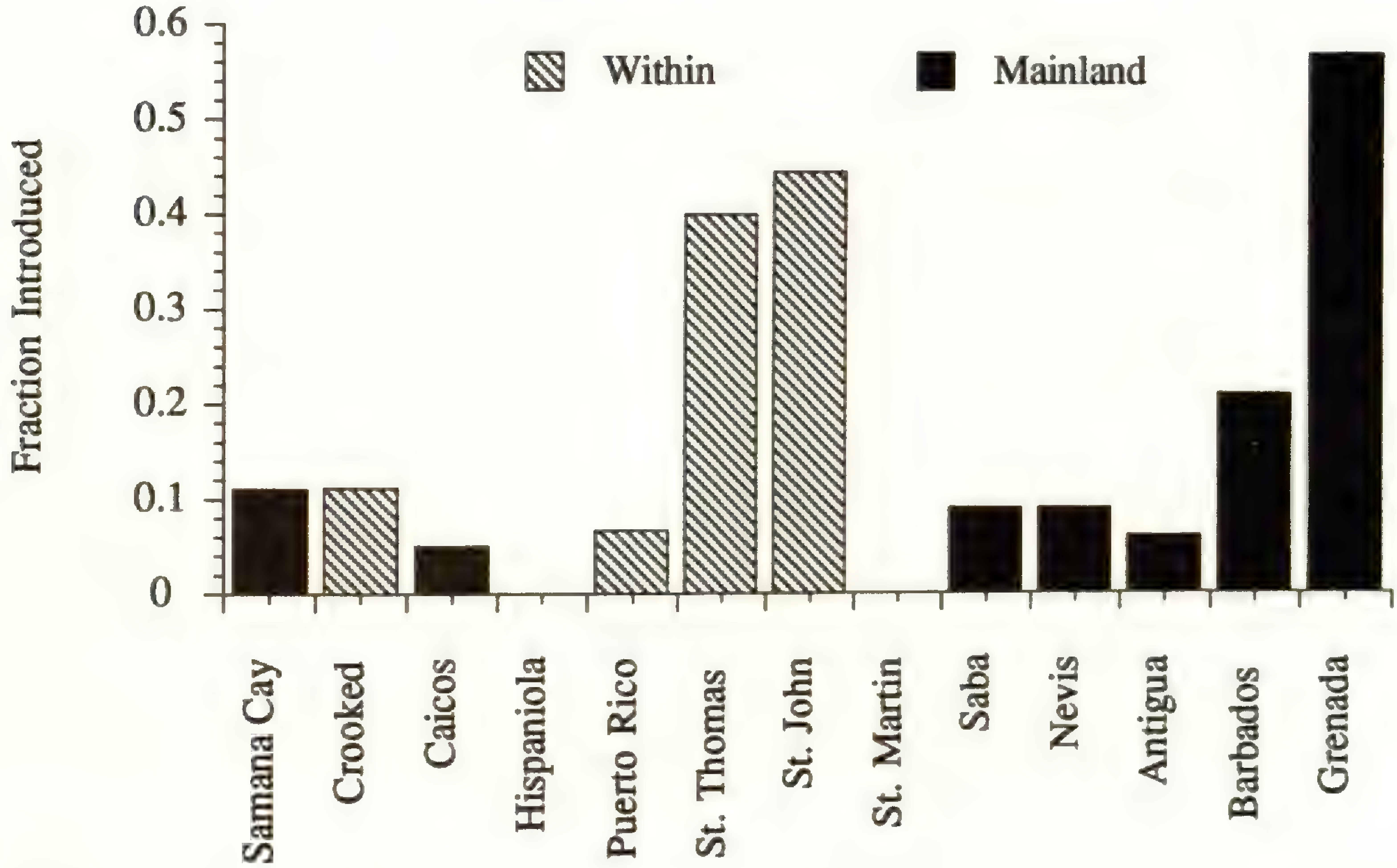

FIG. 11.—The fraction of introduced animals that were introduced from within the West Indian islands and from the South American mainland presented on a gradient from Samana Cay to Grenada.

vertebrates, rice rats, pigeons, and thrashers rather than a whole diverse array of reef fishes. Because of the reliance upon these three terrestrial species, the diversity of this sample is correspondingly low (0.97). The inland sample from St. Thomas does not exhibit the same degree of exploitation of terrestrial animals. Two of the terrestrial species, the insectivore *Nesophontes* and the hutia *Isolobodon*, are introduced species from the Greater Antilles, but neither were used intensively (Wing et al. 1993). The hutia increases in importance in subsequent occupations at Tutu and is more abundant in the later ceramic period site of Calabash Boom on the neighboring island of St. John.

Another example of the impact of site location on animal exploitation is in the difference between the two samples from Middle Caicos, one (MC-6) on the south side of the island facing the large lagoon known as Caicos Bank, formed by the arc of the Caicos islands, and the other (MC-12) on the north side of Middle Caicos facing an island shelf with extensive coral reefs. The faunal composition of these two sites reflects the resources of these locations, one with more estuarine species augmented by shore birds, and the other with more resources from the reefs. Differences such as these that relate to the location of sites undoubtedly account for the variability within the clusters of samples.

With this variation in mind, we can describe and compare the characteristics of the cluster of samples from Lesser Antilles, the Greater Antilles, and the Bahamas. The Lesser Antillean cluster has intermediate diversity, with Hope Estate having the lowest and the Pearls site on Grenada having the highest diversity within the cluster. Generic richness is also intermediate, with a mean number of

30 taxa and a range from 21 to 34. The ratio between marine and terrestrial MNI is low, reflecting the relatively greater dependence upon terrestrial animals. These terrestrial species, as at Hope Estate, are primarily rice rats, pigeons, thrashers, iguanas, and shore birds. This relatively greater reliance upon land animals at coastal sites may be an adherence to mainland traditions by the early colonists. Possibly through experience gained from migration further from the mainland, the shift to greater reliance upon marine resources could be made at least among coastal inhabitants.

Equitability of marine resources, excluding estuarine species, is high among both the Lesser and Greater Antillean samples. This shows a broad use of diverse reef fishes. This is what would be expected if either nets or traps were used. Traps are the more likely technique among reefs. Traps typically catch a variety of species, providing a wide choice to the fisherman. Both nets and traps can be constructed of fine gauge mesh making it possible to catch the small individuals represented in the samples.

The cluster of Greater Antillean samples differs in several respects from other clusters. These islands are large and exhibit the most faunal diversity. The samples from these large islands have intermediate equitability between the Lesser Antillean and Bahamian clusters. The characteristics that set them apart are the greater richness and abundance of the estuarine component of the faunas. The greater number of estuarine species is in large part responsible for the greater diversity in this cluster of samples. Large estuarine areas are associated with the river drainage from the large land masses, providing a greater extent of this habitat and, therefore, greater opportunity to exploit the resources living in estuarine habitats. The Greater Antilles, with their richer endemic fauna, was the source of several species that were kept in captivity and introduced to neighboring islands.

The Virgin Islands, between the Lesser and Greater Antilles, share many of the characteristics of the Greater Antillean cluster. The Virgin Islands, except for St. Croix, are on a shallow shelf that at lower sea level during the Pleistocene joined the land mass of Puerto Rico. Virgin Islands are small today and were the same size at the time they were occupied by the Amerindians. Their location, in shallow waters with more abundant estuarine fauna and close to the Greater Antilles, a source for animals that were introduced, are factors responsible for their high diversity. Most important among these introduced animals was the hutia, *Isolobodon portoricensis.* Despite access to terrestrial resources from the Greater Antilles, the Virgin Island samples have relatively more marine organisms, approaching the abundance of the marine samples from the Bahamas.

The marine component is the most important in the Bahamian, Turks and Caicos cluster. Terrestrial species are the least important, despite the presence of a large endemic rodent, *Geocapromys,* in the Bahamas. This rodent is present in the samples from each island but not abundant in any. Shallow lagoons with inshore estuarine species also occur in the Bahamas, as is evident in the sample from MC-6. Other than the intensive use of estuarine species at this site, the samples from the Bahamas form a cluster most different from that of the Greater Antilles. Both diversity and equitability are lowest in the Bahamian cluster. The equitability in the marine fauna is the lowest in this cluster, in other words fishing was the most specialized. The most abundant reef fish among these samples are the parrotfishes. If traps were used and caught the typical diversity of species, then some selection must have been practiced by the fishermen.

The most common endemic terrestrial species are on the small end of the size range of the majority of the fishes encountered in these West Indian sites. The smaller West Indian rice rats that lived in the northern Lesser Antilles weighed approximately 150 gm, which is larger than our North American species (Wing 1993b). The species that lived in the southern Antilles were still larger. The mourning doves average the same 150 gr, whereas the pigeons, members of the same family, are somewhat larger. Most of the fishes are estimated to range in size from 60 to 500 gm. Therefore, a predominance of land vertebrate, as is seen at Hope Estate, would have provided slightly less meat per animal than an economy based more intensively on marine vertebrates. Introduced animals such as agouti and hutia are all larger, weighing between 1 and 2 kg. Dogs were probably not eaten, but represent the largest land animal important to the Ceramic period culture.

How does this help us understand the problems that were faced by the early Ceramic age colonists of the West Indian archipelago? The variation within the recognized clusters reveals flexibility in the food quest within the constraints of the islands' resources. Mass capture fishing methods must have been used to obtain the array of species, and the consistent small size of the individuals in the catches suggest that fishing equipment was constructed of fine gauge mesh. Probably both traps and nets were important equipment and attained different degrees of importance depending on the extent of inshore estuarine waters and coral reefs adjacent to each island. The few large fishes in Caribbean samples were probably caught by other fishing methods. Thus, this flexibility suggests adaptable fishing strategies that took advantage of whatever resources were most readily available and reliable

The one means by which people augmented the resources of the land was through the introduction of animals. The source of these was from the mainland or from larger islands to smaller ones. Other than domestic dogs and guinea pigs, the introduced animals were captive, presumably tame, animals. These introductions are not numerically important in the samples included in this analysis, though hutia do predominate in at least some inland site in Puerto Rico and in a later ceramic period site in the Virgin Islands. Since domestic animals are not abundant in food refuse, perhaps they filled some other function. We know that guinea pigs have a long history of importance in the ritual and medicinal traditions in the Andes. Guinea pigs are also renowned for their high reproductive rates. Yet, when we find them in the Caribbean, their remains are present in widely separated islands but are rare where they are found. Their scarcity suggests that they were not important to the prehistoric diet, but they were probably used for other cultural purposes. The other introduced animals may also have played some role other than purely a subsistence item in Caribbean culture. Since many of these introduced animals were not domesticated, the maintenance of some of them in captivity may have been difficult, accounting for the small numbers of their remains in the refuse. However, two animals, the agouti and the hutia, were widely distributed by people, suggesting that their successful care and feeding was well understood.

What implications do these findings from the islands have for a better understanding of human use of mainland resources? Island biogeographic models were initially applied to actual islands, and then extended to studies of the faunas and floras of habitat islands. Habitat islands in this sense are habitats surrounded by a dramatically different environment, such as an old growth forest totally surrounded by clear-cut land, or an oasis within a desert landscape. These studies demonstrated that many of the same principles applied. Human use of resources may also be constrained by the size of the habitat island they occupied. The small mammal diversity found in habitat islands formed by mediaeval city walls, the confines of convent gardens, and collegiate grounds was examined by Armitage (1985). This study was confined to the small mammals that coexisted with people, but a similar approach can be taken with the economic species used by people living in different sized habitat islands. If such habitat islands were small, we might expect to see proportionally greater use of captive and domestic animals. Animal remains identified by zooarchaeologists in sites outside of their present range are usually described as former range extensions. Indeed, this is often most likely, however, human introductions should also be considered as an explanation for the difference in the former range. Our study has shown that human flexibility in the food quest allowed adjustment to changes in faunal diversity found within the West Indian archipelago. We anticipate that similar adjustments were made by people as they colonized other archipelagoes.

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APPENDIX 1.—Endemic, introduced, estuarine, reef, and pelagic animals represented in each site designated by the site number listed on Table 1. Quantification is a calculation of minimum numbers of individuals

TAXA	1	2	3	4	5	6	7	8	9	10	11	12	13
ENDEMIC													
Brachyphylla									1	1	9		
Oryzomyine								59	23	53	168	12	14
Brotomys				2									
Isolobodon				4									
Geocapromys		8	1										

APPENDIX 1. (continued)

TAXA	1	2	3	4	5	6	7	8	9	10	11	12	13
Plagiodon					1								
Podicipidae			1										
Puffinus						2					32		2
Procellaridae									1				
Phaethon											2		
Pelecanus													2
Sula		1							7		1		
Ardeidae			1							2			
Phoenicopterus											1		
Aythya												1	
Anatidae				1	1								
Pandion			1										1
Porphyrula												1	
Rallidae			1			2				1			
Laridae	3		1						1		2	1	
Columba					3						1		
Zenaida											5		
Columbidae				1			2	12		16			
Coccyzus	2												
Mimidae								17					
Turdus							1						
Passeriformes				1	2					1			
Trachemys				2	1								
Anolis	3		1		2		3			1			
Cyclura			13	3			3						
Iguana					1				10	14	26		5
Diploglossus				1									
Ameiva					1			1		4	4		
lizard						2							
snake/Alsophis				1	2	3	1	2		1	4		
Bufo					1								
Endemic S	3	2	8	9	10	4	5	5	6	10	12	4	5
Endemic MNI	8	9	20	16	15	9	10	91	43	94	255	15	24
INTRODUCED													
Didelphis													11
Nesophontes							1						
Dasypus													1
Rattus	1												
Dasyprocta									3	9	16		17
Geocapromys	1												
Isolobodon					1	4	3						
Canis			1									4	3
Emydidae									1				
Introduced S	2	0	1	0	1	1	2	0	2	1	1	1	4

APPENDIX 1. (continued)

TAXA	1	2	3	4	5	6	7	8	9	10	11	12	13
Introduced MNI	2	0	1	0	1	4	4	0	4	9	16	4	32
ESTUARINE													
Trichechus				2									
Monachus										3			
Crocodylus		1											
Cheloniidae	1		5	1		2	3	3	4	5	13	9	3
Dasyatis			1										
Rajiformes						2							
Elops				1									
Megalops													3
Elopidae							1						
Albula			47	1		1							2
Anguilla				1	1								
Harengula					43								
Clupeidae	2			4		6	7			6			1
Engraulidae						1							
Strongylura					6		1						
Tylosaurus					3		1				3		
Belonidae		1	3	1		3		4	4	8		4	6
Fundulus							1						
Atherinidae							4						
Centropomus			1	2	1								
Selar	6						1						
Seriola												1	
Gerres				1			2						
Diapterus					4								
Gerreidae			14										
Conodon								1					
Archosargus		1									1		
Calamus		15	2	1		3	5	1			5		
Sparidae	1				1					1			
Bairdiella				3	1	1							
Sciaenops													1
Stellifer													1
Sciaenidae			1										
Mugil				3	7	1							
Clinidae				4		1							
Dormitator							1						
Gobiomorus				1	6		1						
Gobionellus					1								
Trichiurus				1									
Lactophrys		2	2	2					1				
Ostraciidae	1					2							
Estuarine S	5	5	9	16	11	11	12	4	3	5	4	3	7
Estuarine MNI	11	20	76	29	74	23	28	9	9	23	22	14	17

APPENDIX 1. (continued)

TAXA	1	2	3	4	5	6	7	8	9	10	11	12	13
REEF													
Ginglymostoma			1						1			1	
Carcharhinus			1	1	1								1
Carcharhinidae									4				1
Lamniformes	1												
Gymnothorax			1	3					1			1	
Muraenidae						3							
Holocentrus				5	2		4			2	9	1	
Holocentridae	1					17			4				
Scorpaena												2	
Epinephelus		30	10	22	6	15	9	9	17	13	28	10	10
Hypoplectrus						2							
Mycteroperca				3		5					1		1
Serranidae	2												
Malacanthus							1			2			
Caranx	8	4		4	6	18	40		6	4	41	12	4
Chloroscomberus				1									
Selene			1										
Trachinotus				1	1								
Trachurus									2				
Carangidae			5					4					
Lutjanus		8	15		3		33		15		16	2	9
Ocyurus					1	8	4				5		
Lutjanidae				13		18		3		6			
Anisotremus					3		1	3			4	1	
Haemulon		18	17	16	6	20	14	5		14	38	11	2
Orthopristis								1					
Haemulidae									5				
Mulloidichthys						1							
Mullus	121												
Kyphosus								1		1			
Chaetodipterus				1									
Holocanthus				1									
Pomacanthus					1						3		
Abudefduf					1	2					5		
Microspathodon						1				2			
Sphyraena		1	4	4		3				2	8		1
Bodianus				1	3			3	11				
Halichoeres		7	6	9	5	10	11	4	6	4		3	
Lachnolaimus			1	1									
Labridae	1										30		2
Scarus	13	27	19	6	1	9			5	1	98	4	
Sparisoma	20	41	67	30	4	50	20	9	12	19	138	39	8
Acanthurus	7	21	6	11	1	20		1	21	18	82	34	2
Balistes		4		4	4	1	8		3				2

APPENDIX 1. (continued)

TAXA	1	2	3	4	5	6	7	8	9	10	11	12	13
Melichthys		1			3	1			17				
Balistidae	3		5			3				6	37	12	
Sphoeroides			1	2									
Diodon		4	7	2	2		8			2	11	3	1
Diodontidae	1								9				
Reef S	11	12	17	22	19	20	12	11	17	15	17	15	13
Reef MNI	178	166	167	141	54	207	153	43	139	96	554	136	44
PELAGIC													
Cypselurus												1	
Hirundychthys												4	
Exocoetidae	19			13	4	5	17		1				3
Alectis		1											
Scomberomorus					1								
Auxis											7	4	
Euthynnus					3	1						1	
Thunnus					1						15		
Scombridae	9						1	4		12			12
Pelagic S	2	1	0	1	4	2	2	1	1	1	2	4	2
Pelagic MNI	28	1	0	13	9	6	18	4	1	12	22	10	15

J. Ethnobiol. 15(1):149–152 Summer 1995

NEWS AND COMMENTS

COMMENTS and **RESPONSES** to articles; **OPINIONS; REQUESTS FOR INFORMATION;** and notes on **COURSES AND DEGREES IN ETHNOBIOLOGY, PAST AND FUTURE MEETINGS, FOUNDATIONS AND GRANTS,** and **PROJECTS, PROGRAMS, AND NETWORKS** may be submitted to the News and Comments editor. Because the *Journal* is published only twice a year, dated items must be received at least six months in advance of the event.

BOOK REVIEWERS NEEDED

The following new titles have been received for review in the *Journal of Ethnobiology:*

Bountiful Island. A Study of Land Tenure on a Micronesian Atoll. David Damas. Waterloo, Ontario: Wilfrid Laurier University Press. 1994. Pp. xvi; 272. $45.00 Canadian ($55.00 U.S. outside Canada) (clothbound). ISBN 0-88920-239-7.

Corn and Culture in the Prehistoric New World. Sissel Johannessen and Christine A. Hastorf (Editors). Boulder, Colorado: Westview Press, 1994. Pp. xvii; 623. $58.00 (softcover). ISBN 0-8133-8375-7.

The Cultural Relations of Classification: An Analysis of Nuaulu Animal Categories From Central Seram. Roy Ellen. New York: Cambridge University Press. Cambridge Studies in Social and Cultural Anthropology, 1993. Pp. xxi; 315. $64.95 (hardcover). ISBN 0-521-43114-X.

Essential Substances: A Cultural History of Intoxicants in Society. Richard Rudgley. New York: Kodansha International. 1993. Pp. 195. ($22.00) (hardcover). ISBN 1-56836-016-9.

Ethnobotany of the California Indians, ***Volume 1: A Bibliography and Index.*** Beatrice M. Beck. Pp. 165. ***Volume 2: Aboriginal Uses of California's Indigenous Plants.*** Sandra S. Strike. Pp. 210. Champaign, Illinois: Koeltz Scientific Books, USA/Germany, 1994. ($80.00 for both volumes) (softcover). ISBN 1-878762-50-8 (USA)/3-87429-353-X.

The Iron Age Community of Osteria dell'Osa. A Study of Socio-political Development in Central Tyrrhenian Italy. Anna Maria Bietti Sestieri. Cambridge and New York: Cambridge University Press, 1992. Pp. xii, 271. ISBN 0-521-32628-1.

Lok Swasthya Parampara Samvardhan Samithi Monograph Series on **Traditional Medicine.** (prices include shipping and handling). (Note: To be reviewed as a set):
Monograph 1. **Local Health Traditions: an Introduction.** 1989. ($10.00);
Monograph 2. **Ayurvedic Principles of Food and Nutrition, Part I.** 1990. ($10.00);

Monograph 3. **Mother and Child Care in Traditional Medicine, Part I.** 1990. ($8.00);
Monograph 4. **Mother and Child Care in Traditional Medicine, Part II.** 1990. ($8.00);
Monograph 5. **Marma Chikitsa in Traditional Medicine.** 1991. ($8.00);
Monograph 6. **Ayurvedic Principles of Food and Nutrition, Part II.** 1991. ($12.00);
Monograph 8. **Bheshaja Kalpana Pharmacology in Traditional Medicine.** 1991. ($8.00);
Monograph 9. **Vrkshayurveda: An Introduction to Indian Plant Science.** 1993. ($12.00);
Monograph 10. **Plant Propogation Techniques in Vrkshayurveda.** 1993. ($12.00);
Monograph 11. 1993. **Nomenclature and Taxonomy in Vrkshayurveda.** 1994. ($10.00) (All volumes available from Lok Swasthya Parampara Samvardhan Samithi. c/o Centre for Indian Knowledge Systems. No. 2, 25th East Street, Thiruvanmiyur, Madras-600 041; Phone: 415909. No ISBN numbers.)

Myths and Tales of the White Mountain Apache. Grenville Goodwin. Tucson: University of Arizona Press, 1994. Pp. xxix; 223. $16.95 (softcover). ISBN 0-8165-1451-8.

Paleonutrition: The Diet and Health of Prehistoric Americans. Kristin D. Sobolik (Editor). Carbondale, Illinois: Southern Illinois University, Center for Archaeological Investigations. Occasional Paper No. 22. Pp. xv; 321. ISBN 0-88104-078-9.

Pastoralists at the Periphery: Herders in a Capitalist World. Claudia Chang and Harold A. Koster (Editors). Tucson: University of Arizona Press, 1994. Pp. xvi; 262. $45.00 (clothbound). ISBN 0-8165-1430-5.

Pottery from Spanish Shipwrecks, 1500–1800. Mitchell W. Marken. Gainesville, Florida: University Press of Florida, 1994. Pp. xvi; 280. $39.95 (clothbound). ISBN 0-8130-1268-6. (Toll free order number: 1-800-226-3822).

Progress in Old World Palaeoethnobotany. A retrospective view on the occasion of 20 years of the International Work Group for Palaeoethnobotany. Willem van Zeist, Krystyna Wasylikowa and Karl-Ernst Behre (Editors). Rotterdam, Netherlands and Brookfield, Vermont: A. A. Belkema, 1991. Pp. ix, 350. $60.00 (hardcover). ISBN 90-6191-881-2.

Smallholders, Householders. Robert McC. Netting. Stanford, California: Stanford University Press, 1993. Pp. xxi, 389. $49.50 (hardcover), $16.95 (paperback). ISBN 0-8047-2061-4 (hardcover), 0-8047-2102-5 (paperback).

Soils in Archaeology: Landscape Evolution and Human Occupation. Edited by Vance T. Holliday. Smithsonian Institution Press, 1992. Pp. xiii; 254. $39.95 (hardcover). ISBN 1-56098-111-3.

Weaving the Threads of Life: The *Khita* Gyn-Eco Logical Healing Cult Among the Yaka. Rene Devisch. Chicago, Illinois: The University of Chicago Press, 1993. Pp. x; 323. ISBN 0-226-14326-7.

If you would like to review any of these books and would be able to have your review completed within four months after receiving the book, please write to:

Nancy J. Turner
Book Review Editor, *Journal of Ethnobiology*
Environmental Studies Program, P.O. Box 1700
University of Victoria
Victoria, British Columbia
CANADA V8W 2Y2

phone: (604) 721-6124; FAX (604) 721-8985;
e-mail: njturner@sol.uvic.ca

LAWRENCE AWARD
SOCIETY FOR ETHNOBIOLOGY

The Lawrence Award was initiated in 1987 to celebrate the life and accomplishments of Barbara Lawrence and to recognize and reward the scholarly efforts of young ethnobiologists. The Award is given annually at the meeting of the Society for Ethnobiology for the best paper presented by a graduate student or first year post graduate. The Award comes with a significant monetary reward that has usually been about $250. This is made possible through donations from family, friends, and colleagues of Barbara Lawrence who established the Award fund and a gift from the F. A. O. Schwarz Family Foundation. This fund is kept in an interest accruing account and the interest is used for the annual award which is announced at the business meeting or banquet depending on the meeting schedule.

This Award celebrates the life and career of Barbara Lawrence. A Bostonian, she began work at the Harvard Museum of Comparative Zoology in 1931 under the guidance of the Curator of Mammals, Glover Allen, and ultimately became Curator of Mammals and served in this position until her retirement in 1976. Early in her career she mounted her own scientific expedition to collect mammals of southeast Asia. She spent two years, from 1936 to 1938, studying and collecting mammals, mostly bats, in the Philippines, Japan, and coastal China. This exemplifies her determination to surmount whatever obstacles she faced. She engaged in a number of research projects, some on porpoise anatomy in association with her late husband, William Schevill. Her major research interest was ethnobiology or more specifically archaeozoology. She studied southwestern Basketmaker dogs and the animal remains excavated under the direction of Robert and Linda Braidwood, of the Oriental Institute, in Turkey. Her zooarcheological work began in 1964 followed by many years of field work. She was instrumental in the founding of the International Congress of Archaeozoology (ICAZ), which continues to thrive. She also trained and inspired a number of students, instilling in them perseverance and care.

It is these qualities that serve as a model for students recognized by the Lawrence Award. Many fine papers have been presented in the Award competition. The past winners of this competition have engaged in diverse studies but what they have in common are careful thorough studies. The Award winning studies are:

1995 Anne S. Henshaw (Harvard University) Seal transport and consumption amongst historic Inuit: Implications for Inuit-European relations on southeast Baffin Island, Canada.

1994 Dana Lepofsky (University of California–Berkeley) Prehistoric human-induced ecosystem changes and agricultural production in the Opunohu Valley, Society Islands.

1993 Elizabeth J. Lawlor (University of California–Riverside) Accounting for bias in assemblages recovered by flotation: Results of experiments with Mojave desert rodents and ants.

1992 Lee Ann Newsom (University of Florida) Early *Cucurbita pepo* from a Florida wetsite.

1991 Joseph Laferriére (University of Arizona) A dynamic nonlinear optimization study of Mountain Pima ethnobiology.

1990 Kat Anderson (University of California–Berkeley) California Indian horticulture: Redbud management and use by Southern Sierra Miwok.

1989 none awarded

1988 Darrel McDonald (Texas A&M) A survey of public planting in front yards of residences in Galveston, Texas, U.S.A.

Dana Bleitz-Sanburg (University of California–Santa Barbara) Ayelkwi, effigies, and rock art: The ethnotaxonomy of the Takic speaking Canaliño. Honorable mention.

1987 Arlene Fradkin (University of Florida) Reconstructing folk classification of past cultures: The animal semantic domain of the protohistoric Cherokee.

Deena Decker (Marie Selby Botanical Gardens) Numerical analysis of archaeological *Cucurbita pepo* seeds from Hontoon Island, Florida. Honorable mention.

This roster clearly demonstrates the interesting diversity of studies undertaken and presented for the Lawrence Award competition. Winners of this Award have been proud of this recognition and most have published the winning paper in peer reviewed journals including the *Journal of Ethnobiology*.

Contributed by Elizabeth Wing

BOOK REVIEWS

Advances in New Crops. Jules Janick and James E. Simon (editors). Portland, Oregon: Timber Press. 1990. Pp. 582. $65.00. ISBN 088192-166-1.

New Crops. Jules Janick and James E. Simon (editors). New York: John E. Wiley & Sons, Inc. 1993. Pp. 710. $89.95. ISBN 0-471-59374.

The two editors of these extremely useful and outstanding volumes suggest that they be reviewed together. And I must fully agree with them. As a long-time economic botanist, I cannot recall any two volumes more needed and destined to fulfill more usefulness than these, unless it be Sturtevant's *Notes on Edible Plants,* restricted to edible plants and now for many years unavailable.

The earlier volume is the result of the First National Symposium of New Crops held in 1988. It is a compendium of many of the papers presented in that symposium, comprising 432 contributors. The aim of this volume— "to provide a national forum for leading authorities from industry, government, agricultural experiment stations and academia to discuss new crops"—has been most admirably attained in the papers from invited speakers, papers derived from many posters and abstracts of the remaining poster presentations.

The volume is summed up with an extraordinary complete index.

The second of these two volumes, an outgrowth of the Second National Symposium of New Crops—with 242 contributors—is made up of three parts: I. *Policy and Programmes.* (Policy, International Developments, Regional Development, Centres). II. *Research and Development.* (Exploration, Biotechnology, Cereals and Pseudocereals, Grain Legumes, Oil Seeds, Industrial Crops, Fibre Crops, Aromatic Spices, Medicinal and Others). III. *Paths towards Commercialisation.* (Industry, Outlook, Commercialisation).

There follows a most detailed and useful Index to Species Crops and Crop Products, with scientific and common names of the plants discussed and an Index to Authors.

The editors are to be highly complimented for their expert and logical arrangement of the many, often diverse, topics making up the 582 pages in *Advances in New Crops* and the 710 pages in *New Crops.*

Both editors are Professors of Horticulture at Purdue University. Dr. Janick has also taught at the University of London and the University of Hawaii.

Both of these two volumes belong on the shelf of every economic botanist, ethnobotanist and agricultural specialist and can be of immense value to numerous researchers in other tangential fields such as environmentalists, ecologists, plant historians, anthropologists, sociologists, economists and numerous governmental and international organisations charged with improvement of agriculture and other aspects of human welfare. In addition, they should be easily available to students in various diverse fields because of the vast amount of information which is difficult to find elsewhere without an extraordinary investment of time.

Richard Evans Schultes
Botanical Museum of Harvard University
Cambridge, Massachusetts 02138, U.S.A.

Footprints of the Forest: Ka'apor Ethnobotany—The Historical Ecology of Plant Utilization by an Amazonian People. William Balée. New York: Columbia University Press, 1993. Pp. xvii, 396. Price not given. ISBN 0-231-07484-0

The Ka'apor live on an indigenous reserve clinging to the boundaries of the States of Para and Maranhao in Eastern Brazil. Their name comes from *Ka'a* for "forest," and the contracted form of *pipor* for "footprints," an appropriate name indeed for a people whose millennial presence in Amazonia has left an indelible mark on their surroundings. An even more appropriate name for a book that documents in impressive and meticulous detail the historical ecological processes that characterize ancient interactions between an indigenous people and their environment. With *Footprints*, Balée, whose research with the Ka'apor and other related Tupi-Guarani-speaking groups has spanned a decade, aims "to present a treatise that may rank among the most exhaustive English-language accounts of the ethnobotany of any indigenous people in Amazonia" (p. ix).

This is not, however, a book of long, boring plant lists. The unconventional concept of "activity contexts" is introduced to link plants with Ka'apor hunting, fishing, swidden gardening, gathering, food preparation, manufacture and repair of material goods, and other activities. By so doing, Balée tries "to convey the rich interweavings of human and plant that jointly produce both society and landscape" (p. 5). This is not to say that ample scientific data are not provided to support these human/nature links. In fact, *Footprints* represents a new genre of ethnobiological treatise, in the company of Philippe Descola's *In the Society of Nature* (Cambridge Press, 1994), that weds good anthropology with good science.

Balée's dissection of Ka'apor historical ecology begins with linguistic data showing the development of ecological terms in Proto-Tupi, the 2,000 year old reconstructed parent language of modern Tupi-speaking groups. Names for traditional domesticates had higher rates of retention than nondomesticates, showing that some modern groups actually lost much of their horticultural tradition ("agricultural regression") although terms for cultivars remain in the oral tradition. This is a reminder that indigenous groups as they appear today have changed drastically since "contact" with the White Man. It is also a reminder that "natural" landscapes of today may well be artifacts of historical agricultural activities.

This approach provides a diachronic optic to ecosystem transformation and the "anthropic disturbances" that have molded them. Perhaps Balée's most remarkable finding is that Ka'apor agroforestry practices can actually enhance regional biodiversity. This is drastically different from the destructive human forces at work in the rest of Amazonia. Data are provided to compare old fallows with high forests, as well as "indicator species" for human impacted forest sites.

Appendices in *Footprints* practically form a scientific treatise in themselves, with data on ecological and utilitarian values of the broad range of plant species and families characteristic of Ka'apor landscapes, plants from "dooryard gardens," dangerous and avoided plants, and medicinal categories.

Balée argues for a comparative ethnobotany that relates transformations between agriculture and foraging/trekking groups in Amazonia: a botanically-based scientific yardstick to characterize the ecological, económic, and social adaptations that indigenous peoples have made to survive in tropical forests. This would recognize the role of semidomesticated species and replace a simple monolineal evolutionary model with one in which change is a see-saw of survival strategies. A comparative ethnobotany would, indeed, provide an important option for ethnology, which to date has utilized a paradigm based almost solely upon comparisons of social structure and political organization.

Some gigantic problems thwart this comparative model: there are few researchers adequately trained in ethnobiology and financed to carry out the necessary research, and the number of indigenous groups who are allowed to continue their traditional agroforestry systems decreases by the day. The very existence of the Ka'apor, for example, is being threatened by a virtual invasion of timber-cutters, miners, and ranchers. As Balée notes in his Preface: "[This study] may soon become an example of a kind of anthropological study no longer achievable and a record of a kind of human-ecological relationship that has disappeared." This is the stuff of which discontent by politicized indigenous leaders for scientists is made: do the best scientific intentions, finest research, and brilliant treatises ever benefit their subjects of intellectual intrigue? Ultimately a book like this will be hailed by scientists as a pioneering volume, but will it leave a Footprint in our own forest of published works leading towards survival of those indigenous peoples whose knowledge form the priceless treasures of a shrinking Planet?

Darrell A. Posey
Oxford Centre for the Environment, Ethics, and Society
Mansfield College
Oxford University
Oxford OX1 3TF
U.K.

In the Society of Nature: A Native Ecology in Amazonia. Philippe Descola. Translated from the French by Nora Scott. Maison des Sciences de l'Homme and Cambridge University Press, 1994. Pp. xviii, 372. Price BP45.00 (hardback) ISBN 0 521 41103-3 [Originally published in French as **La nature domestique. Symbolisme et praxis dans l'ecologie des Achuar,** Editions de la Maison des Sciences de l'Homme, 1986].

Philippe Descola is undoubtedly one of the most eclectic and creative thinkers in anthropology today. In *The Society of Nature: A Native Ecology in Amazonia,* he skillfully weaves technical and conceptual determinations into a brilliantly readable monograph on the Achuar Indians of the Peruvian/Ecuadorian border region of the Upper Amazon. The only problem with this publication is that it was not translated and published in English immediately after the original French edition appeared in 1986.

The Achuar, a relatively isolated bloc of 4,500 individuals, are one of the four dialect groups that compose the Jivaroan linguistic family. Descola describes their settlement patterns as "residential atomism" tempered by a supralocal structure called an "endogamous nexus." Their autodenomination is "achu shuar" (the people of the aguaje palm—*Mauritia flexuosa*), which is a dead giveaway that their identity is in large part defined by what we would call the "natural world" that encompasses them. There are intricate links between the physical landscape and the cosmic order, between terrestrial water and celestial rainfall, between heavenly bodies and earthly activities. Descola found that the Achuar "do not spontaneously comment on the organization of their cosmos, unlike other Amazonian societies, in which philosophical questions on the origin and meaning of the universe seem to comprise the main matter of daily palavers" (p. 63). Nonetheless, discernable spatio-temporal coordinates can be elicited, such as astronomical and climatic cycles, seasonal periodicity of various types of natural resources, landmark systems, and the organization of the universe into layers as defined in mythic thought.

The book integrates measurable scientific evidence for observable phenomena (for example, soil classification, diet, time-motion studies, plant lists, game captures) with ceremonial, mythic, and shamanistic practice and thought. It is made obvious that the Achuar do not see the supernatural as a level of reality separate from nature, since humankind is governed by the same laws as plants, animals, and even meteors that have souls and life. In fact, in mythical times nature's beings even had human forms that can still be encountered during soul journeys. Thus, as Descola points out (pp. 100–101) "the perceptible universe is seen by the Achuar as a many-sided continuum, now transparent, now opaque, now eloquent, now dumb, depending on the mode of apprehension chosen." The Achuar house is taken as an example. It is a structure whose architecture, building materials and construction can be described. But a house is much more than a shelter to the Indians: it is a unit of social relations and a passageway to the sky and netherworld. And just as it is impossible to separate the cosmic dimensions for daily life, it is meaningless to deny the symbolic significance of the dwelling. The Shuar, like all traditional peoples of Amazonia, do not just live in nature, they live with it and are a part of it: it is an extension of their own being no less than kin and ancestors.

Descola does justice to his chosen title for this book (although the original French title gives another nuance: "La nature domestique") by guiding his readers, most of whom come from the disjointed and dysfunctional societies that separate humans from nature, along the holist path that he himself took to get a glimpse of the Achuar World.

Darrell A. Posey
Oxford Centre for the Environment, Ethics, and Society
Mansfield College
Oxford University
Oxford OX1 3TF
U.K.

El Juego de la Supervivencia: Un Manual para la Investigación Etnoecológica en Latinoamerica (The Game of Survival: A Manual for Ethnoecological Research in Latin America). Victor M. Toledo. Berkeley, CA: Consorcio Latinoamericano sobre Agroecología y Desarrollo. 1991. Pp. 76. No price given (paperback).

Since the 1970's, Mexican ecologist Victor Toledo has been laying the groundwork for an integrated field of study called ethnoecology. He may not have coined the term, but his vision is original. This work is a useful summary of his many articles and books on how Latin American peasants classify and manage diverse aspects of the natural environment. Early in the text, he explains that the perspective of most ethnobotanical studies is limited because: (1) they focus on the study of traditional knowledge without considering its role in basic productive activities, that is, they separate culture from production; (2) they place the emphasis on analyzing single domains of folk knowledge—such as plants, animals, climates, and systems of nomenclature—neglecting to generate a holistic vision that integrates these dimensions; and (3) they concentrate on the empirical side of folk knowledge, excluding symbolic and other interpretive approaches.

This handbook, Toledo's remedy to past limitations, is divided into three parts. The first is an overall review of the field, including an extensive description of Toledo's typology of peasant ecological knowledge. The second part, which focuses on ethnoecological research in Latin America, presents information on ecological zones and indigenous groups; it is followed by a reading list of 34 critical papers on the ethnoecology of diverse regions and peoples. The third section is a short essay that explores the relationship between ethnoecology and another growing field, agroecology.

Although called a manual, this text reads more like an annotated course outline on the theory and practice of ethnoecology. This is not surprising, because Toledo states in the prologue that the ideas come primarily from courses he taught at the University of California at Berkeley and the Universidad Nacional Autónoma de México in 1988 and 1989.

This is an armchair manual, useful for helping us think about ethnoecological research, and for gaining access to the growing literature on the subject. As our field grows, the typologies devised to explain the relationships among all its subfields become increasingly complex. Toledo's is an endpoint in this evolution: a three-dimensional model that incorporates environmental, cognitive, and spatial aspects. I found it useful for classifying the different sorts of articles that fall within the scope of ethnobiology, but its practicality in organizing field research is questionable.

In fact, readers who are looking for a manual on how to carry out field studies may be somewhat deceived by the subtitle of this work. The closest that Toledo comes to methodology is in a section called "How to carry out an ethnoecological study" (pp. 40–44), but even here he limits himself to a rather philosophical discussion of how to get down to work.

While well-written, the book was produced inexpensively and shows a lack of editing. The illustrations are hard to read in places, and, beginning with the table of contents, we see evidence of incomplete formatting on the word processor. These minor deficiencies in no way affect its utility as a text, and I highly recommend it for those looking for a primer on ethnoecology, especially as it is viewed from a Latin American perspective.

Inside the front cover, the sponsor of this paperback, CLADES, (Latin American Consortium for Agroecology and Development), is described as an umbrella organization for 11 nonprofit groups from eight South American countries. It is noted that copies of the manual are available from: CLADES; Casilla 97, Correo 9; Santiago, Chile.

Gary J. Martin
Anthropology Department
University of California
Berkeley, CA 94720

Life Cycles: Reflections of an Evolutionary Biologist. John Tyler Bonner. Princeton, New Jersey: Princeton University Press. 1993. Pp. vii, 209. $19.95. (hardcover). ISBN 0-691-03319-6 (Cloth), 0-091-08494-7 (paper).

Although the varied reflections Bonner writes about in this book are interesting and at times entertaining, none of them deals with or addresses the topic of greatest interest to the readers of this journal—ethnobiology. As a past editor of this journal and as a frequent participant in the annual conferences of the Society of Ethnobiology, I have had ample opportunity to observe what ethnobiologists consider to fall within the realm of their discipline. The interactions and interrelationships of people with plants or animals, especially in a cultural or community setting, is the major theme in all the papers and presentations I have read, heard, assigned to students, written or edited during my years as a career ethnobiologist. The final two chapters of *Life Cycles* are entitled "Becoming Social" and "Becoming Cultural." "Ah," I thought, "ethnobiology at last." Wrong! Wrong, since these chapters deal mostly with the evolution of social insects, behavior in animals, division of labor, etc., with brief discussions of the social and cultural aspects of our species, *Homo sapiens*, e.g., the early development of writing, followed by the pencil, steel pen, typewriter, computer, Xerox copier and the Fax machine.

The targeted readership of *Life Cycles* appears to be those with a general interest in science and biology. Since I, like all ethnobiologists, am such a person, I found much to engage me in reading this slender and, in my view somewhat over-priced, book (no photographs; 24 black and white illustrations). It was a pleasure to note that some of Bonner's reflections are similar to those I had early in my academic career when I taught Botany 2—Survey of the Plant Kingdom—in the 1960s. And I always enjoy a different perspective, small or large, on topics over which I have reflected.

The book is organized into three unequal sections: The Background; The Period of Size Increase; and The Adult Period. In each section Bonner reflects upon the various ways different evolutionary lines have taken in achieving a particular end. For example, there have been several evolutionary pathways by which organisms have become multicellular and thus larger, several pathways have led to autotrophy, behavior has had many different origins, and many factors may have led to the development of large brains in, for example, dolphins and humans.

To the extent that Bonner writes of how he became involved in the study of biology in general and the slime molds in particular, *Life Cycles* has autobiographical underpinnings. Ideas and discussions are grounded not only in Bonner's many years of professional research with slime molds but also in the research and viewpoints of early and comtemporary developmental and evolutionary biologists. The interests of these biologists range from organisms as taxonomically diverse as algae and amoebae, to flowering plants, bees, birds, wolves, and primates including humans. Specialities within these taxomomic categories range from morphogenesis, to resource acquisition, reproductive strategies, imprinting, communication and language.

Bonner makes an interesting point which I would like to see incorporated into ethnobiological theory and practive: organisms should be viewed as the life cycles that they are and not just as, usually, the conspicuous, obvious stage. For example, how often do we automatically consider the gametophytes or for that matter, seeds, as part of the entire organism of higher plants? Thus, a sugar maple tree is much more than the biomass of mostly wood standing in, say, woodlots in Brown County, Indiana or bordering the streets and avenues of small cities such as Carthage, Missouri.

So, although *Life Cycles* does not address any of the numerous aspects of ethnobiology *per se* and is not a reference work, it does offer and integrates information and ideas of how the diversity of life evolved. Bonner presents rather technical material lucidly so this is a book that can be enjoyed by those who, although perhaps biologically untrained, like intellectual stimulation. Thus this book will make a fine gift for an aspiring biologist or for anyone who likes to explore new and fascinating topics.

Willard Van Asdall, Past Editor
Journal of Ethnobiology
4479 N. Summer Set Loop
Tucson, Arizona 85715.

Native American Cultural Resource Studies at Yucca Mountain, Nevada. Richard Stoffle, David Halmo, John Olmsted and Michael Evans. Ann Arbor, Michigan: Institute for Social Research, The University of Michigan. 1990. $15.00 (paperbound) Pp. 232. ISBN 0-87944-328-6.

In 1982, the United States Nuclear Waste Policy Act proposed a plan to select safe disposal sites for high-level radioactive waste on the basis of both environmental and cultural investigations. Following a national search, three sites were recommended for further consideration. The first of these candidate sites to be studied was that at Yucca Mountain, Nevada, an area which is of great cultural significance to three Native American ethnic groups: Owens Valley Paiute, Southern Paiute and Western Shoshone. Significantly, the environmental impact assessment required an investigation of potentially vulnerable Native American cultural resources, the findings of which have been published in a series of reports.

This monograph essentially presents a summary of the total published data, collected throughout 1987 and 1988 by both social and biological scientists as well as by indigenous experts from 16 local tribes. The report is divided into six chapters which introduce the historical and current cultural significance of the site, and set out qualitative descriptions of the traditional archaeological and biological resources associated with the area. These chapters are followed by a series of appendices which describe the research methods used, regulations for implementation and possible actions of the U.S. Department of Energy, as well as photographs of Native American collaborators and 17 pages of bibliographic details. Unfortunately, while the table of contents is detailed, there is no index to this report.

The first three chapters, Introduction, Interpreting cultural resources, and Ethnohistory of Native American peoples in the Yucca Mountain region, provide an insight into the traditional subsistence and cultural activities of the Paiute and Shoshone peoples, and describe the legal background and methodological rationale behind the study. In addition, Chapter 2 specifically highlights intercultural differences in the interpretation of a given site or resource, thus illustrating the vital importance of native collaboration in impact assessment. The following chapters, Spatial analysis of Native American cultural resources, Ethnographic summary of Native American plant use, and Native American recommendations, present the major findings of the study based on data drawn from indigenous knowledge, historical documents and archaeological data. Patterns of resource use are discussed in relation to the spatial arrangement of peoples and resources, and a wide variety of plant resources with utilitarian or religious significance are described, including *Juniperus osteosperma* which is still of considerable ceremonial importance. The final chapter lists a series of recommendations made by tribal leaders regarding the conservation of sacred areas, cultural artifacts (including Native American petroglyphs and burials), and biological resources used in subsistence, material culture and ceremonial life.

In conclusion, while it is not clear from the report how the findings are likely to influence a decision regarding the siting of the proposed waste facility, the report does note that in some cases, evidence provided by Native Americans on archaeological sites has proved permissable in federal courts. It also illustrates a number of key issues of particular relevance to modern ethnobotanical studies, including the distribution of knowledge between groups and individuals, and the need for researchers to return details of their findings to native collaborators. Perhaps most significantly, the monograph highlights the practical application of ethnobotanical studies in environmental impact assessment, an application which should set an important precedent for future development projects throughout the world.

Cath Cotton
Biological Sciences, Whiteland's College,
RIHE, West Hill, London, SW15 3SN, UK

NOTICE TO AUTHORS

The *Journal of Ethnobiology* has published "Guidelines for Authors" in Volume 10, Number 2 (Winter 1990). Many authors will be able to prepare their manuscripts by consulting recent issues of the *Journal*. If you need a copy of the "Guidelines for Authors" please consult the issue of the *Journal* in which it was first published or write to the Editor requesting a copy.

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EUGENE HUNN, Editor
Journal of Ethnobiology
Department of Anthropology, DH-05
University of Washington
Seattle, WA 98195 USA
Phone: (206) 543-6825; FAX: 206-543-3285
hunn @u.washington.edu

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NEWS AND COMMENTS

Individuals with information for the "News and Comments" section of the *Journal* should submit all appropriate material to Gary J. Martin, 94 Blvd. Flandrin, 75116, Paris, France. FAX: 33/1/45533001.

BOOK REVIEWS

We welcome suggestions on books to review or actual reviews from readership of the *Journal*. Please send suggestions, comments, or reviews to one of the *Journal*'s book review editors (see inside front cover).

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Subscriptions to the *Journal of Ethnobiology* should be addressed to Brien A. Meilleur, Missouri Botanical Garden, Center for Plant Conservation, P.O. Box 299, St. Louis, MO 63166. Subscription rates are $60.00, institutional; $25.00 individual subscribers from Latin America; $25.00 student subscribers; $35.00 regular individual subscribers except for Latin America; Joint member (spouse; one copy of journal), add $10.00; Postage: $8.00 (outside of U.S.A., Canada, and Mexico). Write checks payable to *Journal of Ethnobiology*. Defective or lost copies will be replaced if written request is received within one year. For information on back issues, contact Cecil Brown, Department of Anthropology, Northern Illinois University, DeKalb, IL 60115; (815) 753-0246.

CONTENTS

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Department of Anthropology
Box 353100
University of Washington
Seattle, WA 98195-3100
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FAX (206) 543-3285
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CONTENTS

ANNOUNCEMENTS

Society of Ethnobiology 19th Annual Conference March 27–30, 1996

sponsors:
Santa Barbara Museum of Natural History
Santa Cruz Island Foundation

contact:
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Anthropology Department
Santa Barbara Museum of Natural History
2559 Puesta del Sol Road
Santa Barbara, CA 93105
USA

Phone: (805) 682-4711 ext. 307
FAX: (805) 569-3170

Registration: $50 ($60 after Feb. 15, 1996)
Student registration: $30 ($35 after Feb. 15, 1996)

Wednesday, March 27, evening: Welcome reception/registration.
Thursday, March 28: Oral and poster presentations; Botanic Garden tour.
Friday, March 29: Oral and poster presentations; evening banquet; keynote address by Dr. Larry Agenbroad: "Latest News on Old Bones: Interactions Between Humans and Mammoths in North America."
Saturday, March 30: Field trips: Garden Tour ($14), Whale Watch ($15), Vandenberg Air Force Base ($30), Santa Cruz Island ($60).
Special Exhibition: "First People: Animals in Native Californian Art" in the Museum Gallery.

Make checks or money orders payable to Ethnobiology Conference-SBMNH.

A NEW ELECTRONIC FORUM

Dr. Dana Lepofsky, Department of Anthropology, Simon Fraser University, Vancouver, B. C. has set up an e-mail bulletin board at the address

ethno-bio@sfu.ca

If you would like to participate you may subscribe by sending the following message (don't include the quotation marks) to the list processor at Simon Fraser University

majordomo@sfu.ca

"subscribe ethno-bio
end"

Use this service to engage in exchanges of information and to debate issues of interest. Remember to observe the customary etiquette. This is a public forum.

ETHNOBIOTICA

I have by now ascended the steepest pitch on the editorial learning curve. I can begin to see a more expansive panorama ahead of me of how the *Journal of Ethnobiology* might evolve over the next few years. The *Journal of Ethnobiology* serves well as a platform for presenting new information about the manifold details that cluster about that nexus of cultural and biological interactions lying at the heart of ethnobiology. The *Journal of Ethnobiology* bridges many disciplines. And we are reaching out to scholars beyond the borders of the U.S.—especially throughout the Americas—and to those whose first language is not English, but Spanish, Portuguese, or French. I am committed to furthering this trend and will work with authors whose English is less than fluent to make it possible for their voices to be more widely heard. We may soon publish our first Spanish language article. Ethnobiology is not only complexly interdisciplinary, but also encompasses a global community of scholars, based in universities and in indigenous communities. The *Journal of Ethnobiology* should be the voice of this multidiscipline we call ethnobiology.

However, our subscription list remains at just a few hundreds, as it has been for a number of years. This despite a powerful recent surge of interest in the subjects within our discipline. I hope to encourage a wider audience for our journal by inviting "state-of-the-art" review articles from leading scholars representing major research programs of broad ethnobiological interest. For example, cognitive psychologists—notably a group at Northwestern University—are pursuing the psychological implications of ethnobiological findings with respect to the universality of the recognition of basic folk biological categories. Ethnobiological research also fuels theoretical fires among linguists who seek to understand the origins of human language.

The issue of indigenous resource management—or "mismanagement," according to many—begs for a careful assessment of the existing evidence. The continuing popularity of the "Pleistocene Overkill" scenario among biologists and with the public at large suggests that our message concerning the complex mutuality of indigenous communities and their subsistence resource bases is not being heard.

The moral ambiguities faced by ethnobiologists seeking to record the environmental knowledge of indigenous peoples seem to grow daily more convoluted. I would hope that we might forcefully articulate in our journal the moral basis for our appreciation of the impressive intellectual achievements these systems of indigenous knowledge represent.

Finally, I would welcome a clear presentation of the physiological and biochemical bases for the apparent effectiveness of so many wild plant medicines. To better evaluate submissions that touch on this last issue, I plan to strengthen the editorial board expertise in this key area.

Your suggestions for sharpening the thrust of our journal and reaching a broader audience are always welcome.

Yours,

Eugene Hunn

J. Ethnobiol. 15(2):161–176 Winter 1995

THE *KITUL* PALM: ETHNOBOTANY OF *CARYOTA URENS* L. IN HIGHLAND SRI LANKA

YVONNE EVERETT
Department of Landscape Architecture
202 Wurster Hall
University of California
Berkeley, CA 94720

ABSTRACT.—*Caryota urens,* known as the *kitul* in Sri Lanka, is a native rainforest species of tropical Asia. It is also one of the most common trees in the perennial forest gardens of highland Sri Lanka. *Kitul* is traditionally tapped for sap from which sweet syrup, sugar, and alcoholic beverages are prepared. The syrup and sugar have a special richness and are highly valued for culinary purposes in Sri Lanka.

Tapping palms is the domain of "toddy tappers" who traditionally divide the yield with palm owners. This paper focuses on the tappers' knowledge and management of *kitul* palm, its products, and tapping and processing activities. The potential economic value of *kitul* is assessed. The ecological and economic importance of developing markets for *kitul* and other forest garden products in relation to forest and landscape conservation in highland Sri Lanka are emphasized.

The paper is based upon the author's interviews with tappers and palm owners, study of *kitul* yields and participant observation during dissertation field research on home gardens in highland Sri Lanka in 1989–91[1].

RESUMEN.—La *Caryota urens,* conocida como *kitul* en Sri Lanka, es una especie nativa de los bosques lluviosos del Asia tropical. Es también uno de los árboles más comunes en los huertos forestales perennes de la zona alta de Sri Lanka. El *kitul* es sangrado tradicionalmente para obtener su savia, de la cual se preparan jarabe dulce, azúcar y bebidas alcohólicas. El jarabe y el azúcar tienen especial riqueza y son altamente valorados para fines culinarios en Sri Lanka. El sangrado de las palmas es el dominio de los "palmeros de vino," quienes tradicionalmente dividen el producto obtenido con los dueños de las palmeras. Este artículo se centra en el conocimiento de los palmeros y el manejo de la palma *kitul,* sus productos, y las actividades de sangrado y procesamiento. Se evalúa el valor económico potencial de *kitul.* Se enfatiza la importancia ecológica y económica de desarrollar mercados para el *kitul* y otros productos de los huertos forestales en relación a la conservación de los bosques y el paisaje en la zona alta de Sri Lanka. El artículo está basado en las entrevistas de la útora con palmeros y dueños de palmas, el estudio de los rendimientos del *kitul,* y la observación participativa durante la investigación de campo para su tesis doctoral sobre los huertos familiares en la zona alta de Sri Lanka de 1989 a 1991.

RÉSUMÉ.—*Caryota urens,* connu sous le nom de *kitul* au Sri Lanka, est une espècê de palmier native de la forêt des pluies de l'Asie tropicale. Egalement un des arbres les plus nombreux des jardins vivaces forestiers dans les hauteurs du Sri Lanka, le *kitul* est traditionellement gemmé pour son nectar dont le sirop, le sucre, ainsi que des boissons alcoholiques sont préparés. Le sirop et le sucre ont un goût distinctif, très apprécié dans la cuisine du Sri Lanka.

Le tirage du nectar est le domaine des *"tappers"*, qui traditionellement partagent le produit avec les propriétaires des palmiers. Nos recherches se concentrent sur le savoir-faire des *tappers*, l'exploitation du *kitul*, et la préparation des produits palmiers. La valeur économique potentielle du *kitul* est évaluée. Nous soulignons l'importance écologique et économique du développement de marchés pour le *kitul* et d'autres produits jardiniers forestiers, à l'égard de la protection écologique dans les hauteurs du Sri Lanka.

Ces recherches sont fondées sur les interviews de l'auteur avec des *tappers* et les propriétaires des palmiers, des recherches sur la préparation des produits à base de*kitul*, et des observations participantes faisant partie des recherches de thèse sur les jardins forestiers des hauteurs du Sri Lanka.

INTRODUCTION

In Sri Lanka palm treacle (syrup) and jaggery (sugar) are important traditional sources of sweeteners. In arid areas treacle and jaggery are produced from palmyra (*Borassus flabellifer*), in the coastal zone from coconut palms (*Cocos nucifera*), and in the wet interior and highland regions from fishtail palms (*Caryota urens* L.). Thus sugar can be locally produced from one or another palm on most parts of the island (Fig. 1). The fishtail palm or *kitul*, as it is locally known in Sinhalese (*tippilipana* in Tamil), is a very common tree in the lowland rain forest and in mixed species forest gardens managed in highland Sri Lanka. This palm yields a rich, dark syrup with a highly valued, distinctive taste. In comparative testing of raw sugars reported from the Fairchild Botanical Gardens in Florida, *kitul* jaggery ranked among those of highest quality (Lotschert 1985). Its export potential is being tested with success in the Australian consumer market.

The purposes of this paper are twofold. First, to present an ethnobotanical description of the *kitul* palm, and second, to discuss the palm in its ecological and socioeconomic context as one of many species with potential market value found in the forest gardens of highland Sri Lanka. The topic is important as there is considerable economic pressure to convert existing forest gardens to less diverse and less ecologically valuable annual cropping systems. I gathered data during field research on forest gardens in the Welimada and Kotmale areas of the Upper Mahaweli Watershed in the Central Highlands from 1989–1991.

BOTANY AND ECOLOGY OF *KITUL*

Caryota urens is native to lowland rain forests of tropical Asia including Sri Lanka (Fig. 2). The genus *Caryota* has 27 species found across tropical Asia to the Malay archipelago, Australia, and New Guinea. (Lotschert 1985). The name *Caryota* stems from the Greek *karyotes,* meaning "nutlike." This is in reference to the small, hard fruits of the palms. *Urens* translates as "burning," and is linked to the irritating, needle-like crystals found on the outer shell of the fruits (McCurrach 1960). A tall, unarmed palm, *kitul* grows to an average height of 15–20 m and diameter of 30–50 cm. It has a sparse crown of very large bipinnate leaves, often 2–3 meters long and 1–2 meters wide (Jayaweera 1982). The leaves are glabrous, dark

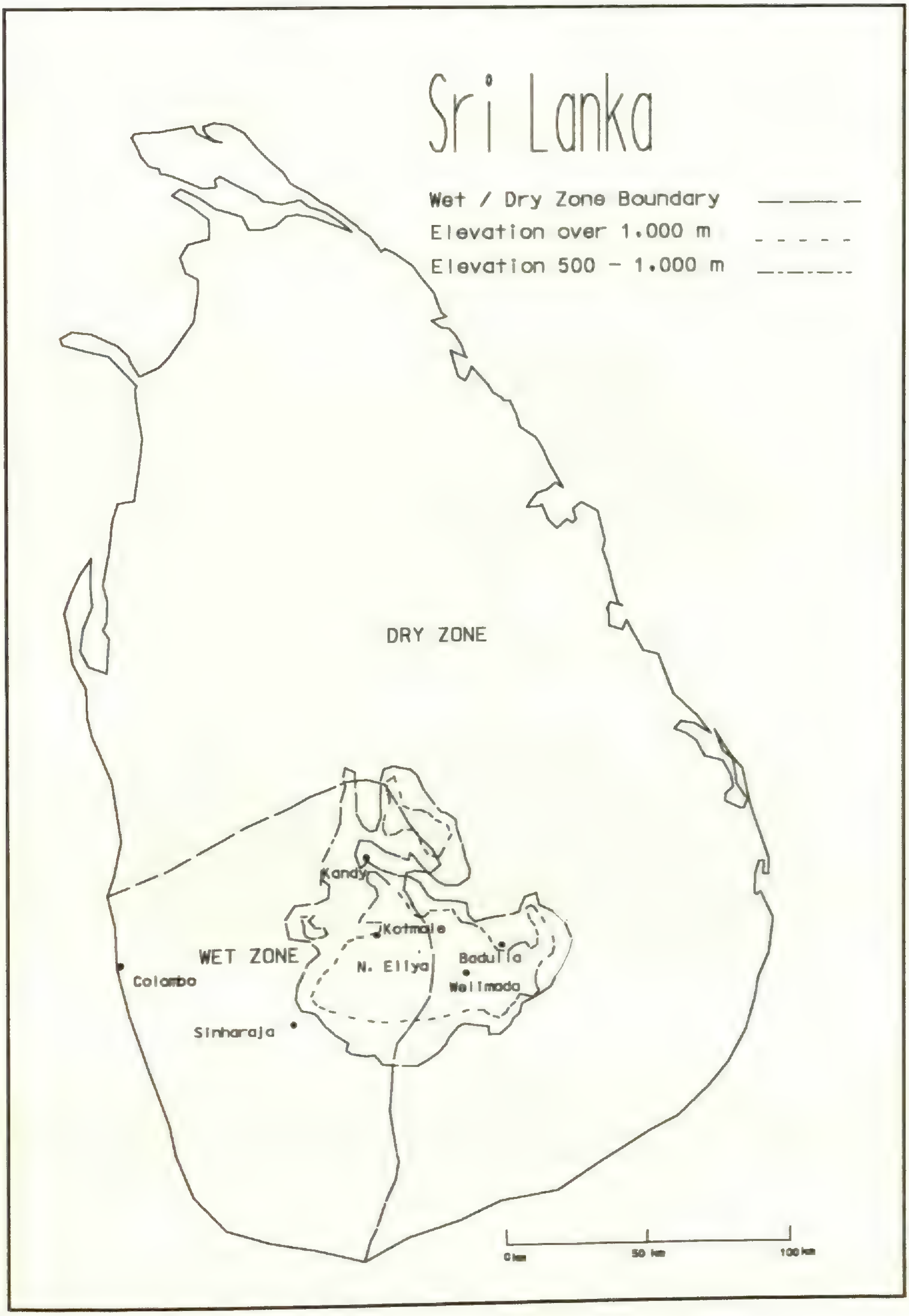

FIG. 1.—Areas Studied in the Sri Lanka Highlands.

FIG. 2.—The Kitul palm (*Caryota urens* L).

green, and shiny. The fishtail-like shape of the outward-turned 15 cm long leaflets give the palm its English name.

Blatter (1926) reports that *kitul* reaches maturity and begins flowering after 10–20 years. Flowers appear from the upper leaf axils and bloom successively downward to the mainstem. The inflorescence is a stalk 3–4 m long on which male and female spadices alternately bloom. An average flower lasts for 3–4 months and several flowers may bloom simultaneously from the main stalk. Therefore, the same individual may bear buds, flowers, and fruits at the same time. McCurrach (1960) suggests that *kitul* typically blooms for a year or two, though a palm may flower periodically for up to seven years as the leaves successively drop. When the last bloom appears above the mainstem and produces fruits, the palm dies. Sri Lankan farmers substantiated these reports during my interviews, and also said that they estimate how many florets a palm will have from the head of the first flower to emerge—usually from one to twelve flowers (as described below).

FIG. 3.—A species diverse, uneven-aged forest garden in highland Sri Lanka.

In Sri Lanka *kitul* palms are common in the mid and low country interior up to 1,500 m. In the lowlands, the palms occur predominantly in the natural forest. In contrast, in the largely deforested mid-elevation highlands palms are managed in small holder forest gardens. These planted gardens are dense stands of uneven-aged, mixed species of perennials surrounding individual family homes (Fig. 3). The gardens are on average less than 0.5 ha in size and typically include 25–35 different species of woody perennials, along with many herbaceous and annual plants. Density of trees is high, ranging from over 350 individuals per 0.5 ha in the intermediate rainfall zone represented by Welimada Division, to 500 per 0.5 ha in a high rainfall area such as Kotmale Division (Everett 1993). Tree canopies on adjoining plots commonly blend together into neighborhood patches of forest-like vegetation.

This vegetation structure provides a suitable habitat for the 17% of garden trees that are remnants of the native forest flora and are not specifically planted but rather persist as self-seeding or animal dispersed "volunteers" (Everett 1987). The *kitul*, dispersed by civet cats (*Civettictis* sp.) and only occasionally transplanted, is one of the most common volunteers.[2] In a survey of woody perennials in 173 gardens in three highland climatic regions, *Caryota urens* ranked eleventh in overall species frequency, with a high abundance, averaging 18 palms per garden (Everett 1993). In surveyed areas with more than 2,300 mm of annual rainfall, *kitul* occurred in all gardens with mature perennial vegetation.

Kitul palms are an economic windfall for their owners. When interviewed about tree species growth requirements and forest garden management practices, 89% of the respondents said the *kitul* needs no attention at all. The remaining gardeners said that they might occasionally spread leaf or household compost under the palms to enhance their growth. This is a marked contrast to other common garden trees and shrubs that produce a cash crop, such as coffee (*Coffea arabica* and *C. robusta*) and cloves (*Eugenia caryophylla*). These are usually raised from seed, or increasingly from packeted seedlings purchased or provided as a subsidy from government extension programs. They require watering when young, and receive regular maintenance inputs, sometimes including chemical fertilizers.

TAPPING PALMS FOR SUGAR

The *kitul* converts starch reserves to large quantities of sugary phloem to fuel the growth of the stem apex or inflorescence (Corner 1966). This sap or "sweet toddy" is tapped through the flower and then boiled down to produce syrup and raw sugar.

Unlike some other sugar palms, *kitul* is not easy to tap. The process of tapping the sensitive *kitul* flower and maintaining the flow of sweet sap requires skill and experience. A specialized occupational caste of tappers has emerged as a traditional cottage industry of sugar and alcohol producers in Sri Lanka. In some areas, a unique set of tenure relationships between palm owners and tappers developed.

In the past, tapping was a major source of income for many people in the lowlands, particularly in villages bordering the forest. Many tappers traditionally gleaned their toddy from palms inside the forest. Present day tapping inside the Sinharaja forest has been described recently (De Zoysa 1992). Today, the forests are government owned and, as large areas are classified as reserves, would-be palm tappers must have a license.[3]

In the highlands, a different culture of tapping has emerged. Typically there will be several people in each village known as tappers who tap all of the palms in their neighborhood. Here the palms are found in privately owned forest gardens. In this case, the tree belongs to the landowner. When a palm appraoches flowering, the owner notifies a tapper. In general, from the time of the first sweet toddy production, the tapper and the tree's owner then share the yield equally by alternating days.

The process of tapping varies in some specifics among individual tappers and between regions (e.g., De Zoysa 1992). The following descriptions are based predominantly upon my interviews with tappers in the Welimada area at the edge of the *kitul* range in the Intermediate climatic zone of the highlands (elevations of over 1,000 m and average rainfall below 2,000 mm per annum).

The tappers' skill lies in maximizing the sap flow to the inflorescence while retarding flower extension. When a palm is about to flower, the inflorescence becomes visible in the tree top. About two months after a young inflorescence first emerges, the tapper climbs the palm and carefully removes the outer layers of the sheath or spathe protecting the flowers. As discussed below, tapping activities are typically carried out by men. The tapper ties a forked stick into place under the inflorescence to replace the spathe's supportive function. Next, he gently cuts and removes the very hard, protective interior spathe layers covering the inflorescence. Tappers say that the number of layers indicates the number of individual flowers to come from the inflorescence, ranging from one to twelve. The tapper makes a roughly 15 cm long, 5 cm wide, and 2 cm deep incision in the side of the flower.

Tappers apply a special "medicine" in this cut to stimulate sap flow. The exact recipe for the medicine is the individual tapper's secret. In the Welimada area, the ingredients include chilies, pepper, salt, garlic, mustard seed, ginger, cloves, coconut grounds, citrus fruit, and vinegar. Salt, lime, saffron, and lime juice are used in other areas (Nonis 1989). The ingredients are ground to a pulp, rolled into a ball, wrapped in a banana leaf, and briefly placed in the hot coals of a fire. The tapper applies the resulting paste in the incision on the flower and tightly packs the hole with fluffy fibers from the inside of the palm bark. Tappers report that the paste seals the cut and keeps the area clean; thus, rotting is reduced. The tappers say that the medicine's function is to "soften" the flowers.

Once he has applied the paste, the tapper gently taps the flower stalk with a special mallet to bruise the area between the stem and the incision. He inserts three needles made from *kitul*, citrus wood, or bamboo on top and on the two sides of the flower between the palm stem and the hole. More of the medicinal paste is spread over this area. Next, he takes strips of cloth and tightly wraps them around the flower base and up over the incision. Agave fiber, *kitul*, or coconut twine are then wrapped around the cloth. Then he places four 30–40 cm long sticks cut from *kitul* leaf stalks on each side of the flower, tying them tightly to give the inflorescence support and avoid wind breakage. Beyond the first hole and tied area the tapper cuts a new incision about 5 cm long, 3 cm wide, and 2 cm deep. Again, he applies the medicine in the hole and carefully inserts a needle of citrus, bamboo, or *kitul* through the flower at the incision point. The hole is tightly sealed with fluffy fiber. To keep the flower stalk from further flowering, the tapper wraps cloth tightly around the inflorescence. Then he cuts off the end of the inflorescence (about 30 cm) and a bit of sap flows out. Three days later the tapper climbs the tree again and cuts a thin slice from the end of the inflorescence. The next day the tapper checks his work. If he finds a small 1/2 cm shoot emerging from the cut, or if the cut is covered with small droplets of sap, the tapper has succeeded. If on the other hand, a longer shoot has emerged, then the treatment has failed and repairs must be undertaken. In the latter case, the tapper takes three needles soaked in salt water and rubbed with coconut oil and inserts them around the second incision. He then waits for three more days in hopes that he will block further growth. If the process is successful, a clay pot covered with wire mesh to keep out insects and squirrels is hung below the end of the inflorescence by tying it with *kitul* or coconut coir rope to the leaves. The tapper then cuts a thin slice off the end of the inflorescence every evening. He climbs the tree twice daily, in the early morning and in the late afternoon to empty the pot which fills with sweet toddy in the interim.

The quality and quantity of sap flow differs considerably with geographic location, season, site quality, and probably with as yet unstudied genetic variation in the palms. Results based on interviews with tappers and farmers in two climatic regions indicate that palms begin to flower sooner and give higher yields in the Kotmale area than in the Welimada area (Table 1).

According to farmers, palms with a large circumference have high yields. Thus short and thick stem form is better than tall and thin. *Kitul* near water have more sap but it is watery. Palms on rich soil with compost produce high yields but

TABLE 1.—Comparison of *kitul* flowering and yields in different climatic regions.

Region	Rainfall (mm)	Average Flowering Age (years)	Average Sap Yield (750 ml bottles)
Kotmale (n = 17)	3,607	11	13
Welimada (n = 10)	1,610	16	7

the toddy's flavor is not as good as from lower yielding trees on harsher sites. Tappers interviewed said that while *kitul* is shade tolerant and commonly grows up through the understory to reach the canopy at maturity, a sunny location, especially with early morning light, enhances the quality of the sap. Elsewhere, research shows soils rich in carbonate of lime to be particularly suitable for *kitul* (Nonis 1989).

Tappers suggest that *kitul* will yield throughout the year, but the best quality sap flows in the dry season, though the flower is more brittle and applying medicine is tricky at this time.[4] During periods of high humidity and rain, the supply of sap increases noticeably. Informants said that sap flow can be a weather indicator. However, the rainy season nectar is watery and more is needed to produce a good quality syrup.

There are other influences which affect sweet toddy yields. Lightning strikes and strong winds can break the flowers. Bumblebees often eat the new shoots of leaves and flowers. One indigenous remedy for bees is to take a ball of cow dung mixed with hair and place it around the shoots. The bees are attracted to the dung but then entangle themselves in the hair and can be removed. In or near natural forests, monkeys can compete with tappers for the sweet nectar. Tappers sometimes hang traps below their toddy pots to snare monkeys.

Tappers also take certain precautions to avert the influence of supernatural forces from their palms. Many believe that the "evil eye" or a greedy look at a flowering tree can stop the toddy flow. *Pirith* water, blessed by Buddhist monks, is sprinkled on the flower and recitations are made to preclude this problem. Before climbing a palm, the tappers may invoke the locally worshipped Hindu gods and the Buddha. Tappers bless and chant over the knife with which they make incisions in the *kitul* flower. The knife is never made of iron, which the tappers believe would stop nectar flows.

PROCESSING SWEET TODDY TO SYRUP AND SUGAR

Household labor used to produce *kitul* syrup and sugar is divided along gender lines. Men climb palms and tap flowers, women process the sweet toddy to syrup. Every morning and evening the fresh toddy is brought home from the palms and handed over to the women. The fresh toddy is sweet, but in the course of a few hours it begins to ferment and becomes cloudy, going completely sour in 24 hours. Processing the toddy into syrup pre-empts this fermentation. Alternatively, when alcoholic beverages are the desired end product, the nectar may be allowed to ferment to the mildly alcoholic "toddy" or be further distilled. Women are usually less involved in processing for alcohol, as social norms against women drinking or even being exposed to alcohol production and consumption are strong in many rural communities.

When producing sugar in the morning or evening, a woman filters the fresh toddy and pours it into a clay pot. She places the pot on a hot, fast burning fire. When foam begins to appear on the surface of the liquid, it is skimmed off with a spoon. Once the foam has been removed, she blends that toddy with any remaining sweet toddy supply. From then on she keeps a low fire going and stirs the pot about every 20 minutes as the nectar boils down. The exact proportions of nectar to syrup vary with the quality of nectar and the individual family's assessment of "good" syrup. In an 11-week yield study of one household in the Welimada area, on average six bottles of nectar produced one bottle of syrup (roughly 0.75 liters). In Kotmale villages people most commonly spoke of a low 1:8 ratio of syrup to toddy. If the local wisdom holds that drier sites produce lower yields but higher quality, this low ratio of syrup to toddy from the wetter Kotmale area is to be expected. In general, the boiling process takes 2.5 to 3.5 hours. When completed, the syrup is poured into bottles and left to cool. Finally, they are sealed with wax. People say that a properly sealed bottle of syrup will keep for three months.

Alternatively, the syrup may be further boiled down to create "jaggery," or crystallized palm sugar. In this case, once the syrup stage is reached, the fire is reduced to a low flame and the syrup is stirred every five minutes or so. Once it approaches the desired viscosity, the syrup is pulled off the fire and continuously stirred. As it cools, the syrup thickens and is finally poured into molds for hardening. The traditional mold is a coconut half-shell, called a *hakuru essa*. Two halves make a *hakuru mula*. Scrapings from the pot can be rolled into small balls for home consumption. The informants' estimates (averaged for the yield study) was that six bottles of nectar would produce one bottle of syrup or 525 g of palm sugar. The lower the moisture content of the sugar, the longer it will keep. A content of 6.9% moisture is commercially permissible (Nonis 1989).

If not boiled into syrup or sugar within a day, sweet toddy ferments into a mildly alcoholic, beer-like beverage also known as toddy. This toddy is always drunk in the evening of the same day it was tapped. Additional left over toddy, by this time fermenting rapidly, is sometimes crudely distilled into a much higher proof alcohol known as *Ra*. Two bottles of toddy yield one bottle of *Ra*.[5] Partially due to the danger of alcohol poisoning stemming from use of toxic substances to control the fermentation process during distilling, and also in order to tax marketing of alcohol, the production and sale of homemade liquor without license is illegal and fines imposed on moonshiners are heavy. *Arrack*, the well known commercial palm liquor, is produced in a similar, though more carefully controlled fermentation and distillation process, most commonly from coconut palm toddy.

ESTIMATING THE ECONOMIC POTENTIAL OF *KITUL* SYRUP AND SUGAR

The major factors to be taken into account in assessing the economic potential of *kitul* for local producers are the average yield of salable product for a given climate, and production and marketing costs, which primarily consist of labor and fuelwood inputs. Estimates of gross yield value are presented here for areas with two different climates, Kotmale (relatively wet) and Welimada (higher elevation and drier). I also discuss the valuation of input costs in the areas studied.

Average yield per palm per day.—As noted above, yields of sweet toddy and syrup vary considerably by site and region. Nonis (1989) cites cases in which 20 bottles (750 ml per bottle) of sap flow from one palm in one twelve hour period. Other estimates include a high of 12 gallons (45 l) per day—probably from a palm with several flowers (McCurrach 1960), and 7–14 l in 24 hours from an average flower (Corner 1966). This latter closely approximates the estimates I gleaned from interviews with people in the Kotmale area, who indicated yields of 10–15 bottles per day. As indicated above, the estimated sap yields for the Welimada area are lower, around 7 bottles per day.

Assuming that one flower produces 12.5 bottles of sap per day in Kotmale and 7 bottles in Mirahawatte, and that one bottle is equivalent to 750 ml, then in Kotmale daily sap yield is 9.4 liters, and in Mirahawatte 5.3 liters. Tappers' responses on estimated syrup yields for Kotmale were one bottle of syrup from eight bottles of sap; for Mirahawatte one bottle of syrup from six of sap. Thus estimated, daily syrup yields are 1.2 liters per day for Kotmale and 0.9 liters per day for Welimada.

Average total yield and discounted value per palm.—An average *kitul* has three flowers that each produce for an average of three months, or roughly 270 days of yield per palm. The total syrup yield for an average palm during the course of its flowering in Kotmale is estimated to be 324 l, in Welimada 243 l. At the average 1990 price of Rs 53.3 per liter, the gross value per palm would be Rs. 17,269 in Kotmale and Rs. 12,952 in the Welimada area. The gross value per palm discounted to the present using the 1988 bank interest rate of 10% (Central Bank of Sri Lanka 1989) would be Rs. 6,059 in Kotmale and Rs. 2,749 in Welimada. Considering that per capita gross national product for Sri Lanka in 1988 was Rs. 11,939 (Ibid.) the value of only one palm is indeed significant. As noted above, most forest gardens have many palms. In Kotmale, the average number of *kitul* was 18 of varying age classes per household. If the palms are distributed evenly across age classes, with mature palms bearing between the ages of 11 and 20 years, each household would have an average of one mature palm per year. These calculations are based on rough estimates and are intended only to convey the palms' high potential value when economic analyses are applied.

Input costs.—Input costs in this rural economy are difficult to assess. The two key costs in syrup production are fuelwood and labor. Estimates from a series of trial tests show that it takes about 0.25 cubic meters of fuelwood to produce one liter of syrup or 700 gr. of jaggery (Ajit Lokuge, personal communication, 1991). For boiling syrup, women select good quality firewood; mixes of hardwoods from fruit trees such as *jak (Artocarpus heterophylla)* and mango are common. In the study areas, one or more of these species are easily available in most forest gardens. Survey results for this area indicate that 75–100% of village firewood comes from private forest gardens, with the remainder supplied by bush prunings from local tea plantations (Everett 1987, 1993). None of the households reported buying wood. Furthermore, none of the households in the area sell wood, despite the fact that in the Welimada area the market price for wood in the closest towns (11 km away) was Rs. 75–100 per m^3 in 1990/91. This is an indication that transport costs from these areas to town are still prohibitive. In effect, fuelwood is still a surplus commodity in the study areas and has zero market value, though the situation may change in future. Fuelwood is a major input in syrup and jaggery processing, and its scarcity could quickly make production uneconomic at present prices.

The second major input in processing is labor. As noted above, production tasks differ for men and women. The male tapper may spend as much as a few hours per day going to and from palms in the morning and evening, climbing the trees, and bringing the sweet toddy home. Local wages for day laborers during 1990/91 averaged Rs. 32 for an eight hour day or Rs. 4 per hour. If a typical palm yields for 270 days, then a very high estimation of the cost of the tapper's labor per palm at one hour per day is Rs. 1,080, or about 18% of the gross value of a palm's yield in Kotmale and 39% in Welimada. At the same time, because tapping goes on in the early morning and evening hours, in most cases the tappers' work does not conflict with other income earning opportunities. Many tappers work full time at another occupation, usually as farmers or day laborers.

Assessing the value of women's labor is complex. For example, the processing effort (largely supervising the boiling pot) for one palm is not doubled by adding toddy from an additional palm. Boiling syrup, gathering wood for the syrup fire, and cleaning and storing bottles takes an average of 3 hours per day. Women carry out many other household tasks while the pot is on the fire. They spend a large portion of most days at home preparing food, supervising children, tending the garden, and so forth. *Kitul* processing adds to the workload but does not directly replace other income earning potential, as the other household tasks must be taken care of anyway and no other cottage industry activity is available. Thus it is difficult to put a reasonable value on women's labor input for *kitul* processing.

An additional factor to be considered is marketing cost. At the present small scale of operations, marketing costs for most producers are minimal, since they sell jaggery and syrup to local traders. Larger scale production issues, including how to increase quantities for a steadier supply to urban and export markets are now being addressed in Sri Lanka. In the past in this very decentralized production system, it has been difficult to gather the larger quantities of high quality syrup required for export to larger markets that might bring increased returns to producers. Cooperative marketing might provide an answer to this problem. The government of Sri Lanka has responded by making jaggery production a component of at least one model village in the Agricultural Production Village (APV) Program initiated during the late 1980s in cooperation with international donors. In early 1990 in Wijebahukande, an APV in the Kotmale area, 25 families were involved in a cooperative syrup collection and marketing effort. Participants interviewed were enthusiastic about the program and more families were expected to join in.

The major problem in cooperative scale production is quality control. There is a certain amount of natural variation in syrup from the undomesticated palms. In addition, it is very easy for producers to stretch the yield of syrup by adding cheaper cane sugar. The adulteration is not always easy to detect in syrup, though the cane sugar crystals are coarser in jaggery. To my knowledge, a low cost, efficient method for testing supplies as they are brought to the collection point had not yet been applied in Sri Lanka in 1990.

The market potential for *kitul* products seems assured, if reliable quality and supply can be achieved. In Australia, for example, the large expatriate community from Sri Lanka is already buying the limited quantities of syrup and sugar imported from home.

OTHER USES OF *KITUL* PALM

While syrup, jaggery, and alcoholic beverages are the most important products from *kitul*, there are many others. When mixed with chilies and spices, toddy turns into a very good vinegar in 2–3 weeks' time. *Kitul* wood is very dense and hard, making excellent tool handles, plows, and mortars for pounding rice. Leaves are used for roof thatching. The nearly one meter long black bristle fibers from the *kitul* leaf base produce better quality string and brooms than does coconut coir. *Kitul* fibers are used in Sri Lanka today and in the past were exported to England for brushes. In the late nineteenth and early twentieth centuries, strands of 5–6 fibers twisted together were a valued substitute for whalebone in women's corsets (Blatter 1926).

The heart of the *kitul* palm can be processed to *kitul* flour, a starch which mixed with *kitul* syrup makes locally esteemed porridge and sweetmeats. The processing is rather laborious but is commonly undertaken for festival days. Men fell and split a young *kitul* palm. They scrape out its heartwood pulp and pound it very thoroughly in a mortar. They mix water into the pulp and then strain the liquid through a soft cloth into a pot. The flour settles at the bottom of the pot and the water can be skimmed off. Finally, the flour is put in the sun to dry.

Kitul products have medicinal properties, and are used in treatments in the ayurvedic medical system practiced in Sri Lanka. Uses recorded in National Science Council of Sri Lanka publications (Jayaweera 1982) include applying root bark and the "cabbage" or terminal bud of the palm to treat rheumatic swellings and snake bite. The cabbage is also employed for gastric ulcers. Treatments for boils call for *kitul* bark and seed. The root is used for tooth ailments.

A variety of religious rituals incorporate *kitul* sugar. The syrup is commonly presented in *puja* offerings at temples and plays special roles in certain rites including the *Kiriamma dane* and the *Malamma dane*. Last but not least, the *kitul* cabbage is a favorite food of the Sri Lanka elephant.

KITUL IN THE CONTEXT OF FOREST GARDENS

Kitul is just one of many potentially valuable multi-purpose perennials found in forest gardens. Farmer knowledge of individual species and varieties, their uses, and the growth requirements of a species for a given purpose is often highly sophisticated and systematically applied in garden management. Detailed interviews in which numerous species were cross-referenced demonstrated that farmers are highly aware of potential light, nutrient, and root competition among trees of various species and design, that to an untrained eye appear to be random and wild looking (gardens accordingly) (Everett 1991). A *jak* tree, for example, might be grown either in a dense stand with other trees to encourage a tall growth form for timber, or given a location in the open where it would receive good light and produce a large fruit crop. Farmers also take full advantage of successional processes in garden development. Use of fast growing species such as bananas (*Musa* spp.) as "nurse" plants to create shade for fruit tree seedlings is very common.

Once fully established, each small garden, which is usually less than 0.5 ha in size, represents a spatial mosaic of vegetation patches of various ages. The earliest successional stage, represented by a few vegetables, tubers, medicinal herbs, flowers, and papayas (*Carica papaya*) for household consumption, grows in a sunny patch close to the house. Surrounding the house, there are typically a series of orchard-like clusters of fruit trees of varying ages and maturation rates that gradually lead into dense stands of comparatively mature, tall trees with timber value. The latter patches include canopy species such as *Michelia champaca, Cedrela toona* or *jak,* and *kitul* and areca nut palms (*Areca catechu*), with understories comprised of native forest trees such as *Neolitsea involucrata* and shade-loving cash crops such as cardamom (*Elettaria cardamomum*). The standing timber functions both as a source of wood for household construction and as a relatively easily liquifiable asset when a family needs cash. Often the dense stands of large trees are located quite distant from the dwelling and along property boundaries. As several neighbors repeat this pattern, the back yard and garden border areas in a hamlet begin to resemble networked patches and corridors of natural forest. The longer an area has been settled, the larger the proportion of mature trees in gardens. In the heart of an old village, rooftops may be hidden beneath a nearly closed canopy.

Gardens include endemic and native trees as well as many introduced species. All of the cloves, nutmeg, and cinnamon; and most of the pepper, cardamom, coffee, and fruit (e.g., avocados, guavas, mangos, mangusteen, rambutan, citrus) produced in Sri Lanka are grown in small holder forest gardens throughout the island. In addition, the potential economic value of species with medicinal properties is increasingly apparent (e.g., King 1992).

While the spice crops thrive primarily in the lowland Wet Zone, there is much unexplored potential for gardens in higher and drier regions as well. Two species of known economic value, the *nelli* fruit (*Phyllanthus emblica*) and sandalwood (*Santalum album*), are well suited to the Welimada region, which being drier than the Kotmale area, is not the best place to grow most spice crops. Both species are found in the Welimada area (sandalwood is currently rare), but neither is managed or marketed effectively. Meanwhile, large quantities of both are imported to Sri Lanka from India. There is a national and possibly international demand now for products from other common forest garden trees, including *Citrus aurantium, Erythrina variegata, Mangifera zeylanica, Gmelina arborea, Gmelina asiatica, Thespesia populnea, Garcinea morella, Ficus hispida, Myristica dactyloides, Pongamia pinnata, Mesua ferra,* and *Cassia auriculata* (G. de Silva, personal communication, 1990). In addition, some timber and firewood species are major garden products that are undervalued since they are not commonly bought and sold in the cash economy.

THE ROLE OF FOREST GARDENS IN CONSERVATON

Studies of forest gardens in the highlands have demonstrated the ecological importance of this land use for the maintenance of biodiversity, watershed protection, and other environmental values (Senanayake 1987; Everett 1987, 1991, 1993). Homestead forest gardens make up about 15% of all land use (NARESA 1991:98, 108). In the highland region specifically, which was once 100% forested, only 12% natural forest with 2–4% forest plantations of exotics remain in a landscape now dominated by large scale tea plantations and annual vegetable cultivation. Here, where they make up as much as 23% of land use, forest gardens play a significant role in sustaining biodiversity by providing habitat for native plant and animal species. Further, research demonstrates the fundamental importance of these gardens—in which nearly all species have some utility value—for rural and suburban household subsistence (Wickramasinghe 1990).

Yet, as the rural highland economy becomes increasingly cash oriented, the longer term ecological and subsistence values of the gardens in some areas no longer suffice for their retention. In the Kotmale area conversion to tea production is common. In the Welimada area, landowners can earn quick returns from replacing gardens of trees and shrubs with fields of annual crops. Well developed market linkages for vegetable crops, ready supplies of seeds and agricultural inputs as well as government agricultural policies all encourage farmers to step in this direction. The localized costs of this land use conversion in terms of soil erosion from the steep highland slopes are already very visible in denuded slopes. The impact on the national water supply of the degradation of the highland water catchment zone, measured, for example, in high siltation rates for downstream dams and the effects of the heavy use of chemical fungicides, pesticides, and fertilizers, have not begun to be assessed seriously.

If forest gardens are to persist, government policy makers and land use planners must focus attention on them. The viability of the ecologically valuable garden systems now depends upon the promotion of a range of sustained yield cash crops that can compete with monocultures of tea and annual vegetables or tobacco. A variety of factors have long served to divert institutional attention away from forest gardens. These gardens have acquired the aura of backwardness. Research and development efforts, including allocation of subsidies to farmers in agriculture, have predominantly focused on rice and vegetable field crops or on the three key plantation export crops: tea, rubber, and coconut. Research and development in forestry have emphasized timber production in large scale monoculture plantations to the exclusion, until very recently, of nonindustrial private forests or forest gardens.

Efforts to promote horticultural crops, mainly through the Department of Export Agriculture, have had much smaller portions of research funding and have focused on a few well known minor exports of limited climatic range, particularly spices. Still, many farmers have benefited from these efforts, and by incorporating higher yielding varieties of crops such as coffee, pepper, and cloves into their gardens, now receive increased cash incomes, while retaining the ecological value of mixed gardens. In other cases, a less encouraging agronomic approach to management of a narrow range of species (with government subsidies to support them) has encouraged farmers to replace their complex multitiered agroecosystems with single or few species production plots.

A broader, systems approach to "analog forestry" (Senanayake 1987) is needed that would emphasize forest gardens as a complex and diverse forest management system, and seek ways of increasing yields of salable products from them while maintaining their ecological structure and function. Analog forestry techniques, some of which are being tested in cooperation with local farmers by the NeoSynthesis Research Centre, a private nonprofit research station located in the Central Highlands, include identification of products with existing or potential market values. Management can include a range of activities from basic husbandry to programs for genetic improvement of cultivars. Introductory trials of shade tolerant species with economic value, such as understory herbs, flowers, mushrooms, or epiphytes, are currently underway.

The development of marketing structures compatible with the small scale and dispersed culture of forest garden production is vital as access to national and international markets depends upon supplies of adequate quantity and quality. Cooperative collection and marketing is one approach that is being tested by the Department of Agriculture in an Agricultural Production Village in the Kotmale area for the case of *kitul* syrup and jaggery production. Cooperative structures have already proven very successful for other commodities in the region, most recently for milk production. Forest garden market cooperatives will ideally accommodate a large variety of products from a given area.

The potential for enhanced cash earning for forest gardeners is clear. Whether the immediate returns will be competitive with the value of conversion to annual vegetable cropping, particularly outside the narrow range of the spice growing areas, remains to be seen. Other institutional responses in the form of land use policy may be required. For highland Sri Lanka the issue has many of the well known ramifications of tropical deforestation and valuation of non-timber forest products, one of which is that you often don't know what you've lost until it's gone.

NOTES

[1]This paper was presented at the 1992 Society of Ethnobiology Annual Conference, National Museum of Natural History, Smithsonian Institution, Washington, DC.

[2]People say that *kitul* seed is difficult to germinate and that it requires passing through animal dispersal agents (e.g., civet cat, known locally as "toddy" cats). Therefore, the preferred method for planting *kitul*, which is not common, is to transplant young seedlings. Great care must be taken not to damage the roots in the process.

[3]One study showed that 25% of 67 households interviewed near Sinharaja forest held such a license, but there may be a good deal of illicit tapping and estimates of yields from the forest are difficult to make (McDermott 1986).

[4]The dry season is from May through August in the Sri Lanka Intermediate climate zone near Welimada, and from January through February in the Wet Zone, including Kotmale.

[5]In 1990 a bottle of toddy typically sold in this area for 5 Sri Lanka Rupees (Rs). A bottle of *Ra* sold for 6 Rs.

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PUMÉ EXPLOITATION OF *MAURITIA FLEXUOSA* (PALMAE) IN THE LLANOS OF VENEZUELA

TED L. GRAGSON
Department of Anthropology
250 Baldwin Hall
University of Georgia
Athens, GA 30602-1619

ABSTRACT.—The benefits and potential cumulative effect of Pumé exploitation of *Mauritia flexuosa* L.f. (Palmae) are covered. The Pumé (also called Yaruro) live in semi-nomadic villages in the Venezuelan Llanos where they depend on fishing, hunting, gathering of wild foods, and some gardening of manioc and corn. *M. flexuosa* is a palm species characteristic of low-lying flooded areas throughout South America and is used by the Pumé for food, fiber, and building materials, but the most important use is for thatching houses. The various houses maintained by a single Pumé community contain some 13,498 fronds which means an annualized harvest of approximately 577 mature palms. Upon disposal, this quantity of fronds provides an estimated 3,373 kg of dry matter to the soil of the settlements involved.

RESUMEN.—Se describen los beneficios y efectos cumulativos potenciales de la explotación de *Mauritia flexuosa* L.f. (Palmae) por parte de los Pumé. Los Pumé (también llamados Yaruro) viven en aldeas semi-nomádicas en los Llanos de Venezuela, donde dependen de la pesca, caza, recolección de alimentos silvestres, y algo de cultivo de yuca (mandioca) y maíz. La *M. flexuosa* es una especie de palma decaracterística de lugares bajos e inundados distribuida ampliamente en América del Sur, y los Pumé la utilizan como alimento, fibra y material de construcción, pero el uso más importante es para techar casas. Las varias viviendas mantenidas por una comunidad Pumé contienen alrededor de 13,498 pencas de palma, lo cual significa una cosecha anual de aproximadamente 577 palmeras maduras. Al ser desechadas, esta cantidad de hojas contribuyen al suelo una masa estimada de 3,373 kg de materia seca en las comunidades donde son empleadas.

RÉSUMÉ.—Cet article décrit les avantages et les effets cumulatifs possibles résultant de l'exploitation de *Mauritia flexuosa* L.f. (Palmae) par les Pumé. Les Pumé (également connu sous le nom de Yaruro) habitent des villages semi-nomadiques dans les llanos du Venezuela où ils vivent de pêche, de chasse, de cueillette et, dans une moindre mesure, de culture du manioc et du maïs. *M. flexuosa* est une espèce de palmier caractéristique de régions basses et inondées de l'Amérique du Sud qui est utilisée comme nourriture, fibre et matériau de construction, en particulier pour les toits des habitations. Les diverses maisons d'une seule communauté pumé nécessitent l'emploi d'environ 13,498 frondes, ce qui représente une récolte annuelle approximative de 577 palmiers mûrs. Après usage sur les toits, la même quantité de frondes enrichit le sol des communautés concernés d'environ 3,373 kg en matière sèche.

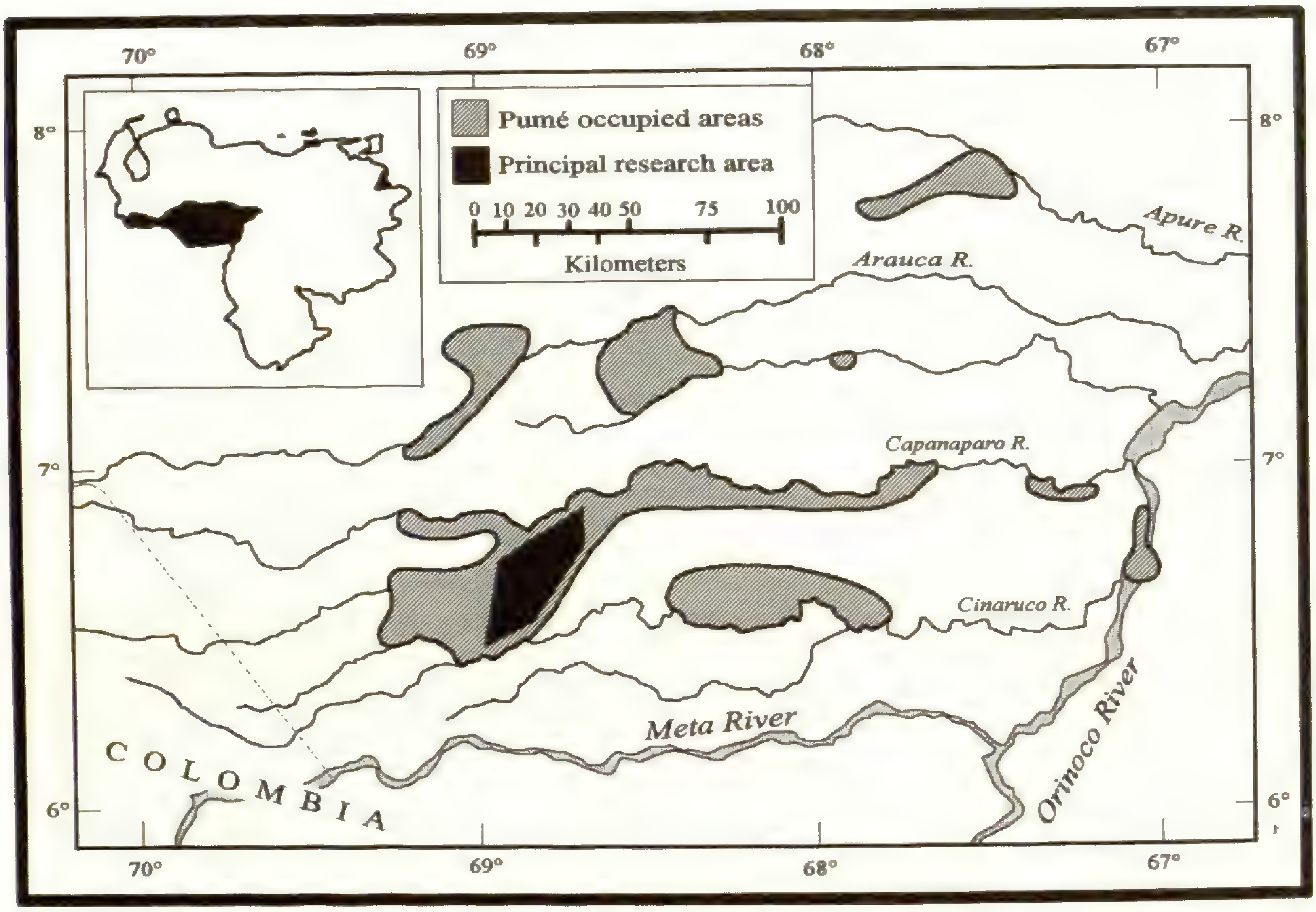

FIG. 1.—Location of the Llanos de Apure in Venezuela and distribution of Pumé villages thoughout the area (based on Lizarralde in Mitrani 1988).

INTRODUCTION

Few palm species have ever been domesticated worldwide yet they probably provide more economic benefits to humans in the form of food, fiber, building materials, fuelwood, and folk medicine than any other family of plants (Uhl and Dransfield 1988; Johnson 1988; Beckerman 1979; Lévi-Strauss 1950; Balick 1986; Clement 1988). Despite the many benefits derived from palms very little is known about the environmental effects of exploiting palms. This is a relevant issue because it has been shown that native peoples in South America can decidedly modify through low-intensity disturbance the productivity and structure of portions of the environment they inhabit (Stocks 1983; Posey 1983, 1984; Balée 1988; Anderson and Posey 1989; Bodley and Benson 1979). For example, to thatch a traditional communal Barí house *(bohio)* may require as many as 750,000 palm leaves (*Geonoma* spp. [Palmae]) leaves harvested from approximately 125,000 plants over a 40 km^2 area (Beckerman 1977). The environmental effects of Barí housebuilding are unknown, but the evidence is supportive of Balée's (1988) argument about indigenous adaptation to Amazonian palm forests.

BACKGROUND

The Pumé (also called Yaruro in the earlier literature) inhabit the Llanos de Apure of southwestern Venezuela located west of the Orinoco river and south of the Apure river (Figure 1). The Llanos de Apure with an average elevation of less than

TABLE 1.—Use of *Mauritia flexuosa* by the Pumé.

Anatomical part	Major time of harvest	Principal use
heart	March–May	food
fruit	June–August	food
stem	March–May	food (larva)
leaf	March–May	house thatch, baskets, manioc sifters
sword leaf	November–May	cordage and fiber, hammocks, baskets and bags, manioc press, floor mats, loin cloth, mosquito net[1]
petiole	as needed	rafts, shelving, barriers and fences

[1]During historic times before cloth became widely available.

200 m above m.s.l. lie at the center of a tropical savanna extending from the Delta of the Orinoco in northeastern Venezuela to the Guaviare river in southern Colombia. The average annual rainfall in the area occupied by the Pumé is nearly 2,000 mm, but most precipitation is concentrated in a 5 month rainy season (May-September). The seasonal concentration of rainfall combined with the slight gradient of the Llanos de Apure results in extensive flooding that can last from 1 to 10 months out of the year (Zink 1986; Andel and Postma 1954; FAO 1965; Goosen 1964).

In 1986–1987 and again in 1989 I conducted ethnographic research on the subsistence ecology and settlement practices of ***čiri k^honome*** Pumé who represent the least acculturated segment of Pumé society (Gragson 1989, 1992a). The ***čiri k^honome*** Pumé constitute approximately 17% of the total Pumé population in Venezuela of 3,873 (OCEI 1985) and occupy the interfluvial savanna between the Capanaparo and Cinaruco rivers. The ***bea k^honome*** Pumé represent the balance of the population and live on the margins of the principal rivers traversing the Llanos. The ***čiri k^honome*** Pumé live in semi-nomadic villages following a subsistence pattern based on fishing, hunting, gathering of wild foods, and some gardening of manioc and corn (Gragson 1992a). Like most other native South Americans, the ***čiri k^honome*** Pumé rely extensively on palms for fiber to manufacture artifacts and clothing, food in the form of fruits, palm heart, and larvae, and leaves used to thatch houses and make additional artifacts (Gragson 1992b).[1]

MAURITIA FLEXUOSA AS A RESOURCE

Mauritia flexuosa L.f. (Palmae) is a solitary, arborescent palm growing to a height of 30 m with reduplicate and palmate leaves with a short midrib. The stem is unarmed, grayish-brown in color, and bears distinctive leaf scars. *M. flexuosa* is the most widely used of all palms among the Pumé (Table 1). (The other palms used are *Astrocaryum jauari* Mart., *Euterpe precatoria* Mart., and *Mauritiella aculeata* (Kunth) Burret [Gragson 1992b].) The cuticle separated from the leaf segment of the young, unrolled leaf (sword leaf) is sun-dried and used as a multipurpose fiber. Dyed red by boiling in a decoction of *Arrabidaea chica* (H. et B.) Verl. (Bignoniaceae) leaves, the fiber is used as a "loincloth" by women. The fiber can be woven to make small bags for holding personal possessions, slings for carrying babies, and most importantly mats; soils in this area are loose and sandy, and mats are used for sitting on, laying uncooked and prepared food on, and as wind or rain shields. Twined, the fiber is used to manufacture the hammocks Pumé sleep in.

A byproduct of fiber extraction are the prominent midribs found on each leaf segment, which are loosely woven into manioc flour sifters. Whole, mature leaves of *M. flexuosa* are used to weave floor mats, upright windshields, and the large baskets used to store personal belongings and to carry manioc, wild roots and firewood. The major use of mature leaves, however, is for thatching houses. After sun-drying for several days, leaves are split in half lengthwise and hung over roof slats typically made from the stem of *Mauritiella aculeata* (Palmae).

Dry petioles of acaulescent juveniles of *M. flexuosa* reach lengths of 5 m and are fairly straight, quite rigid, and extremely light. The petioles of acaulescent juveniles are used to make fences around small patches of squash or tobacco within the village. Several petioles can also be pierced onto a stick to form a platform used as a shelf when suspended from the rafters of Pumé houses, a windbreak/rainshield when stuck upright into the ground or as a personal water raft. Petioles are charred and the ash mixed with resin droplets of *Symphonia globulifera* L.f. (Guttiferae) to manufacture a substance used to seal, bind, and waterproof a multitude of manufactured items. *M. flexuosa* items consumed include the fruit, the palm heart and the large *Rhynchophorus palmarum* L. (Bruchidae) larvae which inhabit rotten stems of this species.

MAURITIA FLEXUOSA AS AN ECOSYSTEM UNIT

M. flexuosa is undoubtedly the most widely used species of palm by Native and non-native alike in South America (Ruddle *et al.* 1978; Anderson 1978; Clastres 1972; Balick 1985; van den Berg 1984). It is also the most widely distributed species of palm in Amazonia (Uhl and Dransfield 1988; Kahn 1988; Balick 1984; Ruddle *et al.* 1978) a fact already noted by Spruce during his travels throughout South America over 100 years ago (1869:77): "The most universally distributed palm throughout the basins of the Amazon and Orinoco, or, say from the Andes of Peru and New Granada [Colombia] to the shores of the Atlantic, is undoubtedly *Mauritia flexuosa* (L.)." The distribution of *M. flexuosa* outside the Amazon basin has been postulated as due to human transportation (Kahn and de Granville 1992).

M. flexuosa is characteristic of seasonally flooded swamp-forests such as várzea, igapó, and gallery located adjacent to rivers and streams but achieves its highest density in permanently flooded swamps (Table 2). Soils in these areas tend to be hydromorphic (e.g., gleysol, district histosol), highly acidic (down to pH 3.5), and can have several meters accumulation of slightly decomposed organic matter (Kahn 1988, Aristeguieta 1968, Braun 1968, Moore 1973, Pires and Prance 1985, Kahn and de Granville 1992). *M. flexuosa* occupies poorly drained soils characterized by anaerobic conditions through reliance on aerial roots with pneumatophores similar to other swamp-dwelling palms of America and Africa—e.g., *Raphia* spp. (de Granville 1974, Profizi 1985, Kahn and de Granville 1992).

M. flexuosa is frequently a dominant among the palm species found in swampy environments, this observation is recognized in popular and scientific classifications

TABLE 2.—Systematics and ecology of *Mauritia flexuosa* L. f. (Palmae).

Scientific name:	*Mauritia flexuosa* Linnaeus filius	
Common names:	Bolivia:	*palma real;*
	Brazil:	*caraná, burití, muriti, muriti do brejo, ita;*
	Colombia:	*aguaje, canangucha, moriche;*
	Ecuador:	*acho, aguaschi, morete;*
	French Guiana:	*palmier bâche;*
	Guyana:	*aeta, aete, eta, ita, ite palm;*
	Peru:	*achuál, aguaje;*
	Surinam:	*maurisie, morisi;*
	Venezuela:	*moriche.*

Biogeography: solitary tree-palm distributed between approx. 14 S Lat and 14 N Lat throughout the island of Trinidad and South America east of the Andes (Bolivia, Brazil, Colombia, Ecuador, Fr. Guiana, Guyana, Peru, Surinam, and Venezuela); found at elevations below 500 m, typically growing on swampy or seasonally flooded lands with poor drainage and acid soil; often forms dense, almost pure stands with up to 645 indiv/ha.

Root: subterranean root branches into small, thin, absorbing roots; aerial roots have pneumatophores for oxygen uptake; can also produce many 2–10 cm long erect aerial rootlets on stem ("aerial root muff").

Stem: 15–30 m tall typically 0.3–0.6 m in diam. but reported up to 1.75 m; cortex is hard, unarmed and straight with distinct internodes; middle of stem is sometimes swollen; pith is spongy, reddish in color and contains up to 60% dry weight in starch (up to 60 kg starch can be extracted); sap can be fermented to produce a wine; rotten stems (particularly male plants) inhabited by the edible *Rhyncophorus sp.* (Bruchidae) larva (up to 500 larvae/stem).

Leaf: 10–12 per palm and restricted to a terminal crown; production 5–12 leaves/palm/year; briefly costapalmate, approx. 3.0 m in diam. with deeply cut and glossy green blades 0.8–1.2 m long and 1.5–2.0 m wide; leaf-blades bear a low hastula-like crest (^shaped) adaxially at base and have prominent midribs; leaf-blades are 2–4 cm wide drooping at tips; last 2–3 years as thatch. Petioles 2–3 m long and conspicuously adaxially channeled near base; otherwise circular in cross-section, smooth and unarmed.

Flower: dioecious, but occasionally hermaphroditic; interfoliar (originates among leaves), persistent and pendulous; 2–3 m long with numerous short, tubular bracts, and catkin-like branches; male flower has six stamens; young inflorescence produces a sap that can be fermented into wine.

Pollination: known pollen transporter is *Melipona seminigra merrillae* (Apidae).

Fruit: 5–8 fruiting panicles per tree with up to 724 fruits per panicle; productivity 6.1–9.1 mt fruit/ha/yr. Fruit is large, usually one-seeded and sometimes wider than long: 4 cm in diam. and up to 5 cm long with depression at top; loricate pericarp: many neat vertical rows of reflexed scales, red-brown when mature; rather thick, fleshy, edible, yellowish-red mesocarp; spongy, undifferentiated endocarp; corneous, homogeneous endosperm. Average fruit weight 75 g; mesocarp represents 20.5% and endocarp 12.0% of fresh weight; moisture constitutes 67%. Mesocarp contains up to 12.0% oil, woody seed and kernel up to 4.8% oil, dry remainder of meso- and endocarp; 5.2% protein, 26.2% fat, 38.2% starch and sugar, 2.9% ash, 27.5% cellulose, 30–300 mg/100 g edible portion b-carotene (50,000–500,000 IU provitamin A), and 18.4 mg/100 g edible portion a-tocopherol (vitamin E). Seeds are used as vegetable ivory; nuts are baked, ground and consumed as abortifacent.

TABLE 2.—Systematics and ecology of *Mauritia flexuosa* L. f. (Palmae). (continued)

Phenology: flowering: annually for a period of approximately 2 months during the dry season. Fruiting: annually for a period of up to 6 months during the wet season. (Wet and dry season months vary north and south of the equator.)
Seed dispersal: probably by water as a result of spongy endocarp. Seed known to pass intact through the gut of *Tapirus terrestris* (Tapiridae), which defecates in water.
Germination: embryo sprouts laterally from fresh seeds in 65 days and from stale seeds in 210–270 days; thrives in partial shade as well as full sun; requires hot climate and swampy, strongly acid soil (≈3.5 pH).
Sources: Absy and Kerr (1977), Balick (1979, 1984, 1985), Balick and Beck (1990), Beckerman (1979), Bodmer (1991), Braun (1968), Cavalcante (1976), Dahlgren (1936), de Granville (1974), Kahn (1988), Kahn and de Granville (1992), Kubitzki (1985), Marx and Maia (1983), McCurrach (1960), Pesce (1944), Peters (personal communication, 1987), Pires and Prance (1985), Ruddle et al. (1978), Spruce (1869), Tomlinson (1961), Uhl and Dransfield (1987), Wilbert (1976).

tions as a distinct formation called a *morichal*, a *buritizal*, or an *aguajal* (Moore 1973, Blydenstein 1967, Pires and Prance 1985, Beard 1944). In forested areas of the Amazon basin, the absolute density of *M. flexuosa* ranges from 15 to 645 individuals/ha and its relative representation among all palm species in a local area ranges from 0.5% up to 54.5% (Kahn and de Granville 1992). In the Llanos of the Orinoco Basin, *M. flexuosa* densities of 20 individuals/ha are reported for *morichals*. These swampy areas in which the water can seasonally reach depths of 40 cm constitute well-defined vegetational units with a species composition distinct from that of the surrounding savanna (Blydenstein 1967, Beard 1944, Ramirez and Brito 1990). No density information is available for *M. flexuosa* in gallery forests of the Llanos, but in some areas it seems to occur in greater numbers than those indicated for seasonal swamps.

CUMULATIVE EXPLOITATION EFFECTS

The most important use of *M. flexuosa* among the ***čiri k^honome*** Pumé is for thatching houses and other shelters; this is also the observation made of their neighbors to the south, the Guahibo, and several Indian groups of the Guiana region (Balick 1979, Lévi-Strauss 1950). The second most significant use of *M. flexuosa* among the Pumé is to obtain fiber. As practiced by the Pumé, both extracting fronds for thatch and the sword leaf for fiber destroy a palm and thus these two activities can have a significant impact on the local standing population of *M. flexuosa*. The ***čiri k^honome*** Pumé of any given community are attentive to the population size of mature *M. flexuosa* within "their" portion of savanna. In locating settlements, the Pumé speak of the importance of being within easy walking distance of a palm swamp since all fronds extracted for thatch are carried on their backs from source to destination (Figure 2).

Other uses of *M. flexuosa* among the Pumé are either secondary or incidental to thatching and fiber. For example, a palm will seldom be cut for the sole purpose of extracting the heart; however, if the sword leaf is taken for fiber or leaves are col-

FIG. 2.—Pumé man returning to community with *M. flexuosa* fronds to be used in house thatching.

lected for thatch then the heart is usually taken as well. *Rhynchophorus* larvae are collected from the rotten stems of *M. flexuosa* cut in previous years to obtain thatch; however, I have no indication the Pumé actively create habitats for *Rhynchophorus* by cutting palms for that purpose alone. There are no good natural substitutes in the interfluvial zones occupied by ***čiri k^{h}onome*** Pumé for the thatch and fiber produced from *M. flexuosa*. The ***bea k^{h}onome*** Pumé living along major rivers in the region such as the Capanaparo, Cinaruco and Riecito use *M. flexuosa* for thatching, but *Astrocaryum jauari* (Palmae) is commonly substituted for fiber. While commercial substitutes for thatch and fiber can be obtained this depends on the availability of cash, which is still a rare commodity among the Pumé (both ***čiri k^{h}onome*** and ***bea k^{h}onome***) in this area of Venezuela. Zinc roofing sheets, for example, are expensive for the Pumé (each sheet is equivalent to about two weeks fulltime labor), difficult to transport and ultimately less comfortable to live under than palm thatch in this environment.

While the local population of *M. flexuosa* may be considered by the Pumé in their settlement decisions, a more significant concern to the long-term viability of a given Pumé community are the cumulative effects harvesting this palm has on the local environment. Some idea of the significance of these effects to Pumé community viability can be gained by considering in more detail house thatching. The ***čiri k^{h}onome*** Pumé construct three types of palm-thatched shelters: 1) multifamily houses used in wet-season settlements; 2) nuclear-family houses used in dry-season settlements and wet-season camps; and 3) conical huts used in early and late dry-season camps. A ***čiri k^{h}onome*** Pumé community will normally use in the

TABLE 3.—Use of *Mauritia flexuosa* for thatch by Pumé of the community of Doro Ana.

Site	House type	Season occupied	Total fronds/ village	Number of houses/village	Average fronds/house
S-1	multi	wet	6,208	5	1,242
s-2	nuclear	dry	4,956	12	451
c-1	nuclear	wet	2,334	6	398

course of a year one wet-season settlement, one dry-season settlement, and a variable number of camps that may be as many as 10 (not all of which have palm-thatched shelters). Conical huts will not be considered further as they are temporary shelters used for a few days to a few weeks and the thatch used is generally recycled into multifamily and nuclear family houses.

Multifamily and nuclear-family houses are lived-in for up to six months out of a year and the annual reoccupation of houses is ensured by periodic replacement of thatch and other structural components as they deteriorate. *M. flexuosa* fronds used as thatch are reported to have a 2- to 3-year lifespan by the Pumé and others (Balick 1984; Peters, personal communication 1987); from personal experience, fronds in the Llanos become brittle to the touch and somewhat bug-eaten in as little as 12 months although their condition remains good enough to last one more year. The ***čiri kʰonome*** Pumé reoccupy a given settlement for three to five years; after this amount of time, the thatch on houses is infested with insects such as centipedes and scorpions, and the wooden frame is riddled with termites and is structurally unsound. Replacing individual building components seldom solves these problems and houses at this point must be completely rebuilt. Frequently, the entire village is simply relocated since another major consideration noted by the Pumé in a village this age (particularly dry-season villages) is dust—continuous trampling pulverizes surface materials which are then more readily airborne during the dry season when average daytime wind speed is 4.2 km/hr (calculated from raw data provided by MARNR[2]).

A substantial number of palms must be cut to provide thatch for Pumé houses on a 2- to 3-year interval. Based on information collected in the ***čiri kʰonome*** Pumé community of Doro Ana during 1986–87, the average multifamily house contains 1,242 fronds and a nuclear-family house contains between 389 and 451 fronds (Table 3). (The average conical hut contains 15 fronds.) Given the average production of 11.7 thatching-fronds/palm (Table 4) and using a frond lifespan of 2 years translates into an annualized requirement of approximately 53 palms to provide enough thatch for the average multifamily house and between 16.6 and 19.3 palms for a nuclear family house. There is a total of 13,498 fronds in the various houses maintained by the ***čiri kʰonome*** Pumé community of Doro Ana, which translates into an annualized requirement of 576.8 palms. How this cropping rate ties into local turnover rates (mortality + recruitment) of *M. flexuosa* is unknown; however, another dimension of this cropping rate that can be estimated is the circulation of biomass within the local environment.

TABLE 4.—Leaf yield per palm of *Mauritia flexuosa* harvested for thatch by Pumé of the community of Doro Ana.

Frond Quality	n	% Total	Average fronds/palm[1,2]
mature	240	75.9	10.9 (sd 2.5)
senescent	18	5.7	0.8 (sd 1.8)
lost in felling	58	18.4	2.6 (sd 2.8)
Total	316	100.0	14.4

[1]Based on n = 22 palms.
[2]Thatching-fronds = mature + senescent or 11.7 (sd 3.3) fronds/palm.

The total of 13,498 fronds used in thatching by the community of Doro Ana translates into an annualized demand of 6,749 fronds exported from a palm swamp; these fronds will eventually be disposed in village dumps as they deteriorate and represent an estimated contribution to the soil of the three settlements involved of 3,373 kg of dry matter. [3] It is not possible to estimate with any accuracy the dry-weight contribution the stems and root mass of 576.8 mature palms would have on the palm swamp environment in which they were cut; I did not collect weights for stems or roots and no biomass measures currently exist for the woody portions of M. *flexuosa*. However, if *Elaeis guineensis* (Palmae, the African oil-palm) which has growth habits similar to M. *flexuosa* can be used as a reasonable starting analog, the stems alone of 576.8 palms would contribute somewhere on the order of 147,661 kg of dry matter.[4]

CONCLUSION

The issue of how low-intensity human disturbance can accumulate over time resulting in noticeable changes in natural environments is an important question in tropical ecosystems. During the Holocene history of Lowland South America, for example, the disposal of organic refuse by humans over long periods of time led to the genesis of terra preta soils throughout many parts of Amazonia (Eden *et al.* 1984, Balée 1988, Clark and Uhl 1987). Low-intensity disturbance has important implications for the future as well as revised tenure systems are implemented in frontier settings and these systems lead to changes in rates of resource exploitation (Bodley and Benson 1979, Stearman and Redford 1992, May 1986).

NOTES

[1] Voucher specimens for plants reported in this article are deposited in the Dr. Victor Manuel Ovalles Herbarium (MYF) and duplicates will eventually be placed at the Venezuelan National Herbarium (VEN) and the Missouri Botanical Garden (MO).

[2] Ministerio del Ambiente y de los Recursos Naturales Renovables, República de Venezuela

[3] The average weight of fronds used by the Pumé of Doro Ana for thatching is 833 g (n = 180

fronds). The average dry-weight contribution of fronds is calculated by taking 60% of the total estimated weight.

[4] The average dry-weight content of *Elaeis guineensis* (Palmae) stems is 256 kg (n = 6 mature individuals of different ages) (Hartley 1977).

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IDENTIFICATION OF FIREWOOD SPECIES IN THE ARCHAEOLOGICAL RECORD OF THE PATAGONIAN STEPPE

ELENA ANCIBOR
Cátedra de Anatomía Vegetal
Facultad de Ciencias Exactas y Naturales
Ciudad Universitaria Pabellón 2
1428 Buenos Aires, Argentina

CECILIA PÉREZ DE MICOU
Sección Prehistoria
Instituto de Ciencias Antropológicas
Facultad de Filosofía y Letras
25 de Mayo 217 - 4° Piso
1002 Buenos Aires, Argentina

ABSTRACT—The microscopic study of nine species of local woody plants used as fuel in the Piedra Parada Valley (Province of Chubut, Argentina), is presented. The purpose of the paper is to give the main anatomical characteristics of their woods, in order to aid in their identification in the archaeological contexts of the Patagonian steepe.

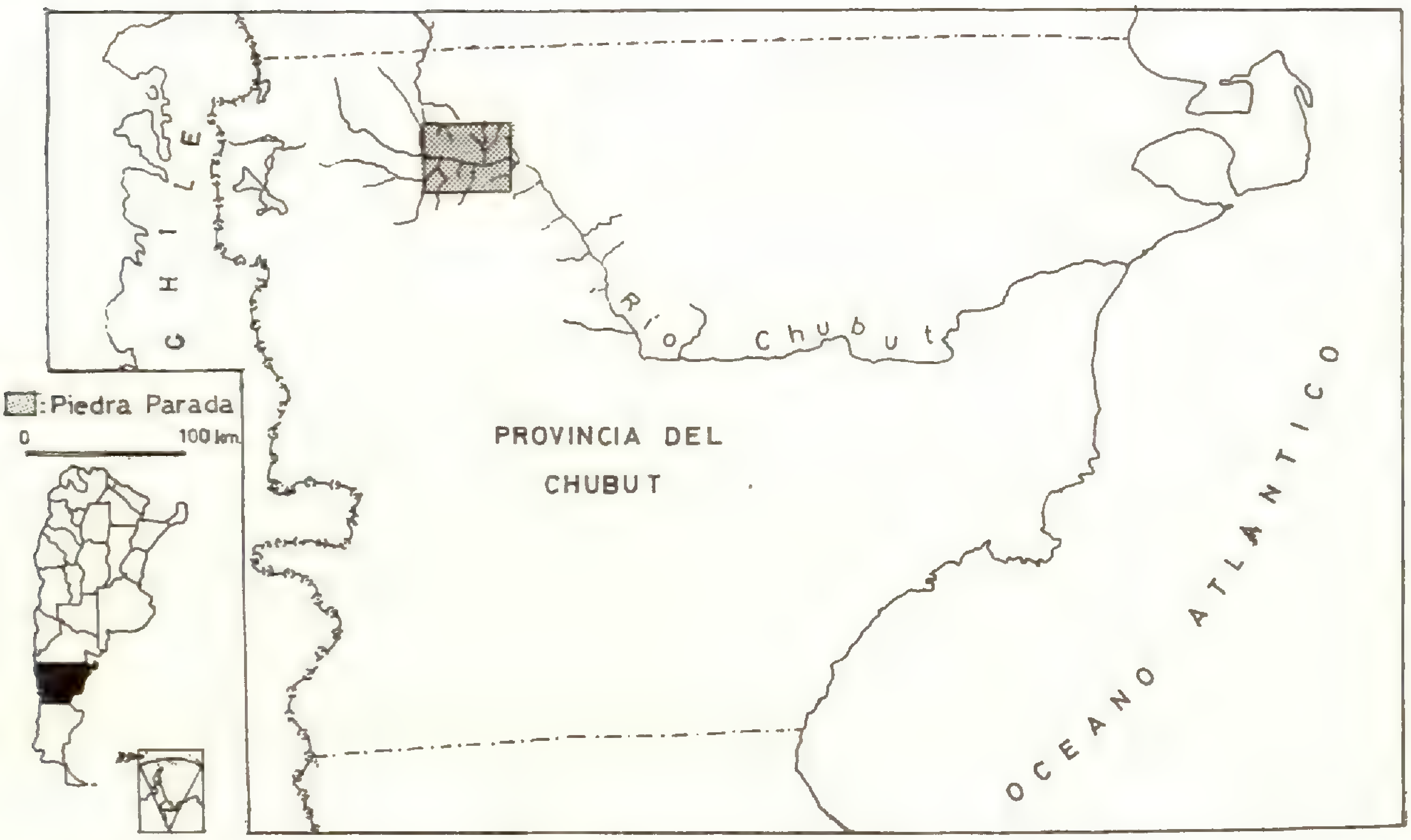
RESUMEN—Presentamos el estudio microscópico de nueve especies de plantas leñosas utilizadas como combustible en el Valle de Piedra Parada (Provincia de Chubut, Argentina). Su objetivo es dar a conocer los caracteres anatómicos principales de las leñas para facilitar su reconocimiento en los contextos arqueológicos de la estepa patagónica.

RÉSUMÉ—Nous présentons une étude microscopique de neuf spèces de plantes ligneuses employées comme combustible domestique par les habitants de la Vallée de Piedra Parada. Ce travail donne les charactères pricipaux de ces bois pour faciliter leur identification dans les contextes archéologiques de la Steppe Patagonique.

INTRODUCTION

This study is a part of an ethnoarchaeological research project conducted in the Piedra Parada Valley, Province of Chubut, Argentine Patagonia under the direction of Carlos Aschero (Aschero et al. 1983).[1]

Patagonia is located in the south of the Republic of Argentina, between latitudes 40°S and 55°S. From a broad, ecological point of view it can be considered a cool semi-desert. "Far from being uniform, the region exhibits quite a rich spectrum of vegetation types, from the real desert to shrub or grass steppe. No estimates have been made of the area actually covered by each one of the different



MAP 1.—The study area, Chubut Province, Argentina.

physiognomic units present, but a rough approximation could be: 45% shrub desert, 30% shrub-grass semi-desert, 20% grass steppe and 5% water surface and minor types like meadows, locally named "mallines cañadones," and "vegas" (Soriano 1983:423).

Although the current human population density in Patagonia is very low (0.6 people/km^2), human impact has become evident not only through the sheep industry but also through wood cutting, the oil industry, dam construction, and town and road building (Soriano 1983:245).

The Piedra Parada Valley is located in the northwest of the province of Chubut, between latitudes 42°20´-S and 43°00´-S, and longitudes 69°30´-W and 70°30´-W. The Chubut River crosses the province from west to east, and has a constant flow all year round. The climate is dry and cold (138 mm annual precipitation with temperatures between 17.9°C in January and 3°C in July); dominant winds are from the west. The native fauna is receding, but *Lama guanicoe, Rhea* sp., *Dusicyon griseus, Zaedius pichii,* and *Chaetophractus villosus* can still be seen (see Map 1).

The flora corresponds to the Patagonian Province, Western District (Soriano 1983:441). "The same general vegetation extends over plateaus, mountains, and the non-humid parts of valleys. It is a semi-desert in which the dominant plant form is tussock grass with linear, spiny leaves. Scattered among the grasses, shrubs less than 1 m high, frequently cushion-like, present themselves in a very wide range of density" (Soriano 1983:441).

This landscape does not, at first sight, present a large quantity of plants, nor a great variety of species, which could provide firewood. Nevertheless, in the archaeological excavations which one of us has been carrying out in the area, a large quantity of coals was recovered. These coals were found isolated as well as associated with combustion features[2]. To find out what steppe shrubs could have been used for firewood, a contemporary ethnobotanical investigation was planned, based on the idea that the coal remains present in the archaeological contexts may provide information on a variety of functions carried out at the time of occupation: heating, lighting, drying, the cooking of food, smoking of meat, etc. The first results indicated that there is a relationship between 1) the shape adopted by the coal remains (flat spots, deep hearths, loose coals) and the activity which produced them, and 2) the type of firewood, activity carried out, and location of the activity in the site. This implies, not only that different firewoods were used for lighting, cooking, or heating, but also that the same function (cooking for example) may require different firewoods depending on the *locus* of the activity. This ethnobotanical information allowed us to state hypotheses about the functions of the combustion features which were found in the excavated sites (Pérez de Micou 1991a, 1991b).

Our main purpose in this paper is to offer the necessary reference material for identifying woody species present in the archaeological record, thus laying the groundwork for further interpretations regarding their possible uses. Taking into account that anatomical studies of these Patagonian shrub species are not available and that the information given here will be useful to archaeologists with a limited background in botany and plant anatomy, descriptions will be restricted to essential characteristics illustrated by photographs taken with an optical microscope.

MATERIALS AND METHODS

Materials.—The samples were collected in Languiñeo and Cushamen Departments, Province of Chubut, Argentina, with the advice of local inhabitants. Adults born here with a sustained residence in the area were selected as informants; persons permanently involved in rural activities were chosen. During our fieldwork we carried out open-ended interviews, direct observation, and participant observation of all the activities involving plant combustion. Notes were taken regarding the environments in which the informants located each species, the ways in which each type of firewood was obtained, and the use given to each according to its qualities. The scant population which is now scattered throughout the area has repeatedly and concordantly reported nine plant species which furnish firewood of different qualities. According to these qualities they are used for specific functions and in certain circumstances. We present the data as they were reported by the informants, who attributed special qualities to each firewood.

Herbarium materials are almost impossible to obtain in the case of firewoods, at least not from the same plants that provided the firewood samples. This is due to the transportation of the wood for variable distances after it is gathered.

Firewood varieties and their qualities.—The inhabitants of Piedra Parada distinguish environments in the area which are similar to those indicated in scientific papers. The alluvial plain adjacent to the Chubut River is called *"costa"*; this land constitutes the lowest floor of the Valley (400m elevation), with mild winters and natural protection for cattle. For these reasons the present inhabitants settle here during the greater part of the year. The following species which supply firewood are reported for the *costa* of the Middle Chubut River:

Calafate (*Berberis buxifolia* Lam., Berberidaceae). The local inhabitants use the underground stems for fuel ("its firewood is buried") because the aerial stems are very thin. They dig around the plant and pull up the stems, or they strike them until they break. This hard wood is good because it burns slowly. In the area under study there is another species of *Berberis* which is also called *calafate* and used for firewood.

Algarrobillo (*Prosopis denudans* var. *patagonica* (Speg.) Burkhart., Leguminosae: Mimosoideae). It is found in low, warm areas. The underground stem is used for firewood ("its firewood is buried"), and this is obtained by digging. When the wood is dry, it breaks very easily; when burnt, it renders a bluish flame. The smoke causes headaches; therefore, it is not used in closed spaces. As a result of combustion it turns into ashes and not into coals.

Sauce criollo or *sauce de la costa* (*Salix humboldtiana* Willd., Salicaceae). This was once the most abundant species used for fuel by the Chubut River. It is currently only available in small remnant patches, having been replaced by (osiers) to which local inhabitants assign similar properties: "it burns very well." At present it is used in hearths both in the open air and in shelters.

Molle colorado (*Schinus marchandii*., Anacardiaceae). It grows in sandy ground in warm areas. Its wood is valued because it is long-lasting and has high caloric value. Like *molle blanco*, it should not be used as the sole fuel but rather mixed with others of lower caloric value.

The informants find the best firewoods (now the scarcest) in the ravines (*cañadones*), which botanists recognize as a differentiated environment within the steppe. According to informants the ravines, which naturally link the *costa* with the higher land in the area, are well-travelled routes.

Barba de chivo (*Caesalpinia gilliessi* (Hook.) Benth., Leguminosae: Caesalpinoidea). Currently this species is very scarce. Its wood does not ignite easily but it is long-lasting and produces an intense flame.

Coliguay (*Colliguaya integerrima* Gill. et Hook., Euphorbiaceae). Its stem is underground, so it is necessary to dig in order to obtain firewood. The firewood has high caloric value, but when burnt it gives off "fat" which produces thick smoke, so it is not used in closed places. It turns quickly to ashes.

Calafate (*Berberis buxifolia* Lam., Berberidaceae). See above.

Typical steppe vegetation in the *campo alto* or high pampas, at a maximum elevation of 1000m. At present, flocks of sheep are brought here during the summer.

Monte guanaco (*Anarthrophyllum rigidum* Gill. ex Hook. et Arn., Leguminosae: Papilionaceae). It grows in warm areas. At present it is scarce because it has been used for firewood and for other purposes (for example to make posts for wire fences). Its firewood is easily lit and produces live coals which burn for a long time.

Molle blanco (*Schinus polygamus* (Cav.) Cabr., Anacardiaceae). It grows on the hills between 1000m and 1500m above sea level. Its wood is very hard to break. Like *molle colorado*, it should not be used as the sole fuel but rather mixed with others of lower caloric value.

Monte laguna (*Discaria* sp., Rhamnaceae). Nowadays plants of this species are very hard to find. It produces a very hard firewood with good combustion quality (easy to light, long-lasting, and of a high caloric value).

Leña de piedra (*Azorella monantha* Clos., Umbelliferae). This plant grows in cold highlands. It is difficult to ignite, and has to be mixed with dung to facilitate combustion. It is used only when nothing else is available. The plant is abundant in the coldest and most exposed environments, with persistent snow; therefore it is gathered in summer and is stored for winter. Because it is not a woody plant it has not been included in the table. Anatomical studies of a similar plant are available (Ancibor 1980).

Methods.—The samples of firewoods were cut into portions approximately 1 cm long. They were hydrated and softened by boiling them in water with drops of commerical detergent to facilitate hydration. The boiling time varied from 14 hours (e.g., *Salix humboldtiana*), to 56 hours (e.g., *Prosopis denudans*). The samples were oriented, and sections ± 20-25 μ thick were made with a sledge-microtome. Transverse (TS), longitudinal tangential (LtgS), and longitudinal radial (LrdS) sections were made. These three planes allow the appreciation of the characteristics of the woods studied (see Figures 1, 2, and 3).

The sections were treated with sodium-hypochlorite for five to ten minutes to eliminate their cellular content. They were carefully washed six times to eliminate the chlorine. The sections were dehydrated and stained to obtain a double coloration in a series of stains and ascendant alcohols (70° alcohol, 80° alcohol with safranin, 96° alcohol, 100° alcohol with fast green, 100° alcohol, and xylene). The sections were permanently mounted in artificial Canada balsam (D'Ambrogio 1986). This technique stains the lignified tissues (xylem) red and nonlignified tissues (parenchyma) blue.[4]

Observations.—The mounts were observed with an OM, and the three above-mentioned planes photographed for each specimen. The results of the observations were tabulated using the characters which were easily distinguishable in the photographs. The wood identification was made by comparison with the descriptions of Metcalfe and Chalk (1950), Tortorelli (1956), Cristiani (1962), Wheeler et al. (1989), and Castro (1994).

DISCUSSION

The visible and more useful characters for non-botanists who wish to study woods are vessels, their disposition and size. Compare, for example, Figure 3D with Figure 2D; the differences in vessel disposition are clear. The rays are also useful, mainly in tangential view: note their width, height, and cell composition, e.g. Figure 1C and Figure 2C. Features such as secretory canals in rays permit one to distinguish one species of *Schinus* from another, Figure 3F and 3I. Woods are readily classified if one has adequate comparative material and a minimum of practice and know-how (see Table 1).

From the point of view of archaeology, woods are extremely useful: they are an "open book," since woody materials are usually well preserved in archaeological

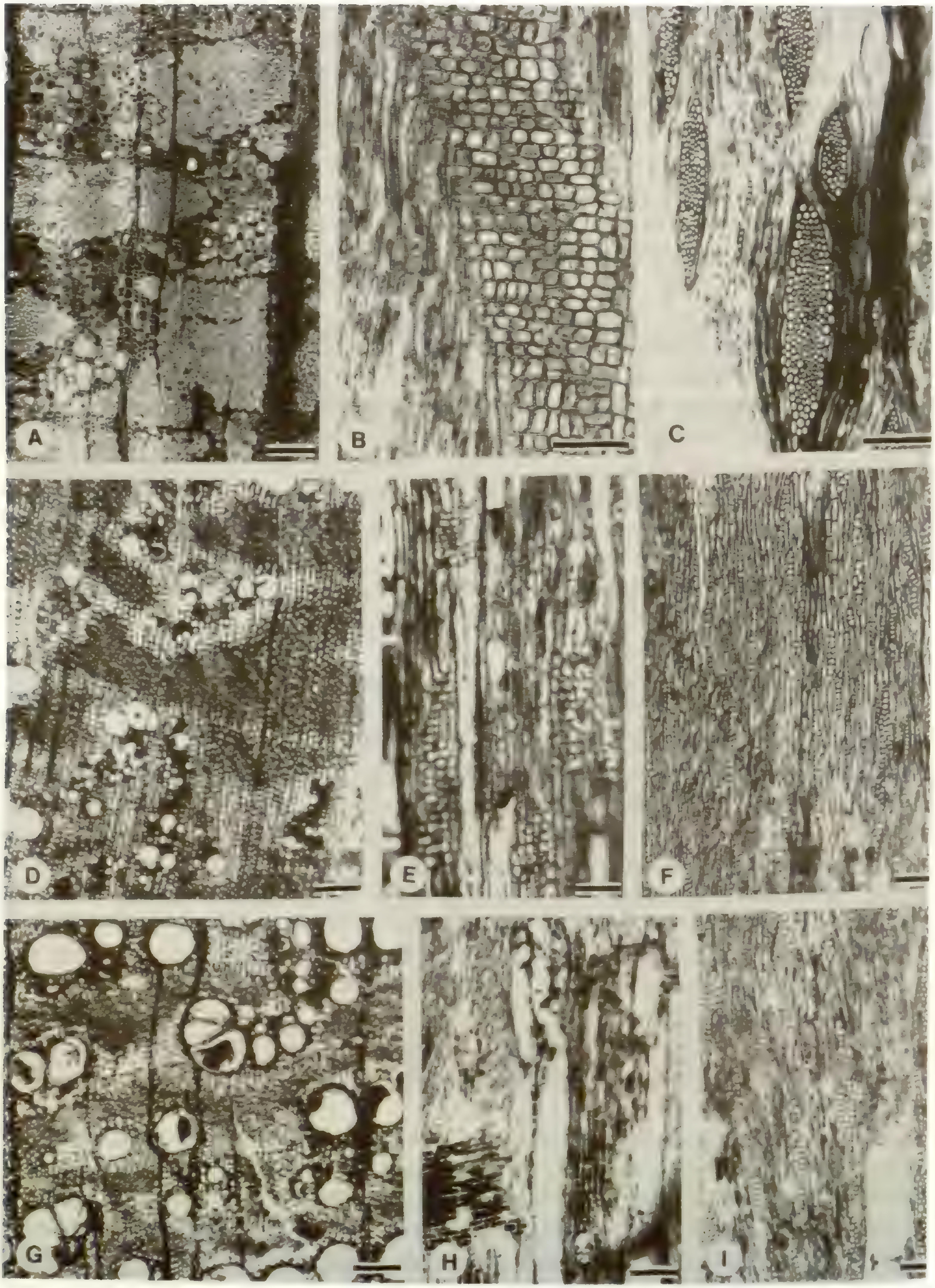


FIG. 1.—Wood sections observed with an optical microscope. A, D, G: Transverse sections; B, E, H: Longitudinal radial sections; C, F, I: Longitudinal tangential sections. A–C: *Anarthrophyllum rigidum*, **monte guanaco;** D–F: *Caesalpinia gilliesii*, **barba de chivo;** G–I: *Prosopis denudans var. patagonica*, **algarrobillo.** Scale lines = 100µ.

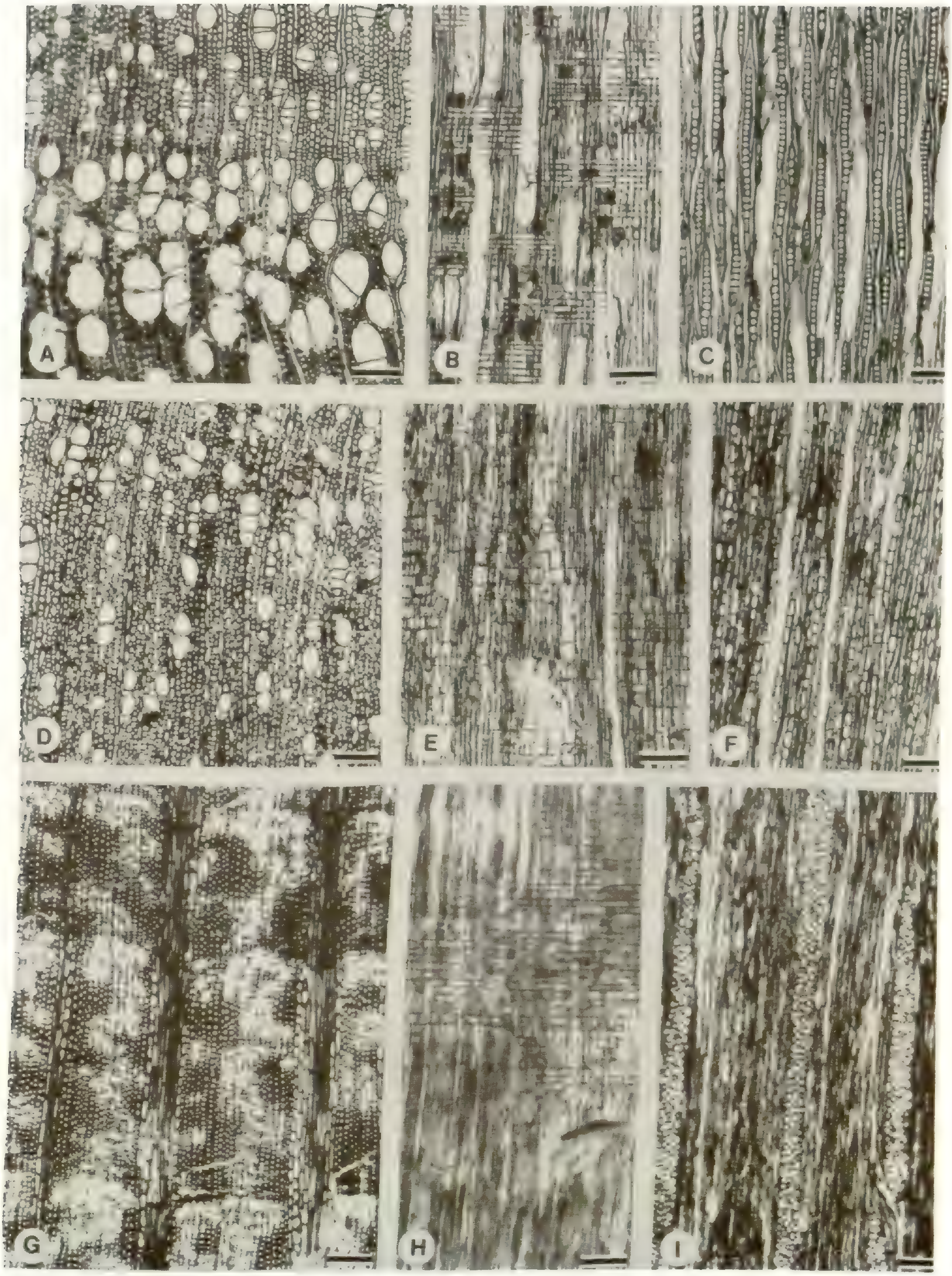


FIG. 2.—Wood sections observed with an optical microscope. A, D, G: Transverse sections; B, E, H: Longitudinal radial sections; C, F, I: Longitudinal tangential sections. A–C: *Salix humboldtiana*, ***sauce criollo;*** D–F: *Colliguaya integerrima*, ***coliguay;*** G–I: *Berberis buxifolia*, ***calafate.*** Scale lines = 100µ.

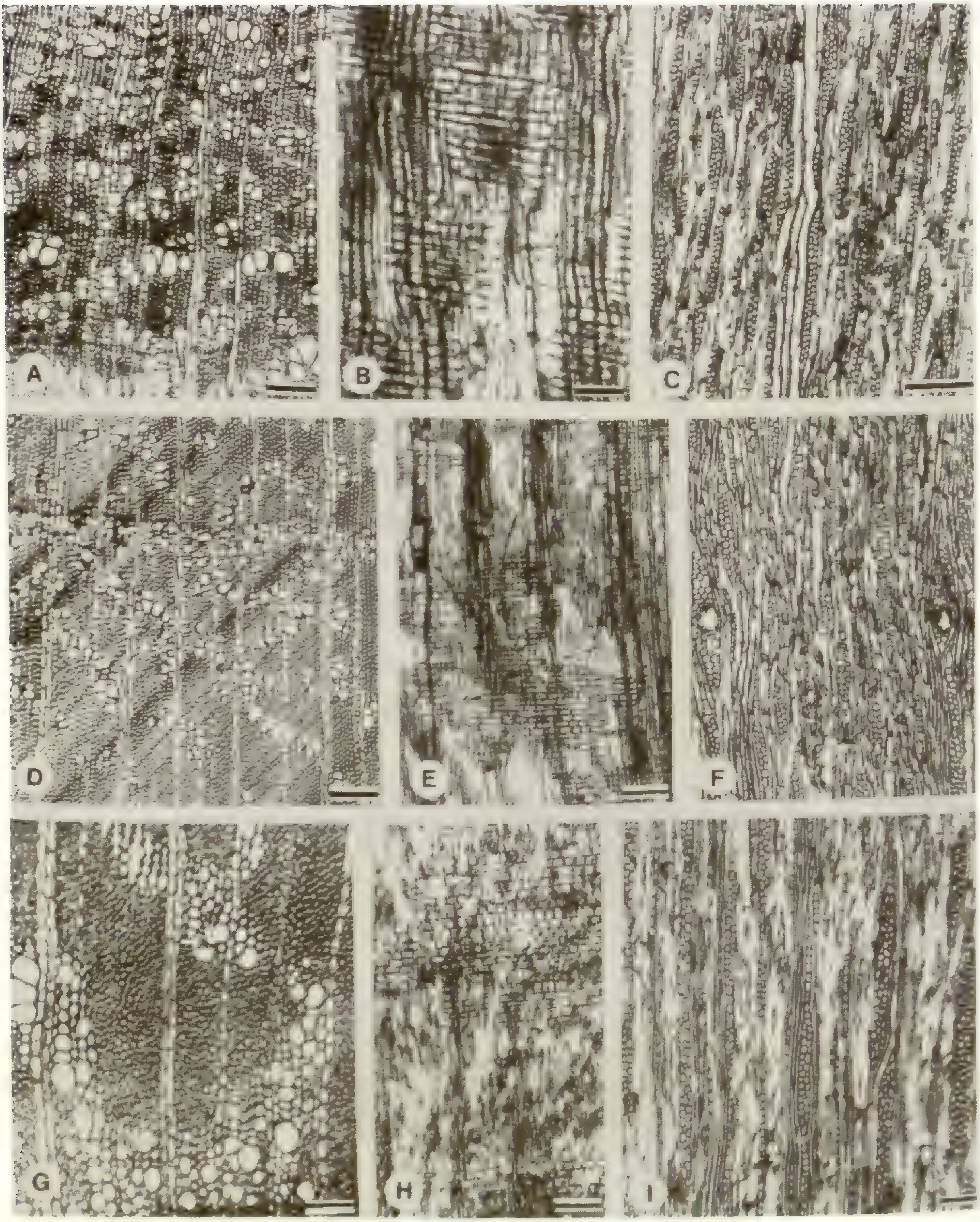


FIG. 3.—Wood sections observed with an optical microscope. A, D, G: Tangential sections; B, E, H: Longitudinal radial sections; C, F, I: Longitudinal tangential sections. A–C: *Schinus polygamus*, ***molle blanco;*** D–F: *Schinus marchandii*, ***molle colorado;*** G–I: *Discaria* sp., ***monte laguna.*** Scale lines = 100µ.

TABLE 1.—Firewood characteristics visible in microscopic sections: TS, LtgS and LrdS

Species	Figures	Porosity	Vessel disposition	Parenchyma	Fibers	Rays system	Rays type	Cell-inclusions
Berberis buxifolia (Berberidaceae) "calafate"	2 G,H,I	ring-porous	solitary, dendretic, in tangencial and radial bands	rare paratracheal vasicentric	aboundant thick-walled	homogenous 4-8 seriate	heterocellular	crystals of calcium-oxalate
Caesalpinea gillessi (Legum.: Caesalpinoideae) "barba de chivo"	1 D,E,F	diffuse-porous	solitary and short tangencial bands	paratracheal in confluent bands	aboundant thick-walled terminal	heterogeneous 1-2 seriate	heterocellular	cryst. calc.-oxal. tanins
Prosopis denudans var. *patagonica* "algarrobillo" (Legum.: Mimosoideae)	1 G,H,I	ring to semi ring-porous	solitary in short radial bands	paratracheal in confluent bands and aliform	aboundant thick-walled terminal	heterogeneous 1-3 seriate	heterocellular	cryst. calc.-oxal. tanins
Anarthrophyllum rigidum (Legum.: Papilionoidea) "monte guanaco"	1 A,B,C	diffuse-porous	solitary in radial and tangencial bands	paratracheal in confluent bands	aboundant thick-walled terminal	heterogeneous 1-10 seriate	heterocellular	tanins
Discaria sp. (Ramnaceae) "monte laguna"	3 G,H,I	diffuse-porous	solitary and in short and long radial bands	paratracheal and inicial	aboundant thick-walled	heterogeneous 1-3-4 seriate	heterocellular an aggregate	—

TABLE 1.—Firewood characteristics visible in microscopic sections: TS, LtgS and LrdS (continued)

Species	Figures	Porosity	Vessel disposition	Parenchyma	Fibers	Rays system	Rays type	Cell-inclusions
Calliguaya intergerrima (Euphorbiaceae) "colliguay"	2 D,E,F	diffuse to semi ring-porous	solitary and short radial bands	apotracheal diffuse and rare paratracheal	thick-walled	1 homogeneous 1 seriate partially 2 seriate	heterocellular	—
Schinus polygamus (Anacardiaceae) "molle blanco"	3 A,B,C	diffuse-porous slightly dendritic	in clusters in tangencial and radial bands	scarcely paratracheal	aboundant thick-walled	heterogenous 1-2-4 seriate	heterocellular	cryst. calc.-oxal.
Schinus marchandii (Anacardiaceae) "molle colorado"	3 D,E,F	diffuse-porous slightly dendritic	solitary in radial and tangencial bands	scarcely paratracheal	scarce thick-walled	heterogeneous 1-5 seriate	heterocellular with resin ducts	tanins scarce
Salix humboldtiana (Salicaceae) "sauce criollo"	2 A,B,C	semi ring-porous	solitary and radial bands	apotracheal and rare	scarce thick-walled	1 homogeneous 1 seriate partially 2 seriate	heterocellular	—

sites. For this reason interdisciplinary cooperation in their study is important to document human life in dwellings from the past. It is also important for achaeologists to obtain a rudimentary knowledge of plant structures which may help them understand, date, and classify woods and other plant materials.

The identification of woods and coals present in the archaeological record opens a broad range of possibilities for 1) the interpretation of the activities carried out at the sites and 2) for our knowledge of the prehistoric Patagonian inhabitants' use of the environment.

Regarding the first aspect, the identification of woods used for fuel allows us to separate them from those destined for other functions. Even if only coals were studied, their identification would allow the differentiation of firewoods selected for their high caloric value and duration (destined for hearths for the cooking of food) from others burnt for other reasons (e.g., smoke signals).

Regarding the second aspect, the firewoods identified in the archaeological record clearly indicate the environmental zones which were utilized from the site. Based on this, firewood procurement territories can be outlined, firewood being considered a critical resource for the settlement of human groups in the past. In Piedra Parada there are prehistoric settlements in the three environments recognized by contemporary informants, and all three environments have species that provide firewood of different qualities. The identification of species through the study of the coals in each context will allow us to know if they correspond to those of the surrounding environment or if they come from environments which are far from the site. It will also allow us to establish possible connections between sites.

NOTES

[1] The project for the Recovery of the Archaeological Patrimony of the Province of Chubut has been carried out since February, 1979 in the Valley of Piedra Parada, directed by Carlos Aschero. The main objective of the project is the reconstruction of the different successive cultural systems in the north of Patagonia. This region was peopled around 5000 years ago by hunter-gatherer groups. This economy was maintained in a general way until the end of the nineteenth century, in which the Tehuelche and Araucano were decimated by European colonists. At present some descendants of these indigenous peoples remain who vaguely remember their ancestors' customs.

[2] The term "combustion features" is used to designate groups of coals of different shapes recovered in archaeological excavations. After analysis of the remains, these features can be called "hearths," "ovens," "hearth cleaning zones," etc.

[3] The informants who participated in this study are: Coca San Martín de Grenier, Nela San Martin, Irma Herrera de Oses (Paso del Sapo locality), Mila Fidalgo de Grenier and Juan Grenier (Sierra Negra), Elba Espinoza (Piedra Parada locality).

[4] Boiled and fixed materials, as well as dry firewood, are preserved in the wood collection of the Laboratory of Plant Anatomy, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina.

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AN ETHNOBOTANICAL ACCOUNT OF THE PLANT RESOURCES OF THE WOLA REGION, SOUTHERN HIGHLANDS PROVINCE, PAPUA NEW GUINEA

PAUL SILLITOE
Durham University
43 Old Elvet
Durham, England DH1 3HN

ABSTRACT.—The plant classification scheme of the Wola people of the Southern Highlands Province of Papua New Guinea evidences an extensive knowledge of the region's flora. These people distinguish seven vegetational communities and identify by name within them several hundred kinds of plants. This paper includes a catalog of over 500 named plant categories, as follows: 191 trees and shrubs, 31 ferns and tree ferns, 19 screw pines and palms, 45 vines and climbers, 18 bamboos and canegrasses, 96 herbaceous plants and grasses, 37 crop plants, 7 mosses, and 60 fungi. The plant communities they distinguish parallel those recognized in Western ecological studies. The Wola have an intriguing plant taxonomy which in some regards parallels the familiar hierarchical scheme of European science, albeit with fewer classes. In other respects it is quite different, lacking higher level terms for classifying many prominent plants ("unaffiliated generics"), which are known only by their primary names. The Wola ethnobotanical evidence problematizes any attempt to portray their plant naming practice as a wholly consistent system. Rather, their oral tradition is inherently flexible, and attempts to fit it to an oversystematic scheme distorts their experience.

RESUMEN.—El esquema de clasificación de plantas del pueblo wola de la provincia del Sur de las Tierras Altas de Papúa Nueva Guinea hace patente un conocimiento extensivo de la flora de la región. Esta gente distingue siete comunidades de la vegetación, y dentro de ellas identifica por nombre varios cientos de clases de plantas. Este trabajo incluye un catálogo de más de 500 categorías nombradas de plantas, como se enumera a continuación: 191 árboles y arbustos, 31 helechos y helechos arborescentes, 19 pandanáceas y palmas, 45 enredaderas y trepadoras, 18 bambúes y cañas, 96 plantas herbáceas y pastos, 37 plantas de cultivo, 7 musgos y 60 hongos. Las comunidades de plantas que ellos distinguen son paralelas a las que son reconocidas en los estudios ecológicos occidentales. Los wola tienen una taxonomía de plantas intrigante, que en ciertos aspectos es paralela al esquema jerárquico familiar de la ciencia europea, si bien con un número menor de clases. En otros aspectos es bastante diferente, careciendo de términos a nivel más alto para clasificar a varias plantas prominentes ("taxa genéricos no afiliados") que se conocen sólo por sus nombres primarios. La evidencia etnobotánica wola problematiza cualquier intento de representar sus prácticas de nomenclatura de plantas como un sistema completamente consistente. Por lo contrario, su tradición oral es inherentemente flexible, y los intentos de encuadrarla en un esquema demasiado sistemático distorsionan su experiencia.

RÉSUMÉ.—Le système classificatoire des plantes des Wola, un peuple habitant les Southern Highlands de la Papouasie-Nouvelle-Guinée, montre une connaissance approfondie de la flore régionale. Les Wola distinguent sept zones de végétation à l'intérieur desquelles ils identifient en les nommant plusieurs centaines de sortes de plantes. Cet article comprend une liste de plus de 500 catégories végétales nommées, soit 191 arbres et arbustes, 31 fougères et fougères arborescentes, 19 pandanus et palmiers, 45 vignes et plantes grimpantes, 18 bambous et arundinaires, 96 plantes herbacées et herbes, 37 plantes récoltées, 7 mousses et 60 champignons. Les zones végétales définies par les Wola sont comparables à celles reconnues dans les études écologiques occidentales. La taxinomie des Wola pique la curiosité. À certains égards, elle est similaire au système hiérarchique scientifique européen qui nous est familier, quoiqu'elle comporte moins de classes. Sous d'autres rapports, elle est très différente, en particulier dans les niveaux les plus élevés de la classification où il manque certains termes pour classer plusieurs plantes proéminentes (<< ÿgénériques non affiliéesÿ >>) qui sont uniquement connues par leur nom primaire. Les données ethnobotaniques wola rendent problématique toute tentative de décrire leur mode de nomenclature des plantes comme un système totalement cohérent. Au contraire, les Wola ont une tradition orale intrinséquement flexible et toute démarche visant à faire entrer de force cette tradition dans un arrangement trop systématique déforme leur expérience.

INTRODUCTION

The Wola, like New Guinea highlanders generally, are keenly aware of the many plants that comprise the different vegetational communities of their region. Their extensive system of botanical classification reflects their considerable acquaintance with them, including several hundreds of names familiar to all as everyday knowledge (Straatmans 1967). The plants supply them with foods, construction materials, medicines (for humans and their animals), and raw materials for making artifacts. This paper reports on their system of botanical classification and includes a catalog of their plant identifications. (See Haberle [1991] for a comparative ethnobotanical catalog on the neighboring Huli; also Kocher Schmid 1991; Hays 1979, 1980; Hide et al. 1979; Miklukho-Maclay 1886; Powell 1976a & 1976b; Sterly 1974/75, 1977 for ethnobotanical accounts elsewhere in Papua New Guinea.)

THE WOLA AND THEIR REGION'S VEGETATION

Wola speakers occupy five valleys in the Southern Highlands of Papua New Guinea, from the Mendi river in the east to the Ak in the west. They live in small houses scattered along the sides of their valleys, in areas of extensive canegrass land, the watersheds between which are heavily forested. Dotted across the landscape are their neat gardens. They practise a form of shifting cultivation and subsist on a predominantly vegetable diet in which sweet potato is the staple. They keep pig herds of considerable size. They hand these creatures, together with other items of wealth such as sea-shells and cosmetic oil, around to one another in interminable series of ceremonial exchanges, which mark all important social events. These transactions are a significant force for the maintenance of order in their fiercely egalitarian acephalous society. Their supernatural conceptions center on beliefs in the ability of their ancestors' spirits to cause sickness and death, in various other forest spirit forces, and in others' powers of sorcery and "poison."

The vegetation of the Wola region relates to topography and altitude, notably as these influence human settlement patterns and land exploitation.[1] In the majority of valleys, between 1,600 m and 2,000 m, where people live and cultivate most of their gardens, dense canegrass regrowth predominates, interspersed with the short grassy clearings of recently abandoned gardens and the brown earth and dark green foliage of current ones. On steep and uncultivable land, pockets of undisturbed forest occur. Over 2,000 m—on the mountains and watershed ridges and dolines and in the unpopulated areas of river valleys—lower montane rainforest predominates, with a few patches of regrowth and occasional gardens. The cane grasslands, besides having an abundant cover of canegrass or sword grass (*Miscanthus floridulus* [Labill.] Warb.), support a limited range and number of secondary regrowth trees and a relatively meagre wildlife population, consisting primarily of small rodents and birds. The forest, on the other hand, is notably richer, supporting many hundreds of species of trees and other plants, together with a teeming animal population of marsupials, rodents and birds, some of them large and colorful.

This introduction to the vegetation of the Wola region according to its two major plant successions, of forest and grassland, serves broadly to characterise it, particularly as it first strikes the visitor. However, it overlooks some noteworthy plant communities and fails to do justice to Wola conceptions regarding their region's floristic ecology. They distinguish the following seven vegetational communities:

- ***iyshabuw:*** lower montane rainforest
- ***obael:*** secondary forest regrowth
- ***gaimb:*** canegrass regrowth
- ***pa:*** swampy vegetation
- ***mokombai:*** recently abandoned garden successions
- ***em*** and ***aendtay:*** gardens and houseyard environs
- ***maendaim:*** alpine vegetation.

The lower montane forest and canegrass regrowth communities predominate across the region, covering some 98% of the area. While predictable variations occur between territories across the region, the other communities are small in comparison.

ETHNOBOTANICAL CATALOG CLASSES

The catalog presented here (beginning on page 216) arranges the flora according to higher classes that parallel those used in the folk classification of the Wola, indicating how they think they relate together. This is more relevant in an ethnobotanical context, conveying more about those qualities perceived locally to be important than a scientifically grounded classification that sometimes groups otherwise outwardly dissimilar species according to quite foreign, technically-defined characteristics, which may not be obvious to local people nor easily observed. The list is arranged from the perspective of overall morphology and habit, which furnish the key features used by the Wola in plant taxonomy. It consequently cuts across some botanical categories, particularly on the family level and above: the Wola, for instance, unequivocably classify certain climbing palms and pandans as ***ya*** or vines, excluding the free-standing members of the Palmaceae and Pandanaceae families, for which they have no overall class names.

The catalog is ordered according to a total of thirteen major life-form categories, as follows:

WOLA FAMILY NAME	ENGLISH LIFE-FORM GLOSS
•*Iysh**	Trees, woody plants
•*Henk**	Tree ferns
•*Saezuwp*	Ferns
•*Goiz*	Palms
•*Aenk*	Pandans
•*Ya**	Vines and climbers
•*Pay*	Bamboos
•*Gaimb*	Canegrasses
•*Munk**	Large-leaved herbs, some epiphytes
•*Den**	Grasses, herbaceous plants
•*Em-bor-bway*	Cultivated plants, crops
•*Kwimb**	Mosses and liverworts
•*Sez**	Fungi

* Indicates explicitly named life-form categories.

The Wola explicitly acknowledge only some of these life-form categories by assigning names to them (those marked with asterisks in the above list). For example, they call all ligneous plants ***iysh*** 'tree' and all climbing plants ***ya*** 'vine'. Some of these life-form terms have wider connotations in certain contexts; the word ***iysh***, for example, may also refer to firewood and timber generally; the word ***ya*** to string or rope, and ***den*** 'grass' to weeds when used in relation to gardens. Other categories in the list the Wola do not distinguish explicitly. For example, they have no named categories covering palms, pandans, ferns, bamboos, or canegrasses. Within these groups the Wola assign names to individual species but not to the group as a whole. For them there are not palms or canes but only such-and-such a palm or cane. However, there is evidence that they nevertheless recognize a certain kinship among the plants of these groups.

The logic behind the catalog's classification of plants reflects Wola thinking, though it goes beyond their verbalized customary conceptions. The life-form categories listed above that correspond to named Wola groupings include only those plants put in each by my Wola consultants. The other categories listed above correspond to the covert categories variously named "intermediates" or "complexes" by others (see Berlin 1992; Berlin et al. 1968; Hays 1976; Hunn 1982). While the Wola appreciate the reasoning behind the covert groupings listed, such categories are of a different classificatory status, less salient or prominent than the customarily-named categories. They may on occasion refer to these groups by extending the names of prototypical members to cover them, or they may label them in some other way according to some shared trait. After repeated questioning some of my friends came up with labels for a few of the unnamed categories, for example, calling bamboos ***pay*** (lit. *'containers'*) because these plants have hollow stems some of which they use as containers, but they did so largely as a foreign exercise prompted by the author.

The point I wish to make is not that the Wola are unable to recognize that the bamboos or palms or whatever can conceptually be grouped together. I do not deny the possible existence of universal classificatory principles argued for by others, who recognize covert intermediate complexes of taxa to accomodate such unaffiliated plants (Berlin 1992; Brown 1984). Rather, I would stress that where people do not customarily group certain plants verbally in their classificatory schema, we see a somewhat different conception of the ordering of the plant world from that which pertains in cultures like the author's where all plants occupy a series of named places in a nested hierarchy. Unnamed life-forms or unaffiliated generics may not be merely figments of the ethnobotanist's imagination. They have common morphological properties which the Wola also readily observe, but Wola chose not routinely to group plants according to these criteria, having no names for them as taxonomic groups. This is a significant point of difference between their system of taxonomy and that of Western science which strives to accomodate **all** plants within a hierarchical system of categories.

WOLA PLANT TAXONOMY

These comments on the arrangement of the ethnobotanical catalog raise questions about the nature of Wola plant classification compared to that of either the English folk system or that of botanical science (Berlin *et al.* 1973). There are similarities evident, but also some significant differences. In the first place, the Wola have no word equivalent to plant or vegetation; they do not in speaking group all plants into a named taxon equivalent to our concept of a plant kingdom. Nor do all plants belong to mid-level named taxa equivalent to life-form, class, order, or family. The Wola refer to such categories, when they are noted, as ***sem*** (lit. 'family'), speaking for instance of the ***iysh sem*** 'tree family' or ***henk sem*** 'tree-fern family'. It is the next taxonomic level, which occurs below the ***sem*** when it is present, that is central to Wola plant classification and nomenclature. It equates in most cases with the genus and species taxa levels of scientific botany and the oak or primrose terminological level of the common English system and is equivalent to Berlin's folk generic rank (Berlin *et. al.* 1973). It is at this level that the following catalog matches Wola plant names to those of Western botany.

When naming plants the Wola may, but need not, use primary or life-form terms to form composite names (Bulmer 1974). For example, people may talk of ***iysh pel***, which is equivalent to referring in English to 'beech tree'. The use of such binomials varies with context, emphasis, danger of confusion if not used, and so on. There is also an element of customary usage; people often talk of ***den leb*** *(Acorus calamus)*, for instance, but rarely speak of ***den bol*** *(Ischaemum polystachyum)*, prefferring to say just ***bol***, though both plants are classed as ***den*** 'grass'. The use of binomials incorporating folk generic taxon labels is common at the lowest or tertiary level of classification, though not invariable. In some contexts, terms for taxa may be polysemous with supplemental meanings that do not relate to plants at all. For example, ***ya hung*** refers to string made of the bast fiber of ***hung*** (*Pipturus* sp.), which is an ***iysh*** 'tree', not a ***ya*** 'vine' of any kind.

The equation of Wola names with scientific ones requires qualification; the latter are relatively invariable, experts defining categories carefully and applying specified criteria consistently to specimens when making identifications. Wola categories are not necessarily so rigid. Individuals disagree on occasion over the naming of plants, sometimes displaying a surprising degree of dissent (see Sillitoe 1983). While they may be almost unanimous in the naming of common plants, their unwritten classification system has an intrinsically flexible aspect, so they may disagree considerably over the naming of uncommon plants. Regardless of the extent of nomenclatural variation—which others have documented elsewhere, and accounted for on dialectic, idiosyncratic, polysemic, and other grounds—there exists a majority opinion on the correct name for any specimen, and the list gives these consensus identifications, so far as they are determinable using a few respondents.

The extent of disagreements over plant identification depend on the level involved in the classification hierarchy, the commonness of the plant concerned, and the fineness of the distinctions made in naming it. There are few disputes at the life-form level. People largely agree over whether a plant is an ***iysh*** 'tree' or a ***ya*** 'vine' or whatever. Nonetheless, the ascription of some plants to life-form taxa is not unambiguous. People may place a plant in more than one superordinate category on different occasions (Healey 1978/79). For example, they sometimes refer to ***shaenshuwril*** (*Pennisetum macrostachyum*) as ***den*** 'grass' but on other occasions talk about it as more akin to ***gaimb*** 'sword grass' (*Miscanthus floridulus*), which they never think of as a ***den*** 'grass'.

Likewise, few individuals disagree over the identification of common plants at the species level. For example, of crop plants like sweet potato *(Ipomoea batatas)* and taro *(Colocasia esculenta)* or of frequently encountered trees or shrubs like casuarina *(Casuarina oligodon)* and cordyline *(Cordyline fruticosa)*. But less often seen plants, for instance of remote forested regions, may provoke denials of others' identifications or claims of ignorance of any names. People are also more likely to dispute identifications where the discriminations required in naming plants are particularly fine, as for example, in differentiating the ferns ***saezuwp*** *(Dicranopteris linearis* var. *altissima)* and ***puwt*** *(D. linearis* var. *montana)*, which demands making particularly acute distinctions (B. Parris, personal communication).

It is at the lowest indigenous taxonomic levels that disagreements over the naming of plants are most probable. The Wola discriminate some plants below the folk generic rank, i.e., the level equivalent to Western scientific genera or species. They may discriminate between either closely related species or between varieties and cultivars of a single species. They distinguish, for example, four types of ***pel*** 'southern beech' (*Nothofagus* spp.) and four kinds of ***muwnaen*** 'bracket fungus' *(Grifola frondosa)*, as well as considerable numbers of cultivars of some crops (Sillitoe 1983). It is understandable that disagreements over naming plants is most likely at this taxonomic level, since such identifications frequently depend on fine details of morphological variation in plant shape, size, and color, together sometimes with other small differences in habitat and growth.

The extent of variation between individuals in naming plants can be disconcerting at times, leaving one to ponder the nature and significance of differences between our notions and theirs of what a classification system should be. To what extent are the Wola, who have been socialised into an entirely alien cultural tradition, doing something analogous to Western scientific classifying when they categorize plants and other natural phenomena? They appear to conceive of plant ordering in a way that is familiar to yet different from European conceptions. This impression of familiarity mixed with strangeness is commonly alluded to in accounts of other cultures' classifications of the natural phenomena found in their regions. One common explanation for this ambivalence is to cite the varying scope afforded cultural elaboration at different taxonomic levels. At the higher levels there is more opportunity for cultural innovation and invention, whereas at lower levels morphological discriminations leave little room for cultural variation (e.g., Berlin *et al.* 1974, Riley and Brokensha 1988).

The absence of a term at the kingdom level equivalent to 'plant' immediately marks off Wola plant taxonomy as somewhat different from ours.[2] They do not appear to conceive of all plants being collected together at the apex of a classificatory hierarchy. This is not to suggest that the Wola are unable to recognise that a pandan or a taro plant are qualitatively different from, say, a cassowary or a skink. The manner in which they talk about plants suggests that they do conceive of all plants as having some kinship, as being more alike than they are to other entities in their natural world, such as animals, rocks, or insects. However, their traditional verbal classification of natural phenomena does not allow them readily to distinguish between what we call plants and animals. Nor are they unique in this regard, as the absence of kingdom level terms has been reported as a feature of many ethnoscientific systems of classification. (Some ethnobiologists argue that this does not undermine the case for the existence of univeral taxonomic principles [Berlin 1992, Atran 1990].)

The absence of a kingdom name aside, the manner in which the Wola classify many plants, though not so elaborate regarding numbers of classes and levels, parallels the hierarchical classification of botanical science, with up to three taxonomic levels, as follows:

WOLA CLASS TERM	ETHNOSCIENTIFIC LEVEL
sem	life forms (primary taxa)[3]
↓	↓
semonda	folk-generic (secondary taxa/specieme)
↓	↓
semg^{e}nk	folk-specific (tertiary taxa)

It is noteworthy that the Wola refer to these classes as ***sem*** or 'family'. They use ***sem*** widely to refer to groups of phenomena, including local community groupings of human-beings. They frequently qualify ***sem*** as ***onda*** 'large' or ***g^{e}nk*** 'small'. They call certain socio-territorial groups ***semonda*** and sub-divisions of them ***semg^{e}nk***. (Extended or nuclear families they call simply ***sem***.) Regarding plant classification, the highest indigenous taxonomic level categories, i.e., the life-forms, are called ***sem*** (e.g. ***iysh sem*** 'tree family', ***ya sem*** 'vine family'). They refer to mid-level classes (folk generics) as having ***semonda imbiy*** (lit. 'family-large names'), while the lowest level categories are said to have ***semg^{e}nk imbiy*** (lit. 'family-small names').

The use of the same terms for plant classes as are employed in their classification of social groups (Ryan 1961, Sillitoe 1979b, Lederman 1986) suggests that the Wola think of these as analogous categories. Plant taxa are organized hierarchically, one descending from the other, in the same way as local genealogical groups. When they classify these plants, they appear to conceive of them as arranged in a nested hierarchy, in a manner similar to botanical science, as follows:

life form: ***iysh*** 'tree'

genera/species: ***hobaen*** *'Rapanea'* — ***haegaes*** *'Schefflera'*

species/varieties: ***haegaes*** '*Schefflera* sp.' — ***hebhond*** '*Schefflera* sp.' — ***munduwm*** '*Schefflera* sp.'

The classification of some plants however, appears to reinforce the strangeness intimated for the Wola taxonomic system by the absence of any kingdom-like 'plant' term. Many plants do not fit into the above hierarchical scheme. They are assigned to no higher class nor do they include lower level classes. Several of the pandans and palms are classified in this way; for example, the large multi-crowned forest pandan ***aendashor*** *(Pandanus antaresensis)* and the tall stately palm ***goiz*** (*Gulubia* sp.). These are 'unaffiliated folk generics' in Berlin's typology (1992). But merely labelling them does not adequately explain why they should exist in a system postulated to be governed by universal hierarchical classificatory principles.

It is difficult to explain why the Wola should include some plants in life-forms and not others. Such plants are often quite distinctive and stand out among all the rest. Regarding the lowest level or ***semg^{e}nk*** taxonomic class, it is easier to appreciate why the Wola may subdivide some plant taxa more than others. Though some anthropologists eschew "naturalist" explanations (Lévi-Strauss 1966, Douglas and Hull 1992, Douglas 1975), there is a relationship apparent between the extent to which the Wola classify plants at the ***semg^{e}nk*** level and their utilitarian importance, whether as food or raw materials. This they acknowledge themselves. When asked why some plants have no names, why they are called ***imbiy na wiy*** (lit. 'name not have'), my friends repeatedly referred to them as having no ***kongon*** (lit. 'work'), by which they intended "use." In addition, they distinguish at least sixty-four cultivars of their staple crop, sweet potato (Sillitoe 1983).[4] The detail of ***semg^{e}nk*** level classification and the occurrence of notable differences between plants classed together in the same mid-level ***semonda*** taxon bears some relationship also to the abundance of those plants or how often people see them.

This is not to subscribe to the 'utilitarianist' position in the recent debate between so-called 'utilitarianists' and 'intellectualists' (Berlin 1991, 1992; Hays 1982, 1991; Posey 1984; Hunn 1982). I do not wish to suggest that ethnobiological taxonomies derive simply from the utility of species for human-beings nor from the degree to which they might facilitate ecological adaptation. The Wola name and classify many things in their natural world that serve no pragmatic ends. Furthermore, the definition of utility poses problems. Must people eat a species or use it directly in making things, for it to qualify as useful? Or might plants used as symbols or in myths count too? Furthermore, an apparently useless plant or animal may prove essential to the continued existence of a more obviously useful one. Thus knowledge of it indirectly serves a utilitarian purpose. This is an inevitable consequence of the interconnectedness of the natural world, of the global ecosystem. In any case, there is some correlation apparent between the extensiveness of Wola taxonomic classification and the extent to which the phenomena classified feature in their lives.

DISTORTING INDIGENOUS KNOWLEDGE

The up-shot is that no single classificatory scheme can comprehensively represent Wola ordering of plants. Whatever framework we adopt will be somewhat distorting. This is perhaps to be expected since writing down any oral scheme misrepresents it. The approach taken in this paper is to catalog all plants according to the indigenous three-level taxonomy (though many taxa can only be ascribed to one or two levels). It "invents" life-form taxa for those similar plants that the Wola do not explicitly group together but for which there is evidence of implicit grouping. But I believe it risks no gross distortion. It expands the indigenous scheme in a way that the local people can understand and appreciate, as witnessed by the fact that we together coined suitable life-form names for my "invented" taxa.

The ethnobotanical catalog presented here further risks misrepresenting Wola views by equating their plant names with the family, genus, and species labels of botanical science. There is a danger that the idea might be conveyed that the Wola not only classify but also identify plants in a way similar to Western scientists, seeing the same objective specimen "out there." When asked how they identify particular plants, informants usually point to morphological features as differentiating between them. They give no standard responses, however. Different individuals may point out varying features, suggesting that when the Wola identify a plant they see it in its entirety and do not customarily search for specific cues as criteria for naming it. They simultaneously consider a range of observable cues, viewing a plant as a distinct entity and not as something distinguished by having a limited number of distinctive features. Those characteristics which seem to figure prominently in the configuration seen by the Wola focus on plant form primarily, particularly the shape, size, and color of a plant's parts. Occasionally scent features too, and habitat. When making identifications at the ***semgenk*** level, the points people look for become narrower, with micro-morphological variations and color changes particularly important. At this level they look for these cues more systematically, in a manner familiar to Western botanists. The problem here is the considerable level of disagreement encountered between informants about the use of these diagnostic criteria to name particular plant specimens, which again contrasts with what we might assume to be the more systematic procedures of scientific botany.

It is pertinent here to note how I learned about the way the Wola identify and classify the plants of their region. All the data tabulated in the catalog result from botanical collections made largely in the Was valley (west of Nipa) and some in the neighboring Nembi and Ak valleys. I have amassed them over the last two decades in the course of anthropological fieldwork in the region. I made the collections from a Wola viewpoint: I noted the local names for plants collected, together with other related information such as habitat where found, relative abundance, and any uses to which people put them. When I had this information, I then pressed the collected specimens for scientific identification between newspaper and card in a plant press (after Womersley n.d.). The botanical identifications came later, sometimes several years later. (I could hazard the identification of only the more obvious specimens collected by using botanical manuals, such as Henty 1969, 1981; Havel 1975; Coode 1969; van Royen 1964a, 1964b, 1964c, n.d.a, n.d.b; Verdcourt 1979; Holttum 1967; Johns and Hay 1984; Millar 1978; Womersley 1978).

I gathered the botanical specimens in a variety of ways. Many of them I collected personally, not always on special plant collecting trips but frequently when engaged in ethnological research, walking from one place to another. Always accompanied by one or more Wola friends, I regularly enquired about plants we passed, and they, aware of my interest, frequently volunteered information. The problem has been finding adequate flowering and fruiting materials for scientific identification. To guide collection of suitable materials, I have compiled a checklist of Wola plant names, an open-ended list to which I continue to add names as I learn them. I inform Wola friends of gaps in my collections so that they might point out the plants to me or, if returning from somewhere without me and seeing them, they might bring back suitable leafy fruiting/flowering material for pressing. I have collected considerable numbers of specimens in this way. I have also on occasion employed young men for a day specifically to go searching for uncommon plants.

This way of learning is quite foreign to the Wola, who normally pass on knowledge in a casual and piecemeal manner. Asking them to find plants to fit names on a list, how they classify them, why they have life-form classes for some and not others, why those plants that have life-form names are so labelled, and so on, are odd questions demanding contrived answers. Nevertheless, the principles the Wola use come across clearly, and it is around these principles that I have structured the catalog, giving it a Wola focus. Even so, it inevitably distorts their ideas to some extent, presenting them as more formalised than they are. However, this distortion is no greater than that of any anthropological account of a culture. Post-modern criticism of this unavoidable misrepresentation misses the point; we inevitably work in an imperfect world.

ORGANIZATION OF THE ETHNOBOTANICAL CATALOG

The catalog is organized as follows: each entry provides Wola and scientific names (family, genus, and species) for the plants, together with details of the vegetational communities in which they are found, their frequency of occurrence, and any use they have. Any impression that the catalog is comprehensive is unintended, though I think that it includes all the more important plants occurring in the Wola region and the majority of those identified and named by them. There are doubtless many plants omitted for which the Wola have no names. The Wola-centric as opposed to Western scientifically informed collection of the data has made this inevitable. The few plants listed as having "no name" are ones that came to my attention in other contexts (e.g. reviewing fallow garden vegetational sequences); they represent only a fraction of those plants apparently not given names by the Wola, which they sometimes label with life-form names as "just" grasses/small herbs or whatever (cf. Hunn 1982); they are evidently of no interest to them. The catalog is arranged in sections by life-form, the plants listed by ***semonda*** name. If there are ***semg^{e}nk*** level distinctions made, these are given as hyphenated names; they customarily include the ***semonda*** name as a prefix or suffix. The three levels (illustrated for *Nothofagus* 'southern beech') are as follows:

Sem life-form	***iysh sem*** 'tree family'
Semonda name	***pel*** *'Nothofagus'*
Semg^{e}nk name	***pel-kelkel*** *'N. grandis'*

The catalog includes voucher collection numbers for specimens deposited in herbaria. I have deposited specimens of the various plants listed with the following institutions (the letters in brackets occur throughout the list, combined with voucher specimen numbers, to indicate where deposited): Cambridge University Herbarium (CGE); the Herbarium of the Royal Botanic Gardens at Kew (KEW); the University of Papua New Guinea Herbarium (UPNG); University of Malaysia Herbarium (KLU); Manchester University Herbarium (MAN); Department of Forests Herbarium in Lae (LAE); a personal fungi collection (FNG), and Barbara Parris' private fern collection (BC).

After identifying the plants, each entry gives the vegetational communities or habitat where found, as follows: **RF:** rainforest; **SF:** secondary forest/woodland; **LA:** lower altitude vegetation; **CG:** canegrassland; **BL:** bogland; **AG:** recently abandoned gardens; **GH:** gardens and houseyard environs; **DW:** on dead wood, and **SL:** on the soil (the last two applying to fungi). These are Wola-centric categories and judgements, indicating how they perceive plant occurrence. A Wola assessment of the habitats of plants was obtained by asking a group of men to cite the places at which they find them. The catalog gives the principal, or in some cases the sole habitat where the plant occurs, though there is some inevitable overlap between vegetational zones and some plants may occur in habitats not listed.

The list also indicates the relative abundance of the plants, assessed by the same men, who were asked to judge their frequency of occurrence by placing them into one of the following six categories (Wola equivalents given in brackets): (1) abundant (***onduwp ora***), (2) common (***onduwp***), (3) occasional (***onduwp sha***), (4) limited (***g^{e}nk sha***), (5) scarce (***g^{e}nk***), and (6) rare (***g^{e}nk den ora***).[5] While only approximate, this classification indicates the frequency of occurrence of different plants, as the Wola see it. The catalog gives the abundance assessment some added quantitative weight by including a score for the average number of plants occurring in a 100 m^2 area, as determined in a survey and analysis of data on the composition of different vegetational communities.[6] The occurrence of plants in the surveys are scored as follows (all data standardised to 100 m^2 quadrats): i: <1 plant; ii: 1–10 plants; iii: 11–100 plants; iv: 101–1000 plants; and v: >1000 plants. It is necessary to bear in mind the large range of sizes spanned by different plants when comparing these scores with the local assessments. (A tree occurring ten times per 100

m^2 may be from the indigenous perspective considerably more "abundant" than a grass occurring one hundred times per 100 m^2.)

The catalog includes finally an indication of any use to which the Wola put the plants, as follows: **Af:** raw materials used in making artifacts and for decoration (see Sillitoe 1988 for details); **Ct:** construction work (house building, bridges etc.); **Ed:** edible or consumed plant (see Sillitoe 1983 for details and account of crop cultivars, some of which are omitted from this catalog)[7] ; **Md:** medicinal plant; **Rt:** plant with ritual or ceremonial uses; and **Ht:** plant used in hunting.

NOTES

[1]For further information on the various vegetational communities described here and a finer botanical classification of the different communities see Robbins and Pullen (1965), Paijmans (1976:84–97), and Johns (1976).

[2]See Hays (1979) for a discussion of the Ndumba system of plant classification and Hide *et al.* (1979) on that of the Chimbu.

[3]The terms in brackets are those suggested by Bulmer (1974).

[4]Haberle (1991) makes the same point for the neighbouring Huli.

[5]See Sillitoe (1979b:116) for comments on this manner of assessment, which the Wola use frequently when ranking anything, achieving relatively fine distinctions.

[6]These data come from a series of quadrat surveys conducted in the Wola region. The dimensions of the areas surveyed varied according to the size of the vegetation comprising the communities. Where the vegetation included some substantial plants (montane forest [total area surveyed = 2500 m^2], secondary woodland [total area surveyed = 2000 m^2], and cane grassland [total area surveyed = 2000 m^2]), 10 m x 10 m quadrats were marked out using a surveyor's tape, and all of the plants occurring in the demarcated area were counted. Where the plants were less large (gardens [total area surveyed = 200 m^2], abandoned gardens [total area surveyed = 100 m^2], rockland [total area surveyed = 10 m^2], and swampland [total area surveyed = 50 m^2]), 1 m x 1 m portable frames were used, thrown at random in the locations surveyed, and all plants that grew within the area delimited by the squares were counted.

[7]The catalog also omits some recently introduced but uncommon crops (e.g., choko, peanuts, and carrots) and also some of those restricted to low altitudes in the Kutubu region (Sillitoe 1983).

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Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
TREES AND WOODY SHRUBS *(iysh sem)*					
aegop	Liliaceae	*Cordyline fruticosa* (L.) Chev.	CGE 78/255	AG(1/ii) GH(1/ii) CG(ii)SF (i)	Af,Rt (25 cvs)
aerel	Sapotaceae	*Planchonella* cf. *monticola* Krause	CGE 78/1a	RF(4/i)	Af
		P. macropoda H.J.Lam	CGE 78/1b		
babortugum or *babort*	Myrsinaceae	*Discocalyx* sp.	KEW H1835 93/11	RF(4/ii)	
baerel	Sapindaceae	*Cupaniopsis* sp.	CGE 78/2	RF(4/i) SF(i)	Af,Rt
		Pometia pinnata J.&G. Forst			
bat	Lauraceae	*Cryptocarya* sp.	KEW H1835 93/7	RF(5/i)	Af
bat-haen	Haloragidaceae	*Gunnera macrophylla* Bl.		RF(5/ii)	
bat-hok	Lauraceae	*Cryptocarya* sp.	KEW H1835 93/8	RF(5/i)	
bat-kwimb	Monimiaceae	*Levieria beccariana* Perkins	CGE 78/3	RF(6/i)	
bat-kalay	Winteraceae	*Bubbia* sp.	CGE 78/4	RF(3/i)	Af,Ct,Rt
bat-konduwk	Winteraceae	*Bubbia* sp.	CGE 78/5	RF(3/i)	Af,Ct,Rt
bobae	Euphorbiaceae	*Macaranga* sp.	CGE 78/6	SF(2/i) CG(4/i) RF(i) GH(i)	Af,Ct
boliya	Euphorbiaceae	*Codiaeum* sp.	CGE 78/101	LA(2) RF(6)	Cg
bon-maip	Cunoniaceae	*cf. Schizomeria* sp.	KEW H1937 83/65	RF(5/ii)	Ct
bort	Lauraceae	*Cryptocarya laevigata* Blume	UPNG 78/2	RF(6/i) CG(4/i)SF(2/ii) AG(ii) GH (ii)	Af,Ct
buruman or *mbolin-iydaeptael*	Leguminosae	*Senna septemitrionalis* (Viv.) Irwin & Barnaby	KEW H1835 93/12	SF(6) CG(6) GH(6/i) AG(6)	
dayow	Polygalaceae	*Eriandra* sp.	LAE 78/8	RF(5/i)	Af
	Thymelaeaceae	*Aquilaria* sp.	CGE 78/8		
digil	Euphorbiaceae	*Phyllanthus* sp.	CGE 78/9	RF(5/i) CG(5/i)	
	Elaeocarpaceae	*Sericolea* sp.	KEW H1835 93/22		
dobay	Gnetaceae	*Gnetum* sp.	CGE 78/10	LA(5)	Af
dobay	Myrtaceae	*Psidium* sp.	KEW H1835 93/16	RF(5/i) CG(5/ii)SF(5/i)	Ct
donk	Elaeocarpaceae	*Aceratium sp.*	CGE 78/140	RF(6/i)	
dorok	Proteaceae	*Helicia oreadum* Diels	CGE 78/11	RF(5/i) CG(5/i)	Ct
duwk	Euphorbiaceae	*Euphorbia* sp.	CCE 78/12	GH(5)	Af
en or *enbuwk*	Euphorbiaceae	*Macaranga* sp.	CGE 78/13	RF(5/i) SF(5/i)CG(5/i)	Af,Ct
enjat	Euphorbiaceae	*Breynia cernua* (Poir) M.A.	CGE 78/14	RF(6/i) SF(6/i) CG(6/i)	
gonkliyp	Acanthaceae	*Graptophyllum pictum* (L.) Griff.	UPNG 82/22	SF(6) CG(6) GH(5)	Af,Rt
gun	Podocarpaceae	*Dacrycarpus imbricatus* (Bl.) de Laub	KEW H1835 93/28	RF(3) GH(6)	Af
gwai	Sapindaceae	*Dodonaea viscosa* L.	CGE 78/17	SF(2/i) CG(5/i)AG(ii) GH(ii)	Af,Ct,Rt
gwaigwai	Melastomataceae	*Astronia* sp.	KEW H1835 93/27	RF(5/i)	Ct
haebuwk or *ngariya*	Podocarpaceae	*Podocarpus neriifolius* D.Don	CGE 78/18	RF(5/i)	Af
haegaes	Araliaceae	*Schefflera* sp.	CGE 78/19	RF(3/i) CG(3/ii) SF(ii)	

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
haegaes-hebhond or *heb-haegaes*	Araliaceae	*Schefflera* aff.*chaetorachis* Harms	UPNG 83/1	RF(3/i) CG(6/i) SF(i)	
haegaes-munduwm	Araliaceae	*Schefflera* sp.	UPNG 83/2	RF(3/ii) CG(3/ii) SF(i)	
hael	Moraceae	*Ficus* sp.	KEW H1937 83/67	RF(5/i) SF(5) CG(5)	Af
	Winteraceae	*Bubbia* sp.	CGE 78/20		
haemaemtaenk or *haemaem*	Euphorbiaceae	*Antidesma* sp.	CGE 78/22	RF(2/i) CG(6/i) SF(i)	Ct
haen-ponjip	Moraceae	*Ficus* sp.	KEW H1835 93/29	RF(4) SF(6) CG(5)	Af
haenshor or *egayshor*	Euphorbiaceae	*Glochidion pomiferum* Airy Shaw	KEW H1835 93/23	RF(3/i) CG(3/i) SF(3/i)	Ed
haezuwmb	Sapotaceae	*Pouteria* sp	CGE 78/25a	RF(3/i)	Af,Ct
	Loganiaceae	*Fagraea* sp.	CGE 78/25b		
	Himanyandraceae	*Galbulimima belgraveana* (F.v.M.) Sprague	UPNG 78/1		
haega		*Indet.*		LA(6)	Af
haiyow	Moraceae	*Ficus porphyrochaete* Corner	CGE 78/26	RF(5)	Ed
	Moraceae	*Ficus pungens* Reinw ex Bl.	CGE 78/27		
hayak	Euphorbiaceae	*Claoxylon ledermannii* Airy Shaw	CGE 78/28	RF(5/i) CG(5) SF(i)	
hegnenjay	Rosaceae	*Prunus* sp.	UPNG 83/9b	RF(5/i)	Af
hibish	Aquifoliaceae	*Ilex ?spicata* Blume	CGE 78/30	RF(2/i) SF(5) CG(5/i)	Af
hlaenk	Oleaceae	*Linociera* sp.	CGE 78/32a	RF(6)	Af
	Melastomaceae	*Memecylon* sp.	CGE 78/32b		
	Oleaceae	*Chionanthus* sp.	KEW H1835 93/32		
hobaen	Myrsinaceae	*Rapanea* sp.	CGE 78/33	RF(3/ii) SF(3/i) CG(3/i)	Af,Rt
hobay	Moraceae	*Ficus* : Rhizoclada sect.	CGE 78/34	RF(3/i) SF(5) CG(5/i)	Af
hoboga or *maenhomb*	Monimiaceae	*Levieria acuminata* (F.v.M.) Perkins	CGE 78/35	RF (5) SF (5)	Af
hok	Sterculiaceae	*Sterculia* sp.	CGE 78/36	RF(1/i)	Af
hogbal	Apocynaceae	*Alstonia glabriflora* Mgf.	CGE 78/37	RF(3/i) SF(5)	
homay	Rubiaceae	*Timonius belensis* Mond P.	CGE 78/38	RF(2/i) CG(5/i) SF(i)	
hombolem or *hegnenjay*	Rosaceae	*Prunus gazelle-peninsulae* Kan.& Hat.	CGE 78/39	RF(5/i)	Af,Ct
hombom	Melastomaceae	*Beccarianthus* sp.	CGE 78/41	RF(4/ii SF(i) CG(i))	Af
homhaes	Urticaceae	*?Maoutia* sp.	CGE 78/40/5	RF(3/i)	Af
hung	Urticaceae	*Pipturus* sp.	CGE 78/46	SF(2/i) CG(4) GH(i)	Af
huwgiyt	Meliaceae	*Toona sureni* (Bl.) Merr.	CGE 78/43	RF(3) SF(5) CG(5)	Af
huwmabuwp	Rutaceae	*Acronychia trifoliata* Zoll.	CGE 78/44	RF (5)	
huwmb	Rutaceae	*Evodiella cauliflora* (Lautb.) Linden	UPNG 78/3	RF(3/ii) SF(6/i) CG(5/i) GH(6)	Rt
huwshiy	Cunoniaceae	*Caldcluvia papuana* (Pulle) Hoogl.	CGE 78/42/7	RF(3/i) SF(6/i) CG(3/i)	Af
in	Moraceae	*Ficus quercetorum* Corner	CGE 78/48	RF(3/i) CG(3) SF(6/i)	Af
in-shindel	Moraceae	*Ficus wassa* var. *nubigena* Roxb.	CGE 78/51	RF(3/i) CG(5/i)	Af

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
injil	Araliaceae	*Schefflera* cf. *hirsuta* Harms.	CGE 78/49	RF(3/i)	Ct
inom	Urticaceae	*Debregeasia* sp.	CGE 78/50	SF(2/i) CG(4/ii) RF(i) GH(ii)	Af,Ct
	Urticaceae	*Maoutia* sp.	KEW H1937 83/70		
iybdinj	Staphyleaceae	*Turpinia pentandra* (Schltr.) v.d. Linden	CGE 78/52	RF(6/i)	
iybkol	Icacinaceae	*Rhyticaryum* sp.?	CGE 78/53	BL(4)	Af
iybwasndiy	Moraceae	*Ficus adenosperma* Miq.	KEW H1835 93/42	BL(3) GH(6)	
kaeriyl	Fagaceae	*Lithocarpus rufovillosus* (Markgr.) Rehder	CGE 78/54	RF(2) SF(6/i)CG(6/i)	Af,Ct,Ed
kaeriylhaez	Fagaceae	*Lithocarpus schlechteri* Mgf.	CGE 78/55	RF(5)	Af
kalay	Winteraceae	*Bubbia* sp.	CGE 78/56	RF(4)	Af
kaybaeng	Flacourtiaceae	*Pangium edule* Reinw	CGE 78/57	LA	Af
kend	Urticaceae	*Pipturus* sp.	CGE 78/59	SF(3) CG(5) RF(3) GH(ii)	Af
kol	Euphorbiaceae	*Phyllanthus* sp.	CGE 78/60	RF(4/iii) CG(6/i) SF(i)	Af,Ct,Ed
kolomb	Araliaceae	*Mackinlaya* sp.	CGE 78/61	RF(4) SF(i) CG(i)	Ct
komb	Rubiaceae	*Timonius* sp.	UPNG 82/4	RF(3) CG(i)	Af
kongol	Piperaceae	*Piper* sp.	CGE 78/63	RF(1/i) SF(1/ii)CG(1/ii) BL(5/ii) GH(iii)	Rt
korael	Moraceae	*Broussonetia papyrifera* (L.) Vent.	CGE 78/64	GH(5)	Af
kuwliy	Sapindaceae?	*Ganophyllum?* sp.	CGE 78/67	RF(4/ii) CG(i)	Af
kuwlow	Winteraceae	*Bubbia* sp.	CGE 78/68	RF(4/i)	Af
kuwmkuwm	Verbenaceae	*Callicarpa arborea* Roxb.	KEW H1835 93/48	RF(6) SF(4/i)	
kuwnd	Solanaceae	*Solanum* sp.	KEW H1835 93/50	RF(6) SF(6) CG(6) AG(6)	Af
kuwriyl	Cunoniaceae	*Caldcluvia nymanii* (K. Sch.) Hoogl.	CGE 78/69	RF(5) BL(4)	
laenjlaenj	Symplocaceae	*Symplocos cochinchinensis* var. *leptophylla* (Lour) Moore	CGE 78/70a	RF(2/i) CG(4/i) SF(i)	Af
		& var. *schummaniana*	CGE 78/70b		
mabep or *h^egmabep*	Rosaceae	*Prunus glomerata* (Koehne) Kalkm	CGE 78/71	RF(5/i)	Af
maen	Araucariaceae	*Araucaria cunninghamii* Sweet	LAE 74/121/3/1	GH(6)	Af
maenget	Dilleniaceae	*Saurauia* sp.	CGE 78/72	RF(3/ii) SF(3/ii) CG(5/ii) GH(iii)	Af
maenget-long	Dilleniaceae	*Saurauia* sp.	KEW H1937 83/74	RF(5) SF(5) CG(5/i)	
maenhomb	Sterculiaceae	*Commersonia bertramia* (L.) Merr.	CGE 78/73		
magol	Celastraceae	*Salacia* sp.	UPNG 82/3	RF(4)	Af
magiliym	Melastomataceae	*Poikilogyne* sp.	KEW H1835 93/63	CG(3/ii) RF(i) SF(ii) AG(i)	
magumb	Myrtaceae	*Decaspermum* sp.	CGE 78/75a	RF(2/i) SF(5/i) CG(5/i)	Af
maguwmb-taez	Myrtaceae	*Indet.*	CGE 78/75b	SF(3) RF(3) CG(3)	
mahaep	Lauraceae	*Litsea guppyi* (F.v.M.) Forman	UPNG 83/6	RF(2/i) SF(5) CG(3/i)	Af
	Moraceae	*Ficus calopilina* Diels vel. aff.	KEW H1937 83/19		

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
maip	Cunoniaceae	*Schizomeria* sp.	CGE 78/77	RF(2/ii) CG(4/i) SF(i)	Af
mak	Araliaceae	*Harmsiopanax ingens* Philipson	CGE 78/78	RF(3/i) SF(2/i) CG(6/i) GH(i)	Ct
mashor	Malvaceae	*Hibiscus d'albertisii* F. Muell.	CGE 78/79	RF(2/i) SF(4/i) CG(4)	Af
mat	Lauraceae	*Cinnamomum* sp.	CGE 78/80	RF(4/i) CG(i)	Af
mbuwp	Moraceae	*Artocarpus vriesianus* Mig.	CGE 78/81	RF(5)	Ed
memenj	Leguminosae	*Ormosia calvensis* Blanco	CGE 78/82	LA	Af
mol	Sterculiaceae	*Sterculia* sp.	CGE 78/83	LA	Af
molmol	Melastomataceae	*Melastoma polyntum* Bl.	CGE 78/84	SF(6/i) AG(3/ii) GH(ii)	Af
mom	Loganiaceae	*Fagraea* sp.	CGE 78/85	RF(4/i) SF(i)	Af,Md
momkak	Araliaceae	*Mackinlaya schlechteri* Philipson	KEW H1835 93/64	RF(6/ii)	
momuwn	Cunoniaceae	*Caldcluvia celebica?* (Bl.) Hoogl.	CGE 78/86	RF(6/i)	Ct
momuwn-maendak	Meliaceae	*cf. Chisocheton* sp.	KEW H1835 93/51	RF(5) SF(5) CG(5)	Ct
mondiyt	Loranthaceae	*Indet.*	KEW H1835 93/56,57	RF(5) SF(5/i) CG(5/i) GH(5)	
mondok	Icacinaceae	*Gomphandra* sp.	CGE 78/87	RF(6) BL(6)	
morowa or *hogoba* or *limbisuw*	Cupressaceae	*Papuacedrus papuanus* (F.v.M.) Li	UPNG 83/8	RF(5) GH(6)	Af,Ct
mul	Euphorbiaceae	*Glochidion sp.*	CGE 78/88	RF(5/i) SF(2/i) CG(6/ii)	Af
mul-saembish	Euphorbiaceae	*Glochidion* cf. *insectum* Airy Shaw	KEW H1937 83/75	RF(4) SF(3) CG(6)	
mund		*Indet*	KEW H1835 93/66	RF(5/i) SF(i)	
munk	Guttiferae	*Garcinia* sp.	CGE 78/91	RF(3/ii)	Af
munkiyriyt	Guttiferae	*Garcinia* sp.	CGE 78/90	RF(4/i) CG(i)	Af
naelwaes or *waes*	Moraceae	*Ficus* sp.	KEW H1835 93/69	RF(6)	Af ,Ed
naep	Casuarinaceae	*Casuarina oligodon* Johnson	LAE 74/121/3/2	SF(3) CG(6) BL(2) GH(1)	Af,Ct,Rt
nak	Monimaceae	*cf. Anthobembix* sp.	CGE 78/92	RF(6/ii) SF(i)	Af
natnat	Elaeocarpaceae	*Aceratium tomentosum* Coode	CGE 78/93	RF(6/i) CG(6) SF(6/i)	
naykitkit	Pittosporaceae	*Pittosporum sinuatum* Bl.	KEW H1835 93/67	RF(6/i)	
nemb	Pittosporaceae	*Pittosporum* sp.	CGE 78/94a	RF(2/i) CG(5/i) GH(5)	Af
nemb-nongol	Pittosporaceae	*Pittosporum* sp.	CGE 78/94b	RF(2) CG(5) GH(5)	Af
nenjay	Theaceae	*Eurya longisepala* Kob.	UPNG 83/9a	RF(5/ii) CG(4/i) SF(3/i)	Af
niykiykolomb or *nigiynael*	Moraceae	*Ficus mollior* Bentham	CGE 78/96	RF(2)	Af
niykor	Urticaceae	*Indet.*	KEW H1835 93/68	RF(5/i)	Md
niysh	Urticaceae	*Laportea decumana* (Roxb.) Wedd.	CGE 78/97	RF(2) GH(6)	Af,Md
ol	Malvaceae	*Hibiscus archiboldianu* Borssum	UPNG 82/61	RF (2)	Af
ongol	Elaeocarpaceae	*Elaeocarpus polydactylus* Schltr.	CGE 78/99	GH(6)	Af,Rt
oljomb	Saurauiaceae	*Saurauia* sp.	CGE 78/21	CG(5/i) RF(2/i) SF(i)	Ct

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op	Ochnaceae	*Schuurmansia henningsii* K. Schum	CGE 78/100	RF(2/ii) CG(3/ii) SF(i)	Af,Ct
orol	Melastomataceae	*Medinella* sp.	KEW H1835 93/70	RF(6/i) CG(i)	Rt
paerep	Myrsinaceae	*Maesa* sp.	CGE 78/103	RF(6/i) CG(5/i) SF(2/ii) GH(ii)	Af
paeznol or *hatshap*	Sapindaceae	*Mischocarpus* sp.	KEW H1835 93/76	RF(6/i)	Af
pak	Myrtaceae	*Syzygium* sp.	CGE 78/104a	RF(4)	Af
pakensok	Myrtaceae	*Syzygium* sp.	CGE 78/104b	RF(3)	
pakpak	Moraceae	*Ficus microdictya* Diels	CGE 78/105	RF(2/i) CG(4/i) SF(i) AG(i) GH(i)	Af
pay	Fagaceae	*Castanopsis acuminatissima* (Bl.) A.DC.	CGE 78/106	RF(4) CG(2)	Af,Ct,Ed, Md
pel-haeraep	Fagaceae	*Nothofagus starkenborghi* Steenis	KEW H1937 83/50	RF(1/ii) SF(6)	Af,Ct,Rt
pel-kelkel	Fagaceae	*Nothofagus grandis* Steenis	KEW H1937 83/51	RF(1/ii) SF(6)	Af,Ct,Rt
pel-port	Fagaceae	*Nothofagus starkenborghi* Steenis	KEW H1937 83/52	RF(1/ii) SF(6/i) CG(i)	Af,Ct,Rt
penden	Daphniphyllaceae	*Daphniphyllum* sp.	CGE 78/107	RF(5/i)	Ct
pil or *hiriybiy*	Moraceae	*Ficus mollior* Bentham	CGE 78/108	RF(2) CG(4/ii) SF(5/i)	Af
pil-ndiy	Moraceae	*Ficus mollior* Bentham	CGE 78/109	RF(2/i) CG(4) SF(5)	Af
piyp-ak	Myrtaceae	*Syzygium* sp.	KEW H1835 93/72	RF(3/i) BL(6)	Af,Rt
piyp-maeraem	Myrtaceae	*Syzygium* sp.	CGE 78/110	RF(3/i) BL(6)	Af,Rt
piyp-taguwt	Myrtaceae	*Syzygium* sp.	CGE 78/111	RF(3/i) BL(6) CG(i)	Af,Rt,Ct
plortriy	Myrtaceae	*Eucalyptus* spp.	N/A	GH(3)	Ct
poiz or *tuluwp*	Moraceae	*Ficus wassa* Roxb.	CGE 74/33	GH(5) AG(5) SF(5)	Ed
polpol	Cresneriaceae	*Cyrtandra* sp.	CGE 78/112	RF(3/iii) SF(i) CG(ii)	Af
pongol	Myrtaceae	*Xanthomyrtus* sp.	CGE 78/113	RF (4/i) CG(i)	Af
	Myrtaceae	*Decaspermum* sp.	KEW H1937 83/21		
ponjip	Moraceae	*Ficus iodotricha* Diels	CGE 78/114	RF(2/ii) SF(5/ii) CG(4/ii) GH(i)	Af
ponjiy	Elaeocarpaceae	*Elaeocarpus* sp.	CGE 78/115	RF(3)	Ct
porthul or *ibilkay*	Araliaceae	*Polyscias* aff. *royeni* Philipson	CGE 78/116	RF(5)	Af
romiya	Melastomaceae	*Astronia* sp.	CGE 78/117	RF(3/i) SF(6) CG(6)	Ct
sabhul	Rubiaceae	*Gardenia gjellerupii* Val.	KEW H1937 83/54	RF(3/i)	Af
sabok or *sabkeb*	Sabiaceae	*Meliosma pinnata* ssp. *macrophylla* (Roxb.) Walp	CGE 78/119	RF(5/i) SF(5) CG(5/i)	Af
		ssp. *humilis*	CGE 78/122		
saemow	Leguminosae	*Albizia fulva* Lane-Poole	CGE 78/120	RF(5) CG(5) SF(2)	Af,Ct
serep	Icacinaceae	*Platea excelsa* var. *borneensis* Bl.	CGE 78/121	RF(2/i) SF(i)	Ct
shina-aenk	Ericaceae	*Rhododendron* sp.	KEW H1835 93/81	RF(3) SF(6) CG(5)	Af
shiyp	Meliaceae	*Chisocheton ceramicum* Miq.	CGE 78/123	RF(5/ii) SF(i) CG(i)	Af,Md,Rt
shiyp-haez	Myristicaceae	*Myristica* sp.	KEW H1835 93/80	RF(5)	

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shongaen	Euphorbiaceae	*Macaranga pleioneura* var. *pleioneura* Airy Shaw	CGE 78/124	SF(5/i) CG(5/i) RF(i) GH(ii)	Af,Ct
shongom	Elaeocarpaceae	*Elaeocarpus leucanthus* A.C.Sm.	CGE 78/125	RF(5/i)	Ed
shonon	Euphorbiaceae	*Acalypha* sp.	CGE 78/127a	SF(2/i) CG(2) GH(3) RF(2)	Af,Ed,Ct
shonon-womb	Euphorbiaceae	*Acalypha* sp.	CGE 78/127b	GH(6)	Ed,Ct
shonwenj		*Indet.*	UPNG 78/4	RF(5) SF(6)	Ct
shortpaygoiz or *oyataen*	Rubiaceae	*cf. Amaracarpus* sp.	CGE 78/126	RF(6/ii)	Af
shuguwl	Lauraceae	*Litsea irianensis* Kost.	CGE 78/129	RF(6)	Ct
shuwat	Moraceae	*Ficus dammaropsis* Diels	MAN 80/1	RF(3) SF(6) CG(5) GH(5)	Af,Ed
shuwat-p^{e}gaend	Moraceae	*Ficus megalophylla* Diels	CGE 78/128	RF(5/i) SF(i)	Af
shwimb	Elaeocarpaceae	*Elaeocarpus dolidrostylus* ssp. *collinus* Schlk.	CGE 78/130	RF(2) SF(5) CG(5) GH(6)	Af,Ct,Rt
shwimb-set	Elaeocarpaceae	*Elaeocarpus ptilanthus* Schlk.	CGE 78/131	RF(3/i) SF(5) CG(5)	Ed
soiz	Moraceae	*Ficus mafuluensis* Summerhayes	CGE 78/132	RF(4/i)	Af
sunglaes	Aquifoliaceae	*Sphenostemon papuanum* (Laut) Steen & Erdtm	CGE 78/133	RF(5/ii)	Af
taben	Rubiaceae	*Psychotria* sp.	CGE 78/134	BL(6)	
taentaen	Rubiaceae	*Amaracarpus* sp.	CGE 78/135	RF(5)	Af
taygel	Rutaceae	*Zanthoxylum* sp.	CGE 78/136	RF(2/i) CG(5/i) SF(i)	Af
tibil	Podocarpaceae	*Podocarpus* sp.	CGE 78/137	RF(5)	Af
timbol or *aemb*	Euphorbiaceae	*Homalanthus novoguineensis* (Warb.) Laut. & K.Schum	CGE 78/138	RF(4/i) SF(2/ii) CG(5/i) GH(ii)	Af
tomba	Elaeocarpaceae	*Elaeocarpus* sp.	CGE 78/139	RF(6/i) SF(i)	Ct
towmown-gonk	Loganiaceae	*Geniostoma* sp.	CGE 78/142	RF(5) SF(6/ii) CG(6/ii)	Ct
tuwmuwaengael	Urticaceae	*Cypholophus* sp.	CGE 78/143	RF(4/ii) SF(2/ii) CG(5/i) GH(ii)	Af
tuwn	Podocarpaceae	*Phyllocladus hypophyllus* Hook.f.	KEW H1835 93/88	RF(6)	Ct
uwk or *was-komb*	Rubiaceae	*Wendlandia paniculata* (Roxb.) DC.	KEW H1937 83/56	RF(5)	Af,Ct
uwk-kongol	Piperaceae	*Piper* sp.	KEW H1835 93/45	RF(5) SF(5/i) CG(5)	Ed
waen	Ulmaceae	*Trema orientalis* (L.) Bl.	UPNG 78/5	SF(2/ii) CG(5/i) AG(iii) GH(iii)	Af,Ct
waengum	Lauraceae	*Cryptocarya densiflora* Bl.	LAE 82/5	RF(5) CG(6/i)	Af
	Myrtaceae	*Metrosideros* sp.	CGE 78/145		
wat	Elaeocarpaceae	*Sloanea* cf. *aberrans* (Brandis) A.C.Smith	CGE 78/146	RF(3/i) CG(5) SF(i)	Af
wenet or *h^{e}gwenet*	Juglandaceae	*Engelhardia rigida* Bl.	CGE 78/147	RF(2) CG(5)	Af,Ct
wil-waen	Ulmaceae	*Prasponia* sp.	CGE 78/149	RF(6/i) SF(3/i) CG(3) AG(3)	Ct
wok	Guttiferae	*Garcinia* sp.	CGE 78/150	RF(3/ii)	Af,Ct,Rt

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wol	Moraceae	*Ficus* sp.	UPNG 78/6	LA	
woliy	Erythroxylaceae	*Erythroxylum ecarinatum* Burck.	UPNG 82/2	LA	Ct
wolsuwpuw	Euphorbiaceae	*Drypetes* sp.	KEW H1835 93/90,95	RF(5/i)	
wombwomb	Melastomaceae	*Astronia* sp.	CGE 78/151	RF(3) SF(6) CG(6)	
wombok-shwimb	Anacardiaceae	*Campnosperma brevipetiolata* Volk	LAE 74/121/3/3	LA(4)	Af,Md,Rt
TREE FERNS *(henk sem)*					
aguwpaguwp	Dennstaedtiaceae	*Dennstaedtia* sp.	CGE 73/174	RF(4/i) SF(i)	Rt
bobaya	Athyriaceae	*Diplazium archboldii* (Copel) D.a.	CGE 73/175a, 73/175b	RF(5)	Ed
	Aspleniaceae	*Diplaziopsis javanica* (Blume) C.Chr.			
daepdaep	Cyatheaceae	*Cyathea* sp.	CGE 73/177	RF(3/ii)	
dalep or tuwmoktay	Woodsiaceae	*Lunathyrium japonicum* (Thunb.) Kurata	KEW H1835 93/83	SF(3/ii) CG(6/i) BL(ii) AG(3/iii) GH(6/iii)	
hongok or *henk*	Cyatheaceae	*Cyathea magna* Copel.	CGE 78F/2	RF(5) SF(1/ii) CG(3/ii) AG(ii) GH(ii)	Af,Ed,Rt
iydaeptael	Lycopodiaceae	*Lycopodiella cernua* (L.) Pichi Serm.	KEW H1835 93/41	RF(5/i) CG(6/i) SF(i)	
kabiyp	Cyatheaceae	*Dicksonia grandis* Rosenst.	CGE 78F/3	RF(2/ii) SF(i) CG(i)	Af,Ed,Rt
kolmaen	Cyatheaceae	*Cyathea* sp.	CGE 73/176	RF(2/i) SF(6/i) CG(3/i) GH(iii)	
lorwalorwa	Cyatheaceae	*Cyathea* aff. *macgillavrayi* (Bak.) Domin	CGE 73/181	RF(3/i) CG(6) SF(i)	Ed
meshmesh	Thelypteridaceae	*Cyclosorus* aff. *archboldii* (C.Chr.) Copel	CGE 73/183a, 73/183b	RF(1/iii) SF(3/iii) CG(3/iii) BL(ii)	Af
	Thelypteridaceae	*Sphaerostephanos archboldii* (C.Chr.) Holttum			
nolimb	Cyatheaceae	*Cyathea pilulifera* Copel	CGE 78F/4	RF(4/i)	Af
omak	Marattiaceae	*Marattia* sp.	CGE 73/182	RF(3/ii) CG(6/i) SF(i)	Rt
pukuwmb	Dennstaedtiaceae	*Pteridium aquilinum von wightianum* (L.) Kuhn.	CGE 73/185	SF(2/ii) CG(2/i) AG(2)	Ct
showai	Cyatheaceae	*Cyathea pycnoneiva* Holttum	CGE 78F/6	RF(2/i) CG(5/i) SF(i)	Af
shumbuwhon	Aspleniaceae	*Polystichum keysserianum* Rosenst.	CGE 73/186,187	RF(6/iii) SF(i) CG(i)	Ed
taendbiyaib or kilakila	Cyatheaceae	*Cyathea hunsteiniana* Brause	CGE 73/188	RF(4/i)	Ed
	Cyatheaceae	*Cyathea notofagorum* Holttum	CGE 73/180		
teltel	Thelypteridaceae	*Sphaerostephanos unitus* (L.) Holttum	CGE 78F/7a, 78F/7b	RF(5) CG(5/ii) SF(3/ii) AG(iii) GH(ii)	Af
	Thelypteridaceae	*Sphaerostephanos invisus* (Forst.f.) Holttum			
tiyptiyp	Thelypteridaceae	*Pneumatopteris* sp.	KEW H1835 93/86	RF(6/i) SF(5/ii) CG(5/i) GH(6) AG(ii)	

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tombogaim	Athyriaceae	*Diplazium latilobum* (Capel) Parris	CGE 73/190	RF(5/ii)	Ed
wem	Athyriaceae	*Diplazium dilatatum*	CGE 78F/9	BL(3)	Ed
wolhenk	Cyatheaceae	*Cyathea pilulifera* Copel.	CGE 78F/8	SF(2) CG(5)	Af,Ed
yagorom	Dennstaedtiaceae	*Kypolipis* sp.	CGE 73/192	RF(6)	Ed
FERNS *(saezuwp sem)*					
aesuwpsaesuwp	Lycopodiaceae	*Lycopodium volubile* Forst.	CGE 78F/1	SF(6) CG(4/ii)	Af
dorb	Gleicheniaceae	*Sticherus hirtus* var.*candida* (Rosenst.) Copel.	CGE 73/202	RF(2)	
haegak	Oleandraceae	*Nephrolepis biserrata* (Sw.) Schott.	KEW H1835 93/31	RF(4) SF(i) CG(i)	Rt
laek-dorb	Dipteridaceae	*Dipteris conjugata* Reinw.	CGE 73/203a	RF(6)	Ct
laek-dorb	Dipteridaceae	*Dipteris novoguineensis* Posth.	CGE 73/203b		
puwt	Gleicheniaceae	*Dicranopteris linearis* var. *montana* (Burm.f.)Unders.	CGE 73/204	RF(5/ii)	
saezuwp	Gleicheniaceae	*Dicranopteris linearis* var. *altissima* (Burm.f.)Unders.	CGE 78F/5	RF(2) SF(5/i) CG(3/ii) AG(6/ii)	Af
taziy	Gleicheniaceae	*Gleichenia milnei* Baker	CGE 73/206	RF(2) SF(6) CG(3) AG(6)	Af
yablaengay	Dennstaedtiaceae	*Hypolepsis brooksiae* v.A.v.R.	KEW H1835 93/97	RF(2/i) SF(6/i) CG(2/i) AG(ii)	Ed
PALMS *(goiz sem)*					
doba	Palmae	*Caryota rumphiana* Blume	CGE 78/212	LA	Af,Ed
goiz or *goizluwp*	Palmae	*Gulubia* sp.	CGE 78/213	RF(5) GH(6)	Af,Ed,Ct, Rt
hiywa	Arecaceae	*Metroxylon sagu* Rottb.	N/A	LA(2)	Ed
may	Palmae	*Heterospathe* aff. *muelleriana* Becc.	CGE 78/214	RF(3)	Af,Ed
mbet	Arecaceae	*Areca* aff. *macrocalyx* Zipp.	CGE 78/215	RF(3)	Af,Ed,Ct
shugbol	Palmae	*Orania* sp.	CGE 78/216	RF(4)	Af
sitiypa	Palmae	*Indet.*	N/A	LA	Ct
waeb	Palmae	*Caryota* sp.	N/A	LA	Af
zin	Palmae	*Heterospathe elegans* Becc.	CGE 78/217	RF(3)	Af,Ed
SCREW-PINES *(aenk sem)*					
aendashor or *paym* or *mayabuw* or *mataeng*	Pandanaceae	*Pandanus antaresensis* St.John	KLU 83/13	RF(2/i) BL(5) CG(6) GH(6)	Ed,Ct,Rt
aenk	Pandanaceae	*Pandanus julianettii* Mart.	UPNG 78/P1	RF(3) SF(1/i) GH(1) CG(i)	Af,Ct,Rt,Ed (45cvs)
dalep or *tuwmok*	Pandanaceae	*Pandanus brosimos* Merr. & Perry	KLU 83/15a	RF(3) MT(5)	Ed
keret or *tazh*	Pandanaceae	*Pandanus adinobotrys* Merr. & Perry	KLU 82/10	RF(3/ii)	Af
pundin-maziy	Pandanaceae	*Pandanus archboldianus* Merr. & Perry	KLU 82/24a	RF(2/ii)	Af,Ct
pundin-oziy	Pandanaceae	*Pandanus archboldianus* Merr. & Perry	KLU 82/24b	RF(2/ii)	Af,Ct
pundin-sugumb	Pandanaceae	*Pandanus archboldianus* Merr. & Perry	KLU 82/24c	RF(2/ii)	Af,Ct

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nort	Pandanaceae	*Pandanus concavus* St.John	KLU83/14	RF(5)	Ct
tuwmok-hobaen	Pandanaceae	*Pandanus* cf. *brosimos* Merr. & Perry	KLU 83/15b	RF(6) MT(6)	Ed
wabel	Pandanaceae	*Pandanus conoideus* Lamk.	UPNG 78/P2	LA	Af,Ed (4cvs)
VINES (*ya sem*)					
aendluwpluwp or *tatmuwbayalem*	Cucurbitaceae	*Zehneria cissybium*	KEW H1835 93/5	RF(5) SF(5/i) CG(5/i) GH (5)	
aenkpakpak	Apocynaceae	*Parsonia* sp.	KEW H1835 93/6	RF(2/i) SF(5/i) CG(2/i)	Ct
aymonk	Goodeniaceae	*Scaevola oppositifolia* R. Br.	KEW H1835 93/4	RF(4) SF(4/i) CG(4) AG(ii)	
bawiy	Dioscoreaceae	*Dioscorea* sp.	CGE 78/253	RF(6) SF(6)	Ed
dinbuwm	Leguminosae	*Mucuna schlechteri* Harms.	CGE 78/190	RF(4/i)	Ed
gaiya or *tolop*	Pandanaceae	*Freycinetia* cf. *flaviceps* Rendle	KLU 83/15	RF(3/ii) CG(i)	Af,Rt
		F. angustissima Ridley	CGE 78/195		
haeluwp	Palmae	*Calamus fuscus* Becc.	CGE 78/191	RF(3/i)	Af,Ed,Ct, Rt
haeraedaepon oliy	Urticaceae	*Pipturus* sp.	CGE 78/23	RF(2/i) SF(6/i) CG(2/i)	Af,Md
haeraedaepon weray	Urticaceae	*Pipturus* sp.	CGE 78/24	RF(2) SF(6) CG(2)	Af,Md
hezaembul	Rosaceae	*Rubus moluccanus* L.	CGE 78/192	RF(2/i) SF(6/i) CG(6/ii)	Ed
hibishya or *bushya*	Aquifoliaceae	*Ilex* sp.	CGE 78/30b	RF(i) SF(i) CG(i)	
hobogaya	Rubiaceae	*Mussaenda* sp.	KEW H1835 93/33	RF(3) SF(3) CG(3)	
homat	Cucurbitaceae	*Melothria belensis* Merr. & Perry	CGE 78/193	RF(6) SF(i) CG(i)	Ed
hulhaeruwk	Leguminosae	*Mucuna tomentosa* K. Schum *Mucuna albertisii* F.v.Ruell.	CGE 78/194	RF(3) SF(6)	Ed
huwmun	Araceae	*Rhapidophora pachyphylla* K. Krause vel. aff.	KEW H1835 93/30	RF(2) SF(6)	
kaegak	Vitaceae	*Cissus* sp.	KEW H1835 93/47	RF(3/i) SF(6) CG(6)	
kemshiy	Gesneriaceae	*Agalmyla* sp.	CGE 78/196	RF(5)	Af
kishwomb	Anacardiaceae	*Rhus caudata* Laut.	CGE 78/197	RF(3/i) CG(4/i)	Af
kondoliyp	Tiliaceae	*Triumfetta* sp.	CGE 78/198	SF(6/i) CG(5/i) AG(ii)	Af
kulkulya	Compositae	*Mikania* sp.	KEW H1835 93/46	RF(6) SF(6) BL(6) CG(6/i) AG(6/i)	
kuwkpuw	Oleaceae	*Jasminum* sp.	KEW 82/19	RF(2/i) SF(i) CG(i)	Ct
mael	Gramineae	*Racemobambos congesta* (Pilg.) Holttum	CGE 82/138	RF(1/iii) SF(i) CG(i)	Af
maip	Asclepiadaceae	*Hoya* sp.	CGE 78/199	RF(4/i) CG(i)	Ct,Rt
munduwm	Sapindaceae	*Cardiospermum halicacabum* L.	MAN 80/2	Huli import?	Rt
ngai	Liliaceae	*Smilax leucophylla* Blume	CGE 78/200	RF(4)	Af
ngais	Pandanaceae	*Freycinetia archboldiana* Merr. & Perry	KLU 83/17	RF(5/ii)	Ht.
paerelya	Vitaceae	*Cayratia* sp.	KEW 82/20	RF(2/ii) SF(i) CG(i)	Ct
pahunduwmya	Memspermaceae	*Indet.*	KEW H1835 93/73	RF(6) SF(6) CG(6)	Rt
pakenduminya	Myrsinaceae	*Embelea* sp.	KEW H1835 93/74	RF(3) SF(3) CG(3)	Rt

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
sebseb	Moraceae	*Ficus* aff. *insculpta* Summerhayes	KEW 82/17	RF(2/i) SF(i) CG(ii)	Ct
segerab		*Indet.*	UPNG 78/V1	LA	Ed
sel	Palmae	*Calamus aruensis* Becc.	CGE 78/201	LA	Af,Ct
sel-piyndaekndaek	Palmae	*Korthalsia zippelii* Blume	CGE 78/202	LA	Af,Ct
shor	Monimiaceae	*Palmeria brassii* Philipson	CGE 78/203	RF (5)	Ed
taengaliyna	Pandanaceae	*Freycinetia beccarii* Solms. *Freycinetia elegantula* B.C. Stone	CGE 78/204a, 78/204b	RF(5)	Af
tainjtainj	Rubiaceae	*Psychotria* sp.	KEW H1835 93/85	RF(4/i) SF(6/i) CG(i)	
tiy	Palmae	*Calamus* sp.	CGE 78/205	LA	Af,Ct
toben	Apocynaceae	*Alyxia* sp.	KEW 82/18	RF(2/i) CG(i)	Ct
tomaep	Palmae	*Calamus* sp.	CGE 78/207	RF(4)	Af
tombel	Dioscoreaceae	*Stenomeris dioscoriifolia* ? Planch.	KEW H1937/83/81	RF(5/ii) SF(i) CG(i)	Af,Ed
towmontat or *towmonpuliyba*	Cucurbitaceae	*Trichosanthes pulleana* Cogn. ex Harms *Luffa cylindrica* (L.) M.J. Roem	CGE 78/246 CGE 78/208	RF (5)	Ed
unguwruwm	Liliaceae	*Geitonoplesium cymosum* (R.Br.) Cunn.	CGE 78/209	RF(3/i) SF(5/i) CG(5/ii)	Af
waenjwaenj	Rhamnaceae	*Rhamnus nepalensis* (Wall.) Laws ex Hk.	KEW H1835 93/92	RF(5/i) SF(i) CG(i)	Ct,Rt
waenuwkunguwp	Aristolochiaceae	*Aristolochia* cf. *engleriana* O. Schmidt	CGE 78/210	RF(6)	Ed
wolaya	Ericaceae	*Dimorphanthera* sp.	CGE 78/211	RF(4/ii) SF(i) CG(ii)	Af
BAMBOOS *(pay sem)*					
daymungow	Palmae	*Linospadix* sp.	CGE 78/225	LA	Af
hulumb	Gramineae	*Nastus productus* (Pilger) Holttum	KEW 82/128	RF(5)	Af
kaenainj	Gramineae	*Schizostachyum* cf. *lima* (Blanco) Merrill	KEW H1937/83/23	LA	Af
kwiyp	Gramineae Gramineae	*Bambusa forbesii?* (Ridl.) Holttum *Schizostachyum* sp	CGE 78/227a, 78/227b	LA	Af
taembok	Gramineae	*Nastus elatus* Holtt.	CGE 78/254	GH(5)	Af,Ct,Ed
talumb	Gramineae	*Schizostachyum* cf. *lima* (Blanco) Merrill *Bambusa* sp.	CGE 78/223a, 78/223b	LA	Af
tegelab	Gramineae	*Nastus* sp.	CGE 78/255	LA	Af,Ct

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
wolahaeriy	Gramineae	*Nastus obtusus* Holttum	KEW 82/118	RF(4)	Af
CANE GRASSES *(gaimb sem)*					
gaimb	Gramineae	*Miscanthus floridulus* (Labill.) Warb.	CGE 78/G220	RF(6/i) SF(4/iii) GH(iii) CG(1/iii) AG(iii)	Af,Ct,Rt
gaimb-aendasil	Gramineae	*Miscanthus floridulus* (Labill.) Warb.	CGE 78/G225	GH(5)	
gaimb-henj	Gramineae	*Miscanthus floridulus* (Labill.) Warb.	CGE 78/G221	GH(6)	Ct
gaimb-ondal	Gramineae	*Miscanthus floridulus* (Labill.) Warb.	CGE 78/G223	GH(5)	Rt
gaimb-waip	Gramineae	*Miscanthus floridulus* (Labill.) Warb.	CGE 78/G224	GH(5)	Af
holor	Gramineae	*Coix lacryma-jobi* L.	CGE 78/G158	SF(3/ii) CG(6) GH(5) AG(2/ii) BL(4/iii)	Af
holor-koliya	Gramineae	*Coix lacryma-jobi* L.	CGE 78/G159	SF(3) CG(6) AG(2) GH(5) BL(4)	Af
iybkombez	Gramineae	*Saccharum robustum* Brandes & Jeswiet ex Grassl.	KEW H1835 93/43	BL(6) GH(6)	
mokombez	Gramineae	*Saccharum robustum* Brandes & Jeswiet ex Grassl.	CGE 78/G222	CG(5/ii) BL(2/ii) SF(i) GH(ii)	Af,Ed
shaenshuwril or *aeliyma*	Gramineae	*Pennisetum macrostachyum* (Brongn.) Trin.	CGE 82/14	SF(5) CG(6) AG(6)	Af
TALL LARGE-LEAVED HERBS (munk shor sem)					
borok	Polypodiaceae	*Microsorum punctatum* (L.) Copel.	CGE 78F/10	RF(2/ii) CG(5/ii) SF(i)	Af,Cg
hogben	Zingiberaceae	*Alpinia* sp.	CGE 78/196	RF(5) SF(i)	Af,Cg
hweb	Marantaceae	*Cominisia gigantea* (Scheff.) K. Schum.	CGE 78/218	RF(3) GH(5)	Af,Cg
kapepshor	Zingiberaceae	*Riedelia* sp.	KEW H1835 93/49	RF(5)	Af,Cg
kat or *katshor*	Musaceae	*Musa* sp.	N/A	RF(5)	Ed,Cg
munk	Zingiberaceae	*Pleuranthodium* aff. *schlechteri* (K.Schum.) R..M.Smith	KEW H1835 93/55	RF(4)	Cg
piyborgo	Zingiberaceae	*Alpinia* sp. (sect. Pycanthus)	KEW H1835 93/71	RF(5/i) SF(i) CG(i)	Cg
pep or *pepshor*	Zingiberaceae	*Pleuranthodium* sp.	KEW H1835 93/75	RF(i)	Cg
sulshor or *suwl*	Zingiberaceae	*Riedelia* sp.	CGE 78/200	RF(6/ii) SF(i) CG(i)	Cg
taenktaenk	Zingiberaceae	*Alpinia odontonema* K. Schum.	KEW H1835 93/84	RF(6/iii) SF(ii) CG(i) GH(iii)	Cg
tedbel	Zingiberaceae	*Alpinia* sp. (sect. Dieramalpinia)	KEW H1835 93/82	RF(3/ii) SF(i)	Ct,Cg
yogorlom	Marantaceae	*Donax* sp.	CGE 78/219	LA	Cg
GRASSES & LOW HERBS *(den sem)*					
aenksuwp	Polypodiaceae	*Microsorum papuanum* (Baker) Parris	KEW H1835 93/1	RF(5/i) CG(2/ii) SF(i) BL(ii)	
		Phymatopteris albidosquamata (Blume) Pichi Serm.	KEW H1835 93/2,3		
beliyl	Orchidaceae	*Dendrobium subclausum* Rolfe	UPNG 82/83	RF(2) CG(5)	Af

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
bol	Gramineae	*Ischaemum polystachyum* Presl.	CGE 78/153	SF(5/iii) CG(5/ii) AG(1/v) BL(4/v) GH(6/iii)	
burumbol	Gramineae	*Paspalum conjugatum* Berg.	CGE 78/177	SF(ii) CG(ii) BL(iii) AG(iv) GH(iv)	
buwkbuwk	Gramineae	*Garnotia stricta* Brongn.	KEW H1835 93/9	RF(6/iii) SF(iii) CG(ii) BL(iii) AG(iii) GH(ii)	
		Ophismemus hirtellus (L.) P. Beauv.	KEW H1835 93/10		
chiyasiy	Hydrocotylaceae	*Hydrocotyle javanica* Thunb.	CGE 78/154	RF(6)	Af
cowaden	Leguminosae	*Desmodium* sp.	KEW H1835 93/13	AG(6/iii) GH(6/i) SF(i) CG(i)	
dayngeltay	Gramineae	*Agrostis avenacea* J. Gmelin	KEW H1835 93/14	GH(6/i) BL(iii)	
dedwal	Araceae	*Alocasia nicolsonii* A. Hay	KEW H1835 93/21	SF(6) CG(6) AG(6) GH(6)	
deraen-momoniyl	Rosaceae	*Rubus ferdinandi* Focke	CGE 78/251	RF(6/i) SF(6)	
dikiyta-kot	Gramineae	*Setaria sphacelata* Stapf & C.E.Hubb ex Chipp	CGE 74/44	CG(6/i) GH(5) SF(3/ii) AG(2/iii)	Af,Ed
dinshor	Gramineae	*Eulalia* cf. *Leptostachys* (Pilg.) Henrard	KEW H1835 93/15	GH(5)	
dunguwlumb	Juncaceae	*Junus effusus* (l.)	KEW H1835 93/17	BL(3/iv) SF(i) CG(ii) AG(iii) GH(iv)	Af
	Cyperaceae	*Kyllinga brevifolia* Rottb.	KEW H1835 93/18		
		Kyllinga melanosperma Nees	KEW H1835 93/20		
		Eleocharis sp.	KEW H1835 93/19		
flowa	Compositae	*Tithonia* sp.	KEW H1835 93/24	AG(2) GH(2/i) SF(i)	Af
	Leguminosae	*Crotalaria lanata* Beddome	KEW H1835 93/25		
haemnom	Gramineae	*Digitaria violascens* Link	CGE 78/156	GH(2/ii) AG(ii)	
haeraebaluw	Bixaceae	*Bixa orellana* L.	UPNG 78/S1	LA	Af
holiygiyn or *hedholiyn*	Gramineae	*Paspalum conjugatum* ? Berg.	CGE 78/157	SF(6/ii) AG(3/iv) GH(3/iv) CG(i) BL(iii)	
hombiyhaem or *kondow*	Commelinaceae	*Commelina diffusa* Burm. f.	CGE 78/160	GH(5/iii) AG(2/iii) BL(iv)	Ed
homsep	Umbelliferae	*cf. Centella* sp.	KEW H1835 93/34	SF(6/ii) CG(6/ii) BL(6) AG(6/iii) GH(3/iv)	
hultort-leb	Araceae	*Acorus calamus*	KEW H1937/83/27	Huli import	Rt
hungmaenk	Balsaminaceae	*Impatiens* sp.	GCE 78/161	SF(6/iii) CG(6/i) BL(ii) GH(6/ii) AG(2/iii)	Ed,Rt
hurinj	Cyperaceae	*Eleocharis sphacelata* R.Br.	GCE 78/162	BL(4/iii)	Af
huwguwp	Cyperaceae	*Kyllinga melanosperma* Nees	KEW 82/21	BL(5/iv)	Af
huwguwp	Cyperaceae	*Cyperus* sp.	UPNG 82/21	BL(5/iii)	
iriyduwliy	Compositae	*Crassocephalum crepidioides* (Benth.) S. Moore	CGE 78/166	RF(6) SF(6/ii) CG(6) AG(3/iv) GH(1/iv) BL(iii)	
iriywaenj	Compositae	*Erigeron sumatrensis* Retz.	CGE 78/167	SF(6) GH(2/iii) AG(1/iii) CG(i)	

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
iyb-taziy	Umbelliferae	*Oenanthe javanica* DC.	CGE 78/242b	RF(6) SF(3) CG(6) BL(3) AG(2) GH(6)	Ed
kaebayawomb or *hebaylababuw*	Compositae	*Helichrysum bracteatum* (Vent.) Andr.	CGE 78/168	GH(5)	Af
kaerobkaerob	Labiatae	*Plectranthus scutellariodes* (L.) R. Br.	CGE 78/169	SF(3/iii) CG(6/ii) AG(1/iii) GH(6/iii)	
kiygaren	Gramineae	*Eleusine indica* Gaertn. f.	CGE 78/171	GH(5)	
kobkob	Boraginaceae	*Cynoglossum javanicum* (Lehm.) Thunb.	CGE 78/172a	AG(1/iv) GH(1/iv) SF(ii) CG(ii) BL(iii)	
	Compositae	*Adenostemma lavenia* var. *parviflorum* (L.) O. Ktze	CGE 78/172b	AG(i/iv) GH(i/iv) SF(ii) CG(ii) BL(iii)	
	Compositae	*Bidens pilosus* var. *minor* L.	CGE 78/172c	AG(i/iv) GH(i/iv) RF(i) SF(ii) CG(ii) BL(iv)	
komnol	Labiatae	*Plectranthus scutellariodes* (L.) R. Br.	CGE 78/173	AG(6) GH(5)	Af
kuwmkaes	Selaginellaceae	*Selaginella* sp.	CGE 78/174	RF(5/i)SF(5/ii)CG (5/ii) AG(5/iii) GH(5/iii)	Rt
kuwmkuwm	Compositae	*Blumea arnakidophora* Matt. f.	CGE 78/175	CG(5/ii) RF(i) AG(ii) SF(i)	Af
leb	Araceae	*Acorus calamus* L.	KEW 83/27	BL(4) GH(6)	Md,Rt
loliy	Solanaceae	*Physalis peruviana* L.	UPNG 78/52	AG(6/ii) GH(6/ii) SF(i)	Ed
magiliym	Haloragidaceae	*Gunnera macrophylla* Bl.	KEW H1835 93/58	SF(5) CG(5/i) AG(5) GH(ii)	
mahap	Labiatae	*Plectranthus* sp.	KEW H1835 93/59	RF(3) SF(6/i) CG(3/)	Af
makaengap	Polygalaceae	*Polygala* sp.	KEW H1835 93/60	SF(6/i) BL(6/ii) CG(ii) GH(3/iv) AG(3/iv)	
mapunpogol-shombay	Acanthaceae	*Rungia klossii* S. Moore	CGE 78/241b	RF(6) SF(2) CG(6) AG(2) GH(6)	Ed
mbolin-bol	Gramineae	*Axonopus affinis* Chase	KEW H1835 93/62	AG(ii) GH(ii)	
mbolin-komnol	Amaranthaceae	*Iresine herbstii* Hook. f.	KEW H1835 93/65	GH(ii)	
mbolin-momoniyl	Rosaceae	*Rubus niveus* Thunb.	CGE 78/252	GH(6)	Ed
mombiltay	Gramineae	*Panicum paludosum* Roxb.	KEW H1835 93/53,54	AG(5/iii) BL(5)	
momoniyl	Rosaceae	*Rubus rosifolius* J. M. Sm.	CGE 78/250	SF(6/ii) CG(6/i) AG(2/iv) GH(2/iii)	Ed
mondba	Araceae	*Alocasia macrorrhiza* (L.) G. Don	KEW 82/16	RF(2/ii) BL(5) CG(5)	Rt
mondkaend	Urticaceae	*Pouzolzia* sp.	CGE 78/176	GH(2/iii) SF(i) BL(i) AG(2/iv) CG(i)	Ed
mondkaend-oliy	Rubiaceae	*Hedyotis* sp.	KEW H1835 93/61	AG(iii) GH(iii)	
muwmonhuwshiy	Violaceae	*Viola arcuata* Bl.	CGE 78/178	SF(6/ii) CG(6/ii)BL(iv) GH(2/iv) AG(3/iv)	

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
ngat	Polygonaceae	*Polygonum nepalense* Meissn.	CGE 78/179	GH(3/iv) AG(3/iv) SF(iii) CG(i) BL(iii)	
no name	Gramineae	*Setaria pallide-fusca* Schumach.	CGE 78/185b	GH(5) AG(5)	
no name	Caryophyllaceae	*Drymaria cordata* (L.) R. & S.	CGE 78/163		
no name	Gramineae	*Panicum paludosum* Roxb.	CGE 78/165	BL(iv)	
no name	Gramineae	*Sacciolepis indica* (L.) Chase	CGE 78/165	CG(i)	
no name	Leguminosae	*Trifolium repens* L.	KEW H1549/87/1		Md
no name	Guttiferae	*Hypericum* sp.	KEW H1835 93/36		
no name	Scrophulariaceae	*Veronica* sp.	KEW H1835 93/37		
no name	Juncaceae	*Juncus prismatocarpus* R. Br.	KEW H1835 93/38	BL(6)	
no name	Orchidaceae	*Eria javanica* (SW.) Blume	KEW H1835 93/40		
obol	Gramineae	*Leersia hexandra* Sw.	CGE 78/180a	BL(1/v) GH(6/iii) AG(3/iv) CG(i)	Af
obol-oliy	Gramineae	*Leersia* sp.	CGE 78/180b	BL(i/iv)	
omok	Acanthaceae	*Dicliptera papuana* Warb.	CGE 78/181	SF(6) CG(6)	Ed,Rt
pibiytaeztaez	Gramineae	*Isachne arfakensis* Ohwi	CGE 78/182	GH(iii) SF(6/i) BL(2/v) AG(3/iv) CG(ii) RF(4)	
pondiyp	Orchidaceae	*Dendrobium* sp. (sect. *Grastidium*) *Spathoglottis grandiflora*	KEW H1937/83/62 KEW H1937/83/63a	RF(2/ii) SF(5/i) CG(2/ii)	Af
pondiyp	Orchidaceae	*Spathoglottis plicata* *Dendrobium prostheciglossum* Schltr.	KEW H1937/83/63b		
saemonmiyt	Boraginaceae	*Cynoglossum* sp.	KEW H1835 93/79		
senz	Gramineae	*Imperata conferta* (Presl) Ohwi	CGE 78/183	SF(5) CG(5) AG(1)	Af,Ct
shaenat	Commelinaceae	*Zebrina pendula* Schnitzl	CGE 78/184	GH(6)	Md(dogs)
showmaychit	Lindsaeaceae	*Sphenomeris chinensis* (L.) Maxon	KEW H1937/83/24	RF(6) CG(i) GH(i)	Md (pigs)
showmayleb	Iridaceae	*Montbretia laxiflora* Klatt.	CGE 74/69	GH(6)	Md (pigs)
suw-taguwt	Solanaceae	*Solanum americanum* L.	CGE 78/248	GH(3/iii) AG(5)	Ed
tangbiyp	Gramineae	*Arthraxon hispidus* var. *hispidus* (Thunb.) Makino	CGE 78/185a	AG(2/iv) GH(2/iii) CG(i) RF(i) SF(i)	
taguwt-oluwng	Cruciferae	*Cardamine* sp.	CGE 78/249	GH(6)	Ed
tombel	Piperaceae	*Piper* sp.	KEW H1937/83/12	GH(6)	
tombshombiy	Orchidaceae	*Spathoglottis parviflora* Kraenzl	KEW H1835 93/87	CG(4) AG(4)	Md
torwatorwa	Leguminosae	*Desmodium repandum* (Vahl.) DC. *Desmodium sequax* Well.	CGE 78/186a, 78/186b	RF(2/ii) SF(2/iii) CG(6/ii) AG(5/iii) GH(2) BL(5)	Ed,Af
ungwem	Equisetaceae	*Equisetum debile* Roxb.	CGE 78/187	BL(5)	Af
waelturuwk	Cyperaceae	*Scleria ciliaris* Nees	KEW H1835 93/91	GH(4/ii) AG(4/iii) BL(4) SF(i) CG(ii)	

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
waem	Compositae	*Erechtites valerianifolia* (Wolf) DC.	CGE 78/188b	GH(6/iii) SF(i) CG(i) AG(iii)	
waembuw or *duwliy* or *paluw* or *nalbaerep*	Compositae	*Crassocephalum crepidioides* (Benth.) S. Moore	CGE 78/188a	RF(6) SF(6) CG(6/ii) AG(4)	
waembuw-lol	Compositae	*Indet.*	CGE 78/188c	RF(6) SF(2) CG(2/i)	
wel-komb	Amaranthaceae	*Amaranthus sp.*	KEW H1835 93/93	GH(6/i) AG(6)	Ed
wesaembowshoba	Cyperaceae	*Cyperus distans* L. f.	KEW H1835 93/94	BL(6)	
winden	Gramineae	*Poa saruwagetica* Pilg.	KEW H1835 93/89	GH(4)	
woluwmsaeren or *saeren*	Urticaceae	*Elatostema* sp.	CGE 78/189	RF(6/iii) CG(i) BL(iii)	
		Cyphlophus sp.	KEW H1835 93/96		
CROPS *(em-bort-bway sem)*					
aspus or *kagow*	Solanaceae	*Solanum tuberosum* L.	MAN 80/As1/2	GH(6)	Ed (2cvs)
bet	Dioscoreaceae	*Dioscorea alata* L.	MAN 80/B1	GH(6)	Ed
cobaj	Cruciferae	*Brassica oleracea var. capitata* L.	MAN 80/C1/5	GH(6/iii)	Ed (5cvs)
copiy	Rubiaceae	*Coffea arabica* L.	N/A	GH(6/ii) AG(6)	
diyr or ebel	Musaceae	*Musa* hort. var.	MAN 80/E1/12	AG 4) GH(1)	Af,Md Ed (10cvs)
ᵉnyun	Alliaceae	*Allium cepa* var. aggregatum L..	MAN 80/01	GH(5/iii)	Ed
hokay	Convolvulaceae	*Ipomoea batatas* (L.) Lamk.	MAN 80/H1/68	GH(1/v) AG(5/iv) SF(6)	Ed (64 cvs)
horon	Leguminosae	*Pueraria lobata* (Willd.) Ohwi	CGE 78/238	GH(6) AG(6)	Ed (2 cvs)
huwshiy or *ol-shombay*	Malvaceae	*Hibiscus manihot* L.	MAN 80/Hw1/5	GH(5/ii) AG(6)	Ed (5cvs)
komb	Amaranthaceae	*Amaranthus tricolor* L.	CGE 78/243	GH(5)	Ed (5cvs)
kot or *pombiy*	Gramineae	*Setaria palmifolia* (Koenig) Stapf.	MAN 80/K1/10	GH(1/iv) SF(6) AG(5/ii)	Ed (9cvs)
kuwmba or *mbolin-taguwt*	Cruciferae	*Nasturtium officinale* R. Br.	MAN 80/T9	BL(6/iv)	Ed
kwa	Cruciferae	*Brassica chinensis* L.	MAN 80/Kw1/2	GH(5/ii)	Ed (2cvs)
kwaliyl	Gramineae	*Zea mays* L.	MAN 80/Ky1/2	GH(5/ii)	Af,Ed (2cvs)
laek	Cucurbitaceae	*Cucumis sativus* L.	MAN 80/L1-2	GH(6/i)	Ed (2cvs)
ma	Araceae	*Colocasia esculenta* (L.) Schott.	MAN 80/M1/44	GH(3/iv) AG(6)	Md,Ed (43cvs)
mbin	Leguminosae	*Pisum sativum* L.	MAN 80/B10	GH(6)	Ed
mbolin-ma	Araceae	*Xanthosoma sagittifolium* (L.) Schott.	MAN 80/Mm1	GH(5) AG(6)	Ed
mbolin-komb	Amaranthaceae	*Amaranthus caudatus* L.	MAN 80/Ko6	GH(6)	Ed
miyt	Solanaceae	*Nicotiana tobacum* L.	MAN 80/Tb1/6	GH(3)	Ed (6cvs), Md
muwliy	Rutaceae	Citrus spp.	N/A	GH(6) AG(6)	Ed
paluw	Amaranthaceae	*Amaranthus cruentus (A. hybridis* p.p.) (L.) Thell.	CGE 78/244	GH(3/iii)	Ed (2cvs)
piynat	Leguminosae	*Arachis hypogaea* L.	MAN 80/P1	GH(6)	Ed
pompkin	Cucurbitaceae	*Cucurbita maxima* Duch. ex Lam.	CGE 74/38	GH(2/iii) AG(6)	Ed
senem	Cucurbitaceae	*Lagenaria siceraria* (Mol.) Standl.	MAN 80/Se1/3	GH(5)	Af,Rt,Ed (3cvs)

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
shombay or *ten-shombay* or *taen*	Acanthaceae	*Rungia klossii* S. Moore	CGE 78/241a	SF(6/ii) AG(5/ii) GH(2/iii) CG(i)	Af,Md,Ed (3cvs)
shombiy	Zingiberaceae	*Zingiber officinale* Rosc.	MAN 80/Sb1/3	GH(5)	Af,Md,Ed (3cvs)
shuga	Cucurbitaceae	*Sechium edule* (Jaqu.) Swartz	MAN 80/Su1	GH(5/i) AG(6)	Ed
sokol	Leguminosae	*Lablab niger* Medik.	MAN 80/B1/4	GH(5/i) AG (6)	Ed (4cvs)
taeshaen-pebway	Leguminosae	*Phaseolus vulgaris* L.	MAN 80/B5/9	GH(5/iii)	Ed (4cvs)
taguwt	Cruciferae	*Nasturtioum schlechteri* O.E. Schulz.	CGE 78/240	GH(5)	Ed (6cvs)
tat or *puliyba*	Cucurbitaceae	*Trichosanthes pulleana* Cogn. ex Harms.	CGE 78/245	GH(6) AG(6)	Ed
taziy	Umbelliferae	*Oenanthe javanica* D. C.	CGE 78/242a	RF(6) SF(6/iii) CG(ii) AG(5/iv) GH(4/iv) BL(v)	Af,Rt,Ed (2cvs)
tomasow	Solanaceae	*Lycopersicon esculentum* Mill.	CGE 74/35	GH(6/ii)	Ed
wol	Gramineae	*Saccharum officinarum L.*	MAN 80/W1/12	GH(1/iii) AG (6/ii)	Ed (12cvs)
wolapat	Leguminosae	*Psophocarpus tetragonolobus* (L.) D. C.	MAN 80/B8	GH(6)	Ed
ya iyl	Passifloraceae	*Passiflora edulis* var. *edulis* Sims	MAN 80/Y1	GH(5) AG(6) SF(i)	Ed
MOSSES, LIVERWORTS, LICHENS AND ALGAE *(kwimb sem)*					
g^e^mbwaez	Lichens	*Several symbionts*	KEW H1835 93/26a,26b	RF(2) SF(2) DW(2)	
homb	Sphagnaceae	*Sphagnum novo-guineense* Fleish. & Warnst.	KEW H1937/83/28, MAN 83/31	RF(5) CG(3)	Af,Ct
kwimbhaez	Frullaniaceae	*Frullania orientalis* Sande Lac *F. reflexistipula* Sande Lac *Spruceanthus pluriplicatus* (Steph.) Gradst. *Meteorium miquelianum* (C. Muell) Fleisch *Aerobryopsis longissima* (Doz. et Molk.) Fleisch	MAN 83/32 KEW H1937/83/30 CGE 78/234	RF(1)	Af,Rt
kwimbkal	Lepidoziaceae	*Lepidozia cladorhiza* (Reinw. et al.) Nees *Bazzania adnexa* (L &L.) Trevis	MAN 82/9, UPNG 83/5	RF(5) CG(1)	Af,Rt
iybwaeraek	Chlorophyceae	*Several spp.*	N/A	Watercourses	
shononpep	Frullaniaceae	*Meteorium miguelianum* (C. Muell) Fleisch *Frullania sp.*	CGE 78/235	RF(5)	Af,Rt
waekpep or *kwimbpep*	Frullaniaceae	*Dicrancloma* cf. *blumei* (C. Muell) Par.	CGE 78/236	RF(4)	Af,Rt

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
FUNGI *(sez sem)*					
aelgit or *gilprat*	Pleurotaceae	*Lentinus araucariae* Har. & Pat.	KEW H1835 93/101	DW RF(6) CG(6)	Ed
aelow	Russulaceae	*Russula eburneoareolata* Hongo	KEW H1835 93/102	SL RF(4) CG(4)	Ed
bordorwiy	Cortinariaceae	*Pholiota austrospumosa* Hongo	KEW H1835 93/104	SL CG(6)	Ed
bortngaelngael	Polyporaceae	*Pycnoporus coccineus Pycnoporus sanguineus* (Linn.:Fr.) Murr.	FNG 78/12 KEW H1835 93/103	DW RF(6) SF(6) CG(6)	Af
dimbul	Boletaceae	*Strobilomyces velutipes* Cooke & Massee	KEW H1835 93/105	SL RF(6) CG(6)	Ed
elkondiyt	Russulaceae	*Russula* sp.	KEW H1835 93/106	SL CG(6)	Ed
g^emb	Boletaceae	*Boletus* sp.?	FNG 78/16	SL CG(6) RF(6)	Ed
goizmayja	Cortinariaceae	*Inocybe* sp.	KEW H1835 93/108	SL CG(6) RF(6)	Ed
hael	Polyporaceae	*Grifola frondosa* (Dicks.:Fr.) Gray	KEW H1835 93/116	DW RF(6) SF(6) AG(6) GH(6)	Ed
haeriypaend	Russulaceae	*Pholiota* sp.	KEW H1835 93/117	SL CG(6)	Ed
haesort	Russulaceae	*Russula* sp.	KEW H1835 93/112	SL CG(6)	Ed
hasez or *korshasez*	Polyporaceae	*Microporus xanthopus* (Fr.) Pat.	KEW H1835 93/120a	SL DW RF(3) CG(3) SF(2) AG(3)	
	Tricholomataceae	*Armillaria sp.*	KEW H1835 93/120b		
	Polyporaceae	*Coriolus versicolor* (Linn.:Fr.) Quél.	KEW H1835 93/120c		
	Cortinariaceae	*Gymnopilus novoguineensis* Hongo	KEW H1835 93/120e		
	Hymenochataceae	*Phellinus senex* (Nees & Mont.) Imaz.	KEW H1835 93/120f		
hert or *dingit*	Russulaceae	*Russula* sp.	KEW H1835 93/110	DW RF(1) SF(3) CG(3) AG(5) GH(6)	Ed
hertoliy	Cortinariaceae	*Phaeomarasmius affinis* Horak	FNG 83/87	DW RF(1) SF(3) CG(3) AG(5) GH(6)	Ed
hogben or *naypung*	Russulaceae	*Lentinula lateritia* (Berk.) Pegler	KEW H1835 93/111	DW CG(5) RF(5) SF(5)	Ed

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
hulba	Boletaceae	*Boletus erythropus* var. *novoguineensis* (Fr.) Alessio	FNG83/83	SL CG(2)	Ed
huwlhaeruwk	Boletaceae	*Boletus* sp.	KEW H1835 93/115	SL RF(6) CG(3)	Ed
huwpsez	Bondarzewiaceae	*Bondarzewia berkeleyi* (Fr.) Bond & Singer	FNG 78/17	DW CG(6)	Ed
hyuw	Russulaceae	*Russula* sp.	KEW H1835 93/114	SL RF(4) CG(4)	
iybashor or *iybonduwliy*	Polyporaceae	*Polyporus tenuiculus* Beauv.: Fr.	KEW H1835 93/119	DW RF(6)	Ed
iykolsez	Paxillaceae	*Phylloporus bellus* (Massee) Corner	KEW H1835 93/118	SL RF(5)	
kaeriyl-paengon	Russulaceae	*Russula* sp.	KEW H1835 93/122	SL	Ed
kaeriylpak	Russulaceae	*Russula* sp.	KEW H1835 93/121	SL RF(6) CG(3)	Ed
keriyteliybaem	Russulaceae	*Lactarius* sp.	KEW H1835 93/127	SL SF(6) CG(6)	
kiliykombuw	Cortinariaceae	*Cortinarius* sp.	KEW H1835 93/126	SL RF(3) CG(3)	Ed
kolbamoinj			KEW H1835 93/124	SL RF(6) CG(6)	Ed
koltaysez	Boletaceae	*Boletus nigroviolaeus* Heim	KEW H1835 93/125	SL RF(6) CG(6)	Ed
kombolhael	Auriculariaceae	*Auricularia polytricha* (Mont.) Fr.	KEW H1835 93/123	DW RF(2) SF(5) CG(6)	
lomat	Lycoperdaceae	*Calvatia gigantea* (Batsch: Pers) Lloyd.	FNG 78/2	DW RF(6)	Rt,Af
mahobor	Boletaceae	*Boletus* sp.	KEW H1835 93/133	SL CG(6)	Ed
mondsem or *mondshoba*	Polyporaceae	*Microporus affinis* (Bl. & Nees ex Fr.) Kunze	KEW H1835 93/132	SL RF(5) CG(5)	Ed
mongowshuwt	Polyporaceae	*Polyporus arcularius* Batsch:Fr.	KEW H1835 93/130	DW RF(2) SF(5) CG(6)	Ed
muwnaen-aegael	Polyporaceae	*Grifola frondosa* (Dicks.: Fr.) Gray	KEW H1835 93/131	DW RF(1)	Ed
muwnaen-haezort	Polyporaceae	*Grifola frondosa* (Dicks.: Fr.) Gray	KEW H1835 93/134	DW RF(1)	Ed

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
muwnaen-mugumb	Polyporaceae	*Grifola frondosa* (Dicks.: Fr.) Gray	KEW H1835 93/135	DW RF(1)	Ed
muwnaen-sebhibiy	Polyporaceae	*Grifola frondosa* (Dicks.: Fr.) Gray	KEW H1835 93/129	DW RF(1)	Ed
naen	Pleurotaceae	*Pleurotus djamor* (Fr.) Boedijn	KEW H1835 93/138	DW RF(3) SF(6) CG(6) GH(6) AG(6)	Ed
ndaruwk		*Indet.*	KEW H1835 93/140	SL	Ed
ndol		*Indet.*		SL RF(6) CG(6)	Ed
nokhobor or *showmayiymiy*	Tricholomataceae	*Oudemansiella canarii* (Jungh.) Hohn.	KEW H1835 93/139 & 150	DW RF(6) SF(6) CG(6) AG(6) GH(6)	Ed
nonknaisiy	Boletaceae	*Boletus* sp.	KEW H1835 93/136	SL CG(6)	
nuwpiriysez	Ticholomataceae	*Collybia* sp.	KEW H1835 93/137	SL RF(6)	
olhultomb	Russulaceae	*Russula eburneoareolata* Hongo	KEW H1835 93/141	SL RF(6) CG(6)	
paengaliy	Cantharellaceae	*Cantharellus* sp.?	FNG 78/9	SL RF(6)	Ed
pay-paengon	Russulaceae	*Russula* sp.	KEW H1835 93/145	SL RF(5) CG(5)	Ed
paiyow	Russulaceae	*Russula pseudoamaendum* Heim	KEW H1835 93/142	SL RF(6) CG(6)	Ed
pak or *hondpak*	Russulaceae	*Russula* sp.	KEW H1835 93/146	SL RF(6) CG(6)	Ed
pel-paengon	Russulaceae	*Russula amaendum Heim*	FNG 83/86	SL RF(5)	Ed
piyt	Boletaceae	*Boletus* sp.	KEW H1835 93/143	SL CG(5)	Ed
shiyortombor	Tricholomataceae Pleurotaceae	*Laccaria amethystea* *Lentinus umbrinus* Reich.	FNG 78/5 KEW H1835 93/149	DW RF(6) GH(6) AG(6)	Ed
showmaybogaysez	Boletaceae	*Boletus* sp.	KEW H1835 93/147	SL RF(5) CG(5)	
showmayhend	Boletaceae	*Boletus nigroviolaceus* Heim	KEW H1835 93/151	SL RF(5) CG(5)	Ed
shumbuwhon		*Indet.*	KEW H1835 93/152	SL CG(6)	Ed
shwimbiya or *nabtaysez*	Tricholomataceae	*Trogia* sp.	KEW H1835 93/148	SL CG(6) GH(6)	Ed

Wola name	Family	Genus & Species	Coll. No.	Habitat	Notes
tenhungiynhael		*Indet.*	KEW H1835 93/154	SL	
waenhael	Polyporaceae	*Polyporus blanchettianus* Berk. & Mont.	FNG 83/89	DW RF(6) SF(6) CG(6)	Ed
walow	Russulaceae	*Russula* sp.	FNG 83/88	SL RF(6) CG(6)	
wolmaip or *wolpay*	Boletaceae	*Boletus* sp.	KEW H1835 93/156	SL RF(6) CG(6)	Ed
womgita	Gomphaceae	*Ramaria* sp.	KEW H1835 93/157	SL CG(4)	Ed
yaelgiy	Gomphaceae	*Ramaria fistulosa* Corner	KEW H1835 93/158	SL RF(3) CG(3)	

BOOK REVIEW

Domestication of Plants in the Old World, 2nd edition. Daniel Zohary and Maria Hopf. Oxford: Clarendon Press, 1993. £35.00 (ca. US $63.00) (hardcover). Pp. x; 278. ISBN 0-19-854795-1.

This second edition substantially updates Zohary and Hopf's excellent review of domesticated plants in the Old World. Readers familiar with the earlier edition will be pleased to find archaeological and archaeobotanical citations substantially updated. As with the previous edition, the text covers plants domesticated and cultivated in the Near East, parts of Central Asia, the northern portion of the Indian subcontinent, and Europe. The book is nearly comprehensive for the early Near East and Europe: outside these regions the authors have included fewer sites. As with the first edition, Africa, East and Southeast Asia are not covered.

This book is most useful as a reference tool, and there are few sources in print that provide as much information for so reasonable a price. Entries for each species include a brief review of habitat, dispersal mechanisms, propagation, uses, wild ancestry, genetic affinities, and available archaeological evidence for early domestication. Intensive research focus on a few plants has generated far more information on several of the cereals and pulses than on what have always been viewed as lesser crops—flax, rye, and tubers, for example. The authors provide a useful review of the sources of evidence for plant cultivation in a first chapter. A brief concluding essay summarizes the domestication of crops in the Near East and their spread to European sites with subsequent horticultural and other plant cultivation.

This is an excellent book, suitable for libraries, reference shelves, and anyone who teaches or writes about plant domestication. The second edition includes much recently recovered archaeological material, such as the charred plant remains from Netiv Hagdud and Ohalo II (Jordan Valley and Galilee). Coverage of other parts of the Near East are slightly less current: the possibility that much of the Tell Mureybet "wild einkorn wheat" may be wild rye and the early recovery of safflower at Selenlkahiye are not included (both in Syria). While it would be almost impossible to keep a book like this fully current, it marks the first reference for anyone studying domesticated plants in the Near East and Europe.

Joy McCorriston
Department of Anthropology
University of Minnesota
mccor015@gold.tc.umn.edu

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THE TAPHONOMY OF GOLDEN EAGLE PREY ACCUMULATIONS AT GREAT BASIN ROOSTS

DAVE N. SCHMITT
Antiquities Section
Division of State History
300 Rio Grande
Salt Lake City, Utah 84101

ABSTRACT.—Surface collections and limited excavations at Cathedral Roost in northern Utah retrieved hundreds of leporid bones accumulated by golden eagles (*Aquila chrysaetos*). These bones provide data for identifying golden eagle prey accumulations in archaeological and paleontological contexts. Jackrabbit (*Lepus* spp.) bones dominate the assemblage and are represented predominantly by posterior body parts, especially tibiae and hind feet. Evidence of bone attrition inflicted by eagle feeding is rare and indicates that skeletal damage alone will seldom prove useful in identifying prey remains accumulated at nest sites. However, the data suggest that combined consideration of taxonomic presences, skeletal element completeness, and body part representation can be used to distinguish eagle-produced bone accumulations associated with nests and perches. Comparison of the Cathedral Roost prey assemblage with leporid remains collected recently from a golden eagle roost in western Nevada reveals marked similarities in taxonomic and skeletal composition. Leporid skeletal frequencies and completeness in golden eagle nest accumulations will often be different than those produced by other Great Basin predators, including humans.

RESUMEN.—Las colectas de superficie y excavaciones limitadas en Cathedral Roost en el norte del estado de Utah, en los Estados Unidos de Norteamérica, produjeron cientos de huesos de lepóridos acumulados por águilas doradas (*Aquila chrysaetos*). Estos huesos proporcionan datos para identificar las acumulaciones de presas de águilas doradas en contextos arqueológicos y paleontológicos. Los huesos de liebre (*Lepus* spp.) dominan el conjunto y están representados predominantemente por las partes traseras del cuerpo, especialmente tibias y pies traseros. Es rara la evidencia de desgaste de los huesos ocasionado por las águilas al alimentarse, lo cual indica que el daño esquelético por sí solo pocas veces será útil para identificar restos de presas acumulados en sitios de anidamiento. Sin embargo, los datos sugieren que una consideración combinada de presencias taxonómicas, integridad de elementos esqueléticos, y representación de partes del cuerpo puede ser usada para distinguir acumulaciònes de huesos producidos por águilas, asociadas con nidos y perchas. La comparación del conjunto de restos de presas de Cathedral roost con restos de lepóridos recolectados recientemente en un lugar de anidamiento de águilas doradas en el occidente del estado de Nevada revela semejanzas marcadas en la composición taxonómica y esquelética. La frecuencia e integridad de los esqueletos de lepóridos en las acumulaciónes asociadas con nidos de águilas doradas frecuentemente serán diferentes de aquéllas producidas por otros depredadores, incluyendo los humanos, en la zona de la Gran Cuenca del occidente de los Estados Unidos.

RÉSUMÉ.—Des collections de surface et des excavations limitées menées à Cathedral Roost dans le nord de l'Utah ont permis de découvrir des centaines d'ossements de léporidés accumulés par des aigles royaux (*Aquila chrysaetos*). Ces ossements fournissent des données pour identifier les accumulations de proies de l'aigle royal dans des contextes archéologiques et paléontologiques. Les ossements du gros lièvre américain (*Lepus* spp.) dominent l'assemblage et ils sont représentés principalement par les parties postérieures du corps, surtout les tibias et les pattes arrière. Il y a peu d'évidence d'attrition des os occasionnée par l'alimentation des aigles et les dommages squelettiques à eux seuls ne pourront donc que rarement servir à l'identification des restes de proie accumulés sur les sites des nids. Cependant, les données suggèrent que les présences taxinomiques, l'état complet ou non du squelette et la représentation des parties corporelles peuvent, considérés dans leur ensemble, servir à distinguer les accumulations des ossements produites par les aigles associées aux nids et aux perchoirs. La comparaison de l'assemblage de proies du site de Cathedral Roost avec des restes de léporidés d'un perchoir d'aigle royal dans l'ouest du Nevada révèle des similarités marquées en ce qui concerne les compositions squelettique et taxinomique. Les fréquences et l'état des squelettes de léporidés montreront souvent une différence suivant qu'ils proviennent des accumulations des nids d'aigles royaux ou des restes produits par d'autres prédateurs du Grand Bassin, y compris l'être humain.

INTRODUCTION

Jackrabbits (*Lepus* spp.) and cottontails (*Sylvilagus* spp.) are familiar inhabitants of a variety of Great Basin environmental contexts (Durrant 1952; Hall 1946, 1981). Due to their abundance, body size, and behavior, they constitute an integral portion of the diet of most local avian and terrestrial predators. Similarly, prehistoric and ethnographically known peoples in the region commonly exploited hares and cottontails for a variety of resources. A number of Great Basin ethnographic accounts describe hunting and carcass processing techniques (Fowler 1989; Steward 1938, 1941; Stewart 1942), and regional archaeofaunas commonly contain abundant leporid remains, as well as clothing, tools, and adornment manufactured from leporid fur and bone (Aikens 1970; Dansie 1987; Grayson 1988, 1990; Hockett 1993, 1994; Marwitt 1968; Schmitt 1990; Schmitt and Lupo 1995; Thomas 1983). The recovery of leporid bone tools offers definitive evidence of human modification. However, the identification of bone refuse generated by human subsistence activities is an arduous task because the bones of leporids and similarly-sized taxa usually lack the cut marks and flake scars often found on the remains of larger mammals (Gifford 1981; Lyman 1982, 1994a). Many of the leporid bones recovered from Great Basin sites probably represent human subsistence refuse, but raptorial birds and carnivorous mammals are capable of introducing leporid and other small animal remains into both open and sheltered archaeological deposits (Andrews 1990; Fernandez-Jalvo and Andrews 1992; Hockett 1989, 1991; Klippel *et al.* 1987; Schmitt and Juell 1994; Stiner 1994). Thus, the mechanisms responsible for the accumula-tion of hare and rabbit bones often are ambiguous, regardless of the depositional context.

In this paper I present data on leporid bones accumulated by golden eagles

(*Aquila chrysaetos*) at a nest site in northern Utah. Body part frequencies and evidence of skeletal attrition are described. These data may facilitate investigations directed toward identifying raptor prey assemblages in paleontological sites (Andrews 1990, Hoffman 1988, Kusmer 1990, Mayhew 1977) and distinguishing human and non-human leporid accumulations in archaeological contexts (Hockett 1989, 1991, 1993; Schmitt and Juell 1994; Szuter 1991). I briefly discuss golden eagle behavior and food habits in western North America. The study site (Cathedral Roost) and field and laboratory methods are described, followed by quantitative data and qualitative observations on the recovered bone assemblage. The Cathedral Roost assemblage is compared with leporid remains from a golden eagle roost in western Nevada to investigate potential variability in prey composition and body part representation. Golden eagle prey accumulations are then compared with leporid assemblages produced by other Great Basin raptors and terrestrial predators, including humans.

GOLDEN EAGLE ECOLOGY AND FOOD HABITS

Golden eagles are currently widespread in North America, Eurasia, and parts of northern Africa. In western North America they winter and breed in a variety of habitats extending from the southern Alaska coast to the highlands of northern Mexico (Johnsgard 1990, Ryser 1985, Snyder and Snyder 1991). Golden eagles are common residents of Great Basin mountains and foothills, often utilizing intermontane valleys for hunting (Edwards 1969, Ryser 1985, Smith 1971). Most golden eagle nests in the Great Basin are situated atop elevated ledges along cliffs or canyon walls (Smith 1971, Smith and Murphy 1982) where they roost singly or as mated pairs. Paired eagles often have several different nesting sites situated fairly close together and, "from year to year the birds may alternate sites, although one may be favored over the others" (Ryser 1985:240). Trees also may support nests (Cameron 1908, Hayward *et al.* 1976, Ryser 1985), but trees and similarly elevated natural and artificial structures more often serve as habitual perching sites used for resting, feeding, and/or evaluating hunting opportunities (Edwards 1969, Marion and Ryder 1977, Workman and Peterson 1989; see also Sugden 1928). Regardless of location, nest site selection appears to depend upon a number of factors, including inaccessibility (i.e., brood protection) and view of favorable foraging habitats (Smith and Murphy 1982).

Golden eagles are formidable diurnal raptors with wingspreads approaching 2.5 m (8 ft) and weights up to 4.8 kg (13 lbs) (Snyder and Snyder 1991:164). In a stoop these swift predators may reach speeds in excess of 300 km per hour (Ryser 1985). Small and medium-sized mammals constitute their principal prey, but golden eagles occasionally pursue other birds, fish, and reptiles, and scavenge carrion from medium and large mammal carcasses (Johnsgard 1990, Ryser 1985, Snyder and Snyder 1991). Records also exist for solitary and tandem attacks on larger mammalian taxa, including deer (*Odocoileus* spp.), pronghorn (*Antilocapra americana*), red fox (*Vulpes vulpes*), and coyote (*Canis latrans*) (Ford and Alcorn 1964, Johnsgard 1990, Lehti 1947).

Leporids (especially hares [*Lepus* spp.]) are the primary prey of golden eagles in the Great Basin and many other parts of North America (Edwards 1969, Mac-

Laren *et al.* 1988, McGahan 1968, Ryser 1985, Smith and Murphy 1979, Workman and Peterson 1989). Hunting techniques involve walking through low brush or, more commonly, observing prey movement from a perch and executing a series of low flights over vegetative cover to flush potential quarry. Golden eagle pairs occasionally hunt leporids cooperatively, with one driving the game from cover into the talons of the other (Ryser 1985:243). Once carcasses are obtained, the intestines are removed and discarded and the remaining soft organs are rapidly consumed. Flesh is then stripped and consumed along with a few bones that are eventually cast in pellets (Edwards 1969, Hockett n.d.). Golden eagles may consume most of their prey at the kill site, but they commonly transport whole carcasses or selected body parts to nests or favored perch sites for leisurely consumption. Variability in carcass/body part transport appears to be contingent upon the location of the kill site, competition with other predators, and whether or not a brood of chicks await food at the nest. Thus, golden eagles may produce scattered bone assemblages at open kill sites and/or bone concentrations below perches and nest sites (see also Hockett 1989). The presence of intact marrow cavities and adhering tissue in these bone concentrations attract other predators and scavengers (Edwards 1969: 101–102; see below). Consequently, bone assemblages originally produced by eagles are often rapidly affected by other taphonomic agents.

PROJECT SETTING AND METHODS

Investigations at Cathedral Roost were instigated as part of an interdisciplinary project focusing on paleoenvironmental change in the Bonneville Basin. The purpose of this project is to use data on non-human floral and faunal remains from regional packrat (*Neotoma* spp.) middens and dry caves in reconstructing environmental change over the past 15,000 years, and to investigate the processes behind those changes (Madsen 1994). In Homestead Cave on Homestead Knoll in the Lakeside Mountains of western Utah, excavation of a stratified 1 x 1 m column retrieved tens-of-thousands of small animal remains deposited primarily by avian predators. To investigate mechanisms responsible for fossil accumulations at the cave, bone assemblages produced by local predators were collected for comparison, including the golden eagle prey remains deposited at Cathedral Roost.

Cathedral Roost is situated on a steep, craggy limestone cliff on the northern tip of Homestead Knoll (Figure 1) approximately 1 km northwest of Homestead Cave. The site consists of two large nests located on narrow ledges approximately 10 m apart and 8 m from the ground surface at an elevation of 1,360 m. The nests afford a panoramic view of the Great Salt Lake and associated alkali flats to the north and northwest, and of vegetated hills and lowlands to the northeast. Modern vegetation in the region is a treeless desert scrub community dominated by greasewood (*Sarcobatus vermiculatus*), big sagebrush (*Artemisia tridentata*), shadscale (*Atriplex confertifolia*), and a variety of native and introduced grasses. Given site context and golden eagle home ranges in similar habitats (Smith 1971), the Cathedral Roost eagles probably procured most of their prey from vegetated valleys and ridges south and east of the roost (Figure 1). Golden eagles were observed at the roost and vicinity in 1992 and 1993, but none were observed while conducting field collections in July of 1994.

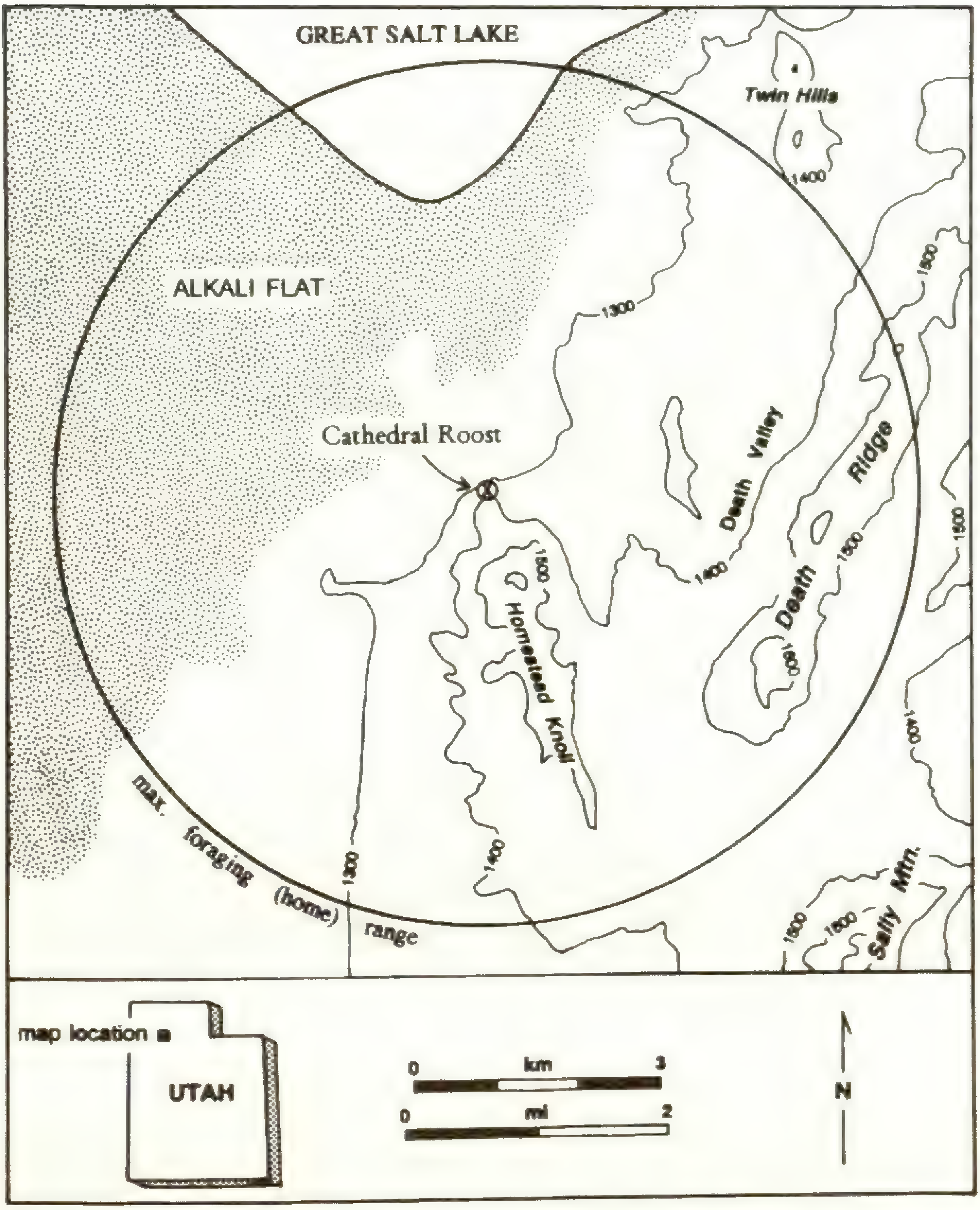

FIG. 1.—Location of Cathedral Roost in northwestern Utah. Golden eagle maximum home range is adopted from Smith (1971).

Abundant leporid bones littered approximately 5 x 20 m of the ground surface below the nests. Field investigations involved collection of all bones from the surface and shallow (5–10 cm) excavations of a ca. 1 x 2 m area below the westernmost nest. Excavated sediments were passed through 3.2 mm (1/8 in) mesh to extract a sample of small bones and bone fragments from the substrate. The majority of the bones were retrieved from surface collections; excavations yielded only a few identifiable leporid bones, five bird bones, and approximately 20 leporid-sized limb bone shaft fragments. Recovered bones were transported to the laboratory and sorted by taxon and skeletal element. No attempt was made to identify leporid species, but site context and reported modern taxonomic distributions in the region (Durrant 1952, Hall 1981) indicate that the specimens probably represent the black-tailed jackrabbit (*Lepus californicus*) and Nuttall's cottontail (*Sylvilagus nuttallii*) and/or the desert cottontail (*S. audubonii*). Average body weights for adult *L. californicus* and *S. nuttallii* are approximately 1.40 kg and 0.78 kg, respectively.

Bones were tallied by the number of identified specimens (NISP; Grayson 1984) per taxon, and minimum number of element (MNE) counts were derived by calculating the "minimum number of elements necessary to account for an assemblage of specimens of a particular skeletal element" (Lyman 1994b:289). Individual bones in articulated body segments were counted as single specimens. MNE values were derived with the intent of assessing the frequencies of skeletal element/body segment accumulations at the roost, and to appraise the extent of bone fragmentation by examining NISP to MNE ratios (see Lyman 1994b, 1994c). Based largely on the presence-absence of epiphyseal fusion, MNE calculations take into account the ontogenetic age of identified hare and cottontail specimens. Regardless of quantitative technique, *Lepus* remains dominate the assemblage, followed by *Sylvilagus* bones. Scant remains of a few additional taxa also were recovered, including three ground squirrel (*Spermophilus* spp.) bones, five articulated reptile (Squamata) vertebrae, and 14 bird bones representing at least two species.

LEPORID BODY PART FREQUENCIES AND SKELETAL ATTRITION

Surface collection and excavation retrieved 909 identified leporid specimens, with jackrabbits comprising the majority of the assemblage (Table 1). Most of the specimens are from adults, but a few subadult (i.e., unfused) jackrabbit and cottontail bones were collected. The most salient aspect of the assemblage is the high frequency of *Lepus* posterior body parts, indicating that these relatively meaty portions were preferentially transported to the roost. In the assemblage of paired elements, tibiae are most abundant followed by femora and calcanei. Astragali are relatively common, but given their small size I suspect that some additional specimens (as well as a few calcanei) passed undetected during surface collections. Innominates also are abundant, suggesting that hind quarters may often have been transported to the roost in articulated segments (Hockett 1993, Schmitt 1994). Scapulae appear to have been brought to the roost on rare occasions, as were front limbs and skulls.

While the majority of the leporid remains are incomplete (Table 2), much of the fragmentation resulted from post-depositional weathering. Most specimens are bleached and exhibit bone loss in the form of exfoliation, and many limb bones display longitudinal breakage as a result of split-line cracking (Behrensmeyer 1978, Tappen 1969; see also Hockett 1989). In several cases fragments of splintered limb bones were discovered *in situ* as conjoining pieces of the same weathered bone, and therefore were tallied as complete specimens. Although breakage largely consists of split-line cracking, a few specimens possess jagged, transverse breaks that probably were produced by eagles. Given the frequency and extent of the former,

TABLE 1.—Jackrabbit and cottontail remains collected from Cathedral Roost, Utah.

Element	*Lepus* NISP	*Lepus* NISP Unfused	*Lepus* MNE	*Sylvilagus* NISP	*Sylvilagus* NISP Unfused	*Sylvilagus* MNE	Total MNE
Cranium	12	0	5	2	0	1	6
Mandible	11	0	11	5	0	4	15
Scapula	5	0	4	2	0	2	6
Humerus	22	3	17	2	0	2	19
Radius	17	1	13	1	1	1	14
Ulna	11	0	11	0	0	0	11
Vertebra*	88	18	–	8	2	–	–
Rib	11	0	–	0	0	–	–
Innominate	39	7	36	4	0	4	40
Sacrum	15	4	15	1	0	1	16
Femur	62	16	47	3	1	3	50
Patella	7	0	7	1	0	1	8
Tibia	98	22	71	8	5	7	78
Astragalus	26	0	26	1	0	1	27
Calcaneus	48	0	48	2	0	2	50
Carpal/Tars.	39	0	–	3	0	–	–
Metapodial	183	27	–	11	1	–	–
Phalange	158	17	–	3	1	–	–
Totals	852	115	311	57	11	29	340

*Most (70%) are lumbar vertebrae.

the proportions of complete bones have been reduced. Golden eagles customarily discard complete bones, often in articulated body segments (Hockett 1993; see below), and I suspect that some of the interdependence of skeletal parts reflects post-depositional weathering. As a result, even though the calculated limb bone ratios are relatively low (Table 2), many of the NISP:MNE values have been inflated and all should be appraised as maximum ratios.

The leporid bones also exhibit damage resulting from rodent gnawing, predator digestion, and possible carnivore scavenging. Partially digested bone could have been deposited in pellets cast by golden eagles and/or carnivore scats; no intact pellets were discovered below the roost, but a single partially disaggregated coyote scat was observed. Most of the digestive corrosion is pronounced, often resulting in substantial bone disintegration similar to bones passed by mammalian carnivores. A number of taphonomic studies note that terrestrial carnivore digestion usually mars bone more extensively than raptor digestion given the high acidic constitution of gastric juices and because digestion takes place in both the stomach and intestines of mammalian predators (Andrews and Evans 1983, Rensberger and Krentz 1988). However, a number of factors are capable of causing inter-predator overlap in the extent of digestive corrosion (notably variability in the duration of digestion; Rensberger and Krentz 1988) and recent research has found that eagle digestion also corrodes bone extensively (Hockett n.d.). Thus, many of the Cathedral

TABLE 2.—Number and proportion of whole bones and NISP:MNE ratios of leporid remains from Cathedral Roost.

Element	*Lepus* NISP Whole	*Lepus* % NISP Whole	*Lepus* NISP:MNE[a]	*Sylvilagus* NISP Whole	*Sylvilagus* % NISP Whole	*Sylvilagus* NISP:MNE[a]	Total NISP:MNE[a]
Cranium	0	0	2.40	0	0	2.00	2.33
Mandible	0	0	1.00	0	0	1.25	1.07
Scapula	0	0	1.25	0	0	1.00	1.17
Humerus	7	31.8	1.50	0	0	1.00	1.42
Radius	7	41.2	1.67	1	100.0	1.00	1.55
Ulna	3	27.3	1.00	–	–	–	1.00
Innominate	4	10.3	1.09	1	25.0	1.00	1.09
Sacrum	3	20.0	1.00	1	100.0	1.00	1.00
Femur	21	33.9	1.58	1	33.3	1.00	1.54
Tibia	24	24.5	1.57	4	50.0	1.33	1.56
Astragalus	26	100.0	1.00	1	100.0	1.00	1.00
Calcaneus	44	91.7	1.00	1	50.0	1.00	1.00
Totals	139	38.0	–	10	32.3	–	–

[a]NISP and MNE values are presented in Table 1. Ratios calculated as: NISP - N whole/ MNE - N whole (after Lyman 1994b:296).

Roost pitted and polished leporid remains are identified simply as partially digested bone. I acknowledge the effects of these and other taphonomic processes by employing discretion in attributing leporid bone attrition solely to eagle feeding.

Bone damage: Leporid crania and mandibles.—Most of the skull portions (NISP = 9) are maxillae with intact alveoli containing molars. The elements are usually separated at sutures and exhibit no punctures or breakage indicative of golden eagle feeding. Ten mandibles are represented by intact anterior portions with broken ascending rami. Figure 2 shows examples of this damage on a sample of Cathedral Roost specimens and *Lepus* mandibles recovered from a golden eagle nest in central Nevada. This damage appears to be a common consequence of raptor feeding (see also Hockett 1989) and probably is produced while stripping the masseter muscle and/or breaching the occipital region to extract the brain. However, the ascending ramus is a thin, low density portion of the mandible (Lyman 1984, Lyman *et al.* 1992), thus similar breakage may be produced by any number of taphonomic processes. Other mandibular fragments from the roost include two intact coronoid processes retaining small portions of the ascending rami, and one masseteric fossa with a portion of the angle. Two additional specimens are horizontal ramus fragments where extensive digestive corrosion has exposed root apices along the ventral borders. These specimens may represent bones cast in eagle pellets, but the location and extent of digestive corrosion is comparable to damage on coyote scatological bone (Schmitt and Juell 1994:253).

Bone damage: Leporid front limbs and scapulae.—Humeri from the roost exhibit damage generated by split-line weathering, partial digestion, and golden eagle feeding.

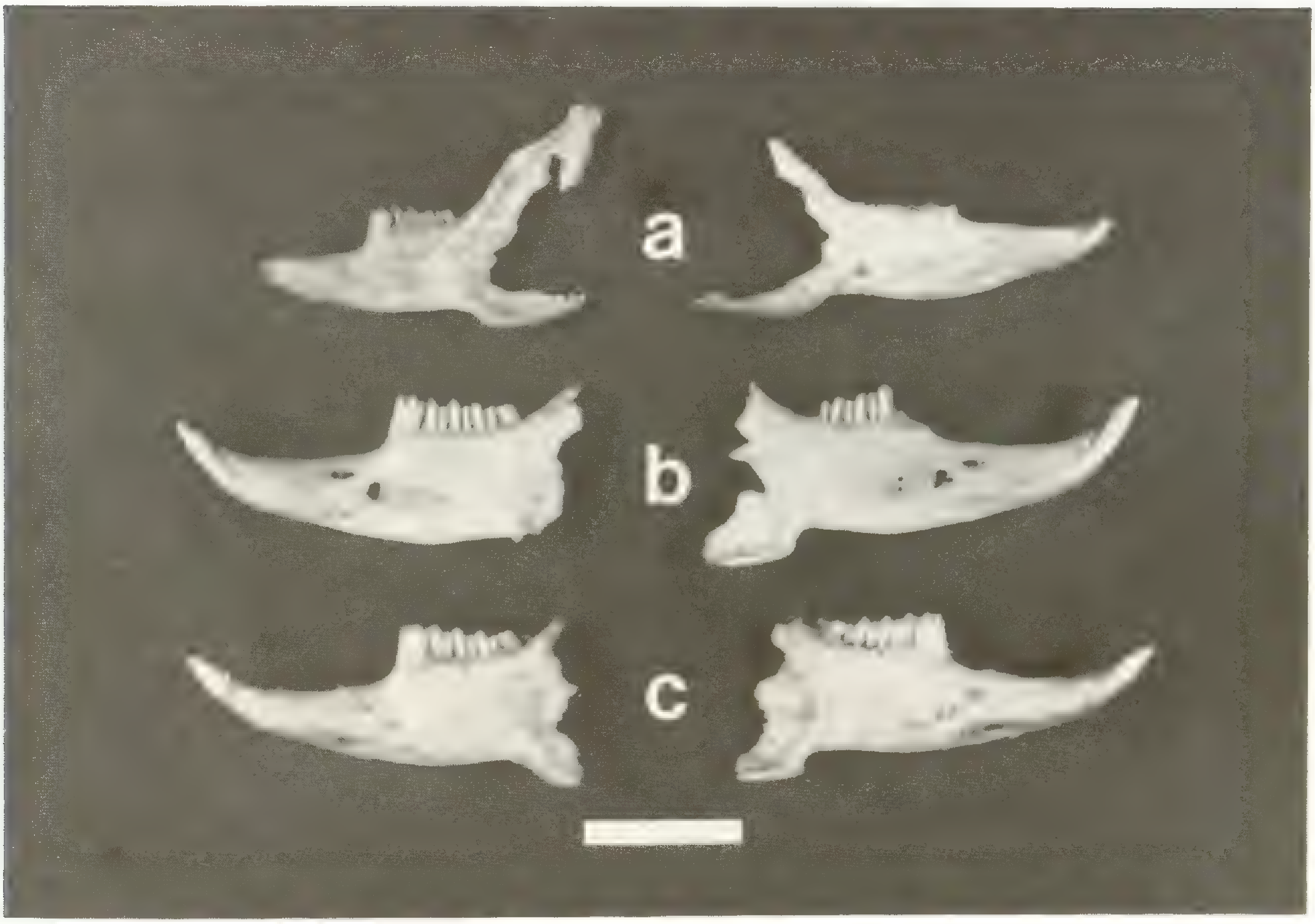

FIG. 2.—Lateral (buccal) view of leporid mandibles showing examples of ascending ramus damage produced by golden eagles. *Sylvilagus* sp., Cathedral Roost (a); *Lepus* sp., Cathedral Roost (b); *Lepus* sp., Railroad Valley, central Nevada (c). Bar scale is 2 cm in length.

Two cottontail proximal humerus fragments possess crushed shafts and localized rounding of fracture surfaces indicative of predator digestion. One jackrabbit proximal humerus possesses a small (2.6 mm diameter) aperture between the medial and lateral tuberosities, and a second (2.2 mm diameter) perforation on the opposing anterio-medial surface just below the head. Damage location and morphology suggest that they were created by an eagle beak or talons (see also Hockett 1989, Livingston 1988:196–200). Five additional *Lepus* humeri are represented by distal ends retaining a few millimeters of shaft. These are relatively uniform in size (range = 17.0–22.7 mm; mean = 21.1 mm) and each displays transverse fractures that probably were produced by golden eagles; breakage morphology does not suggest the consequences of weathering. Barring longitudinal weathering fractures, the remaining humeri are complete and undamaged.

The modest assemblage of radii and ulnae largely contains whole, undamaged elements or nearly complete bones affected only by split-line exfoliation. One *Lepus* proximal ulna exhibits polish and pitting of the posterior margin of the olecranon process, traits common to scatological bone passed by Great Basin coyotes (Schmitt and Juell 1994:252–254). Fragmentary scapulae are represented by intact glenoid fossae retaining portions of the neck or neck/blade fragments. None displays breakage or punctures indicative of eagle feeding.

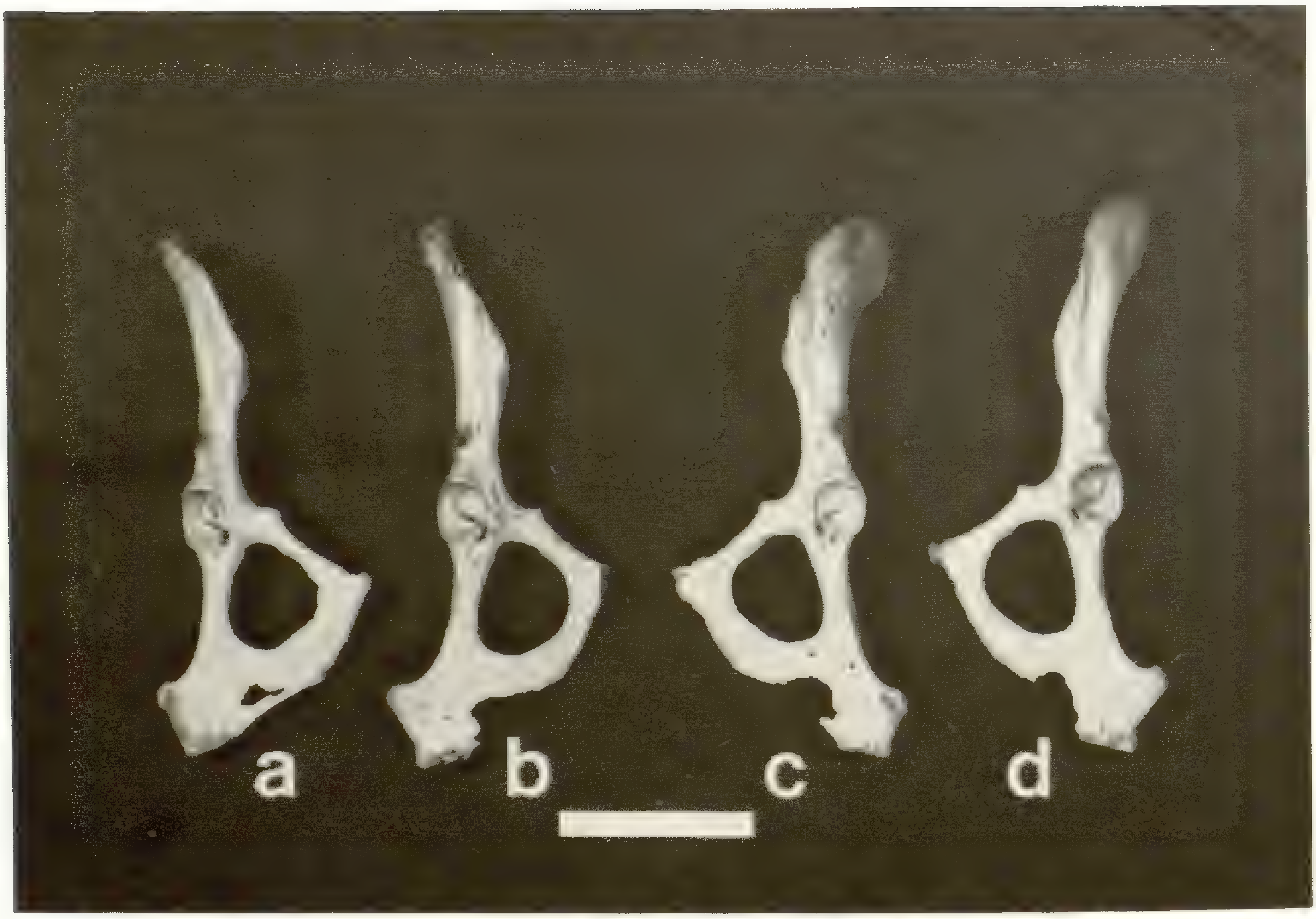

FIG. 3.—Anterio-lateral view of selected Cathedral Roost *Lepus* innominates showing examples of initial (a) and progressive stages (b-d) of weathering/bone loss along the ischiopubic ramus. Bar scale is 3 cm in length.

Bone damage: Leporid vertebrae, sacra, and innominates.—The vertebrae, sacra, and innominates are predominantly complete or nearly so, and none exhibits damage that can unequivocally be attributed to golden eagles. Most vertebra transverse and spinous processes and sacrum median crests are broken to some degree, but any number of taphonomic mechanisms are capable of damaging these thin, projecting segments. Each of the adult leporid innominates exhibits varying degrees of damage on the ischiopubic ramus. Attrition consists of localized bone removal of the posterior margin adjacent to the ischial tuberosity (Figure 3, b-d; NISP = 11) or breakage/removal of the ischiopubic ramus (NISP = 23; see also Hockett 1989: 128–129). Numerous superficial and deep muscles (e.g., adductor femoris, gracilis, and semimembranosus) are associated with the ischiopubic ramus and ischial tuberosity, and I suspect that golden eagles occasionally damage this portion of the pelvis while feeding on leporid carcasses. However, because the ischiopubic ramus is slender and the mineral density of this segment is low (Kreutzer 1992, Lyman 1984, Lyman *et al.* 1992), some may have been damaged by processes unrelated to golden eagle feeding (Schmitt 1994). Two Cathedral Roost specimens tend to support this inference as each possess small apertures formed by initial stages of weathering (Figure 3, a).

Twelve Cathedral Roost innominates also possess damaged ilia. Damage consists of transverse, jagged breakage just below (posterior) the iliac crest. As is the case with many of the recovered limb bones, this attrition may have resulted from post-depositional weathering. The anterior ilium is a porous, low density segment (Lyman *et al.* 1992) and the "feathered" breakage of seven specimens appears to have resulted from prolonged exposure to the elements. However, five specimens are relatively unweathered and breakage is similar to the raptor "shearing" damage described by Hockett (1989, 1991). Hockett (1991, 1993) also reports the occurrence of beak/talon punctures behind the acetabular fossa in raptor-produced leporid assemblages, but no punctures occur in the large sample of innominates from Cathedral Roost. Finally, two cottontail innominate fragments are pitted and polished from partial digestion.

Bone damage: Leporid hind limbs.—Only four femora (6% of the NISP) exhibit damage that appears to have been inflicted by golden eagle feeding. The greater trochanter of one proximal femur is sheared off and is comparable to raptor damage described by Hockett (1991, 1993:121–122). A number of additional specimens display damage on their proximal ends, but attrition commonly is superficial and appears to reflect the initial stages of bone weathering. Three intact distal ends retain a few millimeters of shaft with transverse fractures. In these cases a comparison of breakage location and morphology with the numerous weathering fractures in the femora assemblage indicates breakage by a different taphonomic agent, possibly golden eagles. The remaining femora appear to have been deposited as complete bones that subsequently weathered and fractured, including one distal epiphysis which has sustained extensive rodent gnawing.

Golden eagle damage on tibiae includes punctures and fractures. Although numerous specimens have weathering breaks, two proximal fragments and five distal ends exhibit transverse fractures that are unlike the split-line weathering breaks observed elsewhere in the assemblage; these appear to have been generated by eagle feeding. One proximal fragment is unweathered and possesses a spiral break just below the anterior crest, and the other is a small (21 mm) intact proximal end retaining a few millimeters of shaft. The five distal fragments are relatively uniform in size (range = 22.6–27.4 mm; mean = 25.2 mm) and each exhibits jagged, transverse fractures of the distal shaft; one specimen was found articulated with the foot. Both raptors (Hockett 1989, 1993) and terrestrial carnivores (Andrews and Evans 1983, Schmitt and Juell 1994) are capable of snapping distal tibia shafts, therefore the Cathedral Roost specimens may have been fractured by golden eagles, scavenging carnivores, or both.

Localized damage on the medial surface of proximal tibiae has resulted from both golden eagle feeding and post-depositional weathering. Two specimens exhibit ovate, crushed apertures that appear to have been produced by a beak or talon (Figure 4, f). Nine additional specimens display varying types of damage in the same location, but most appear to have resulted from weathering. Five proximal ends exhibit early stages of weathering in the form of small pits exposing cancellous bone (Figure 4, a-b), and two display progressive weathering that resulted in the disintegration of part of the articular surface and anterior crest (Figure 4, d). A gouge on the proximal and lateral surface of one specimen resembles rodent gnawing (Figure 4, c) and the remaining specimen appears to have sustained a beak/talon puncture and subsequent weathering damage (Figure 4, e).

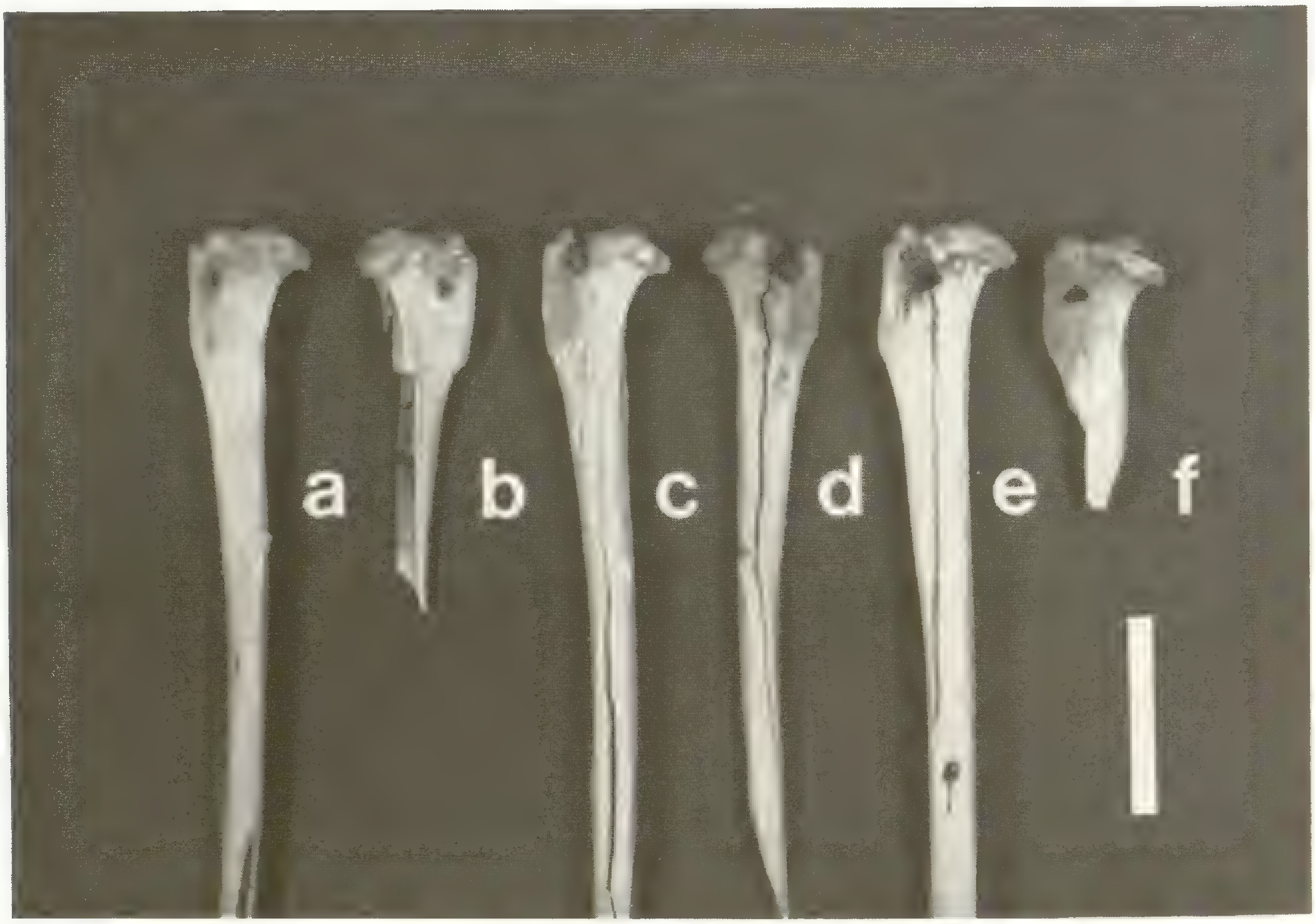

FIG. 4.—Damage on the lateral surface of selected proximal *Lepus* tibiae from Cathedral Roost; note also longitudinal weathering cracks/breakage. Initial pitting from weathering (a-b); rodent gnawing (c); progressive weathering (d); possible beak/talon puncture with subsequent weathering (e); beak/talon puncture (f). Bar scale is 3 cm in length.

Front and hind limb foot bones are abundant (Table 1) and most are complete. All of the carpals, tarsals, and astragali are complete and undamaged, and only seven phalanges (4.4%) are fragmentary. Forty-four (24%) of the *Lepus* metapodials are fragmented, including specimens splintered by advanced weathering and a few that display localized bone loss and overall polish that resulted from partial digestion. Calcanei are largely complete and undamaged (Tables 1 and 2), but two specimens also exhibit bone loss and corrosive attrition from predator digestion (Figure 5, b-c). The extent of corrosion suggests either that they passed through the stomach and intestines of a coyote or were subject to prolonged golden eagle digestion (see Hockett n.d.:Figure 3).

Evidence of bone attrition caused by golden eagles is extremely rare in the Cathedral Roost prey assemblage. Only three bones possess punctures that appear to have been inflicted by eagle beaks or talons. I am confident that breakage of the ascending rami and transverse fractures of some limb bones resulted from eagles feeding on prey carcasses, but other taphonomic mechanisms are capable of producing similar fractures (e.g., human subsistence activities or post-depositional trampling) and none of the bones exhibit attrition that can be attributed solely to golden eagles. While evidence for eagle-produced damage is scarce and often am-

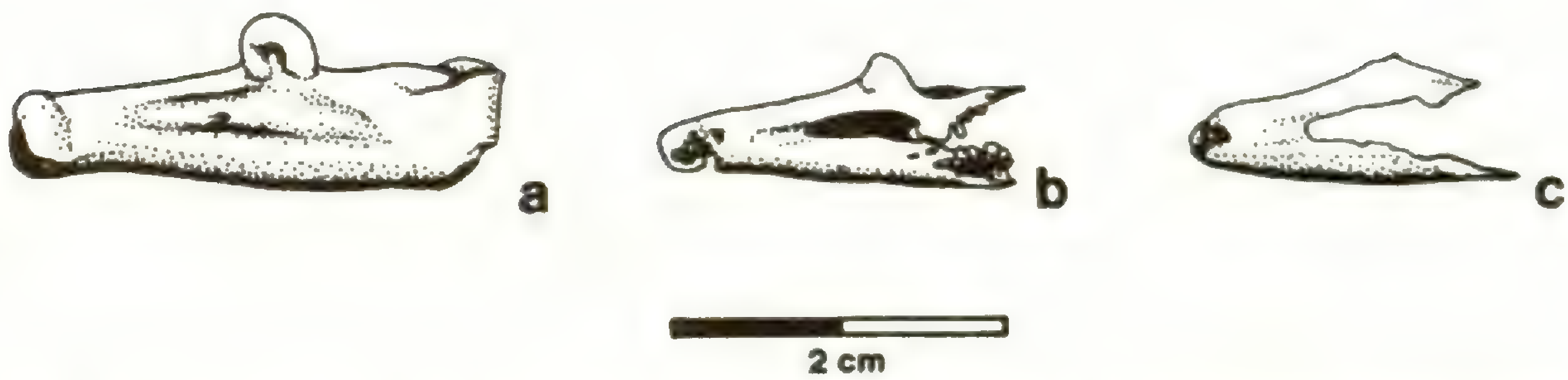

FIG. 5.—*Lepus* calcanei from Cathedral Roost showing a complete, undamaged specimen (a) and corrosive attrition from partial digestion (b-c).

biguous, taxonomic abundances and body part frequencies may distinguish bone accumulations produced by golden eagles. To investigate this possibility, the Cathedral Roost assemblage is compared with golden eagle prey accumulations from another context.

PREY AND BODY PART FREQUENCIES: AN INTER-ASSEMBLAGE COMPARISON

Recently Hockett (1993, 1995) analyzed and reported leporid remains from Matrac Roost, a golden eagle nest in northwestern Nevada, thereby offering an exceptional collection to compare with the prey assemblage from Cathedral Roost. Matrac Roost is a single nest situated on a small ledge along the steep face of a bedrock ridge. The nest is approximately 10 m from the ground surface and overlooks the valley bottom. Hundreds of leporid remains were observed during 1990 field investigations and two golden eagle chicks along with three skinned and beheaded leporid carcasses were discovered in the nest in 1992 (Hockett 1993:106, 1995). Collections from the nest and vicinity yielded 930 leporid specimens (Hockett 1993:Table 6.3) representing both individual bones and articulated body parts. As with the Cathedral Roost assemblage, elements in articulated segments were isolated and tallied as single specimens. Hockett (1993:106–122) presents data on all of the skeletal remains collected from Matrac Roost, but his quantitative analyses focus on 12 major elements: crania (maxillae), mandibles, scapulae, humeri, radii, ulnae, innominates, sacra, femora, tibiae, astragali, and calcanei. The following comparisons employ only these 12 elements (see also Table 2).

The proportions of hare and cottontail bones recovered from Matrac Roost are similar to the Cathedral Roost assemblage. Identified jackrabbits from Matrac consist of 136 specimens representing a minimum of 130 elements, and the cottontail assemblage is comprised of 19 specimens representing an MNE of 17 (Hockett 1993:108). Most of the Matrac leporid remains are complete skeletal elements, especially foot bones (100%), radii (100%), and femora (80%). Matrac Roost contains higher proportions of juvenile *Lepus* elements (Hockett 1993:98) than Cathedral Roost (Table 1). Due to their limited size and transport capacity, prey assemblages produced by smaller raptors (e.g., northern harrier [*Circus cyaneus*] and barn owl [*Tyto alba*]) tend to be dominated by juvenile leporids (Hockett 1991). Golden eagles, however, are quite capable of capturing and carrying adult leporids (Eakle and Grubb 1986, McGahan 1968) and differences between the Matrac and Cathe-

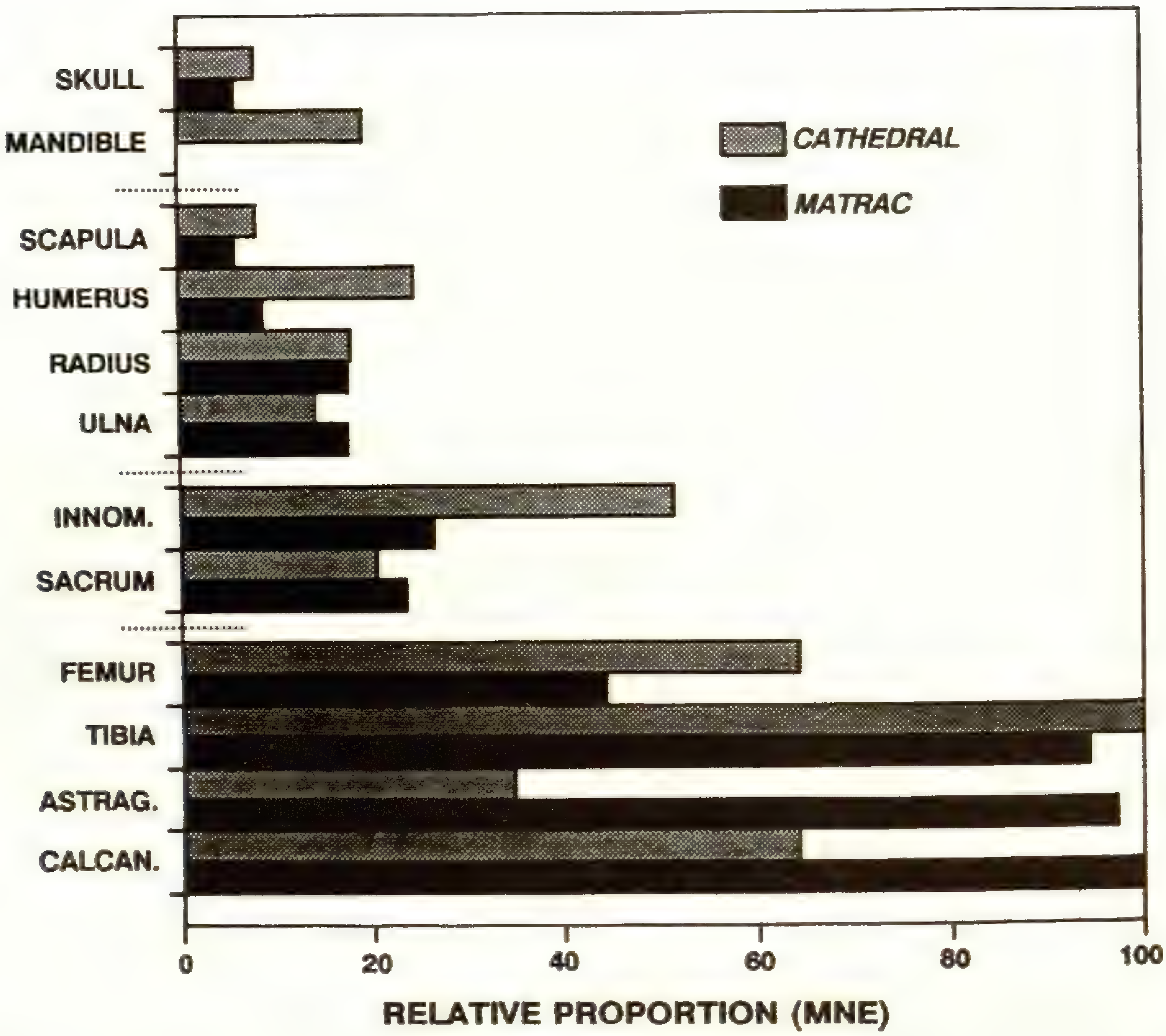

FIG. 6.—Relative proportions (MNE) of leporid elements recovered from Cathedral and Matrac roosts. Relative proportions for each aggregate are calculated as MNE/greatest MNE (Cathedral = 78 tibiae; Matrac = 34 calcanei [Hockett 1993: 108]) x 100. Dashed lines segregate gross body segments.

dral prey age structures likely reflect seasonal variation in the abundances and age structure of local prey populations rather than deliberate predator selection. Regardless, the high proportion of *Lepus* at Matrac Roost (88.4% of total MNE) corresponds with the proportion of *Lepus* recovered from Cathedral Roost (91.6%; Table 1). Although cyclical fluctuations in prey abundances may cause an increase in cottontail predation, jackrabbits characteristically dominate golden eagle diets in the Great Basin (Edwards 1969, Ryser 1985, Smith and Murphy 1979). The Matrac and Cathedral prey assemblages prove no exception.

Leporid body part representation at the two roosts also is markedly similar. Figure 6 presents the relative proportion of skeletal elements in each assemblage. Note that tibiae and associated foot bones are most common and front limbs and crania are rare (see also Edwards 1969:103). Innominates, sacra, and femora tend to be more abundant than forelimbs but they occur less frequently than tibiae. Variation in the proportion of these associated elements suggests that pelves (and some lumbar vertebrae), legs, and feet may have been brought to the roosts as articulated segments on some occasions, but more often pelves and femora were stripped of flesh and abandoned and only the tibiae and articulated feet brought to the roosts as smaller, detached segments (see also Hockett 1993:113). The rank order abundances of the Matrac and Cathedral total leporid NISP values for the 12 major elements are positively correlated (*tau* = .605, *p* = .003), as are the derived leporid MNE values (*tau* = .641, *p* = .002). Comparing *Lepus* body part representation between the two aggregates also results in positive correlations for both NISP (*tau* = .678, *p* = .001) and MNE (*tau* = .711, *p* < .001). Regardless of the quantitative measure, these data suggest that golden eagle prey accumulations at Great Basin nest sites are dominated by hare remains characteristically comprised of high proportions of hindlimbs and low proportions of forelimbs and skulls. The next question is whether the homogeneity characterizing golden eagle prey accumulations is different from bone assemblages accumulated by other types of predators.

COMPARISONS WITH OTHER PREDATOR ACCUMULATIONS

A comparison of taxonomic and skeletal representation in the Cathedral Roost prey assemblage with those produced by other Great Basin predators reveals some rather pronounced differences. For example, Hockett's (1991) analyses of leporid bones from the Two Ledges barn owl pellets found cottontails (90.2% of leporid NISP) to be markedly more abundant than hares, high frequencies of anterior elements, especially humeri and mandibles, and high proportions of juvenile bones. Figure 7 illustrates differences between the proportions (NISP) of paired elements recovered from Cathedral Roost, Two Ledges barn owl pellets, and Great Basin coyote scats (Schmitt and Juell 1994). The rank order abundances of the Cathedral Roost and barn owl pellet (Hockett 1991:Table 1) leporid NISP are not correlated (*tau* = .18, *p* = .235). Similarly, NISP:MNE ratios for the barn owl pellet leporid limb bones (i.e., humeri = 2.25, radii = 1.98, ulnae = 1.23, femora = 3.03, tibiae = 3.43; Hockett 1991:Tables 1 and 2) are larger and significantly different than the limb bone ratios at Cathedral Roost (Table 2: $X^2 = 218.69$, $df = 4$, $p < .001$).

Leporid assemblages produced by Great Basin coyotes also differ from eagle nest accumulations. Coyote food habits are similar to those of golden eagles in that both prefer to hunt jackrabbits, opportunistically pursuing both adults and juveniles, but body part representation (Figure 7) and bone attrition in coyote scat accumulations are often different. Although coyotes may leave body segments with little attached soft tissue at feeding loci, especially distal limbs with articulated feet (Andrews and Evans 1983, Schmitt and Juell 1994), they commonly consume the entire carcass. Furthermore, coyote scat assemblages will contain a more fragmentary and random array of body parts because they chew their prey. These assemblages will be dominated by high density segments because gastric acids will affect the survivorship of porous, low density segments (Schmitt and Juell 1994). Comparing leporid body part frequencies (NISP) of the ten paired elements from Cathedral Roost against leporid bone extracted from 40 coyote scats (Schmitt and Juell 1994:Table 4) results in an insignificant correlation (*tau* = -.09, *p* = .358). Though coyote-generated scatological remains are conspicuously different than golden eagle prey bones stripped of flesh and deposited at nest sites, some corroded scat bones may be indistinguishable from eagle pellet bones

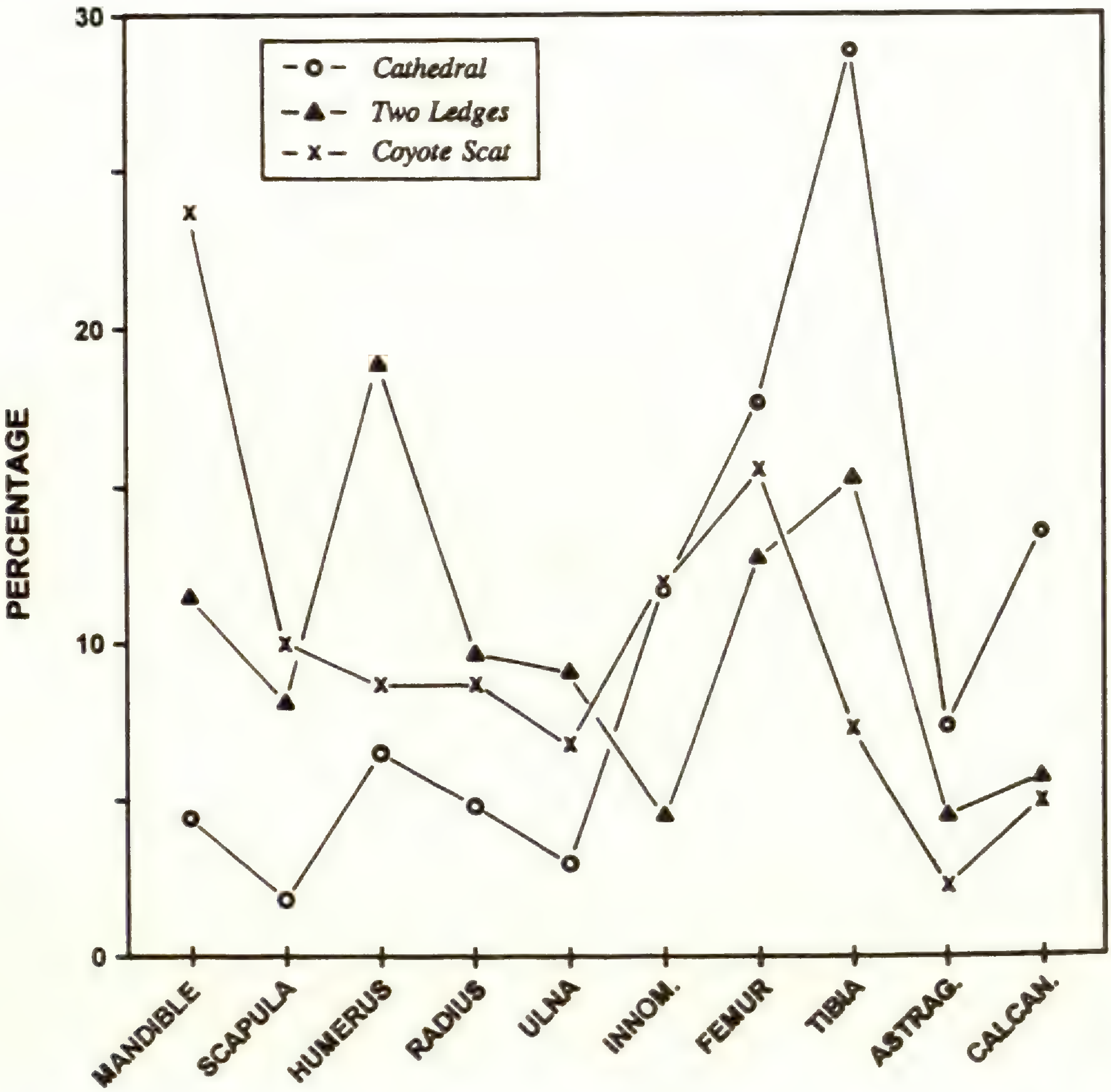

FIG. 7.—Percentage (NISP) of leporid paired body parts from Cathedral Roost (NISP = 367), Two Ledges barn owl pellets (Hockett 1991; NISP = 971), and Great Basin coyote scats (Schmitt and Juell 1994; NISP = 219).

(Hockett n.d.). In any case, "the presence of partially digested bone in an archaeological site will largely represent bones accumulated by non-human taphonomic agents" (Schmitt and Juell 1994:259), especially when represented by large leporid bone fragments.

Most important are the differences between golden eagle prey accumulations and human subsistence refuse. Great Basin ethnohistoric foragers used a variety of techniques to hunt hares and cottontails, including stalking or snaring individual prey, and procuring large numbers of individuals in communal drives (Downs 1966, Fowler 1992, Steward 1938). Given leporid body size and ethnographic descriptions of entire carcass utilization (Fowler 1989, Wheat 1967), the skeletal byproducts of Great Basin human subsistence activities probably will contain a more even distribution of body parts than those accumulated by golden eagles (see also Schmitt and Lupo 1995). Carcasses commonly were roasted on coals or dried and pounded for soup and bone meal (Downs 1966; Fowler 1989, 1992; Steward 1941; Wheat 1967). In some instances the ends of jackrabbit tibiae were broken off for marrow removal and subsequent manufacture of bone beads (Hockett 1994, 1995; Schmitt 1988, 1990). As a result, leporid skeletal element completeness and body part representation in golden eagle nest accumulations should differ from the fragmentary and/or burned bone assemblages customarily generated by human subsistence activities.

SUMMARY

The Cathedral Roost faunas provide data for distinguishing golden eagle prey accumulations in archaeological and paleontological contexts. Taxonomic and body part representation and skeletal element completeness offer the most reliable resolution, especially when considered together. Jackrabbits are the dominant prey species at nest sites and their skeletal remains are represented predominantly by posterior body segments, especially tibiae and foot bones. Comparison of the Cathedral Roost prey remains with leporid accumulations from a modern roost in Nevada disclosed marked similarities in taxonomic and skeletal element representation, and aspects of these assemblages were found to differ from prey remains accumulated by other predators. Golden eagle nests in the Great Basin are most often situated along steep craggy cliffs and canyon walls. As a result, prey assemblages will tend to accumulate at the base of cliffs, especially in associated caves and rock shelters (see Elston and Budy 1990), but they also may occur below trees used as perches or nest sites in mountains and valley foothills. Evidence of leporid skeletal attrition produced by eagle capture and/or feeding is rare; except for beak or talon punctures, bone damage alone will seldom distinguish golden eagle prey accumulations. The majority of the Cathedral Roost bones were complete and undamaged when deposited (often in articulated body segments) where they were subject to subsequent modification, especially split-line weathering. Bone weathering may have masked or erased a few additional punctures or fractures caused by golden eagle feeding, and some eagle-damaged bone may have been scavenged by local avian and mammalian predators and deposited elsewhere. Conversely, it is possible that some of the few partially digested specimens represent prey deposited by other predators. Although I am confident that the majority of the leporid remains were accumulated by eagles inhabiting the roost, the presence of rodent gnawing, bone weathering, and probable coyote scatological bone and bone scavenging provide testimony to the complex taphonomic mechanisms that can rapidly affect virtually any bone assemblage.

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CANDOMBLÉ ETHNOBOTANY: AFRICAN MEDICINAL PLANT CLASSIFICATION IN BRAZIL

ROBERT A. VOEKS
Department of Geography
California State University
Fullerton, CA 92634

ABSTRACT.—The African-based Candomblé religion has survived in Brazil since the slave trade. Candomblé priests and priestesses, serving as healers for the Afro-Brazilian community, employ an arsenal of medicinal plant species to cure spiritually-derived illness. Their ethnoflora is systematically organized in reference to a pantheon of African deities, male and female, hot and cold, each of which retains his or her own personal plant pharmacopoeia. Medicinal species exhibit morphological and to a lesser extent medicinal properties that link them to the archetypes of one or more of the deities. The size, shape, texture, color, and aroma of the leaves, flowers, and fruit represent the principal organizational characteristics. Based on an orally transmitted Yoruba legend, this system of plant classification proved highly portable, allowing its successful diffusion from West Africa to an alien, New World floristic landscape.

RESUMEN.—La religión candomblé, de base africana, ha sobrevivido en Brasil desde el comercio de esclavos. Los sacerdotes y sacerdotistas candomblé, sirviendo como curanderos para la comunidad afro-brasileña, emplean un arsenal de especies de plantas medicinales para curar enfermedades derivadas espiritualmente. Su etnoflora está organizada sistematicamente en referencia a un panteón de deidades africanas, masculinas y femeninas, calientes y frías, cada una de las cuales conserva su farmacopea personal de plantas. Las especies medicinales exhiben rasgos morfológicos, y en menor medida propiedades medicinales, que las vinculan a los arquetipos de una o más de las deidades. El tamaño, forma, textura, color y aroma de las hojas, flores y frutos representan las características organizativas principales. Basado en una leyenda yoruba transmitida oralmente, este sistema de clasificación de plantas probó ser altamente portátil, permitiendo su difusión exitosa del África Occidental a un paisaje florístico extraño en el Nuevo Mundo.

RÉSUMÉ.—La religion candomblé dont le siège est en Afrique s'est perpétuée au Brésil depuis le trafic des esclaves. Les prêtres et prêtresses candomblé, qui font office de guérisseurs dans la communauté afro-brésilienne, utilisent un arsenal de plantes médicinales pour guérir des maladies d'origine spirituelle. Leur ethnoflore est systématiquement organisée en fonction d'un panthéon de déités africaines (mâle/femelle, chaud/froid), chacune d'entre elles conservant sa propre pharmacopée personnelle à base de plantes. Les espèces médicinales montrent des propriétés morphologiques et, dans une moindre mesure curatives, qui les lient aux archétypes d'une ou plusieurs déités. La grosseur, la forme, la texture, la couleur et l'odeur des feuilles, des fleurs et des fruits représentent les principaux critères de classification. Ce système de classification, fondé sur une légende yoruba transmise oralement, s'est avéré hautement transposable, ce qui a permis sa diffusion de l'Afrique occidentale à un paysage floral étranger du Nouveau Monde.

INTRODUCTION

Brazil witnessed the forced immigration of over four million African souls during its colonial and imperial history, roughly eight fold the number that reached the United States (Rawley 1981). Uprooted principally from Yoruba-speaking areas of Nigeria and from Angola, they found themselves in a social and physical environment altogether alien. Forced to adapt to the rigors of slave existence and the lifeways of an evolving Portuguese civilization, African slaves lost much of what constituted their material culture. They succeeded, however, in introducing significant elements of their religious and ethnomedical systems. In the northeastern state of Bahia (Figure 1), Yoruba slaves and freedmen had successfully transplanted the seeds of their belief system by the early 19th century (Costa Lima 1977). Candomblé, as the religion came to be called, expanded geographically and numerically to the point that today it represents a powerful cultural influence in the region.

Although various factors contributed to the perseverance of Candomblé (Bastide 1978, Camara 1988, Voeks 1993), one of the most important is its preoccupation with achieving happiness and good health for adherents during this as opposed to the next life. Candomblé *pais* and *mães-de-santo* (priests and priestesses), serving as healers for the Afro-Brazilian community, divine the spiritual source of illness and prescribe culturally acceptable treatments. Purely physical problems, such as colds, headaches, and muscle pain, are treated with an array of drug plants. This portion of their plant pharmacopoeia, however, was largely assimilated from Amerindian and European sources, and has minor relevance to health and healing concepts held by the Candomblé community (Voeks n.d.). It is when physical or emotional symptoms become chronic and recourse to medicinal plants and western medicine fails that imbalances with the spiritual realm are suspected. Illness is then viewed as a physical manifestation of forces outside the realm of secular comprehension. Priests seek out the other-world sources of such spiritual distress, and treat them with a plant pharmacopoeia that is systematically organized and ceremonially administered much as it was in West Africa.

This paper examines the role of ritual plants in healing among Candomblé adherents and secular clients. I focus on the plant pharmacopoeia administered in spiritual healing ceremonies and the system of classification used to organize this ethnoflora. Field research was carried out in the cities of Salvador, Itabuna, and Ilhéus, Bahia between 1988 and 1992. I gathered data through interviews and participant observation with four *pais* and two *mães-de-santo* representing the four principal Candomblé traditions— Ketu, Ijexá, Jeje, and Candomblé de Angola.

Ethnobotanical knowledge represents one of Candomblés closely guarded secrets. In the course of this study, *pais* and *mães-de-santo* seldom responded to direct questions regarding specific plant use and significance. Plant information was provided in each case when the priest felt that I was knowledgeable enough to understand it and to respect it. Moreover, what was considered part of the secret' varied

FIG. 1.—The State of Bahia, Brazil.

among temples. Some priests were thus willing to discuss one dimension of plant use, such as medicinal application, but not another, such as deity correspondence.

A total of 162 species employed in Candomblé spiritual healing ceremonies were discussed by informants or observed being used. Of these, I collected or otherwise identified 105 ritual species and determined their associated deities (Table 1). Plants were collected in various locations. Many of the cultivated species were gathered in temple gardens in the company of the *pai* or *mãe-de-santo*. Other plants were collected in disturbed areas, roadsides, pastures, or second growth forests, or in old growth forest. I gathered the remaining species at Candomblé herb stands in Salvador. Collections and duplicates were vouchered and deposited in the herbarium at the Centro de Pesquisa do Cacau, Itabuna, Bahia.

TABLE 1—Candomblé ritual species. Species and associated deities were provided by six informants. Vernacular names are listed in the order of their most frequent use in the *terreiro*. OW = Old World origin, NW = New World origin, Unkn. = unknown origin, Cosm. = cosmopolitan, Cult. = cultivated. Portuguese names are in italics. African names are in boldface italic. Tupí names are italicized and underlined. Voucher specimens are housed at the herbarium, Centro do Pesquisas do Cacau, Bahia, Brazil.

Family Species/collection number [geographical origin-status]	Vernacular names	Associated Orixá(s) (number of informants)
Agavaceae		
Dracaena fragrans (L.) Ker Gawl./172 [OW-cosm. cult]	***peregun****/nativo*	Ogun (4), Oxóssi, Ossâim
Sansevieria cf. *aethiopica* Thunb./NC [OW-cosm. cult.]	*espada de Ogun/* ***ida orixá***	Ogun (4)
Sansevieria cf. *aethiopica* Thunb./NC [OW-cosm. cult.]	*espada de Oxóssi*	Oxóssi (4)
Anacardiaceae		
Mangifera indica L./NC [OW-cosm. cult.]	*manga*	Ogun
Schinus terebinthifolius Raddi/191, 220 [NW-cosm. weed]	*aroeira/****perôko/ajobiewe***	Ogun, Iansã (2)
Tapirira guianensis Aubl./354, 389 [NW]	*pau pombo*	Oxalá (2)
Apocynaceae		
Catharanthus roseus (L.) G. Don/398 [NW-cosm. cult. & weed]	*bom dia*	Nanã
Catharanthus roseus var. *albus* Sweet/399 [NW-cosm. cult. & weed]	*boa noite*	Oxalá
Araceae		
Dieffenbachia maculata (Lodd.) G. Don/222 [NW-cosm. cult]	*comigo ninguem pode*	Ogun
Philodendron sp./260 [NW]	*sete chagas*	Omolu (2)
Arecaceae		
Elaeis guineensis Jacq./NC [OW-cosm. cult.]	***dendê/mariuô***	Exu, Ogun, all the orixás
Asteraceae		
Baccharis sp./151 [NW]	*abre caminho*	Ogun (3), Oxóssi
Bidens pilosa L./204 [NW-cosm. weed]	*carrapicho/picão/****ewe susu***	Exu (2)
Blanchetia heterotricha DC./154 [NW]	*selva de Ogun*	Ogun (2)
Conocliniopsis prasiifolium (DC.) K. & R./277 [NW]	*cama de coelho*	Oxóssi
Mikania glomerata Spreng./334 [NW]	*folha do ar*	Oxalá

Family Species/collection number [geographical origin-status]	Vernacular names	Associated Orixá(s) (number of informants)
Pluchea sagittalis (Lam.) Cabrera/286 [NW]	*assa peixe branco*	Ogun
Pluchea suaveolens (Vell.) Kuntze/213, 236 [Unkn.]	*quitoco*	Omolu, Ossâim
Rolandra fruticosa (L.) Kuntze/263 [NW]	*vence tudo*	Ogun (3), Oxóssi
Vernonia condensata Baker/177, 243 [NW]	*alumã*/***ewe auro***	Ogun, Omolu
Vernonia cf. *cotoneaster* Less./249 [NW]	*vence demanda*	Ogun
Vernonia schoenanthus L./190 [Unkn.]	*alumã*/***ewe auro***	Ogun, Omolu
Wedelia paludosa DC./383 [NW]	*mal-me-quer*/***bai joco***	Oxum (2), Omolu
Wulffia baceata (L. f.) Kuntze/265 [NW]	*acoci*	Oxum
Bignoniaceae		
Newbouldia laevis Seem./319 [OW-cult.]	***akokô***	Xangô
Boraginaceae		
Cordia sp./352 [NW]	*baba de boi*	Oxalá
Caesalpiniaceae		
Bauhinia ovata Vog./373 [NW]	*unha da vaca*/*pata* da vaca/***abafé***	Ogun, Yemanjá, Exu
Caesalpinia pulcherrima (L.) Sw. [NW-cosm. cult.]	*maravilha*/*barba de barata*	Oxum
Senna occidentalis (L.) Link/184 [NW-cosm. weed]	*fedegoso*	Iansã
Campanulaceae		
Centropogon cornutus (L.) Druce/158 [NW]	*bico de papagaio*/ *crista de peru*/ ***ewe akuku***	Xangô (2)
Caprifoliaceae		
Sambucus australis Cham. & Schlecht./254 [NW]	*sabugueiro*	Oxalá, Oxum
Caryophyllaceae		
Drymaria cordata (L.) Willd. ex. Roem. & Schult./160 [Unkn.-cosm. weed]	*vintém*	Oxum
Chenopodiaceae		
Chenopodium ambrosioides L./238, 244 [NW-cosm. weed]	*mastruz*	Xangô, Iansã
Clusiaceae		
Garcinia kola Heckel/300 [OW-cult.]	***orobô***	Xangô, all the orixás
Commelinaceae		
Commelina diffusa Burm. f./385 [NW-cosm. weed]	*marianinha*/***opodo odo***	Yemanjá
Convolvulaceae		
Ipomoea pes-caprae (L.) Sweet/384 [Unkn.-cosm.]	*salsa da praia*/ ***orobo aiba***	Nanã

Family Species/collection number [geographical origin-status]	Vernacular names	Associated Orixá(s) (number of informants)
Crassulaceae		
Kalanchoe pinnata (Lam.) Pers./175 [OW-cosm. cult. & weed]	*folha da fortuna/ milagre de São Joaquim/saião/* ***oju oro***	Oxum (2), all orixás
Kalanchoe integra (Medic.) O. Ktz./169, 224 [NW-cosm. cult. & weed]	*folha da costa/* ***ewe dudu***	Oxalá, Yemanjá (3), all orixás
Cyperaceae		
Cyperus rotundus L./392 [OW-cosm. weed]	***dandá***	Oxalá, Ogun (2), Yemanjá
Fuirena umbellata Rottb. [Unkn.-cosm. weed]	*tiririka/***labe labe**	Exu (2)
Euphorbiaceae		
Centratherum punctatum Cass. ssp. *punctatum/250* [NW]	*balainho do velho*	Omolu
Cnidoscolus urens (L.) Arthur/170, 180 [NW]	*cansanção/***jojofa**	Exu (5)
Dalechampia ilheotica Wawra./281 [NW]	*urtiga/***esimsim**	Exu (4)
Jatropha curcas L./218 [NW]	*pinhão branco*	Oxalá
Jatropha gossypifolia L. [NW-cosm. cult. & weed]	*pinhão roxo*	Omolu
Pera cf. glabrata (Schott) Baill./257 [NW]	*açoita cavalo*	Exu
Ricinus communis L./NC [OW- cosm. cult. & weed]	*mamona/***ewe lara**	Yemanjá, Omolu/Abaluaiê
Fabaceae		
Erythrina poeppigiana (Walp.) O.F. Cook./310 [NW-cult.]	*mulungú*	Omolu, Exu
Machaerium angustifolium Vog./271 [NW]	*sete capote*	Exu
Zornia cf. gemella (Willd.) Vog. vel aff./256 [NW-cosm. weed]	*arrozinho*	Oxum
Flacourtiaceae		
Casearia sp./306 [Unkn.]	*São Gonçalinho*	Oxóssi, Xangô, Iroko
Gentianaceae		
Coutoubea spicata Aubl./253 [NW]	*papai nicolau*	Oxalá
Irlbachia purpurascens (Aubl.) Mass/264 [NW]	*corredeira*	Exu (3)
Lamiaceae		
Hyptis fruticosa Salzm ex. Benth./255 [NW]	*alecrim*	Oxalá, Oxum, Nanã, Yemanjá
Hyptis suaveolens (L) Poit./164 [NW-cosm. weed]	*neve cheiroso*	Nanã
Leonotis nepetifolia (L.) Alt. f./229 [OW-cosm. weed]	*cordão de São Francisco*	Ogun, Xangô
Mentha sp./205 [Unkn.]	*hortelã grosso*	Nanã

Family Species/collection number [geographical origin-status]	Vernacular names	Associated Orixá(s) (number of informants)
Lamiaceae (cont.)		
Mentha pulegium L./233, 318 [OW-cosm. cult.]	*poejo*	Oxum (2), Yemanjá
Ocimum canum Sims/211 [OW-cosm. cult.]	*manjericão/ catinga da criola*	Oxóssi, Yemanjá (3)
Ocimum gratissimum L./ 219, 230, 247 [OW-cosm. cult. & weed]	***quiôiô**/alfavaca cravo*	Xangô (2)
Plectranthus amboinicus Lour./152, 304 [OW-cosm. cult.]	*tapete da Oxalá*	Oxalá(3)
Pogostemon cf. cablin Benth./NC [OW-cosm. cult.]	*patchulí*	Oxum (2), Oxumarê, Nanã, Yemanjá, Iansã
Lythraceae		
Cuphea racemosa (L.f.) Spreng. [NW]	*barba de São Pedro*	Iansã
Malpighiaceae		
Byrsonima sericea DC/294, 349 [NW]	*muricí*	Ogun, Oxóssi, Xangô
Malvaceae		
Gossypium barbadense L./NC [NW-cosm. cult.]	*algodão/**ewe oxu***	Oxalá(2)
Sida linifolia Cav./258 [Unkn.-cosm. weed]	*lingua de teiú*	Oxóssi
Melastomataceae		
Clidemia hirta (L.) D. Don/159, 363 [NW]	*folha do fogo/**ewe aina***	Xangô, Exu (2)
Miconia hypoleuca (Benth.) Triana/356 [NW]	*candeia branca*	Oxalá, Omolu
Miconia sp./178, 276 [NW]	*canela de velho*	Omolu (3)
Tibouchina cf. lhotzkyana (Presl.) Cogn./279 [NW]	*folha do fogo de Iansã*	Iansã (2)
Mimosaceae		
Mimosa pudica L. [NW-cosm. weed]	*malissa*	Exu
Moraceae		
Cecropia pachystachya Trécul/355 [NW]	*embaúba/**abao***	Omolu, Xangô
Ficus sp./NC [NW]	***iroko/loco**/ gameleira branca*	Iroko (6)
Myrtaceae		
Eugenia uniflora L./189 [NW-cosm. cult.]	*pitanga*	Katende/Iroko
Syzygium jambos (L.) Alston/394 [OW-cosm. cult.]	*jambo branco*	Oxalá
Passifloraceae		
Passiflora alata Dryand./NC [NW-cosm. cult.]	*maracujá*	Oxumarê
Phytolaccaceae		
Petiveria alliacea L./171, 295 [NW-cosm. cult. & weed]	*guiné/pipi/**ojusaju***	Ogun, Iansã (2)

Family Species/collection number [geographical origin-status]	Vernacular names	Associated Orixá(s) (number of informants)
Piperaceae		
Peperomia pellucida HBK./176 [NW-cosm. weed]	*alfavaquinha de cobra/iriri/oriri*	Oxum, Oxalá
Piper aduncum L./210, 376 [NW]	*betis branco*	Xangô
Piper sp./283 [Unkn.]	*betis cheiroso*	Oxum, Oxumarê, Nanã, Iansã
Pothomorphe umbellata (L.) Miq./231 [NW-cosm. weed]	*capeba/agogo iya*	Omolu/Abaluaiê
Plantaginaceae		
Plantago major L./208 [OW-cosm. cult. & weed]	*transagem*	Yemanjá
Plumbaginaceae		
Plumbago sp./165 [Unkn.]	*loquinho*	Iroko, Exu (2)
Poaceae		
Andropogon schoenanthus L./187 [OW-cosm. cult.]	*capim santo*	Oxalá
Lasiacis ligulata Hitchc. & Chase/314 [NW]	*taquara*	Oxóssi
Zea mays var. *rugosa* Bonaf./NC [NW-cosm. cult]	*pipoca*	Oxóssi
Rubiaceae		
Borreria verticillata (L.) G. Mey./275, 296 [Unkn.-cosm. weed]	*caiçara*	Ogun (2), Oxóssi
Borreria sp./269 [Unkn.]	*corredeira*	Exu (3)
Rutaceae		
Citrus aurantium L./NC [OW-cosm. cult.]	*laranja da terra*	Oxum(2)
Murraya paniculata (L.) Jack [OW-cosm. cult.]	*murta da praia*	Nanã
Ruta graveolens L./201, 202 [OW-cosm. cult.]	*arudda*	Oxóssi
Zanthoxylum sp./273, 303 [Unkn.]	*tira teima*	Ogun, Oxóssi, Omolu
Schizaeaceae		
Lygodium volubile Sw./262 [NW]	*samambaia/ewe amin*	Oxóssi
Scrophulariaceae		
Scoparia dulcis L./207, 391 [NW-cosm. weed]	*vassourinha santa/ v. da Nossa Senhora*	Oxum
Solanaceae		
Brunfelsia uniflora (Pohl) D. Don./203, 317 [NW]	*macaçá*	Oxum (3), Oxumarê, Nanã (2), Yemanjá (4), Iansã
Nicotiana tabacum L./NC [NW-cosm. cult.]	*fumo*	Ossâim(3)
Solanum americanum Mill./185, 215 [NW]	*maria preta/erva Santa Maria*	Iansã

Family Species/collection number [geographical origin-status]	Vernacular names	Associated Orixá(s) (number of informants)
Sterculiaceae		
Cola acuminata (Beauv.) Schott & Endl./307 [OW-cosm. cult.]	***obí***/*noz de cola*	Ifá, all the orixás
Verbenaceae		
Lantana camara L./312, 396 [NW-cosm. weed]	*cambara branca*	Oxalá
Lantana camara L./386 [NW-cosm. weed]	*cambara amarella*	Oxum
Vitex sp./232 [Unkn.]	*alfazema*	Oxum
Violaceae		
Hybanthus colceolaria (L.) Schulze-Menz [Unkn.]	*purga do campo*	Oxalá
Zingiberaceae		
Aframomum meleguetta K. Schum. [OW-cult.]	***atarê***/*pimenta da costa*	Exu (3)
Alpinia zerumbet (Pers.) B. L. Burtt & R. M. Sm./192 [OW-cosm. cult.]	*leopoldina*	Oxalá, Oxum (2), Odudua
Hedychium coronarium J. König/305 [OW-cosm. weed]	*jasmin do brejo*	Oxum

RITUAL PLANT USES

The Candomblé ethnoflora is prepared in a myriad of ways for a multitude of disorders. Unlike plant prescriptions for illness perceived to be organically based, ritual species are seldom ingested and occasionally do not even come in contact with the body. Decorative plants are placed near the house or kept on the body to repel evil eye. Priests remove negative fluids from patients by brushing or whipping the body with a bundle of leaves. Adherents wear small cloth amulets around their necks containing leaves, magical phrases, and other sacred objects in order to avoid magical spells. Selected leaves are scattered on the floor and hung above entry ways before public ceremonies to neutralize negative energies that might enter with strangers. Aromatic leaves are burned as incense to cleanse the room and its inhabitants of negative spirits.

Among the African Yoruba and their Brazilian descendants several plant species are considered indispensable to primary initiation ceremonies. These include the seeds of ***obí*** (*Cola acuminata*) and ***orobô*** (*Garcinia kola*), species employed in West Africa and Brazil during divination and initiation (Verger 1981). Secret foliar concoctions are used to wash the sacred necklaces of adepts, and magical powder prepared from leaves, seeds, and chalk is painted on the shaved heads of initiates. During the early months of initiation, the novice spends his or her nights in a small room (***roncó***) sleeping on a bed of sacred leaves.

The ***abô*** (leaf bath) represents the most common plant prescription for novices and secular patients. Baths are employed for initiation, for financial improvement, and for purification (Williams 1979). Their most important role, however, is medicinal. ***Abô*** are taken for organically based medicinal problems, such as rheumatism, skin ailments, headaches, and the like. More commonly, the *pai* or *mãe-de-santo* prescribes baths for psychological disorders, such as anxiety and depression, particularly where these are viewed as spiritual in origin.

Leaf baths are prepared according to the individual needs of the patient. There is no set of predetermined set of foliar recipes. The priest or priestess determines the etiology and the prescriptive remedy during a divination ceremony using the *jogo de búzio,* or cowry toss (Braga 1988). Introduced along with other divination methods during the course of the slave trade, the *jogo de búzio* system allows the temple leader to consult directly with the deities. After rolling sixteen shells on a board, the *pai* or *mãe-de-santo* identifies the number of open and closed shells, that is, apertures facing up or down. The shell combination corresponds to one or several specific ***odu***, or Yoruba myths, which suggests the cause of the problem and the appropriate course of action. When a bath enters into the prescribed remedy, the appropriate leaves are placed in a basin of cool water and slowly macerated with the hands. Physical manipulation of the leaves is essential, as this transfers ***axé*** (vital energy) from the priest to the developing bath. The resultant greenish concoction, charged with the innate power of the leaves and that of the priest of the *terreiro* (Candomblé temple), is placed inside a small altar dedicated to one or another of the African deities until the medicine has assimilated further ***axé***. Finally, the patient pours the cool leaf bath over his or her body, usually starting at the shoulders, and allows it to dry before dressing.

GODS AND LEAVES

Candomblé revolves around propitiation of a pantheon of African deities, the ***orixás***. Although their number in Africa may have been enormous (Bascom 1991), only a dozen or more ***orixás*** gained prominence in the newly constituted Brazilian *terreiros*. Devotees recognize the existence of a high god, Olórun, but he is perceived to be distant and unapproachable by humans. It is the ***orixás***, serving as the earthly ambassadors of Olórun, who are directly linked to the health and happiness of mortals (Povoas 1989).

Each ***orixá*** is associated with a distinct realm of nature: earth, wind, water, and fire (Elbein dos Santos 1988). Ogun is the god of agriculture and iron, Xangô the god of lightning and thunder, Nanã the goddess of swamps, rain, and soil. Temperament and behavior further divide the deities; masculine ***orixás*** are generally hot tempered and unpredictable whereas feminine ***orixás*** are cool and balanced. Thus, Oxóssi is the volatile ***orixá*** of the hunt and of the forest. His personality as well as that of his mortal devotees is characterized by keen intelligence and curiosity. He is the itinerant seeker and explorer. Oxum, on the other hand, is the feminine deity of fresh water streams and rivers. Like the other water goddesses, Yemanjá and Nanã, her temperament reflects the perceived condition of her physical realm—cool and calm.

The ***orixás*** are also connected with specific symbols, preferences, and prohibitions (***euó***). These include color choices of clothing and sacred beads; offerings of food, drink, and sacrificial animals; food taboos, icons, and geographical locations.

Oxalá, for example, the creator god of peace and love, prefers lofty locations. Avoiding the color black, he and his followers dress in white from head to foot. He is prohibited from consuming crabs, hot peppers, and salt.

Candomblé adherents are connected with one or two ***orixás***, and they must strictly respect the preferences and prohibitions of their guardian deities. The perceived essence of the devotee's personality, in turn, corresponds to the recognized archetype of one or more of the ***orixás*** (Lepine 1981). Thus, a vivacious and impulsive follower will "belong" to Iansã, fiery goddess of storms; an inquisitive foreign researcher will belong to Oxóssi, restless god of the hunt. In order to avoid spiritual problems, adherents must remain within the cosmic equilibrium imposed by their particular ***orixás***. These limits, in turn, correspond with the behavioral attributes of the deity. For example, a client who belongs to Oxum, female goddess of fresh waters, is preoccupied with personal appearance and material wealth. This is the natural state of Oxum and that of her devotees. However, when this otherwise normal behavior becomes compulsive, spending grocery money on perfume, for example, the limits of Oxum have been violated and disequilibrium with the spirit world has occurred. By trespassing his or her established limits, the adherent invites physical, material, and spiritual disaster. Overheated or overcooled, he or she must propitiate the appropriate deity promptly with material offerings, more diligent observance of taboos and, in most cases, take the prescribed leaf bath.

Ossâim, guardian of the sacred leaves and medicine, is the deity most directly involved in health and healing. His domain is the forest and the field, wherever curative plants grow spontaneously. Among the Yoruba and their New World diaspora, his image is one of extreme physical disability—one eye, one leg, one enormous ear, and a humorous high-pitched voice (Thompson 1975). As the dedicated but reticent steward of the vegetal realm, Ossâim's knowledge was coveted by other deities who sought to share in his secrets. The following legend, recorded in Africa (Verger 1981), Cuba (Cabrera 1971), as well as Brazil, describes how the ***orixás*** came to possess individualized plant pharmacopoeias:

> There is a legend of rivalry between Ossâim, the ***orixá*** of medicine and leaves, and Iansã, the ***orixá*** of stars, winds, and storms. Everything began as a result of jealousy. Iansã went to visit Ossâim. Ossâim is very reserved, quiet, silent. Iansã wanted to know what he was doing. When Ossâim has the opportunity, he explains things. But Iansã is always rushed, she wants everything done immediately. She is always asking questions, and she needs to know everything that's going on. When Iansã arrived at the house of Ossâim, he was busy working with his leaves. It happens that there are certain types of work with leaves that you can't talk about, you need to remain silent. Iansã started asking, "What are you doing? Why are you doing this? Why are you doing that?" And Ossâim remained silent. "Alright, if you don't want to tell me what you're doing, then I'll make you talk." That's when Iansã began to shake her skirt and make the wind blow. The house of Ossâim is full of leaves, with all of their healing properties, and when the wind began to blow, it carried the leaves in every direction. Ossâim began to shout, **"Ewe O, Ewe O"** ['my leaves, my leaves']. Ossâim

> then asked the help of the ***orixás*** to collect the leaves, and the ***orixás*** went about gathering them. And it happens that every leaf that an ***orixá*** collected, every species, he or she became the owner of that leaf.

Scattered by the winds of Iansã, the sacred leaves became divided among the ***orixás***. Whereas the mysterious power of the vegetal kingdom was retained by Ossâim, each deity nevertheless came to be associated with his or her own personal pharmacopoeia. The following is a summary of the principal characteristics used to divide medicinal species among the deities. Only ***orixás*** with well developed plant correspondences are discussed.

MEDICINAL PLANT CLASSIFICATION

As the god of love and peace, Oxalá embodies the white dimension of nature. His color preference represents the major organizing force in his pharmacopoeia. The white infructescence of cultivated *algodão* (*Gossypium barbadense*) places this shrub within the domain of Oxalá, as do the aromatic white racemes of *sabugeiro* (*Sambucus australis*). The pantropical herb *boa noite* (*Catharanthus roseus* var. *albus*) has both white flowers and latex. The weeds *candeia branca* (*Miconia hypoleuca*), *purga do campo* (*Hybanthus colceolaria*), and *cambara branca* (*Lantana camara* L.) have white flowers, and *jambo branco* (*Syzygium jambos*), a domesticate from Asia, produces pale colored fruit.

Unlike the other masculine deities, whose temperaments are hot and warlike, Oxalá is most intimately associated with the female entities, spiritual forces that serve to sooth and cool. One of his healing roles, as well as that of his associated flora, is to counteract illness associated with overheating, a condition that frequently troubles adherents and clients who are connected to the hot deities. Thick-leaved plants that exude liquid when crushed, such as *folha da costa* (*Kalanchoe integra*), are considered to have cooling properties, and are thus usually associated with the cool-tempered ***orixás*** like Oxalá (Figure 2). In addition to cooling foliar baths, this plant is also employed as a remedy for headache, a perceived hot symptom, by placing the leaf as a poultice on the patient's forehead. These characteristics, along with the belief that Oxalá controls illness associated with the head, places this species firmly within his domain (Sandoval 1979, Williams 1979). Another of his species, the medicinal grass *capim santo* (*Andropogon schoenanthus*), is prepared as an infusion to treat hypertension, another illness associated with heat. Other cooling, thick-leaved species dedicated to this pacifist god include *folha do ar* (*Mikania glomerata*), *alfavaquinha da cobra* (*Peperomia pellucida*), and *tapete da Oxalá* (*Plectranthus amboinicus*), the leaves of which are so densely pubescent as to appear white.

Oxum is the feminine ***orixá*** of running water. She is a voluptuous fertility figure who is anatomically associated with the female organs and the stomach. Vain and materialistic, Oxum adores gold, jewelry, and perfume. Reflective of her love of perfume, nearly all of her leaves and flowers are sweetly fragrant. These aromatic plants are added to baths for their soothing properties, underscoring the cooling influence of Oxum. The mint family, noted for its essential oils, is represented in her pharmacopoeia by *alecrim* (*Hyptis fruticosa*), *poejo* (*Mentha pulegium*), and *patchulí* (*Pogostemon* cf. *cablin*). Other aromatics associated with Oxum include

FIG. 2.—The herb *folha da costa* (*Kalanchoe integra* [Medic.] O. Ktz.) belongs to Oxalá. Its thick leaves distinguish this as a cool plant.

sabugueiro (*Sambucus australis*), *macaça* (*Brunfelsia uniflora*), *jasmin do brejo* (*Hedychium coronarium*), and *beti cheiroso* (*Piper* sp.). *Laranja da terra* (*Citrus aurantium*), which has fragrant flowers and leaves, retains a cooling medicinal influence as a sedative when taken as an infusion. Water retention is believed to be a hot ailment, hence Oxum's ownership of *arrozinha* (*Zornia* cf. *gemella*), a plant employed medicinally as a diuretic. *Leopoldina* (*Alpinia zerumbet*) is particularly well suited to Oxum (Figure 3). Its flowers are prepared into an infusion that is believed to have a tranquilizing effect, diminishing the heat associated with anxiety, whereas its scented leaves are a frequent component of perfumed baths. The leaf extract of *vassourinha*

FIG. 3.—The sweetly scented leaves of *leopoldina (Alpinia zerumbet)* pertain to Oxum. The leaves enter into aromatic baths whereas the flowers are brewed into an infusion for the treatment of anxiety.

santa (*Scoparia dulcis*) is employed to reduce fever, an obvious hot symptom, hence its possession by a cool deity.

Oxum's remaining flora reveals her obsession with wealth. Her love of gold is symbolized by the bright yellow flowers of *arrozinha* (*Zornia* cf. *gemella*), *mal-me-quer* (*Wedelia paludosa*), *maravilha* (*Caesalpinia pulcherrima*), *cambara amarella* (*Lantana camara*), and *acocí* (*Wulffia baceata*). Oxum's material interests account for her association with *folha da fortuna* (*Kalanchoe pinnata*), a fleshy-leaved garden cultivar with perceived cooling properties. It has the curious habit of sprouting roots and seed-

FIG. 4.—*Unha da vaca (Bauhinia ovata)* represents one of Yemanjá's species. The characteristic hoof-shaped leaves of this genus, which occurs in the Old and New World, allowed early Candomblé healers to substitute a Brazilian species for the original African taxon. In some terreiros, this species is still known by its Yoruba name, *abafé*.

lings viviparously at its leaf margins, hence its perceived ability to create something from nothing. This 'leaf of fortune' has long been employed to attract money by attaching it to the doors of adherents homes (Voeks 1990). Another of Oxum's leaves, *vintém* (*Drymaria cordata*), is used for similar material ends.

Yemanjá is another fertility figure whose aquatic home is the ocean. Her preferred geographical location is the shoreline. Warm, maternal, and stable, Yemanjá is the archetype mother image. Her favorite colors are transparent or crystal blue, symbolic of her watery domain. Many of her species are aromatics, including *alecrim* (*Hyptis fruticosa*), *macaçá* (*Brunfelsia uniflora*), *patchulí* (*Pogostemon* cf. *cablin*), *manjericão* (*Ocimum canum*), and ***dandá*** (*Cyperus rotundus*). This latter Africa sedge often inhabits coastal wetlands, reflecting Yemanjá's physical domain. *Marianinha* (*Commelina diffusa*) has pale blue flowers, Yemanjá's color choice, and is employed to treat inflammation, a hot symptom.

Like Oxum, Yemanjá is connected with problems of the uterus and female organs. This may explain the inclusion of *transagem* (*Plantago major*), a medicinal herb that is prepared as an anti-inflammatory tea for uterine problems. The leaves of *unha da vaca* (*Bauhinia ovata*) are prepared as an infusion to treat diabetes, a hot disease, hence its association with this cool deity (Figure 4). Yemanjá's maternal image — she is popularly referred to as the "milk *orixá*"—is reflected in her association with *mamona* (*Ricinus communis*). The use of this weedy shrub to treat lactation problems is widespread in the Old and New Worlds (Ayensu 1978, Morton 1981). According to an elderly Candomblé *pai-de-santo,* African wet nurses in Brazil used to hang pieces of the stem of *mamona* around their necks in the belief that it relieved painful lactation. Derived from the verb *mamar,* to suckle, *mamona* in colloquial Portuguese refers to a female baby who nurses well, again suggesting this plant's connection with mother's milk and hence Yemanjá.

Nanã, the aged female goddess of rain, swamp, and soil, represents the grandmother of the ***orixás***. Like the other cool deities, she is associated with regeneration. Her colors are lavender or blue and white. Nanã's leaves are mostly aromatic, including *neve cheiroso* (*Hyptis suaveolens*), *hortelã* (*Mentha* sp.), *alecrim* (*Hyptis fruticosa*), *beti cheiroso* (*Piper* sp.), *patchulí* (*Pogostemon* cf. *cablin*), and *macaçá* (*Brunfelsia uniflora*). Two of her plants, *bom dia* (*Catharanthus roseus*) and *salsa da praia* (*Ipomoea pes-caprae*), display large lavender-colored flowers, representative of her color preference.

Iansã is the female deity of wind, storms, and stars. Unlike the cool female deities, Iansã can be either hot or cool, bellicose or compassionate, depending on her mood. The fiery side of her temperament is symbolized by her red color preference. The leaves of Iansã, like her archetype, vacillate between the extremes of hot and cool. Several are sweetly aromatic, such as *macaçá* (*Brunfelsia uniflora*), *beti cheiroso* (*Piper* sp.), and *patchulí* (*Pogostemon* cf. *cablin*), which she shares with the other water *orixás*—Nanã, Yemanjá, and Oxum. The majority of her leaves, however, symbolize her warlike qualities. Many have an acrid or foul smell as well as pointed apices, representing her sword. These species include *aroeira* (*Schinus terebinthifolius*), which has bright red, acrid berries; *fedegoso* (*Senna occidentalis*), which has strong smelling leaves shaped like daggers; and *mastruz* (*Chenopodium ambrosioides*), which also has pointed, rank smelling leaves. *Folha do fogo do Iansã* (*Tibouchina* cf. *lhotzkyana*), literally 'Iansã's fire leaf', has pointed leaves and is covered by a dense layer of reddish pubescence, representing her color choice. Iansã's nature is best elicited by *guiné* (*Petiveria alliacea*). Aside from acrid-smelling leaves, this herb is used medicinally as a tranquilizer and somniferant, hence its cooling dimension. If ingested for prolonged periods, however, the root extract of *guiné* is reported to produce anxiety, hallucinations, and even death (Cravo 1984). Thus, like Iansã herself, *guiné* swings unpredictably between the extremes of hot and cold.

Omolu is the dreaded god of smallpox and dermal ailments. Powerful and vengeful if ignored by his supplicants, Omolu is one of the most feared of the Yoruba deities. His image is ancient, bent, and arthritic, with skin so scarred by smallpox that he conceals himself in a suit of palm straw. His colors are white and black. Many of his leaves have rough and punctate surfaces, suggesting his own pockmarked skin. These include *balainho do velho* (*Centratherum punctatum* Cass. ssp. *punctatum*), *candeia branca* (*Miconia hypoleuca*), canela do velho (*Miconia* sp.), and capeba (*Pothomorphe umbellata*). One of Omolu's plants is *sete chagas* (*Philodendron* sp.), 'seven sores', although this plant's connection with skin disease is unclear. *Quitoco* (*Pluchea suaveolens*) represents a medicinal treatment for rheumatism, one of Omolu's noted afflictions.

Popcorn is one of Omolu's principal offerings and bath ingredients. With its contorted shape, popcorn symbolizes the skin eruptions associated with smallpox. Its explosive kernels may also be seen to reflect Omolu's volatile temper. Fear-ing even to mention the name of this plant for fear of invoking Omolu's wrath, devotees refer to popcorn as *'a flor'* (flower) within the confines of the *terreiro. Mamona* (*Ricinus communis*) is another of his plants. The spiny red fruits of this species suggest Omolu's skin condition, as well perhaps as his piqued anger (Thompson 1983). The explosive nature of *mamona's* fruit, which can send its seeds flying several meters, is reflective of this god's violent temperament. *Pinhão roxo* (*Jatropha gossypifolia*), which has reddish leaves and petioles, further suggests Omolu's fiery temper.

Xangô is the volatile god of thunder, lightning, and fire. He is geographically associated with high places, and his colors are red and white. Xangô's temper is reflected by the reddish-purple floral display of some of his species, including ***akokô*** (*Newbouldia laevis*), *bico de papagaio* (*Centropogon cornutus*), and *cordão São Francisco* (*Leonotis nepetaefolia*). The reddish pubsecence of *folha do fogo* (*Clidemia hirta*) further suggests his color preference. Xangô's flora is further characterized by a high representation of trees and shrubs. Sixty-four percent of his flora is arborescent, compared to less than 21% of the combined Candomblé pharmacopoeia. His tree flora includes *bico de papagaio, São Gonçalinho* (*Casearia* sp.), *murici* (*Byrsonima sericea*), *embaúba* (*Cecropia pachystachya*), *betis branco* (*Piper aduncum*), ***akokô***, and ***orobô*** (*Garcinia kola*). Xangô's link to arborescent as opposed to understory vegetation may stem from his preference for elevated locations. It may also follow, as one informant suggested, from the fact that trees are frequently struck by lightning, the source of ***axé*** for Xangô, and that this vital force is transferred from the skies via these conductors to the sacred foliage inhabiting the ground.

The masculine deities Oxóssi and Ogun are brothers according to legend. Oxóssi, who holds sway over the hunt and the forest, shoulders an iron bow and arrow. His colors are green and red. Ogun is the god of iron and war. Forever hammering out his iron implements at the forge, Ogun is by nature very hot. He is the consummate warrior figure, fending off evil, opening up passages, winning battles. His colors are green or blue.

The leaves of these brother deities, many of which they share, are characterized by long blades and pointed apices representing the spears and arrows of these two warrior gods. These species are typified by ***peregun*** (*Dracaena fragrans*) and the bowstring hemps *espada de Oxóssi* and *espada de Ogun* (*Sansevieria* cf. *aethiopica*). The vernacular names of Ogun and Oxóssi's leaves evoke their aggressive archetypes, their ability to solve the problems of their followers. These species include *abre caminho* (*Baccharis* sp.) 'open the way', *vence tudo* (*Rolandra fruticosa*) 'conquers everything', *comigo ninguem pode* (*Dieffenbachia maculata*) 'no one overpowers me', *tira teima* (*Zanthoxylum* sp.) 'take away stubbornness', and *vence demanda* (*Vernonia* cf. *cotoneaster*) 'achieve objectives'. Ogun's association with ***dandá*** (*Cyperus rotundus*) reflects the perceived magical attributes of this plant, as both West Africans and Brazilians chew the rhizomes of ***dandá*** in order to influence the opinion of others (Dalziel 1948).

Exu is the deity of passageways and crossroads. Capricious and at times malicious, Exu serves as messenger to the ***orixás***, the transporter of ***axé***. Although he is a notorious troublemaker, and great effort is expended to placate him during Candomblé ceremonies, Exu is also the god of potentiality, the catalyst that make things happen. Properly propitiated, he clears obstructions to human wants and desires. Ignored, Exu brings calamity with a vengeance. Symbolic of his temperament, Exu's colors are red and black.

The leaves of Exu are as threatening as his personality. Many give off a burning sensation when touched, and most are employed for malevolent purposes—to destroy intimate relationships, to bring bad luck, and to create general chaos. Covered with spines and prickly pubescence, several are painful to the touch, including *urtiga* (*Dalechampia ilheotica*), *folha do fogo* (*Clidemia hirta*), *cansanção* (*Cnidoscolus urens*), the fronds of ***dendê*** (*Elaeis guineensis*), and the stems of *malissa* (*Mimosa pudica*). The razor sharp leaf margins of *tiririka* (*Fuirena umbellata*) readily cut the skin of those who choose to handle it. The prickly fruits of this weedy sedge, along with those of *carrapicho* (*Bidens pilosa*), cling to the legs of passersby, finding by this means transport to trails and roads, the preferred haunts of Exu.

Nearly all of Exu's leaves enter into black magic formulas. The red seeds of ***atarê*** (*Afromum meleguetta*), for example, an African domesticate imported since the 19th century, are ground into powder and scattered in the homes of victims in order to create disorder, a practice still carried out in Nigeria (Voeks 1990). The nearly black flowers of *corredeira* (*Irlbachia purpurascens* and *Borreria* sp.), symbolizing Exu's dark side, are ground into a powder in combination with grave dirt in black magic ceremonies.

HOT AND COLD IN CANDOMBLÉ

The hot-cold opposition that is symbolized by the archetypes of the Yoruba pantheon is one of the organizing principles in the Candomblé medicinal plant classification system. As the gods are seen to gravitate towards either one or the other perceived temperature states, so also do their associated illnesses and healing plants. Hot deities are prone to hot illness, physical and psychological, and their medicinal treatments are often drawn from the pharmacopoeias of the cool goddesses. The leaves of hot gods are, at least in principle, employed to heat the cool feminine deities.

From the perspective of a cohesive ethnomedical paradigm, however, the hot and cold syndrome suffers from noticeable irregularities. First, the characteristics of several Candomblé plants fail to conform to the behavioral attributes of their associated god. *Assa peixe branco* (*Pluchea sagittalis*), for example, is one of Ogun's leaves. However, this plant produces a white floral display, suggestive of Oxalá's color preference, and is employed medicinally as a febrifuge, a hot symptom that should place this taxon within the purview of a water deity. Likewise, whereas *sabugueiro* (*Sambucus australis*) is shared by Oxalá and Oxum, both cool tempered deities, the medicinal use of this plant to treat skin problems suggests an association with Omolu, a hot god. These apparent inconsistencies, at least in some cases, reflect the range of properties that characterize individual taxa. For example, one informant connects the aromatic sedge ***dandá*** (*Cyperus rotundus*) with Yemanjá, suggesting the physical domain of this deity. Two other informants place ***dandá*** with Ogun, a god known for his ability to clear obstructions that serve to constrain his supplicants. This latter correspondence reflects the perceived magical properties of this species. Other apparent inconsistencies in god-plant associations, however, are not so readily explained.

The classification and treatment of hot and cold illness exhibits further problems. Although a host of hot medical problems are associated with masculine gods, and cooling prescriptions are associated with cool deities, the reverse situation is relatively rare. Few of the leaves used to treat cool illness are connected to the hot deities. This is not for lack of perceived cool medical problems, which include colds, flu, hypotension, and hypoglycemia, nor appropriate plant prescriptions to treat these ailments. Healers discussed the use of *mamão* (*Carica papaya*), *capim estrella* (*Rhynchospora nervosa*), *malva branca* (*Sida carpinifolia*), and other plants to treat colds, a cool illness, although none of these species correspond to a masculine deity. They are simply medicinal plants with no perceived spiritual significance. Avocado (*Persea americana*) is likewise not associated with a deity, although the leaves of this New World cultigen are prepared as a diuretic, a perceived heating property. For reasons that are unclear, the hot plant-cool illness concept is poorly developed within Candomblé.

The hot-cold syndrome is not unique to Brazilian Candomblé. This ancient concept is at the heart of early European and Asian health and healing theories, and is a dominant organizing principle in many Latin American and African American folk medical systems as well (Anderson 1987, Currier 1966, Laguerre 1987). Although the presence of a hot and cold etiology among Hispanic Americans can often be attributed to diffusion from Old World sources, the existence of this concept among Mesoamerica's pre-Hispanic civilizations, the Mayas, the Aztecs, and the Zapotecs, as well as among isolated indigenous South American societies, argues for the independent evolution of the hot-cold paradigm in the New World (Colson and de Armellada 1983, Messer 1987).

The origin of the hot-cold dichotomy within Candomblé ethnomedicine is problematic. Although hot and cool temperature states characterize the dispositions of the Yoruba deities, both in Africa and Brazil (Thompson 1983, Verger 1981), evidence that Candomblé's hot and cold etiology traces its roots to Africa is lacking. This binary system does not appear among the sacred oral texts of the Yoruba ***babalaô*** (Bascom 1991). Nor do the incantations recited by the ***babalaô*** to invoke the vital energy of the medicinal leaves allude to any hot and cold properties (Verger 1967). Yoruba herbalists, a separate class of healers who tend to organic rather than spiritual and magical illness, prescribe medicines that are bitter, sweet, sour, or peppery. But like their ***babalaô*** counterparts, they do not classify either illness or medicine along hot and cold lines (Buckley 1985).

There is no evidence one way or the other regarding the possible contribution of Amerindian health and healing concepts to Candomblé's hot and cold opposition. Motivated by practical concerns, particularly the virgin soil epidemics that decimated the indigenous population, sixteenth century Bahian planters and missionaries went to considerable efforts to document the local Tupinambá plant pharmacopoeia, which was extensive (Cardim 1939, Sousa 1971). Other contemporaries described how the indigenous shamans directed the women to sing and dance in a circle, after which they fell into trance and were "able to foretell future things," ceremonies that are highly reminiscent of those currently carried out in Candomblé (Staden 1928:150, Lerivs 1625). Focused on what was considered useful or exotic, these early reports not surprisingly failed to explore the more theoretical dimensions of indigenous etiology and healing.

Among Brazilians of European descent, however, the concept of environmental control of illness, particularly the deletarious effects of heat and cold, has a long pedigree. In the early 1600s, Dutch physician Guilherme Piso counseled recent arrivals to Brazil against the overuse of hot and cold baths (Piso 1948:10). During the colonial period, Brazil's excessive heat was blamed on a multitude of venerial and childhood disorders (Freyre 1986). Today a seemingly endless array of illness episodes, some life threatening, are attributed to the environmental effects of imbalanced temperature states. Activities such as drinking cold water on a hot day, taking a cool shower after a hot meal, or sitting in a recently vacated warm chair are all perceived as unnecessary health risks (Cascudo 1967).

Centuries of culture contact and miscegenation in the Northeast of Brazil has blurred the racial and cultural distinctions that separated Europeans and Africans. In the area of religion and magic, Africans borrowed liberally from their oppressors, particularly when these beliefs were found complementary to their own. Incorporating alien materials and beliefs represented both a survival mechanism—Catholicism was Brazil's only sanctioned religion—as well as actual changes in the convictions of adherents. This flexibility is characterized by the syncretism of African ***orixás*** and Catholic saints, a process that was well advanced in Bahia by the late 19th century (Rodrigues 1935). Such a fusion of spiritual images and meanings was facilitated by the nearly parallel roles played by the African pantheon and Catholic hagiology in the attainment of practical goals, for example, warding off disease, increasing fertility, and maintaining good health (Camara 1988). The malleability of African healing systems, the ability to change and adapt as social, economic, and biological conditions necessitate, is further underscored by the wholesale adoption of European and Amerindian medicinal and magical species by Afro-Brazilian healers (Voeks n.d.).

This process of redefinition and assimilation may well have extended into the conceptual dimensions of ethnomedicine. Two components of the hot and cold system, division of the Yoruba deities into hot and cold categories and correspondence of deities with ritual and medicinal species, arrived with African priests and priestesses during and after the slave trade. Adherents who stray from the archetypal equilibrium imposed by their guardian deities become overheated or overcooled and, in so doing, open the door to spiritual retribution. This simple opposition was, in a sense, preadapted to the addition of and modification by complementary concepts. These would have included the belief that physical and emotional distress is at least partly mediated through relations with the spirit world, to which both belief systems already subscribed. It also could have facilitated the correspondence of hot and cold deities, an African concept, with the folk belief that many illness are the outcome of hot and cold imbalance, concepts that are in all likelihood of Portuguese origin.

CONCLUSIONS

In spite of seemingly insurmountable social, economic, and material obstacles, African slaves and their descendants introduced significant elements of their native ethnomedical systems to Brazil. One of the material dilemmas that confronted newly arrived priests was how to continue practicing a plant-based healing system in an alien floristic landscape. As slave laborers and later poor freedmen, Africans had limited opportunites to directly transplant their original *materia medica*. Two products of apparent intentional introduction are ***akokô*** (*Newbouldia laevis*) and ***obí*** (*Cola acuminata*), both of which were brought to Brazil specifically to fulfill Candomblé ritual (Voeks 1990). A few other taxa, such as ***orobô*** (*Garcinia kola*) and ***atarê*** (*Afromum meleguetta*), continue to be imported by Afro-Brazilians for ritual purposes, but have apparently failed to reproduce in Brazil. Although other useful African taxa were intentionally introduced as well, such as ***dendé*** (*Elaeis guineensis*), ***peregun*** (*Dracaena fragrans*), and *espada de Oxóssi* (*Sansevieria* cf. *aethiopica*), these most likely represented the commercial and decorative interests of Portuguese colonists rather than the demand of their captive laborers. Arriving Africans also encountered and incorporated a host of familiar herbaceous plants, such as ***dandá*** (*Cyperus rotundus*), *tiririka* (*Fuirena umbellata*), and *jasmin do brejo* (*Hedychium coronarium*), opportunistic Old World weeds that had successfully colonized the increasingly disturbed Brazilian landscape. Thus, by means of intentional and accidental plant introductions, Afro-Brazilian healers continued to employ at least a small percentage of their native African ethnoflora.

African immigrants must nevertheless have recognized early that the ability to practice magic and medicine in the Americas depended upon their capacity to adopt the flora immediately at hand. This ethnobotanical flexibility was provided, at least in part, by the Yoruba folk taxonomic system. In West Africa, ritual and medicinal species correspond with one or another of the ancient deities, a relationship mythically underpinned by the legend of Ossâim's leaves. The nature of these god-plant associations, which are encoded in the medicinal recipes and incantations of the ***odu***, are maintained as oral text and recited during divination by ***babalaô*** priests, the most respected class of Yoruba healer (Bascom 1991). Although ***babalaô*** priests are known to have arrived in Brazil both during and after the slave trade, their highly complicated system of divination ultimately failed to survive (Carneiro 1967). Rather, in the newly constituted Candomblé *terreiros*, priests and priestesses continued to divine the source of problems, but now by means of the simpler *jogo de búzio* method (Braga 1988) and with reference to a much diminished and modified corpus of mythical text.

It is unlikely that many of the original Yoruba god-plant correspondences were maintained in Brazil. Among the various African ***babalaô***, there is considerable variation in the verses of the ***odu*** (Bascom 1991), and it seems likely that such diversity of opinion extended to the area of god-plant associations as well. If this were the case, then obviously no single set of correspondences could have arrived in Brazil. Regardless, several introduced African taxa did retain a significant measure of their ritual and magical significance—***akokô*** (*Newbouldia laevis*), ***obí*** (*Cola acuminata*), ***orobô*** (*Garcinia kola*), ***atarê*** (*Afromum meleguetta*), ***dandé*** (*Cyperus rotundus*), ***peregun*** (*Dracaena fragrans*), and ***dendé*** (*Elaeis guineensis*). More importantly, however, priests were able to incorporate hitherto unknown species into their pharmacopoeias based upon a broad suite of characteristics corresponding with the personalities, physical appearances, and preferences of each of the African ***orixás***.

The Yoruba gods that survived in Brazil are divided between those perceived to be hot and cool, masculine and feminine. Hot ***orixás*** are associated with fiery personalities—aggressive, warlike, volatile—and many of the New World species that were assigned to these gods symbolically reflect these behavioral attributes. Leaves and stems are spiny or prickly. Flowers and fruits are red or black reflecting their hot temperaments. Leaves exhibit linear blades, acuminate tips, foul or acrid aromas, or rugose surfaces. The feminine deities, on the other hand, represent cooling and calming influences. They are maternal, sensuous, fertile, and materialistic. Their designated personal floras, in turn, are characterized by sweetly aromatic leaves and flowers with white, gold, blue, or lavender corollas. Leaves tend to be fleshy with abundant sap. Several species enter into medicinal prescriptions to cool down illness associated with the hot deities.

The resultant Candomblé spiritual pharmacopoeia is highly representative of Bahia's evolving floristic landscape. Of those species for which origins could be determined, over 70% are of New World origin. This figure represents endemic American species that were entirely new to Africans, as well as many New World taxa that had been transported to Africa during the course of European colonization, either as weeds or cultigens. South American *algodão* (*Gossypium barbadense*) and *fumo* (*Nicotiana tabacum*), for example, which were introduced to West Africa during the colonial period, must have been familiar to most Africans prior to their enslavement and transport to Brazil (cf. Bosman 1705, Purseglove 1984). These species were incorporated into the corpus of medicinal knowledge retained in the Yoruba ***odu*** (Verger 1976–1977), and were likely transported to Brazil in the memories of arriving priests and priestesses. This process of recognizing and adopting New World species that had been previously introduced to Africa may have been particularly common with weedy taxa, which constitute a significant proportion of the Candomblé ethnoflora. An array of weedy species diffused to Africa during the slave trade, and many assumed importance in Yoruba healing rituals. These included *alfavaquinha de cobra* (*Peperomia pellucida*), *folha da costa* (*Kalanchoe integra*), *malissa* (*Mimosa pudica*), and *vassourinha santa* (*Scoparia dulcis*), all of which enter into healing recipes employed by African Yoruba and their Brazilian descendants (Verger 1976–1977).

Candomblé medicinal folk taxonomy bears little resemblance to its western scientific counterpart. Floral structure is seldom considered in determination, and phylogenetic hierarchy plays no role whatsoever in classification. Salience is wholly defined by those features, tactile, olfactory, visual, geographical, or medicinal, that suggest association with the archetypes of one or another deity. Closely related taxa, for example *manjericão* (*Ocimum canum*) and ***quiôiô*** (*O. gratissimum*), pertain to different ***orixás***, as do varieties of the same species, such as *bom dia* (*Catharanthus roseus*) and *boa noite* (*Catharanthus roseus* var. *albus*).

Candomblé *terreiros* function independently of each other, and competition rather than cooperation characterizes their relationship. There is limited exchange of information among *terreiros* and nothing approaching a Candomblé collective medicinal knowledge. Exposed to a diverse and largely unknown flora, early priests and priestesses determined independently which species belonged to which deity based on the legend of Ossâim's leaves as well as their own perceptions of the essence of each plant. These decisions were passed on to devotees, who founded their own temples and continued to assimilate additional taxa. This independence is evidenced by the Candomblé ritual floras which, although organized by means of the same conceptual framework, nevertheless exhibit limited floristic overlap from one priest to another and from one *terreiro* to another (Barros 1983, Fichte 1976, Williams 1979).

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RECENT DOCTORAL DISSERTATIONS OF INTEREST TO ETHNOBIOLOGISTS XIII

JOSEPH E. LAFERRIÈRE
Herbarium, 113 Shantz Bldg.
University of Arizona, Tucson AZ 85721 USA

TERENCE E. HAYS
Department of Anthropology and Geography
Rhode Island College
Providence, RI 02908 USA

ABSTRACT.—This bibliography includes recent dissertations of interest to ethnobiologists. For each we give the page number where it may be found in Dissertation Abstracts (D.A.) and the order number for dissertation copies from University Microfilm International, P.O. Box 1764, Ann Arbor, Michigan 48106-1346 U.S.A. (telephone: 313-761-4700 or 800-521-3042; 800-343-5299 from Canada).

RESUMEN.—En este bibliografía se incluyen disertaciones recientes de interés a los etnobiólogos. Por cada uno se da el número de la página donde se halla el resumen en Dissertation Abstracts (D.A.), y el número de encargar un ejemplar de la disertación de University Microfilm International, P.O. Box 1764, Ann Arbor, Michigan 48106-1346 U.S.A (teléfono: 313-761-4700 o 800-521-3042; desde Canada 800-343-5299).

RÉSUMÉ.—Cette bibliographie comprend quelques dissertationes recentes d'interet aux ethnobiologistes. Chez chaqu-une on donne le número de la page où se trouve le résumé dans Dissertation Abstracts (D.A.), et le número de commander un exemplaire de la dissertation de University Microfilm International, P.O. Box 1764, Ann Arbor, Michigan 48106-1346 U.S.A (telephone: 313-761-4700 ou 800-521-3042; de Canada 800-343-5299).

INTRODUCTION

This is the thirteenth in an annual series of bibliographies listing selected dissertations drawn from the pages of Dissertation Abstracts. As in the past, this list was compiled by scanning the titles and abstracts published in D.A. and making subjective decisions as to which ones might be relevant to work in ethnobiology or related disciplines such as ecological anthropology and economic botany. Dissertations categorized in D.A. under Agricultural Economics, Agriculture, American Studies, Anthropology, Biology, Botany, Chemistry, Ecology, Folklore, Geography, Health Science, Home Economics, Language, Linguistics, Paleoecology, Physical Geography, Sociology and Zoology were considered for inclusion in the list. An attempt was made to be as inclusive as possible, but some dissertations may have been overlooked. Comments and suggestions would be welcome for items to include in next year's edition.

Dates covered in this report include: for Volume A, September 1993-August 1994; Volume B (Sciences and Engineering), September 1993-July 1994. Note that these are the dates for the issues of D.A. in which the abstracts appear, rather than the dates of acceptance of the dissertations themselves. Unfortunately, Volume C (International Dissertations) is no longer available to either author. We invite anyone with access to this volume to join us in producing next year's edition.

The dissertations are listed below alphabetically by author, along with the year of acceptance, title, institution, length, adviser or major professor, number(s) of the page(s) in D.A. on which the abstract may be found, University Microfilms order number, and the ISBN number when this information was included.

Most of the dissertations accepted at institutions in the United States, and some of those from Australia, Canada, South Africa, and the United Kingdom may be obtained from University Microfilms International, P.O. Box 1764, Ann Arbor, MI 48106-1346, either on microfilm or published by microfilm xerography. Quality of printed matter is generally excellent, but that of figures and photographs varies with the quality of the original. Abstracts of all dissertations below are published in D.A. in English except as noted. D.A. is now available in many libraries on CD-ROM.

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ABSTRACTS OF PRESENTATIONS

at the 18th Annual Conference of the Society of Ethnobiology
Arizona State Museum, The University of Arizona
15–19 March 1995

How does our *Agave* grow? *Karen R. ADAMS, Crow Canyon Archaeological Center; and Rex K. ADAMS, University of Arizona.*

Agave murpheyi is considered a likely candidate for cultivation by ancient Salado and Hohokam groups in Arizona. The reasons for this will be reviewed. A slide presentation will illustrate the growth and development of 359 bulbils (miniature agaves) on the flowering stalk of a single mother plant from spring 1993 through late summer 1994.

Some successes and failures of indigenous management in a Maya town: *E. N. ANDERSON, University of California, Riverside.*

Chunhuhub, Quintana Roo, Mexico, is a Maya town that has grown up in the last fifty years from what was old-growth forest. In that time, it has lost the larger and rarer species of wildlife. Other species are no longer found in the central, inhabited area. Forests have been altered. On the other hand, the *ejido* [farming cooperative] is still primarily forest, rich in plant and animal species.

The edible corm plant *Dichelostemma capitatum:* A study of its vegetative reproduction response to different indigenous harvesting regimes: *M. Kat ANDERSON, University of Kansas.*

Blue dicks *(Dichelostemma capitatum)* was the most widely eaten underground swollen stem by California Indian tribes historically. It is still harvested today with a digging stick by a few native people of different cultural groups. Native Americans sometimes assert that the removal of underground plant parts can stimulate bulb and corm production, maintaining or increasing the population abundance and density and the size of the tract. This talk will focus on an experiment conducted at the University of California at Berkeley which attempted to mimic traditional indigenous harvesting regimes of blue dicks.

Ecology within the four Sacred Mountains: Traditional Dine perception of cosmology through intrinsic relationships and order: *David BEGAY and Nancy MARYBOY, Navajo Community College.*

This presentation will focus on traditional Dine (Navajo) epistemology and organization of knowledge, based on the natural order and cyclical systems of Mother Earth and Father Sky, as expressed through ceremonialism. The focus will be on the understanding of an ecological order based on the interrelationships manifested through the Four Sacred Mountains. Current Dine natural resource management will be discussed within a systemic framework of traditional harmonious relationships of positive and negative forces.

Beans as markers of cultural change in northern Sonora, Mexico: *Stephen J. BOUSCAREN, San Diego City College.*

The tepary (*Phaseolus acutifolius* A. Gray) is an arid-land adapted bean primarily grown and consumed in northwestern Mexico and southwestern United States. A study of the tepary system (consumption, marketing, and production subsystems) was carried out in northern Sonora, Mexico, in an attempt to understand why the production and consumption of teparies was declining. Within the study area, rapid cultural and infrastructural changes have resulted in the decreased biological diversity of some types of beans such as the tepary and in the increased diversity of others such as the pinto or *garrapata*. These changes are reflected in the availability of bean germplasm for producers, types of beans found in the markets, changing food preferences among consumers, and in consumers' folk classification schemes of legumes.

Pollen and opal phytolith evidence of prehistoric agriculture in the lower Verde River Valley, Arizona: *Steven BOZARTH, University of Kansas.*

Pollen and phytoliths were isolated and comprehensively analyzed in 397 samples collected at 28 Preclassic and Classic sites in the lower Verde River Valley of central Arizona. Abundant pollen and phytolith evidence for maize was found in both cultural periods. Bean pollen and phytoliths were recovered from Classic and Preclassic sites. Squash pollen was classified at sites of both cultural periods. Cotton pollen was found in Preclassic sites, but no microfossil evidence of this cultigen was identified in the Classic Period. The utilization of agave during the Preclassic Period is evidenced by the presence of agave pollen in a pit house village. The identification of agave-type phytoliths at a Classic Period field house indicates that agave was cultivated in the adjacent rock pile field. Pollen data demonstrate that chenopods/amaranths were utilized, and probably cultivated, during both cultural periods.

Ethnohistory, archaeology, and economy at the Vigil-Torres site: *Jeff BOYER, Linda MICK-O'HARA, Janet SPIVEY, and Mollie S. TOLL, Museum of New Mexico, Office of Archaeological Studies.*

The Vigil-Torres site, LA 77861, was one of the many Hispanic farms and homesteads surrounding the community of Río Chiquito/Talpa, first settled in the early 1800's. Ethnohistoric information portrays the adobe house as large and relatively elegant, befitting a family with substantial land and livestock holdings and prominent in northern New Mexico politics. Ethnohistoric data also imply access to and use of a considerable diversity of plant and animal products. Excavated features include a *soterrano* or root cellar, and a midden, used in the 1890's and perhaps as late as 1910. Botanical and faunal remains, viewed in counterpoint to ethnohistoric data, produce a more complete and complex picture of this rural farming economy. Biological artifacts also reveal differences between the inferred diet and the recovered remains, pointing out both taphonomic and historiographic issues.

Insights into social and economic behavior in a Basketmaker III pitstructure from flotation data: A stroke of luck: *Carol B. BRANDT, University of New Mexico, Albuquerque.*

A hot fire that was quickly smothered by a collapsing roof provided extraordinary preservation of perishable materials in a Basketmaker III pitstructure in west-central New Mexico (tree-ring dates A.D. 644–696). Flotation data from the features and floor indicate a reliance upon agriculture and the collection of local plants. Measurements of weedy seeds indicate human selection of the sunflower. Botanical materials that imply social activity include tobacco, jimsonweed, and unique wooden artifacts.

Green corn ceremonialism and ethnonutrition: The biocultural evolution of maize use: *Barrett BRENTON, Grinell College.*

Native American farmers have traditionally taken part in ceremonies focused on the harvest and consumption of green corn (unripened maize). Culinary traditions range from pit-baked sweet corn to roasted unripened "field" corn. This paper discusses the ongoing ceremonial significance of its consumption. A further focus will be on the biocultural evolution of corn use in the prehistoric Americas related to different food-processing traditions and the greater nutrient availability of unripened corn compared to ripened corn. Finally, I will discuss additional cross-cultural observances of the use of green corn in an attempt to formulate a more global and ethnonutritional perspective on its use today.

From Biosphere to Noösphere: a case study in cultural values and biodiversity in the Biosphere 2 Terrestrial Wilderness Biomes: *Tony BURGESS and Linda LEIGH, Biosphere 2.*

Biosphere 2 offers several lessons about the effects of cultural values on biodiversity. Management changed during the first mission as problems of atmospheric composition, human food shortages, and weed outbreaks developed. Biodiversity changes revealed by plant censuses from before and after the first mission are briefly summarized, together with general patterns of change in insect diversity. Most changes can be directly linked to human values. After the end of the first mission the "wilderness" was converted into a more intensively managed landscape to produce more human food and harvestable biomass.

Eighteenth century ethnobotany in western Chihuahua, Mexico: *Robert BYE, Universidad Nacional Autónoma de México.*

Colonial Mexican government-mission *Relaciones Geográficas,* or *Relaciones Topográficas,* recorded data on local natural and human resources including wild and cultivated plants. In 1777 the Franciscan clergy had 15 missions in western Chihuahua. Ethnobotanical information shows the prominence of certain plants used by Tarahumara Indians and illustrates the interchange between Indians and missionaries. Two hundred fifteen wild plants from the mountains and canyons are mentioned along with 81 cultivated plants. Experimentation with different grains (wheat, oats, barley), phenological observations of peach trees as climatic indicators, domestication process of mustards, commercial dyewoods *(Haematoxylon brasiletto),* arrow-poison plants *(Sebastiana pavoniana),* contrayerbas for arrow and animal poisons and various medicinal plants are documented.

Intracultural variation and innovation in the management of *Sabal* palms among the Maya of Yucatán, México: *Javier CABALLERO, Universidad Nacional Autónoma de México.*

Sabal palms have been a multipurpose plant resource for the Yucatec Maya for well over 1000 years. The way in which they have been managed has changed as a result of a combination of factors. This includes the introduction of these palms into cultivation. The relation between folk-biological knowledge and cultural change was investigated by applying an ethnobiological test to a sample of 17 informants representing different degrees of cultural change. Dried specimens showing different palm parts as well as color photographs of *Sabal* individuals were used as stimuli for the ethnobiological test. The statistical analysis of the responses to the test indicates that variation in ethnobiological knowledge about *Sabal* is patterned. The milpa cultivators, who can be considered the people best maintaining their traditional culture, are the ones who know most about these palms. They are also the ones responsible for the introduction of *Sabal* into cultivation. The analysis of intracultural variation suggests that technological innovation is closely related to the persistence of the traditional Maya culture.

Traditional management and morphological variation in *Leucaena esculenta* (Moç. et Sessé ex A. DC.) Benth. (Leguminosae: Mimosoideae): *Alejandro CASAS and Javier CABALLERO, Universidad Nacional Autónoma de México.*

Leucaena esculenta is an important food resource for the Mixtec of Guerrero, Mexico. Artificial selection in *L. esculenta* subsp. *esculenta* by the local people was studied. Morphological characters of seeds and pods of individual trees of this subspecies were measured in order to compare phenotypic variation in populations subject to different regimes of management. Samples of trees were analyzed from a) a wild population not affected by intentional disturbances, b) a wild population selectively managed, and c) cultivated individuals. Cluster analysis and ordination methods were used to examine differences between populations. A marked divergence between the three populations was found, especially between the managed and unmanaged wild populations. The frequency of the phenotypes preferred by people was found to be higher in the wild population consisting of tolerated individuals. Our study shows that through *in situ* forms of management, people are able to modify the phenotypic structure of plant populations. Possible routes of plant domestication are discussed.

Ritual reflected in the pollen record? Maize pollen recovered in Pueblo II/Pueblo III structures: *Linda Scott CUMMINGS, Paleo Research Labs.*

Highlights of a pollen record from pithouses, kivas, and their attendant features illustrate the diverse nature of the record for Anasazi occupations along the Puerco River in northeastern Arizona. Floors yielded information concerning patterns of activity within structures, including ritual. Extremely high frequencies of *Zea mays* (maize) pollen (25–90%) indicate ceremonial activity. Starch granules contributed to the interpretation of grinding activities and clarified use of maize pollen. *Nicotiana* seed fragments point to the potential for identification of diverse remains contained in pollen samples.

Prehistoric dietary diversity and coprolite phytolith content: *Dennis DANIELSON and Karl REINHARD, University of Nebraska-Lincoln.*

Coprolite analysts traditionally concentrate their efforts on macroscopic and pollen evidence. We have examined 80 coprolites from six prehistoric sites to evaluate phytolith content. Three Anasazi sites (Antelope House, AZ; Salmon Ruin, NM; and Bighorn Sheep Cave, UT) and three Archaic sites (Bighorn Cave, AZ; Hinds Cave, TX; and Dust Devil Cave, UT) were studied. The analysis shows that phytoliths are very common in coprolites and can make up to ten percent of the mass of coprolites. The phytolith data provide evidence of plant consumption that is not present in the macrofloral or pollen remains from coprolites. A surprising diversity of phytoliths is present in coprolites from vegetative tissue of many plant species. Since phytoliths are harder than tooth enamel and are most abundant in Archaic coprolites, it is probable that phytoliths caused dental disease in remote times and may have resulted in the use of analgesic plants by various cultures.

Semantic classification and biological nomenclature in Mixtec: *Alejandro DE AVILA, Sociedad para el Estudio de los Recursos Bióticos de Oaxaca (SERBO), A.C., & University of California at Berkeley.*

Mixtec constitutes a group of related languages spoken in an ecologically diverse region in southern Mexico. Noun classification is a salient feature of the Mixtec languages. Most plant and animal names are preceded by semantic classifiers. A preliminary survey of contemporary and 16th-Century dialects shows that the composition of the major categories marked by these classifiers is quite consistent across the Mixtec region. Edibility, usefulness, and other, mostly cultural, criteria underlie this system of nomenclature, in apparent contradiction to Berlin's (1992) general principles of ethnobiological classification. Mixtec plant and animal names provide valuable clues for the study of Mixtec cultural history. Their etymologies denote former uses or mythological significance of certain species. Cross-dialectical comparison of plant and animal terms appears to evidence a higher proportion of cognate terms for species characteristic of pine-oak forests, an indication perhaps that proto-

Mixtec developed in the highlands. Plant names, in particular, seem to bear traces of an older classification system in the guise of a fossilized word-initial clitic.

Contribution to the determination of the melliferous flora of the south region of the State of Coahuila, Mexico: *Manuel DE LA ROSA-IBARRA and José GARZA, Universidad Autónoma Agraria "Antonio Narro".*

The objective of the present work was to investigate the plant species that contribute in greatest measure to the production of honey in the apple-cultivation zone in the south of the State of Coahuila. During a 12-month period, the plants of the zone were collected and identified taxonomically. A pollen collection was established for use as a reference in the identification of melliferous plants. Melisopalinological studies were used to determine the species used most by bees in the manufacture of honey. These results will permit collection of seeds of these plants and the dissemination of these seeds in the area in order to increase honey production.

A preliminary list of the medicinal plants of Nuevo León State, Mexico: *Manuel DE LA ROSA-IBARRA, Universidad Autónoma Agraria "Antonio Narro".*

Medicinal plants have been employed by the inhabitants of this part of Mexico from very remote times to alleviate disease and pain. This is commonly accomplished with very good results and without the after-effects of most modern medicines. In this study, information was gathered directly from the inhabitants of 22 *ejidos* (farming cooperatives) in 5 *municipios* (counties) of Nuevo León State. This was in addition to information obtained in markets in metropolitan Monterey. We found 87 species from 78 genera in 51 plant families with assorted uses from simple headaches to diabetes.

Kakau i ka Uhi: plants and tattooing in Hawai'i: *Anna DIXON, University of Hawai'i-Manoa.*

This paper investigates plant taxa used in pre-European Contact and early Post-Contact Hawai'i for the purpose of tattooing. The practice of tattooing was a widespread form of body ornamentation in Polynesia, particularly on the high islands and some atolls. Tattooing needles have been found in archaeological contexts throughout Polynesia. In the Hawaiian Islands, a variety of plant substances was employed to produce tattoo designs. Although most of these fall under the category of "dye plants," at least three indigenous taxa (*Pelea anisata, Plumbago zeylanica,* and *Sisyrinchium acre*) and one Polynesian introduction (*Aleurites moluccana*) apparently created designs through chemical action.

Ethnobotany of the Mayo near Alamos, southern Sonora, Mexico: *Daniel A. DUNCAN, Thomas A. KLEESPIE, and Francis C. SHERLOCK, University of Arizona.*

In a KUAT television segment of "The Desert Speaks," David A. Yetman and Thomas R. Van Devender interviewed Mayo Indians about traditional plant uses in tropical deciduous forest and thornscrub. Trees are cut for wood for furniture and living fences at specific times. Men typically bring plant products to the women. In Teachibe, women weave woolen blankets. Chiju (*Indigofera suffruticosa*) yields a blue dye. Most plants are for personal use; chiltepín (*Capsircum annuum*) and pitahaya (*Stenocereus thurberi*) are sold. Conversion to agricultural fields and buffelgrass (*Pennisetum ciliare*) pastures threaten Mayo plant resources.

Prehistoric plant-food diversity of the Verde River Valley, northern Arizona: *Cherie A. EDWARDS, University of Nebraska-Lincoln.*

The analysis of macrobotanical remains from prehistoric cave sites in the American Southwest has long been used to evaluate prehistoric diet. Presented here is such an analysis of dry cave plant materials from Sinagua sites in the Verde River Valley of Arizona. Included in the analysis are midden and coprolite samples from cave deposits which date from A.D. 1100–1300. The analysis of the deposits reveals a surprising diversity of wild and cultivated plants. Both the seeds and the vegetative parts of the plants were eaten, which testifies that these prehistoric horticulturalists subsisted on a diet that included a diversity of plant foods.

Preserving herbal traditions in southwestern New Mexico: *Tomas ENOS, The Herbal Medicine Project.*

The preservation of ethnobiological information in indigenous cultures is a critical component of scientific understanding of the natural world. As cultures undergo contact and change, new mechanisms must evolve that support the continued utilization of ancient knowledge. Educational programs which place the keepers of the knowledge in the role of primary investigator and professor are becoming essential to a complete system of investigation and preservation.

Indigenous patterns of conserving biodiversity: Pharmacologic implications: *Nina L. ETKIN, University of Hawaii-Manoa.*

While the preservation of species is being debated from a variety of Western postures, predominantly economics, the significance of those taxa has not been properly assessed in the cultural and microecological contexts of their use. Instead, species designated for conservation have been identified by outsiders who are culturally and politically detached from the threatened environments. Ethnopharmacologists—and primarily those representing the social sciences—have drawn on the cogency of indigenous knowledge of biotic diversity and its conservation. This paper reviews how local paradigms of plant use and conservation can be integrated into conservation efforts, and problematizes the issue specifically with reference to the use of plants by Hausa peoples in northern Nigeria.

Cosmology and conservation: The case of gender in Campeche-Maya plant taxonomy: *Betty FAUST, Centro de Investigaciones y Estudios Avanzados (Mexico).*

Analysis of plant descriptions used by a Campeche-Maya ***h'wèen*** (traditional ritual expert and healer) in the making of 350 collected medicinal species has revealed connections to a larger cognitive map, a cosmology with implications for conservation (following Goetz). The Campeche-Maya taxonomy of plants is keyed through concepts of gender to a more general cosmological framework in which the underlying creative forces of the universe are understood as dichotomous, interdependent sets, male and female, which cooperate in continuous cycles in the regeneration of life. Human sexual behavior and reproduction is a subset of this larger system and is often a symbolic device for representing its more complex processes. Gender in plant taxonomy cognitively connects plant identification with both human relationships and a system of understandings about the connections and interdependencies between humans and nature. These traditional connections provide a cognitive mechanism for maintaining awareness of the importance of conservation of rare species and their fragile habitats, which has also been observed in the behavior of the ***h'wèen*** when collecting plants.

Ethnobotany: A 100-year retrospective: *Richard FORD, University of Michigan.*

One hundred years ago, John Harshberger first used the term ethnobotany. The first practitioners were both anthropologists and botanists interested in the natural history of American Indians. The objectives of the field changed when anthropology became a social science and botany assumed an economic orientation. Anthropological emphasis moved toward folk systematics and ethnoscience. Convergence of these trends occurred when ecology was favored as a way to understand human-plant relations and to study biodiversity again from an ethnobotanical perspective. Most recently, plants have become a surrogate for examining post-modern themes of gender, class, and ethnicity in anthropology but is expanding along more conventional approaches by botanists in the non-Western world.

Taxonomy and transformation in Nage conceptions of the animal world: *Gregory FORTH, University of Alberta.*

This paper explores the notions of transformation among the Nage people of central Flores in relation to issues of taxonomy. A local belief that certain animals can change permanently into zoologically quite different species (such as deer and dolphins) potentially challenges the view that natural kinds, in contrast to other entities included in standard folk classifications, are perceived as possessing invariable essences that form the basis of taxonomic hierarchies. Nage conceptually connect natural categories in a variety of ways, constituting several analytically distinct modes of classification.

Death Valley agriculture: *Catherine S. FOWLER, University of Nevada-Reno.*

In 1980 William Wallace examined the case for native agriculture among the Death Valley Shoshone, noting that the historical sources are far from clear as to its antiquity and to the crops involved. This paper reexamines the evidence, combining it with some new ethnographic and linguistic data to suggest that planting corn, beans, and squash probably is not much older than the 1830's in the area. A combination of sources is also suggested, with the Southern Paiute playing a substantial role. Ecological factors may also have played a role in limiting its occurrence.

Famine foods: Little-known plant-food resources: *Robert L. FREEDMAN, Orinda, California.*

The study of little-known plants used throughout the world for food during periods of famine and food scarcity is reviewed here. These plants, commonly referred to as "famine foods," have received scant attention from ethnographers and less from agriculturalists. In addition to pertinent historical background, current and recent research trends are examined, and the "New Crops" potential of particular famine foods is considered.

Ejido Joya de Salas: A case study at El Cielo Biosphere Reserve, northeastern Mexico: *Claudia GONZALES-ROMO, W. Hardy ESHBAUGH, and Adolph M. GREENBERG, Miami University.*

Joya de Salas is located 7 hours on horseback from the Jaumave Valley, Mexico, in the western range of the Sierra Madre Oriental at an elevation of ca. 1900 m. Joya's residents have long made a living from the land by cropping, cattle-raising, horticulture, plant-gathering, logging, etc. In 1987 logging activities ceased due to the establishment of El Cielo Biosphere Reserve, which resulted in the loss of a secure income for the 45 resident families. For the campesinos and their families, a lack of understanding regarding the nature of the biosphere reserve has resulted in an incomprehensible set of forest and wild animal resource-use limitations imposed by state and federal governments. This study explored and assessed past and contemporary knowledge, including expertise about the area's natural resources, and how this is relevant to present conservation effort at El Cielo Biosphere Reserve.

Strategies for the management of natural resources: *José GONZALEZ and Regina LEAL, Universidad Autónoma Metropolitana-Iztapalapa.*

In order to satisfy the need for production, peasants require the utilization of renewable natural resources such as water, soil, cultivated plants, and other vegetation (forest, pasture, etc.). Nevertheless, these resources cannot be exploited without taking into account the legal, social, and economic context in which the indigenous peasant communities are located. In this paper, we review the socioeconomic strategies used by the community of Santa Catarina del Monte for the management of natural resources. We also show how this community integrates the different options offered by the natural milieu in order to satisfy its subsistence demands and the production of commercial benefits.

"A place that's good": Gitksan ethnoecology: *Leslie M. JOHNSON GOTTESFELD, University of Alberta.*

The Gitksan of northwestern British Columbia live in a mountainous, densely-forested environment. Gitksan landscape perception differs from that of Western ecology. In Western ecology, plant communities are based on the dominant species of geomorphic features (e.g. floodplain cottonwood forest, sphagnum bog, black-spruce swamp). Gitksan terms collected for ecological or habitat features include "swamp" ***lalax'o,*** "meadow" or ravine ***lax̠'amit,*** and a generalized bush/forest term ***gilix*** "woods" or ***spagadegantx*** "being out in the bush." Terms such as "aspen forest" do not seem to be present. Gitksan landscape perception is organized with reference to "mountains" and "rivers," to drainage basins and divides; this is quite natural when the nature of the landscape is taken into account. These orienting perceptions are intimately bound up with the territory system, where landscapes, including drainage basins and river fishing sites or mountains forming one side of major lakes or rivers, are delimited as owned properties of House groups. Vegetation is described by discussion of specific species and where they can be found, and the uses of the plant species. Generalized habitat indications such as "in the swamp" or "halfway up the mountain" suffice to indicate the ecological setting.

Out of California: Cultural geography of native North American tobacco: *Julia E. HAMMETT, Muwekma Tribe and Stanford University.*

The evidence for expansion of tobacco (*Nicotiana* spp.) points to two independent prehistoric invasions into the interior of North America, one from the south, another from the far west. The far-western part of the United States is the birthplace of several tobacco taxa; at least two of these are anthropogenic. California and Great Basin ethnographies are rich in examples of plant management strategies including prescribed burning, weeding, and planting seeds. Archaeological pipes, tubes and archaeobotanical residues attest to the longevity of tobacco use in California.

Ethnic homegardens of Santa Cruz County and San Jose, California: *Michael HATHAWAY and Maria AUFMUTH, University of California-Santa Cruz.*

This paper is a cross-cultural survey of home gardens in Santa Cruz County and San Jose, California. Gardeners from Portuguese, Mexican, Japanese, Sri Lankan, and Filipino backgrounds were interviewed, their gardens mapped to scale, and plant species designated. The following issues were examined: the transfer of intergenerational knowledge, aspects of cultural background which contribute to the maintenance of biodiversity, and the variety of ways by which home gardeners conceptualize their gardens.

Seal transport and consumption amongst historic Inuit: Implications for Inuit-European relations on southeast Baffin Island, Canada: *Anne HENSHAW, Harvard University.*

This study examines the transport and consumption of seal, the mainstay of historic Inuit diet, during a period of rapid social and economic change. I present zooarchaeological results from three historic Inuit habitation sites located on southeast Baffin Island to show that throughout the historic period (A.D. 1576–1930), seal carcasses were brought back whole to individual Inuit households, where subsequent butchery and distribution took place. This conclusion is supported by ethnographic descriptions and taphonomic considerations; its significance is interpreted in light of the role Inuit family cohesion played in maintaining economic independence from European agents of change.

A rediscovered agave in central Arizona: *Wendy HODGSON, Desert Botanical Garden.*

A previously undescribed agave was rediscovered in 1988 in Tonto Basin, Gila County, by Rick DeLamater. First found by Susan D. McKelvey in 1929, further searching has resulted in the documentation of over 90 sites. Like the Hohokam agave (*Agave murhpeyi* Gibson), the Tonto Basin agave (to be named *A. delamateri* Hodgson & Slauson, ined.) is believed to have been grown extensively by a pre-Columbian culture, namely, the Salado. Its past and present distribution, characteristics, similarities and differences with other agaves will be discussed. In addition, factors which may have influenced how the plants were managed will be addressed and comparisons made with those of the Hohokam agave. Finally, a recent discovery of an unknown agave in the Grand Canyon will be discussed, providing further evidence that agaves were an important resource north of central Mexico, with distributions influenced by human intervention.

Humans and wetlands: Lessons learned by Biosphere 2: *Todd HORNE, Biosphere 2.*

Biosphere 2 offers a means to study human impacts on ecological structures and functions. Unlike Earth, Biosphere 2 must have constant human intervention in order to maintain the structure and function of its ecosystems. Wetlands of Biosphere 2 can be used to learn how human intervention maintains a wetland in an unstable state. Biosphere 2 wetlands are altered by water pollution, confined spaces and inadequate knowledge for management. Solutions to such problems can be addressed by observations of the states and dynamics of Biosphere 2 wetlands. This case study can be applied to the problems of planetary wetlands.

Identifying prehistoric food-processing methods with Electron Spin Resonance (ESR) Spectroscopy: *Andrea A. HUNTER, Michael P. EASTMAN, Sheri A. MAKTIMA, and Bernadette C. SLATER, Northern Arizona University.*

Electron Spin Resonance (ESR) Spectroscopy is currently being used to explore thermal histories of archaeological seeds recovered from prehistoric human coprolites. This technique is being applied in a study of coprolite macroremains recovered from Southwest archaeological sites. ESR experiments conducted on modern seeds prepared by a variety of food-processing methods were compared with ESR signals from archaeological specimens. Distinct signals were obtained from modern specimens and matched with archaeological signals. Experiments indicate that ESR *g*-value, line width, spin intensity, and line shape are useful parameters that identify maximum temperature and duration of heating associated with differential food-processing methods.

Pollen analysis in prehispanic vessels from the ancient city of Teotihuacán, México: *Emilio IBARRA-MORALES, Universidad Nacional Autónoma de México; and Aurora MONTUFAR, Instituto Nacional de Antropología e Historia.*

An archaeopalynological investigation was carried out on prehispanic vessels found in a small, well-preserved cave near the "Pyramid of the Sun" in the ancient city of Teotihuacán in central Mexico. The evidence consists of palinomorphs in a very good state of preservation, in association with prehispanic burials. Pollen remains include those of several botanical families including Gramineae (Poaceae), Pinaceae, Chenopodiaceae, and Amaranthaceae. A more detailed analysis is underway that will provide new data about the use of plants in funeral rituals in ancient Mexico.

Prehistoric human impacts on riparian fauna and issues of biodiversity in southwestern North America: *Steven R. JAMES, Arizona State University and Gila River Indian Community.*

Archaeofaunal data from Hohokam and Anasazi sites (ca. A.D. 1000–1500) along the Salt, Gila, Little Colorado, and Río Grande Rivers are examined with respect to over-exploitation of game and fish resources in the Southwest. Hohokam agriculturalists in particular brought about the decline of riparian fauna and may have caused local extirpation of some taxa. These results raise the question of where baseline management programs should be established.

Hypocholesterolemic constituents in plant dietary additives of a traditional subsistence community, the Batemi of Ngorongoro District, Tanzania: *Timothy JOHNS, L. CHAPMAN, T. TICKTIN, McGill University; R.L.A. MAHUNNAH, Institute of Traditional Medicine; and P. SANAYA, Mugholo, Tanzania.*

Reports of plants added to milk and meat-based soups by the Maasai and Batemi in East Africa support a role for phenolic antioxidants and hypocholesterolemic agents in the diet in low incidence of cardiovascular disease of populations that traditionally consume high levels of dietary fat and cholesterol. Plant food additives of the Batemi of Ngorongoro District, Tanzania, were tabulated based on interviews with 22 informants, and 17 specimens were collected in the field and analyzed for saponin and phenolic content. Sixty-three percent of the Batemi additives and 75% of these known to be used by the Maasai also contain potentially hypocholesterolemic saponins and/or phenolics.

The palm has its time: Natural history, use, and management of *Sabal uresana* in Sonora, Mexico: *Elaine JOYAL, Arizona State University.*

The results presented here are the ethnographic portion of an ethnoecological study to assess quantitatively traditional resource management (TRM) for one group of wild-collected plant species, i.e., palms, in Sonora, Mexico. Participant observation and formal interviews were used to learn (1) what local people, both indigenous and mestizo, understood of palm natural history, and (2) how palms were used and managed. Harvest pressure was assessed through a combination of ethnographic and ecological techniques. Weavers were asked to sort *cojoyos* (unexpanded leaves) according to use so that variation in *cojoyo* quality and in weavers' knowledge of them could be understood. *Sabal uresana* is one of the most economically important wild-collected plant species in Sonora. Knowledge of its natural history, use, and management varied greatly among users. Many understood basic phenology and that the palm produces few leaves and lives for many years. Many also had a limited view of overall distribution but could describe general habitat and associated species. The most important use of *S. uresana* was weaving for which *cojoyos* were employed. Weavers sorted *cojoyos* into as many as six categories, based on texture, color, and size. TRM consisted of limiting access to populations, "sparing," controlling harvest times and levels, and choice of leaf age and palm size.

Maasai political ecology: Fire management for cultural and biological diversity: *Mark KAIB, Laboratory of Tree-ring Research, University of Arizona.*

Augmented for 3000 years by hunting and gathering and the use of fire to induce grassland renewal, the Maasai developed a pastoral production system of annual cyclic migrations to make use of seasonal resources. Short-sighted development schemes over the last century have encouraged sedentary high-input land-use patterns and resulted in cultural and environmental degradation and incessant land disputes. Historical pastoral land-use patterns illustrate the extensive ecological awareness of the Maasai.The current patchy landscape pattern is maintained by distinct yet interdependent economic practices including resource conservation, traditional pastoralism, and agricultural use. Fire management is a prime field where both conservation and cultural objectives can be complementarily integrated for sustainable ethnobioconservation.

Historical ethnobotany: A case study of the 1933 Huron Smith Winnebago manuscript: *Kelly KINDSCHER and Dana PRICE, University of Kansas.*

Historical manuscripts can provide excellent sources of cultural and biodiversity data, but may also prove to have inherent problems. The only known ethno-botany of the Winnebago is a 1933 unpublished manuscript. It has been archived in the Milwaukee Public Museum along with plant voucher specimens and photographs collected by Huron Smith, a museum botanist. At his untimely death the manuscript was 90% complete. Problems associated with this and similar manuscripts are quality of original work, verification of plant species, changes in botanical nomenclature, linguistics, decisions concerning editing changes, gaps in the manuscript, ownership of the manuscript, intellectual property rights, and bureaucracy of the institutions involved.

Agave cultivation and site use in the Silver Creek and Chevelon Creek Drainages, Sitgreaves National Forest: *Julie L. KUNEN, University of Arizona.*

Agave is known to have been cultivated prehistorically in the highlands of Mesoamerica and among the Hohokam. Less well-known is the use of agave in the northern Mogollon area. Data suggest that agave was cultivated prehistorically above the Mogollon Rim by people who extended the natural range of the plants. Agave sites provide information regarding economic strategies and land use among early residents of this region.

The Native American pipe in a modern context: *Soren LARSEN, Illinois State University.*

The material culture of a people can often aid in determining the environmental relationships of that particular group. In attempting to preserve biological diversity in a modern context, it is helpful to analyze the material culture of groups that have maintained successful environmental relationships. Through a cross-cultural study, it will be shown that ethnographic data support that the ceremonial pipe's use, symbolism, and ceremony directly defined and cemented a positive environmental relationship which preserved biological diversity on a regional basis.

Stalking the immortal vicious yucca: *Elizabeth J. LAWLOR, University of California-Riverside.*

The use of yucca as food and fiber is well-known in the Great Basin, but little attention has been paid to its significance as a food of the Chemehuevis and other Southern Paiutes of the Mojave Desert. Detailed information about the native names and uses of the various species has been unavailable. Stalking this information involved linguistic analysis of native terms and botanical inference from fragmentary descriptions of the yuccas' ranges and characteristics from published and unpublished data collected by Carobeth Laird, John P. Harrington, and Isabel T. Kelly. In mythology, the Immortal Yucca Date was the first source of plant food and the only plant who was a Person, while the Yucca Date Worm Girls were frequently encountered, treacherous characters who stabbed people with their long, sharp knives. The three important yucca species in the region were *Y. baccata* (banana yucca, ***kaayuvimpɨ***); *Y. schidigera* (Mojave yucca, ***'uuvimpɨ***), and *Y. brevifolia* (the Joshua tree, ***sovarampɨ***). All of these produce edible fruit ***(tcɨmpi)*** across the desert homeland, thanks to Cottontail Rabbit's ambush and scattering of the Immortal Yucca Date.

Mushroom gathering in San Pedro Ecatzingo, Mexico: *Edelmira LINARES and Robert BYE, Universidad Nacional Autónoma de México.*

Mushroom collection plays an important economic role in the mountain communities of southeastern Mexico state. In San Pedro Ecatzingo over 20 families supplement their income with mushroom gathering (carried out mostly be women and children) during the rainy season. Today there are more "*hongueros*" and they claim that they obtain fewer mushrooms than collectors before them. Over 22 edible species have been documented to date; the more important ones include *Amanita caesarea, Morchella elata,* and *Ramaria* sp. Mushrooms are considered a meat substitute and may be the basis for a banquet; many collectors prefer to sell them in the regional market in Ozumba for economic benefit rather than include them in the household meals.

The significance of Lacandon Maya animal and plant *onen* or spirit-beings and their potential importance for interpreting ancient Maya art and iconography: *William J. LITZINGER, Prescott College; and Robert D. BRUCE S., Museo Nacional de Antropología.*

Prior discussion of the concept of the ***onen*** among the Lacandon Maya has focused on animal spirit-beings associated with the Lacandon lineages. Herein is presented an explanation of the nature of the Lacandon animal ***onen*** in contrast to animal spirit-beings among other Mesoamerican cultures. Evidence is then presented to suggest that in the past plant ***onen*** also existed among the Lacandon Maya. The cultural role of Lacandon animal and plant ***onen*** is examined in relation to the interpretation of some plant and animal motifs in ancient Maya art and iconography.

***Ge Oidag* (Big Field):** *Danny LOPEZ, Baboquivari School District.*

Traditional Tohono O'odham agriculture in the village of Big Field began to decline rapidly after the late 1940s. Danny Lopez draws upon his childhood memories to recreate a prior era when food crops were raised and families cooperated in farming tasks. Recruitment for labor in cotton fields elsewhere initiated a trend toward greater participation in the cash economy. Boarding schools and military service were among the factors that further accelerated a transition to extra-local employment rather than the cultivation of surrounding fields. This transition is recounted by a Big Field resident who has witnessed all of these changes.

Morphophysiological variation in Mexican species of *Amaranthus*: Evolutionary tendencies under domestication: *Cristina MAPES, Javier CABALLERO, Eduardo ESPITIA, and Robert BYE, Universidad Nacional Autónoma de México and INIFAP.*

Amaranth (*Amaranthus* spp.) is an important food resource for indigenous peoples of Mexico. Grain-producing species and land races are mostly cultivated plants, while the species used as vegetables are commonly promoted in maize plots. There exist noticeable biological differences between these two types of amaranths. This study analyzes the morphophysiological variation in the Mexican species of *Amaranthus* and its relation to use and management. A sample of individuals from 14 collections corresponding to seven species and land races was grown in experimental plots and 18 morphological and physiological characters were measured. A statistical multivariate analysis was performed on these data. The results show that the grain-producing plants tend to allocate a high proportion of energy in the production of inflorescences while in plants used as vegetables the higher biomass proportion is found in the foliage. This suggests that domestication of Mexican species of *Amaranthus* follows two different paths according to the form of use and management by humans.

Natural history of domesticates: Lessons for the future? *Bruno D.V. MARINO-DUCE, Biosphere 2.*

Ever since the Holocene, humans and other people have selected a surprisingly small number of plants from their surroundings for intensive production of foodstuffs and recreational chemicals, resulting in domesticates that feed, clothe, and inebriate the inhabitants of Gaia today. The natural history of the primary domesticates provides insights into the processes that may influence the utility of these plants in the future.

Study of plant and animal remains in urban archaeology: The case of Exconvento de Santa Isabel-Bellas Artes, Mexico: *Abel MARTINEZ, Luz LAZOS, Alvaro ANGOA, Universidad Nacional Autónoma de México; Adolfo DE PAZ and David ESCOBEDO, Instituto Nacional de Antropología e Historia.*

Today, research methods can be presented in attractive visual manner through the use of video recordings. The archaeological project "Exconvento de Santa Isabel-Bellas Artes" has been a great opportunity for the application of video. This 10-minute video shows the basic steps in paleoethnobotany. In particular, the methodology includes: 1) collection and flotation of samples, and 2) identification of macroremains. These data determine the distribution and abundance of plant remains which helps explain their presence in the study site. This video was designed for didactic purposes, and illustrates the relevance of paleoethnobotany as a complement of archaeological studies.

Identification of carbonized archaeological remains of *Amaranthus* spp.: *Emily McCLUNG DE TAPIA, Universidad Nacional Autónoma de México.*

Amaranth use in prehispanic Mesoamerica is widely documented in Sixteenth Century ethnohistorical and historical sources. However, it was used at least as early as 5000 B.C. and possibly earlier. Although carbonized seeds suggesting the plant's importance have been recovered from numerous archaeological sites in the Central Highlands of Mexico, the state of preservation is a limiting factor for the determination of species. Morphological studies based on seeds of modern species were undertaken in order to develop techniques for species differentiation among cultivated and non-cultivated archaeological specimens. Testa thickness is a diagnostic characteristic which allows differentiation between cultivated and non-cultivated specimens, while surface texture allows differentiation between two cultivated species: *A. hypochondriacus* and *A. cruentus*.

Maximizing dietary diversity in prehistoric Durango, Mexico: *Timothy MEADE and Karl REINHARD, University of Nebraska-Lincoln.*

Coprolites were excavated from a cave dating from A.D. 600 on the Río Sape in central Durango, Mexico, and are the basis for dietary reconstruction. Macro-floral, palynological, phytolith, and zoological analyses of 50 coprolites were undertaken. These analyses revealed that a surprising diversity of cultivated and noncultivated plant species was eaten at the site. These included typical Mesoamerican cultigens such as chile, maize, and legumes with indigenous, long-established wild staples such as agave, prickly-pear, and ground cherry. The maintenance of wild plants of Archaic heritage after horticulture was introduced served to maximize dietary diversity.

Why didn't Native Californians invent agriculture? Or did they? *Charles MIKSICEK, Bio-Systems Analysis, Inc.*

Archaeobotanical data collected from various California sites suggest that the plant food contribution to subsistence was far more diverse than the acorn-based diet predicted from late 19th-Century ethnographies. A complex of grasses (little barley, maygrass, ryegrass), legumes (*Lotus*, clover, lupine), and small seeds (goosefoot, chia, tarweed) is present in sites throughout California. This "grass-legume-small seed complex" has strong parallels with archaeobotanical data from sites in eastern North American and Early Neolithic sites in the Near East. Several of these taxa demonstrate morphological changes that suggest some degree of selection or environmental management beyond the simple gathering of a wild plant. These data suggest that pre-contact California could prove to be an important testing ground for many models for the origins of agriculture.

Indigenous intellectual knowledge: Owning or sharing: *Verna MILLER, University of Victoria.*

Ethical debate has been held on the question of ownership of indigenous intellectual knowledge. Indigenous cultures have had their knowledge compromised for the sake of academic and consumer validation without understanding of the spirit in which this knowledge is passed on. Prior to contact with western European cultures, aboriginal knowledge, food, and clothing were shared among community members. Since the "discovery" of indigenous knowledge by non-aboriginal Academia, the spirit of sharing has been grossly compromised. Haida elder Lavina White/Tthow Legwelth puts the present attitudes very succinctly. "They take our knowledge, our information, our art forms, and our artifacts, but they leave us out. They want everything that is us, but they don't want us." This presentation will address this situation and suggest ways in which the two cultures can reach a better understanding and mutual respect.

Biodiversity and sustainable agriculture: *Tilak Ram MOHATO and Bruno D.V. MARINO-DUCE, Biosphere 2 Research Group.*

The Intensive Agriculture Biome (IAB) of Biosphere 2, covering 0.55 acres (0.22 hectares), provides a unique opportunity to study the effects of agricultural practices on yield and overall plant diversity in an atmosphere with elevated CO^2. Observations on the plants selected, the control of pests, and the application of nutrients (derived from waste water) are used to assess the potential of intensive sustainable agriculture under a variety of conditions relevant to a rapidly changing global agricultural landscape.

The coevolution of maize and human cultures: A research proposal: *Deborah A. MUENCHRATH, Iowa State University.*

Maize and maize-based cultures evolved together over millennia. Ancient as well as contemporary maize-human relationships hold lessons pertinent for germplasm and resource stewardship. Understanding the coevolution of maize and associated human cultures may provide critical insights for charting future agricultural and societal development. An interdisciplinary research program to examine maize and cultures, and their relationships through time and across geographic areas, will be described.

Features of indigenous sustainable maize production in the arid southwestern U.S.: *Deborah A. MUENCHRATH and Ricardo J. SALVADOR, Iowa State University.*

Our research examines responses of a traditional cultivar, native to the Sonoran Desert, and a dent hybrid, adapted to the U.S. Corn Belt, to a range of irrigation regimes. Morphological and physiological responses are evaluated in the contexts of traditional indigenous and modern commercial planting arrangements. Objectives of the study are to: 1) identify biological attributes contributing to the reputed drought-tolerance of the native maize, and 2) determine the effect of production practices on the productivity of maize under arid conditions in New Mexico.

The landscape perceived: Fragmented ethnoecologies: *Virginia NAZAREA-SANDOVAL, University of Georgia.*

This paper analyzes the patterns of perception of the landscape by informants belonging to different ethnic, age, and gender groups. Thematic Apperception Tests (TAT's) consisting of photographs depicting various parts of the landscape around the Manupali Watershed in Bukidnon, Philippines, were designed to elicit different points of view on resource management as well as community relations. Human-plant interactions in different production regimes were central considerations in the responses of different categories of informants. A patterning of the relative salience of landscape features is demonstrated.

Plants and animals used in musical drums of Kerala, India: *T. S. NAYAR and P. PUSHPANGADAN, Tropical Botanic Garden and Research Institute.*

Kerala, the southernmost state of India, has, over the centuries, evolved a musical culture having a conscious theoretical basis which involves usage of a remarkable variety of musical instruments peculiar to the region. Drums are used either for pure rhythmic intricacy or as accompanying instruments. They are made of wood and animal skin with high specifications. Plants and animals used for six art drums are detailed and locally evolved processing technology applied are discussed in the light of an age-old musical culture of Kerala.

Historic preservation and the cultural use of plants at Kalaupapa National Historical Park, Hawaii: *Earl NELLER, Kalaupapa National Historical Park.*

Polynesians brought approximately 30 cultivated plants to Hawaii, including taro, which became a major staple in the Hawaiian diet. Some of these plants are seldom seen today, such as ***uhi***, the Hawaiian edible yam. Propagation of these plants in the gardens of Kalaupapa residents gives the public first-hand experience with plants important in ancient Hawaiian culture, an aspect of culture barely visible in the existing archaeological landscape. Remnant patches of Hawaiian plants in the park's wildlands are threatened by competition with noxious weed species, and their chances for survival are improved by continued cultivation in Kalaupapa's residential gardens.

Putting down roots: Edible roots, black holes, and Plateau prehistory: *Sandra PEACOCK and Nancy J. TURNER, University of Victoria.*

This paper examines the ethnobotanical and archaeological evidence for traditional root-vegetable use by the Plateau peoples of the southern interior of British Columbia. Contemporary interior Salish peoples identify at least twenty culturally significant root species. Several of these (e.g. *Allium* spp., *Balsamorhiza sagittata*, and *Erythronium grandiflorum*) were harvested intensively, in quantities of up to 50 kg or more per family per year, and pit-cooked in large earth ovens. Archaeological evidence indicates these practices are at least 2500 years old, suggesting the biological diversity observed today in former aboriginal root-gathering grounds is the result of indigenous peoples' on-going management of these critical resources.

Reconstructing subsistence in the lowland tropics: A case study from the Jama River Valley, Manabi, Ecuador: *Deborah M. PEARSALL, University of Missouri.*

This paper demonstrates how paeloethnobotanical data, specifically, charred macroremains and phytoliths, are used to reconstruct subsistence in the lowland tropical forest. The issue of when maize (*Zea mays* L.) became important in western Ecuador is central to the study. Analysis of macroremains indicates that a change occurs around A.D. 500 in the apparent importance of maize, in the context of expanding settlement. Phytolith data from a river profile document progressive expansion and volcanic ashfall. Phytolith data from cultural contexts reflect the background vegetation, and also document the broad-based subsistence system that remains a feature of human-plant interrelationships in the valley throughout prehistory.

Capacidad de carga humana y biodiversidad en ecosistemas áridos del norte de México [Human carrying capacity and biodiversity in arid ecosystems of northern Mexico]: *L. PEREZ R., H.J. LOPEZ G., R. NAVA C., and J. GUTIERREZ C., Universidad Autónoma Agraria "Antonia Narro".*

[Renewable natural resources have been subjected to intensive use. As a result, the arid environment has experienced change in diversity due to changes in the use of the soil, declining ground cover and species density, acceleration of soil erosion, migration of songbirds, devastation of harvestable resources, etc. This scene has produced human pressure with the sole end of sustaining the human population which uses it. The use of natural resources must be exploited in a manner subject to the carrying capacity of the ecosystem. This permits us to place the matter of potential productivity of arid ecosystems against the matter of biodiversity, as a strategy for conservation of natural resources under the present-day concepts of the sustainability of the ecosystem.]

Starvation and the Hualapai Indians at Hackberry, Arizona: Ethnobotanical remains and ethnocentric perceptions, 1875–1920: *David E. PURCELL, SWCA Environmental Consultants; and Eric. C. HANSEN, Zoobot Archaeological Consultants.*

Ethnobotanical specimens were recovered and analyzed from four features and six subfeatures of Site AZ G:10:8(ASM), Hackberry Townsite, in Mohave County, Arizona. The features are affiliated with the circa 1875–1920 Hualapai Indian barrio or camp at Hackberry. Analysis of microremains yielded 26 taxa and pollen grains yielded 27. Archival primary sources describe mass starvation among the Hualapai which initiated contemporary distributions of food and cooking implements from 1879–1900. Only one domesticate was identified; however, the remainder are native species traditionally exploited by the Hualapai, or non-food resources. Faunal specimens were analyzed and likewise represent traditional preferences. The incidence of starvation appears to be an ethnocentric reaction to native subsistence practices, not chronic physiological deprivation.

A peek in the Anasazi pantry: Macrofloral evidence of possible food resources in Pueblo II/Pueblo III times: *Kathryn S. PUSEMAN, Paleo Research Labs.*

Macrofloral samples were examined from floor matrix and floor fill in pithouses, kivas, and surface rooms representing Anasazi occupations along the Puerco River in northeastern Arizona. Patterns of recovery indicate economic activity within the structures and may be used to address expectations for charred seed recovery. Floor-fill samples contained greater varieties and quantities of charred remains than did floor matrix samples. Samples contained evidence of all three expected cultigens (maize, beans, squash), as well as a variety of native plants.

Do edible insects play a financial role among different ethnic groups in Mexico? *Julieta RAMOS-ELORDUY, Universidad Nacional Autónoma de México.*

In Mexico many ethnic groups that consume edible insects also sell or exchange them for profit. This permits them to buy other necessary goods. We analyze the cost-benefit ratio for four edible insect species. The balance shows a profit. These are grasshoppers of the genus *Sphenarium*, ants called *"chicatanas"* (*Atta* spp.), *"escamole"* ants *(Liometopum apiculatum)* and the white agave-worm *(Aegiale [Acentrocneme] hesperiaris)*. We shall here discuss their economic, ecological, and social effects in Mexico City and in rural areas.

First Mexican Congress of Ethnobiology (August 1994): *Julieta RAMOS-ELORDUY, José M. PINO M., and Juan Manuel RODRIGUEZ, Universidad Nacional Autónoma de México.*

In Mexico, the "Asociación Mexicana de Ethnobiología" was created on 30 March 1993 with 114 members. In August 1994, the First Mexican Congress of Ethnobiology was held in Toluca City. The response to this First Congress was amazing. There was a total of 186 papers presented by 370 Mexican and international authors, supplemented with videos and 14 magistral conferences. Governmental and private institutions as well as independent civil associations participated. The central topic was "Ethnobiology in the Knowledge and Conservation of Natural and Cultural Resources." This was divided into 8 subjects and complemented with a workshop on "Methodology in Ethnobiology." There was also a tasting of non-conventional resources and an exhibition and sale of Mexican crafts.

"If the threshing floor could talk . . . ": Ethnographic studies of traditional crop processing in India: *Seetha N. REDDY, ASM Affiliates.*

This paper presents the results of ethnographic studies of traditional millet crop processing in India; the summer monsoonal cultivation of *Sorghum bicolor* and *Pennisetum typhoides,* and the opportunistic cultivation of *Panicum miliare*. The discussion will examine the definitive identification of their cultivation in South Asian archaeological contexts. Despite previous research, cultivation of millet crops as a distinct activity had not been clearly demonstrated at any site in India. The simple recovery and retrieval of archaeobotanical millet seeds from the sites is inadequate to argue for cultivation. The identification of actual cultivation is important in order to exclude the possibility that millet crop grains were being obtained through trade and exchange. To address this issue, an ethnographic study of millet crop processing particularly tailored for archaeological interpretations was conducted.

Potential new crops in Sonora, Mexico: Medicinal plants of the Pima Bajo near Yécora: *Ana Lilia REINA GUERRERO, Universidad de Sonora.*

The Pima Bajo Indians in the Sierra Madre Occidental near Yécora (28–31°N, 108–110°W) commonly use 145 species of plants for medicine. Of these, 78% are wild and 62% are summer herbs. The related illnesses, uses, and techniques of preparation and consumption were recorded. The entire branch was most commonly used, followed by leaves, roots and bark. Medicines were most commonly administered as tea, followed by poultices and baths. Traditional plant medicines continue to be used due to the lack of medical services and the prohibitive cost of prescription medicines. A number of medicinal plants could be cultivated to relieve pressure on wild populations.

An evaluation of Anasazi diversity of wild plant use: *Karl REINHARD, University of Nebraska-Lincoln.*

The comparative analysis of coprolites from three Archaic caves and three Anasazi sites showed that the diversity of wild plants in the Anasazi diet was greater than that of hunter-gatherer diets. This discovery seemed counterintuitive, considering that wild plants were the staples of Archaic subsistence. Five hypotheses were presented to explain this which were related to aspects of preservation, development of species, increased wild plant diversity due to agriculture, need to increase micronutrient intake, and diversification of diet to support overly-large village populations. Recently these hypotheses were evaluated by the examination of a large series of coprolites from Antelope House in Canyon de Chelly.

A laboratory guide to plant remains in eastern North America: *K. ROBERTS, G. POWELL, K. KELLER, K. BOROJEVIC, M. BROWN, M. WILLIAMS, K. ELLISON, and G. FRITZ.*

Paleoethnobotany, the study of archaeological plant remains, has undergone a theoretical and technological revolution in the last two decades. Recently discovered cultigens in regional assemblages have reconfigured our understanding of prehistoric agriculture in eastern North America. Proof of these cultigens, as such, hinges on their distinctive morphology. "A laboratory guide to plant remains in eastern North America" provides images (photographs, micrographs, line drawings) of plant materials consistently encountered in archaeological assemblages and their modern counterparts. Salient morphological characteristics of seeds and other matter (i.e. nutshell and fruit rind) are described qualitatively and quantitatively within the context of their archaeological distribution. Domesticatory status, taxonomic issues, and use are discussed.

Quantitative ethnobotany in the Atlantic Forest (SE Brazil): *Silvia C. ROSSATO, Universidade de Sao Paulo; and Alpina BEGOSSI, Universidade Estadual de Campinas.*

The native vegetation of the southern coastal parts of Brazil is represented by remnants of tropical rainforests, with a high diversity of species, known as the Atlantic Forest. This region is partially inhabited by native populations, the caiçaras, which have a subsistence economy based on fishing and small-scale agriculture (especially manioc cultivation). This study includes the ethnobotany of the communities of Casa de Farinha, Picinguaba, Puruba, and Vitória Island, Ubatuba District. We conducted interviews based on open-ended questionnaires and calculated diversity indices (Simpson, Shannon-Wiener, and rarefaction) related to plant uses. Comparisons among different categories (per sex and per age) show significant differences in the use of plants for construction and medicine. Comparisons among these and other Atlantic Forest communities show that differences in the use of plants are consistent with the classical theory of island biogeography.

Rarámuri necklaces: A rapidly changing folk-art form in the Sierra Madre of northern Mexico: *Enrique SALMON, Baca Institute of Ethnobotany; and Karen R. ADAMS, Crow Canyon Archaeological Center.*

Colorful seed bead necklaces are made and sold by Rarámuri (Tarahumara) women and children in the Sierra Madre uplands along the famous Copper Canyon railway. A collection of 30 necklaces made in 1994 reveals the necklace materials are quite varied. They include seeds, various fruit types, stems, wood and bark of at least 19 different taxa in at least 10 plant families, strung on a minimum of six modern materials. The materials used in construction include fruit or seeds of three domesticates, parts of three plants naturalized from the Old World, and parts of taxa that grow only in the lowlands or deep canyon bottoms. Alterations to raw materials include carving, cutting, filing, and dyeing, as well as soaking prior to piercing. Although the Rarámuri say their necklaces are traditional, neither the archaeological nor ethnographic record supports a history of necklace-making as seen today.

Traditional uses of lichens: *Sylvia Duran SHARNOFF, Missouri Botanical Garden.*

Reports of lichen use in traditional cultures are being gathered for inclusion in the first color identification manual of North American lichens. Lichens were used as food, both in times of famine and as a delicacy, and gathered as animal fodder. Lichens were widely used in medicine; complex biochemical compounds produced by many lichens have antibiotic properties. There are scattered reports of hallucinogenic lichens and lichens used as poison. Lichens yield excellent dyes; examples may be seen in Chilkat dancing robes, Navajo rugs, and Harris tweeds. Branching arboreal lichens were used as fiber for bedding, diapers, bandages, and even clothing.

The domestication of *Cucurbita pepo*: Reassessing the evidence from Tamaulipas: *Bruce D. SMITH, Smithsonian Institution.*

With the exception of *Cucurbita pepo* materials recovered from Guila Naquitz Cave, Oaxaca, which were assigned an age of 9800 B.P., two caves in Tamaulipas have yielded the earliest evidence of domesticated squash in the Americas. Excavated in 1954 by Richard S. MacNeish and David Kelley, Romero's Cave and Valenzuela's Cave in the Ocampo region of Tamaulipas, Mexico, yielded abundant plant remains, including squash seeds, rind and peduncle fragments. These specimens of *Cucurbita pepo,* recovered from Infernillo Phase (9000–7500 B.P.) and Ocampo Phase (6000–4300 B.P.) occupation layers within the Ocampo caves, have long been recognized as providing some of the earliest evidence for the domestication of this major crop plant. This paper reconsiders these Ocampo cave assemblages and their cultural and temporal context.

Seri ethnozoology: Awls, mule deer and tradition: *Heriberto SOTO-TORAL, and O. J.POLACO, Instituto Nacional de Antropología e Historia.*

In ancient times many people used animal products to manufacture tools. The Seri or Comcáac, Sonora, retain traditional knowledge of how to use mule deer *(Odocoileus hemionus)* metapodials to make awls. These are named ***zix icoop*** and at present are used to weave their baskets or "coritas." They are made by first waisting the proximal end to form a point, then retaining the distal end as a handle. A piece of coral (***zix cohp iquipemth***) is then used for sharpening the proximal end to complete the awl. During 1993 and 1994, we registered a total of 132 awls in use, 60 of the metacarpus and metatarsus. These belonged to 60 of 115 artisans. The mule deer is hunted in Seri lands and the coral is obtained from Isla Patos. The conservation of this knowledge and tradition is threatened because of recent statements that declare the mule deer a species in danger of extinction (and therefore protected) and the Isla Tiburón as a biosphere reserve.

Brainerd Ware pottery function explored through opal phytolith analysis of food residues: *Robert G. THOMPSON, Woodward-Clyde Consultants; Rose KLUTH and David KLUTH, Leech Lake Reservation Heritage Sites.*

Brainerd Ware pottery was thought to be a Middle Woodland form, found underlying Late Woodland ceramics. Recent AMS dates on food residues from Brainerd Ware vessels date to ca. 3000 B.P. The Brainerd Ware pottery tradition lasts until ca. 1500 B.P., over 1000 years. During this time the role of Brainerd Ware vessels changed. Early vessels contained little evidence of the use of grass seeds, but possible evidence for a focus on starchy seeds. The primary staple food of the Late Prehistoric in northern Minnesota and Wisconsin was wild-rice *(Zizania aquatica).* Wild-rice has been thought to be a late addition to the diet of this area. Analysis of opal phytoliths from food residues in Brainerd Ware pottery from north-central Minnesota show that this food was introduced much earlier.

The hands of a lizard: Chumash ethnoherpetology: *Jan TIMBROOK, Santa Barbara Museum of Natural History.*

During the 10,000 years that the Chumash and their ancestors have inhabited the Santa Barbara Channel region, they developed a distinctive relationship with the land and its flora and fauna, including reptiles and amphibians. In addition to being used for food and material items, these creatures also worked their way into Chumash mythology, cosmology, and art. This presentation, the title of which is derived from a Chumash legend, introduces the ways in which these indigenous people have interacted with the snakes, lizards, turtles, and frogs of south-central California.

Cultural dimensions of agrobiodiversity: The case of cowpea varieties in the US South: *Eleanor TISON, University of Georgia.*

In the southern United States, the cowpea (*Vigna unguiculata* subsp. *unguiculata*) is a culturally-relevant legume crop. Southern farmers and gardeners have developed, cultivated, and named localized cowpea varieties since the crop's introduction to the region in the early eighteenth century. Today, some of this agrobiodiversity is maintained by elderly home gardening seed savers. Using an ethnographic approach, case studies of this type of seed saver are investigated in order to examine the cultural factors that contribute to the *in situ* conservation of heirloom and folk varieties of a traditional crop.

"To preserve and maintain for the generations to come": Strategies for sustainable resource use among aboriginal peoples of British Columbia: *Nancy J. TURNER, University of Victoria; Marianne BOELSCHER IGNACE and Ron IGNACE, Simon Fraser University.*

This paper discusses the characteristics and application of Traditional Ecological Knowledge (TEK) of aboriginal peoples in British Columbia. Examples are provided from various groups of a range of features comprising TEK: respectful and interactive attitudes and philosophies; appropriate social institutions; strategies for monitoring, enhancing, and sustainably harvesting resources; knowledge of ecological principles; adaptive strategies; effective systems of knowledge transfer; close identification with ancestral lands; and belief in the power and spirituality of nature. These characteristics combine within a holistic perspective, enabling First Nations societies to live sustainably for many thousands of years.

Floristic variation in Nahua home gardens of Guerrero, Mexico: *Alberto VILLA, Escuela Nacional de Antropología e Historia; and Javier CABALLERO, Universidad Nacional Autónoma de México.*

Home gardens are an important agrosilvicultural system among indigenous peoples of Mexico. The structure and composition of home gardens may vary between different ecological and cultural zones. This study describes the Nahua home gardens of the tropical dry forest region of the State of Guerrero, a kind of home garden still poorly studied. A total of 40 home gardens from two villages with contrasting ecological and sociocultural conditions was sampled. Only one of the villages has tap water or any other means of irrigation. The statistical analysis of the data on floristic composition reveals significant differences between the home gardens of the two villages. Home gardens without irrigation are less diverse and have a higher proportion of native plants, mainly wild trees. In contrast, home gardens with irrigation are more diverse and tend to have a higher proportion of non-native plants. These differences also seem to be a reflection of modernization and sociocultural change. These differences may have important implications for conservation of the local flora.

***Euphorbia pulcherrima* Willd.: *Cuetlaxochitl*, símbolo y recurso de México [. . . symbol and resource of México]:** *Marina VILLEGAS Y DE G., Ma. Eugenia ORDORICA V., Delfina RAMOS Z., and Ma. del Carmen FONSECA N., Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional.*

[*Euphorbia pulcherrima* Willd. (Euphorbiaceae) is a beautiful plant native to the Republic of Mexico, where it is found wild and under cultivation in various regions. Its morphological variation is manifested in its size, branching, foliage, bracts, etc. There are individuals which do not produce flowers or fruits. The relation between this species and humans has been important from the time of the ancient Mesoamerican cultures to the present, both as a symbol and as a resource with various uses. At present, it is known, respected, and appreciated by the Mexican people primarily under the name "*nochebuena*" among mixed-ancestry Mexicans; among indigenous groups there exist various names in the native languages. The principal uses are ceremonial, ornamental, and medicinal.]

Ethnobotany in the classroom: *Gail E. WAGNER, University of South Carolina.*

This presentation offers a three-year perspective on teaching ethnobotany via the four-field approach in anthropology: cultural, biological, linguistic, and archaeological. Mundane issues such as scheduling, textbooks and presentation are discussed. However, the focus is on course goals and relevance: what should one teach about ethnobotany?

Diversity in Chatino traditional medicine: *Janna WEISS, University of Texas-Austin.*

The ethnic group is the most common designation used for delineating ethnobotanical and ethnomedical studies. Fieldwork with the Chatino of Oaxaca, Mexico (1993–1994) suggests that considerable variation exists in traditional medical practices among the Chatino according to geographic location, linguistic subgroups, and diverse habitats. A transition zone exists between two neighboring Chatino municipalities where distinct material cultures and traditional medical concepts overlap. Aspects of diversity within Chatino traditional medicine will be presented.

Ethnobotany in Colonia la Esperanza de Tijuana, México: *Nancy WILLIAMS, San Diego, California.*

This paper describes an attempt to increase the awareness and understanding of plant uses for medicinal and practical purposes in a border town where most of the inhabitants were raised in different regions and cultures. I compare and contrast the plant uses as told to me by the men and women of the Colonia la Esperanza. Most of the residents migrated from other parts of Mexico and Central America. Some have lived in Tijuana for six months and some for over twenty years. Many bring knowledge from their birthplace, handed down to them by their parents, grandparents, or other elders. Many feel that there is no use in passing the knowledge on, either because the plants do not exist or because their children are disinterested. Several of the people grow their own familiar herbs, and are known throughout the community for their skills in healing with herbs.

The Huichol research and assistance project: A proposed program of cultural reciprocity: *Joseph D. WINTER, University of New Mexico.*

The University of New Mexico has been asked to develop a long-term program of research and assistance with the Huichol Indians of west-central Mexico. In return for technical, medical, and educational assistance, UNM faculty and students will be allowed to carry out controlled, non-invasive research. One element of the proposed program is the creation of a family-oriented agricultural organization that specializes in the collection, preservation, and growth of rare, endangered, and heirloom Native American crops such as traditional tobacco. This paper explains how the organization will operate.

Monte Mojino: Trees and Mayos in southern Sonora: *David A. YETMAN, University of Arizona; Thomas R. VAN DEVENDER, Arizona-Sonora Desert Museum; Rigoberto LOPEZ-E. and Ana Lilia REINA-GUERRERO, Universidad de Sonora.*

Mayo Indian consultants in four villages provided information on traditional uses of 91 species of trees in tropical deciduous forest and thornscrub. Uses of trees were categorized as follows: (1) inherent or esthetic, (2) livestock forage, (3) livestock management, (4) construction, (5) industrial, (6) artifacts, (7) medicines, (8) foods, or (9) cultural. Some ethnobotanical knowledge is rapidly disappearing. More pragmatic uses, especially construction, will pass to the Mexican mestizo intact, often with Mayo names. Conversion of forests to buffelgrass *(Pennisetum ciliare)* pastures threatens Mayo tree resources.

Desert and the sown: Pastoral/urban interaction in the Early Bronze Age southern Levant: *Melinda A. ZEDER, Smithsonian Institution.*

The development of a highly specialized economy, which is the hallmark of urban society in the Near East, made increasing specialization in pastoral production both a viable and economically rewarding option, for pastoralist and urban dweller alike. Yet at the same time the distance mobile pastoralists can maintain from centers of urban power also afforded them a great deal of autonomy from urban control, making them a frequently disruptive force for the political stability of urban society. Pastoralists have long been thought to have played a significant role in the rise and fall of urban societies in the southern Levant during the Early Bronze Age (3200–1800 B.C.). This paper examines the faunal evidence from a site on the edge of the Negev Desert spanning the first phases of the Early Bronze Age though the period of urban florescence and decay with an eye to exploring the role of pastoral specialists in the urban economy of the region.

Phytolith analysis and environmental conditions in San Lorenzo, Tenochtitlan Region, Veracruz, Mexico: *Judith ZURITA-NOGUERA, Universidad Nacional Autónoma de México.*

Results of the analysis of plant opal phytoliths recovered from excavations at the Olmec site of San Lorenzo, southern Veracruz, Mexico, contribute to the reconstruction of environmental conditions in the area, as well as to knowledge concerning plant use. Samples were recovered from different archaeological contexts through an intensive sampling strategy from floors, profiles, features, etc. The phytolith analysis shows characteristic species from tropical forest and gives information about Olmec subsistence and construction technique.

SPECIAL SYMPOSIUM:
The Legacy of Sonoran Desert Ethnobiology

Organized by Gary P. NABHAN
Sponsored by the Arizona-Sonora Desert Museum, Arizona State Museum, & Native Seeds/SEARCH

The image of ethnobotany in the popular media suggests that all innovative fieldwork on the medicinal value of and all theoretical advances in our understanding of hunting societies derive from research in the rainforest. Ironically, one of the oldest traditions of ethnobiological study is rooted in the North American deserts. It is one which has already spawned commercial products from jojoba, guayule, creosotebush, and mesquite; it has also engendered a revival in the uses of mesquite, prickly-pear, and tepary beans among indigenous communities. Sonoran Desert-based researchers have been key to the history of dendrochronology and the effects of climate change on prehistoric peoples; to the debate regarding the human role in the extinction of Pleistocene megafauna; and to the revival of desert-adapted native crop diversity in water-limited regions. Ethnobiologists interested in folk classification also recognize the uniqueness of Seri Indian over-classification of certain wild plants and animals, for few studies of hunter-gatherer classification systems have demonstrated such depth of knowledge regarding subspecific variation patterns. Finally, the region's institutions have fostered unique collaborations between ethnobiologists, environmental educators, cultural rights activists, and grassroots community organizations. In many ways, Sonoran Desert research has helped make ethnobiology a household word.

Mountain islands in the Hohokam Sea: Overhunting mesofauna? *Paul S. MARTIN, Christine SZUTER, University of Arizona; and David W. STEADMAN, New York State Museum.*

Over half of the native terrestrial vertebrates on islands of the South Pacific disappeared in recent millennia. Waves of land-bird and sea-bird extinction swept eastward from Melanesia and Micronesia to Polynesia on the heels of prehistoric colonization. Mountain islands of the U.S.-Mexican borderlands resemble oceanic islands in harboring terrestrial vertebrates confined to an isolated habitat. Ecologists model extinctions of montane populations of tree squirrels, marmots, pikas, and other mammals in terms of some 12,000 years of habitat shrinkage. Is that the answer, or, as in the case of the South Pacific, did prehistoric foragers also force mountain island extinction?

Managed and cultivated plants in the Sonoran Desert archaeological record: *Suzanne K. FISH and Paul R. FISH, University of Arizona.*

A basic suite of cultivars has long been recognized in the archaeological record of Sonoran Desert farmers. Recent research shows that almost the full suite was cultivated by the time of initial ceramic phases. The list of plants in addition to the basic suite that are known or suspected of having been managed, tended, or cultivated has grown rapidly in the last decade. The evidence for these additional species is discussed, including the discovery of surprisingly prominent roles for them in prehistoric subsistence systems of the region.

Staying sickness, mammalian biogeography, and the origins of northern Pimans: *Amadeo R. REA, San Diego, California.*

Staying sickness, a disease unique to northern Pimans (O'odham), is caused by violations of the "strengths" of certain plants, animals, objects, or ceremonies. Most of these are mammals. But why some and not others? Of 32 northern Piman mammal folk generics, 13 cause staying sickness, while 19 are "safe." Seven "dangerous" mammals are from northwestern Tepiman country while 14 "safe" mammals range throughout the Tepiman corridor. Five widespread "dangerous" mammals can be explained by strong cultural factors; 5 apparently "safe" northwestern mammals are unexplained. I propose that as northern Pimans expanded out of a core Tepiman area between A.D. 1450 and 1650, they endowed the new and strange species of mammals they encountered in the northwest with sanctions associated with staying sickness.

Peoples of the Gulf of California: Abundances and limitations of marine and terrestrial resources: *Richard FELGER, Drylands Institute; and Felipe MOLINA, Native Seeds/SEARCH.*

Resources of the shores, islands, and river deltas of the Gulf of California were rich but highly varied. Peoples of the river deltas were agriculturalists. All relied on wild animals and plants, but those living away from riverine systems were exclusively hunters and gatherers relying on the desert and the sea. Major resources included sea turtles, fish, mollusks, sea grain, and terrestrial animals and plants. Differences in distribution and types of resources led to greatly different lifeways. Fresh water continues to be the single most limiting factor for the cultures of the region.

Where have all the Mayo gone? *David A. YETMAN, University of Arizona; Thomas R. VAN DEVENDER, Arizona-Sonora Desert Museum; Rigoberto LOPEZ-E. and Ana Lilia REINA GUERRERO, Universidad de Sonora.*

In tropical deciduous forest south of the Sierra de Alamos in southern Sonora formerly

Mayo Indian towns now support *mestizo* (mixed-ancestry) populations. In villages to the west in coastal thornscrub and to the south in Sinaloa the Mayo culture is more intact. The extensive ethnobotanical knowledge of the Mayo appears to be assimilated or lost differentially. Here, as throughout rural Mexico, the ethnobotanical knowledge of the *mestizo* cultures is rich, a mixture of information derived from local indigenous groups with the sum of plant uses and names gleaned from three centuries of previous cultural interchanges. Although the general knowledge of many plants continues after acculturation, the intimacy of Mayo subsistence farmers with the plants in their natural habitats is rarely achieved by the recent, livestock-based *mestizo* cultures.

Reconstructing indigenous diets as a means of planning dietary interventions: the Native Seeds/SEARCH diabetes and desert diet projects: *Gary Paul NABHAN and Angelo JOAQUIN, Jr., Native Seeds/SEARCH.*

Many indigenous peoples have recently questioned whether their communities receive any tangible benefits of ethnobiological, biomedical, and ethnohistoric research. Native Seeds/SEARCH staff has spent the last five years directing attention to ways in which a better understanding of historic *O'odham* diets can lead to the prevention and control of adult-onset diabetes mellitus. Prior to 1940, when traditionally gathered and harvested foods still dominated *O'odham* diets, there was virtually no expression of diabetes. Government health workers and pathologists virtually dismissed the indigenous diet as a major factor in controlling diabetes. We have determined that historic diets were extremely rich in substances which control blood sugar and insulin levels. We have educated more than 3000 health workers, teachers, and community leaders about the value of incorporating traditional foods as a culturally and nutritionally appropriate intervention strategy for diabetes sufferers.

BOOK REVIEW

Lok Swasthya Parampara Samvardhan Samithy Monograph Series. No. 1. Local Health Traditions: An Introduction. A. V. Balasubramanian and Vaidya M. Radhika. Illustrated by Natesh. **No. 2. Ayurvedic Principles of Food and Nutrition. Part I.** Vaidya M. Radhika and A. V. Balasubramanian. Illustrated by Natesh. **No. 3. Mother and Child Care in Traditional Medicine. Part I.** Vaidya M. Radhika and A. V. Balasubramanian. Illustrated by Natesh. **No. 4. Mother and Child Care in Traditional Medicine. Part II.** Vaidya M. Radhika, and A. V. Balasubramanian (editors). Illustrated by Natesh. **No. 5. Marma Chikitsa in Traditional Medicine.** Vaidya V. Dharmalingam, Vaidya M. Radhika, and A. V. Balasubramanian. Illustrated by Natesh. **No. 6. Ayurvedic Principles of Food and Nutrition. Part II.** V. M. Nanal, R. M. Nanal, M. Radhika, and A. V. Balasubramanian (editors). **No. 7. Nidaana Diagnosis in Traditional Medicine.** Vaidya R. Aruna, A. V. Balasubramanian, and V. Sujatha. Illustrated by V. Sathyabama. **No. 8. Bheshaja Kalpana Pharmacology in Traditional Medicine.** Vaidya V. O. Saji and A. V. Balasubramanian. Illustrated by V. Sathyabama. **No. 9. Vrkshayurveda. An Introduction to Indian Plant Science.** K. Vijayalakshmi and K. M. Shyam Sundar. Illustrated by Uma Krishnaswamy. **No. 10. Plant Propagation Techniques in Vrkshayurveda.** K. Vijayalakshmi and K. M. Shyam Sundar. Illustrated by Uma Krishnaswamy. **No. 11. Nomenclature and Taxonomy in Vrkshayurveda.** P. Ram Manohar. Illustrated by Uma Krishnaswamy. Madras, India: Lok Swasthya Parampara Samvardhan Samithi (c/o Centre for Indian Knowledge Systems, No. 2, 25th East Street, Thiruvanmiyur, Madras 600 041, Tamil Nadu, India), 1989-1994. $108.00 U.S. (paperback); (also available individually). No. 1. 1989. Pp. iii, 95. No. 2. 1990. Pp. iii, 121. No. 3. 1990. Pp. iv, 81. No. 4. 1990. Pp. iii, 78. No. 5. 1991. Pp. ii, 75. No. 6. 1991. Pp. vi, 69. No. 7. 1991. Pp. i, 84. No. 8. 1991. Pp. iii, 64. No. 9. 1993. Pp. iii, 101. No. 10. 1993. Pp. iii, 70. No. 11. 1994. Pp. iii, 100. (no ISBN numbers)

This series introduces the reader to the local health and plant traditions of India as practiced at the community level. This traditional knowledge, much of it orally transmitted from generation to generation, is disappearing. The Lok Swasthya Parampara Samvardhan Samithi is an Indian network of individuals and organizations "committed to the cause of revitalization of the indigenous systems of health care and widespread folk health traditions." It is nice to see in this monograph series native scholars working to capture their own traditions, instead of the still typical, but less appropriate and less cost-effective, research expeditions from America or Europe.

The task is formidable: not only is the local traditional knowledge disappearing at an alarming rate, there is so much of it to document. This series cannot be regarded as an attempt to document details—recipes, directions of use, botanical descriptions, etc.—rather it introduces the reader to the extent of the subject and sets the framework by which it can be studied and presented.

The extant health and plant science systems in India may be classified:

i) Local traditional folk system (Lok Swasthya Paramparas);
ii) Indian 'scientific' systems (e.g. Ayurveda, Unani, Siddha);
iii) Western scientific systems.

The emphasis of the present works is on the local health and plant knowledge, although frequent reference is made also to the better known organized Indian systems, the Ayurveda, Unani, and Siddha. These latter systems are considered the "scientific" standard by which the local systems are compared, and little attempt is made to explain the local systems in modern Western terms. It is argued that the Indian sciences are as valid as the modern Western systems and are best understood by their own principles and terminology. The Indian sciences are subjective in observation and analysis, yielding principles and theories that are not susceptible, as are Western sciences, to upheaval wrought by constant refinement of our objective understanding of our external reality. For the Indian health practitioner, height is measured in terms of the patient's ***anguli*** (fingers), not by an arbitrary standard like meters. Likewise, time is measured in ***maatra,*** the time of one cycle of breath; so too is volume similarly normalized to the individual.

The series presentation is at times confusing to the reader. The works shift back and forth from i) detailed exposition of the Paramparas, to ii) setting of the framework of such an exposition based on the Indian sciences. It is never quite clear to whom the works are directed: they are not detailed enough for practical usage and experiment among specialists and practitioners and are too opaque for the Western reader with many terms left untranslated and undefined. For the Western reader, the works demand immersion in the Indian terminology.

Still, there is much to be found here that deserves closer examination. It is noted in *Ayurvedic Principles of Food and Nutrition, Part I* (No. 2) that ***ghee,*** the clarified butter staple of Indian cuisine, is high in fat and cholesterol and is difficult to digest, yet in Ayurveda ***ghee*** is recommended for those in late youth and old age—exactly the ages when it is contraindicated in the West. The Ayurvedic ***acharyas*** (adepts) say that ***ghee*** increases digestive power, increases intellect, memory, the libido, and otherwise helps enhance longevity and youthfulness. On the other hand, milk, though recognized as a healthy food, is incompatible with all sundry of foods like fish, sour foods, meat, horsegram *(Dolichos biflorus),* blackgram *(Phaseolus roxburghii),* radish, and others. It is claimed that continued intake of incompatible foods will lead to infertility, blindness, blisters, psychological imbalance, perception problems, abdominal distension, fevers, frequent colds, chronic nasal drip, and even unconsciousness and congenital disorders of offspring(!). While modern health sciences have much to say about the nutritional content of foods, they understand little of the synergistic effects of foods and nutrients on the body; perhaps "ethnonutritional" data as can be gleaned from these works will suggest approaches for research.

It is surprising that in a section on oral hygiene in *Ayurvedic Principles of Food and Nutrition, Part I* (No. 2) there is no mention of ***neem*** *(Azadarachta indica)* among appropriate materials for toothbrushes, powders, gargles and toothpicks. Everywhere in India villagers can be seen using ***neem*** sticks to clean their teeth, and Ayurvedic toothpastes containing ***neem*** are exported worldwide.

There is an interesting account of the Indian system of ***marma*** (or ***varma***), an ancient system of acupuncture and acupressure similar to the Chinese and Japanese systems. In *Marma Chikitsa in Traditional Medicine* (No. 5), an adept of the system is interviewed at length on the use and efficacy of the system as it is practiced today.

Like Tibetan medicine, testing the pulse (just above the wrist) and urine are important diagnostic tools. The ***naadi,*** or channels of 'energy' through the body, are accessible to examination (***nidaana***) and manipulation in many ways including herbs and ***marma.*** In *Nidaana: Diagnosis in Traditional Medicine* (No. 7) there is a detailed classification of Ayurvedic and Lok Parampara etiology of disease and methods of diagnosis. Typically, medical problems are treated with home remedies, and if there is no relief after two days, patients consult folk practitioners for advice. If these part-time health workers are unable to help, they refer patients to fulltime Ayurvedic or Siddha professionals. Folk practitioners can include specialties as midwives, bonesetters, astrologers, and oracles, each with their own orally-transmitted traditions.

Bheshaja Kalpana Pharmacology in Traditional Medicine (No. 8) is an introduction to the properties and methods of preparation of medicines. *Bheshaja Kalpana* describes the underlying principles and general approach rather than specific recipes. There are guidelines for the appropriate collection time of herbs and their various routes of administration. Among some interesting preparations described are ***aasavaas*** and ***arishtams***: powders and decoctions in sugar or ***jaggery*** solution which are allowed to ferment. Unlike other Ayurvedic medicines, ***aasavaas*** and ***arishtams*** are said to have no expiry date, becoming more potent with time.

The last three volumes (Nos. 9–11) cover Indian botanical and soil science, the Vrkshayurveda, a once extensive literature dating back before the 8th century C.E. Much of what is known today is reconstructed from other sources, such as the ***vedas*** (religious works) and ***nighantus*** (medicinal plant lexicons). *Vrkshayurveda: An Introduction to Indian Plant Science* (No. 9) is largely devoted to soil science. Classification schemes exist for soils based on test results, color and taste, and for each soil types of crops that can be grown are specified. Several soil tests are described including the following: excavate a pit one cubic yard and back fill; if the soil cannot be filled back in the hole even with stamping, then the soil is "very adhesive" and "unctuous" and is considered high quality; if the hole is refilled exactly, that indicates sand with rich clay—a mediocre soil; if the pit cannot be filled, then the soil is poor quality loose sand. Different soils are recommended for different types of herbs—for example, purgative herbs should be grown on ***prithvi*** and ***jala*** (black and sweet) soils and emetic herbs should be grown on sparser ***agni, aakaasha,*** and ***vaayu*** soils. Methods of soil improvement are also described: ***neem*** leaves and oil cake and ***perandai*** *(Cissus quadrangulensis)* are both recommended to reduce salinity.

There is a rich folklore of seed storage and plant propagation, as one would expect for a nation so dependent on agriculture. A wealth of prescriptions and recommendations for collection, treatment, and sowing of seeds is hinted at. Example: sweet flag root *(Acorus calamus)* is used as a seed fungicide, which may bear some relation to its use in the West as a potpourri fixative. Sweet flag is also recommended in irrigation water to produce seedless melon, eggplant, and snake gourd *(Trichosanthes anguina* and others). If this effect can be verified it could have implications for modern agriculture.

Indian plant nomenclature is multinomial: this is, each plant has a unique set of descriptive names which taken together give a profile of the plant. The system is unwieldy and is not unlike the confused state of pre-Linnean nomenclature in Europe. One of the names usually serves as the basonym for the plant, but the system is compared to a crossword puzzle and the identity of plants is often difficult to discern. In *Nomenclature and Taxonomy in Vrkshayurveda* (No. 11) there is an intriguing reference to discovery in 1950 of an ancient Indian manuscript describing a plant classification system based on comparative morphology. A description of the work was published in the *Journal for the Royal Asiatic Society,* but the manuscript itself was never published. Efforts should be made to locate and publish that manuscript.

The Lok Swasthya Parampara Samvardhan Samithy series attempts to cover a vast body of knowledge, both local and "scientific." The result is uneven in style and pace and riddled with many annoyances to the reader. Examples: the absence of indices limits the usefulness of the works considerably; in the course of the 11 volumes there are many folkloric remedies mentioned, like "turmeric for earache," that cannot be accessed quickly by scanning an index. The appendices are generally useful, but errors crop up: in Appendix II of *Nomenclature and Taxonomy in Vrkshayurveda* holy basil or ***tulasi*** (or more commonly rendered as ***tulsi***) is equated to *Vitex trifolia,* a very different plant, while its proper binomial, *Ocimum sanctum,* is incorrectly used for something called "Indian wild pepper"; also, ***kaalajaji*** (***kalonji***), the black cumin *(Nigella sativa),* is equated to *Cuminum cyminum* which is what we know as regular cumin (***jeera***).

Scholarship is lacking by Western standards. Argument by analogy—common in religious literature—is carried over here from the classical texts; several examples appear in *Local Health Traditions: An Introduction* (No. 1). Definitions, when present, are sometimes circular; viz., in Appendix II of *Ayurvedic Principles of Food and Nutrition, Part II* (No. 6), ***shukra janaka*** is defined as "increasing the formation of ***shukra***" but ***shukra*** is left undefined, and only in another volume does one find that it means "semen." Definitions for terms used to describe the actions of 243 foods on body ***doshaas*** (humors) are missing for a table that comprises the largest part of *Ayurvedic Principles of Food and Nutrition, Part II* (No. 6). Spellings of terms unfamiliar to Western readers are inconsistent: the word for an adept ***aachaarya*** is also given the spelling ***acharya*** (p. 30, No. 1); and the words ***ayurvedic*** and ***aayurveda*** appear on the same page (p. vi, No. 6).

Despite annoying detractions, this series will be a valuable addition to any library specializing in the traditional medicine of India. Ethnobotanists, ethnopharmacologists, anthropologists, agriculturalists, and herbalists will find much here to provoke new lines of thought and research.

Conrad Richter
Richters Herbs
Goodwood, Ontario
L0C 1A0 CANADA

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CONTENTS