

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

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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 útiles para uno o más propósitos.

Parece que el uso de las plantas depende de la abundancia relativa en la flora y varias categorías de uso parecen enfocarse 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 veinte por ciento 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 au 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 flore 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 connaître 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 floristique 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 connaissances empiriques 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 examinée. 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-

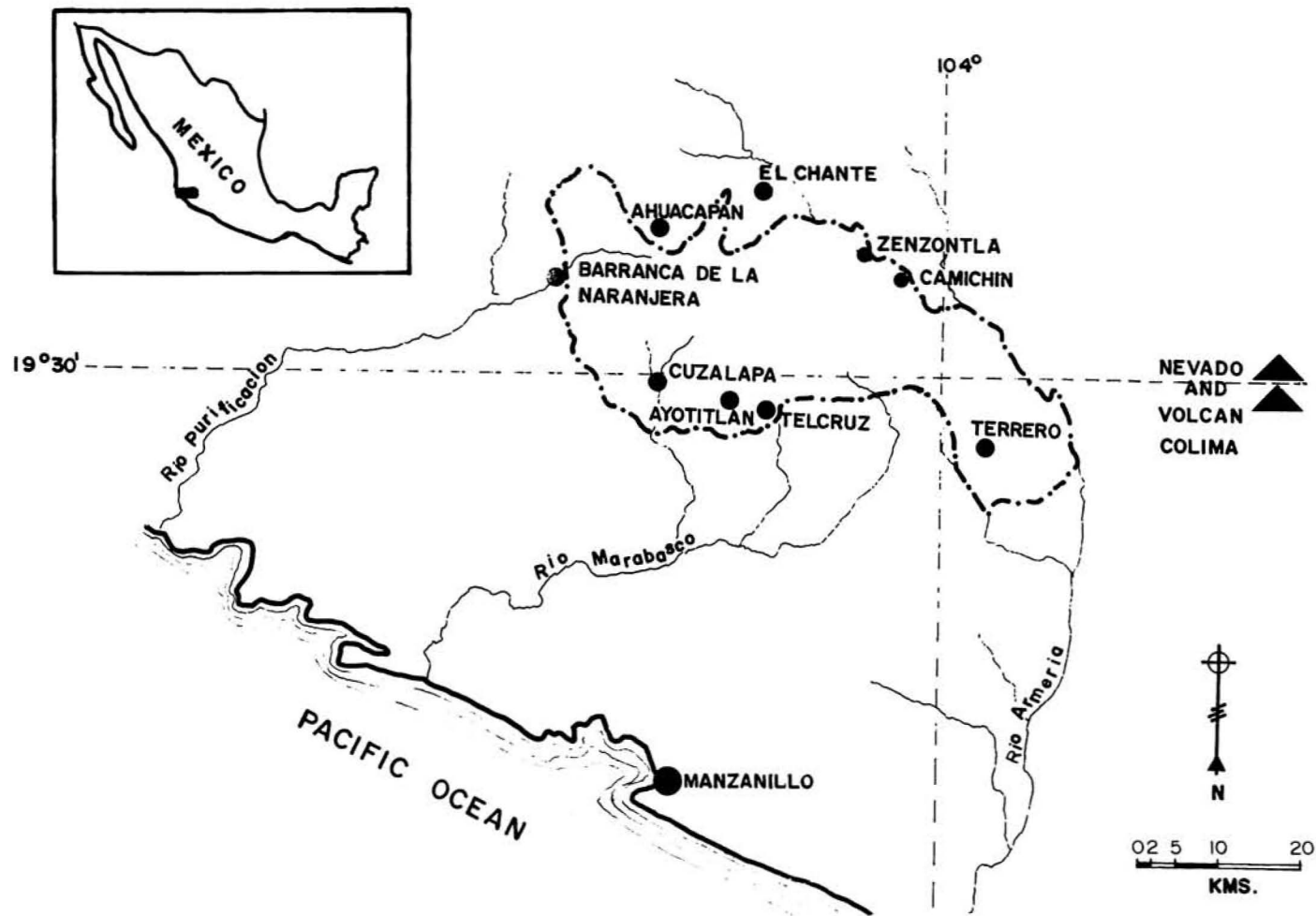


FIG. 1.—Geographic location of the Sierra de Manantlan Biosphere Reserve in western Mexico. Communities where informants were consulted are indicated by small circles.

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 idiosyncrasy 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 Nahuatl speakers (Sauer 1948; Harvey 1972). Only a few indigenous Nahuatl 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. Speci-

mens 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 *guatechil* (*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 Reserve¹

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						Row Total
	OAK FOREST	GALLERY FOREST	CLOUD FOREST	PINE-OAK	TROPICAL DECIDUOUS FOREST	TROPICAL SUB-DECIDUOUS FOREST	
EDIBLE	82 ¹	19	103	4	53	159	420
	96.2	22.2	74.0	20.8	59.4	147.5	19.8%
	-1.6	-8	4.1	-4.2	-1.0	1.3	
FIREWOOD	95	30	36	12	33	85	291
	66.6	15.4	51.3	14.4	41.1	102.2	13.7%
	4.3	4.1	-2.5	-7	-1.5	-2.3	
FENCE POSTS	65	9	23	5	21	67	190
	43.5	10.0	33.5	9.4	26.9	66.7	9.0%
	3.9	-3	-2.1	-1.5	-1.3	.0	
CONSTRUCTION	71	1	45	13	11	64	205
	47.0	10.8	36.1	10.1	29.0	72.0	9.7%
	4.2	-3.2	1.7	1.0	-3.8	-1.2	
FORAGE	19	8	45	1	37	81	191
	43.7	10.1	33.7	9.5	27.0	67.1	9.0%
	-4.5	-7	2.3	-3.0	2.2	2.2	
INSTRUMENTS	37	11	19	10	16	59	152
	34.8	8.0	26.8	7.5	21.5	53.4	7.2%
	.4	1.1	-1.7	1.0	-1.3	1.0	
MEDICINAL	117	34	103	60	129	230	673
	154.1	35.5	118.6	33.3	95.1	236.3	31.7%
	-4.1	.1	-1.9	5.7	4.5	-6	
Column Total	486	122	374	105	300	745	2122
	22.9%	5.3%	17.6%	4.9%	14.1%	35.1%	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		Types of Use	Parts Used
			Reporting Use	Communities Reporting Use		
<i>Guazuma ulmifolia</i>	W,D,TF ¹	96	33	6	6	8
<i>Quercus magnoliifolia</i>	W,N,OF	84	18	3	7	5
<i>Quercus gentryi</i>	L,N,POF	82	25	3	6	6
<i>Vitex mollis</i>	W,C,TF	68	28	7	5	8
<i>Enterolobium cyclocarpum</i>	W,D,TF	67	17	4	9	8
<i>Psidium guineense</i>	W,N,TF	53	16	3	7	5
<i>Byrsonima crassifolia</i>	W,C,?	50	23	5	7	7
<i>Casearia corymbosa</i>	W,D,TF	46	24	5	5	5
<i>Ficus insipida</i>	W,D,TSF	45	24	5	10	7
<i>Inga eriocarpa</i>	W,D,OF	45	20	6	9	7
<i>Quercus elliptica</i>	W,N,OF	43	10	2	6	4
<i>Inga laurina</i>	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 rationale 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

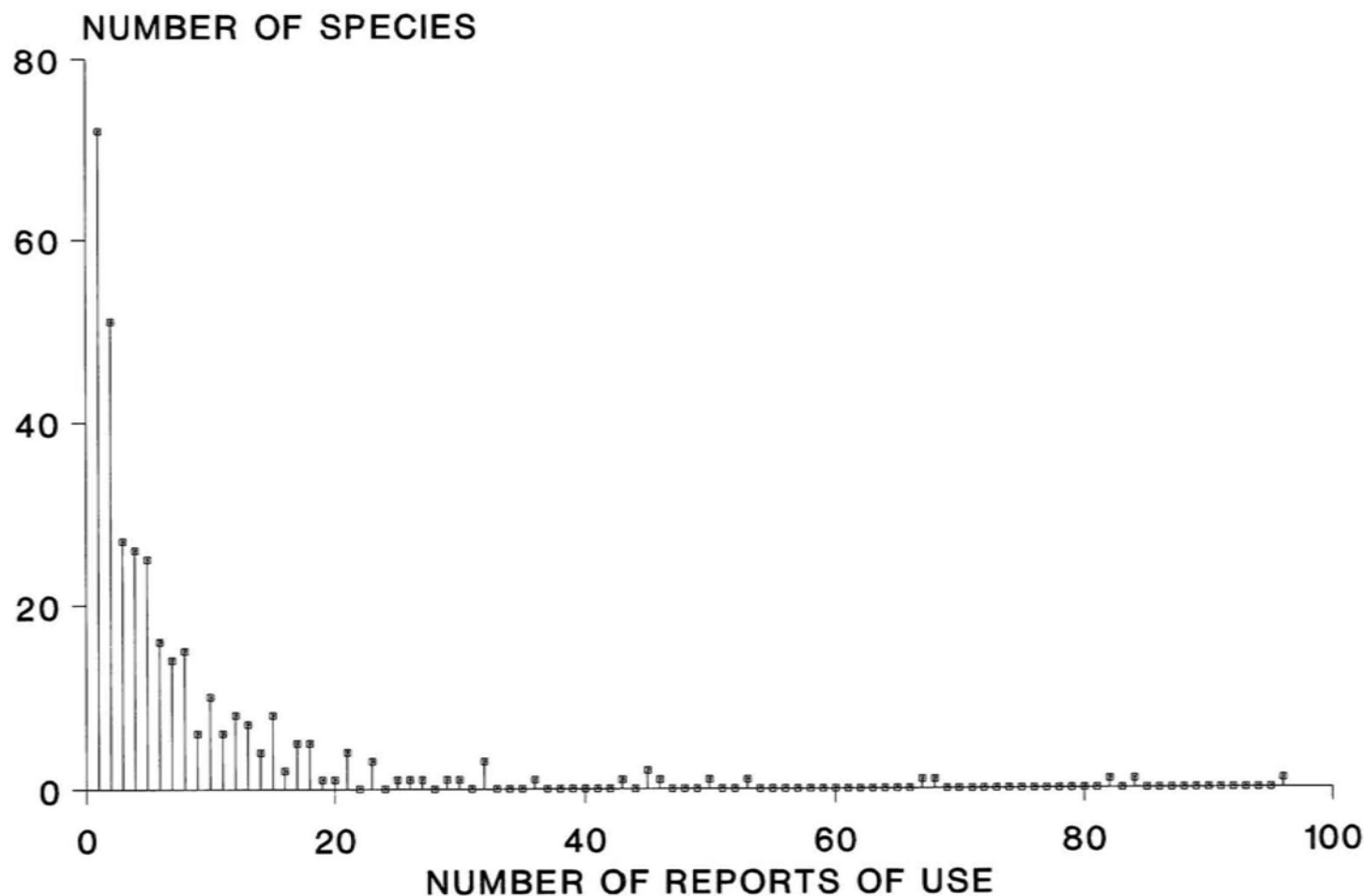


FIG. 2.—Abundance diagram showing the number of reports of use of all useful species (1988–1990). Species exhibiting a significantly ($Z > 2.1$, $P < .05$) large number of reports of use are those numbering more than 36 (see Appendix A). This figure also depicts the relatively large number of species 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 community's 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

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

REPORTS	SPECIES	REPORTS	SPECIES
1	<i>Conostegia volcanalis</i>	2	<i>Chryosophylla nana</i>
1	<i>Magnolia iltisiana</i>	2	<i>Hamelia xorullensis</i>
1	<i>Chamissoa altissima</i>	2	<i>Cestrum lanatum</i>
1	<i>Crescentia alata</i>	2	<i>Ceiba aesculifolia</i>
1	<i>Talauma mexicana</i>	2	<i>Crataegus pubescens</i>
1	<i>Tournefortia densiflora</i>	2	<i>Curatella americana</i>
1	<i>Sambucus mexicana</i>	2	<i>Cyperus hermaphroditus</i>
1	<i>Iresine celosia</i>	2	<i>Rhus pachyrrhachis</i>
1	<i>Buddleia parviflora</i>	2	<i>Cissampelos pareira</i>
2	<i>Salix bonplandiana</i>	2	<i>Eleusine indica</i>
2	<i>Vigna lozanii</i>	3	<i>Iresine interrupta</i>
2	<i>Heimia salicifolia</i>	3	<i>Sapium macrocarpum</i>
2	<i>Hedyosmum mexicanum</i>	3	<i>Calathea sp.</i>
2	<i>Piper rosei</i>	3	<i>Populus guzmanantlensis</i>
2	<i>Phoradendron amplifolium</i>	3	<i>Rhychosia precatoria</i>
2	<i>Dalea versicolor</i>	3	<i>Cayaponia racemosa</i>
2	<i>Fleischmannia arguta</i>	3	<i>Muntingia calabura</i>
2	<i>Leucocarpus perfoliatus</i>	3	<i>Cryptostegia grandiflora</i>
2	<i>Croton draco</i>	3	<i>Passiflora podadenia</i>
2	<i>Citrus aurantium</i>	3	<i>Lycopersicon esculentum</i>
2	<i>Martynia annua</i>		<i>var. leptophyllum</i>
2	<i>Senna foetidissima</i>	3	<i>Licaria triandra</i>
2	<i>Hypoxis mexicana</i>	3	<i>Baccharis trinervis</i>
2	<i>Trichilia americana</i>	3	<i>Citrus aurantifolia</i>
2	<i>Bursera grandifolia</i>	3	<i>Jacaratia mexicana</i>
2	<i>Scoparia dulcis</i>	3	<i>Aristolochia tequilana</i>
2	<i>Bursera fagaroides</i>	3	<i>Xylosma velutinum</i>
2	<i>Acacia riparia</i>	3	<i>Ixophorus unisetus</i>
2	<i>Bursera bipinnata</i>	3	<i>Agonandra racemosa</i>
2	<i>Paullinia tomentosa</i>	3	<i>Allium glandulosum</i>
2	<i>Senna fruticosa</i>	3	<i>Struthanthus interruptus</i>
2	<i>Picramnia antidesma</i>	3	<i>Satureja macrostema</i>
2	<i>Zanthoxylum arborescens</i>	3	<i>Senecio sanguisorbae</i>
2	<i>Eugenia jambos</i>	3	<i>Chenopodium graveolens</i>
2	<i>Passiflora filipes</i>	3	<i>Euphorbia heterophylla</i>
2	<i>Lippia umbellata</i>	3	<i>Jatropha mcvaughii</i>
2	<i>Croton fragilis</i>	3	<i>Cucumis anguria</i>
2	<i>Echinopterys eglandulosa</i>	3	<i>Citrullus vulgaris</i>
2	<i>Nectouxia formosa</i>	4	<i>Verbesina greenmanii</i>
2	<i>Daucus montanus</i>	4	<i>Karwinskia humboldtiana</i>
2	<i>Commelina erecta</i>	4	<i>Crotalaria longirostrata</i>
2	<i>Solanum brachystachys</i>	4	<i>Calliandra houstoniana</i>
2	<i>Xanthosoma robustum</i>	4	<i>Petiveria alliacea</i>
2	<i>Crusea longiflora</i>	4	<i>Nicotiana glauca</i>
2	<i>Gnaphalium canescens</i>	4	<i>Cissus sicyoides</i>
2	<i>Sapium pedicellatum</i>	4	<i>Pithecellobium lanceolatum</i>
2	<i>Amaranthus spinosus</i>	4	<i>Ipomoea bracteata</i>
2	<i>Sonchus oleraceus</i>	4	<i>Heteropterys laurifolia</i>
2	<i>Triumfetta gonophora</i>	4	<i>Machaerium salvadorensis</i>
2	<i>Melochia adenodes</i>	4	<i>Cnidocolus autlanensis</i>

APPENDIX A (continued)

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

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