Food and nutrition in the African rain forest

Claude Marcel Hladik, Serge Bahuchet, Igor De Garine

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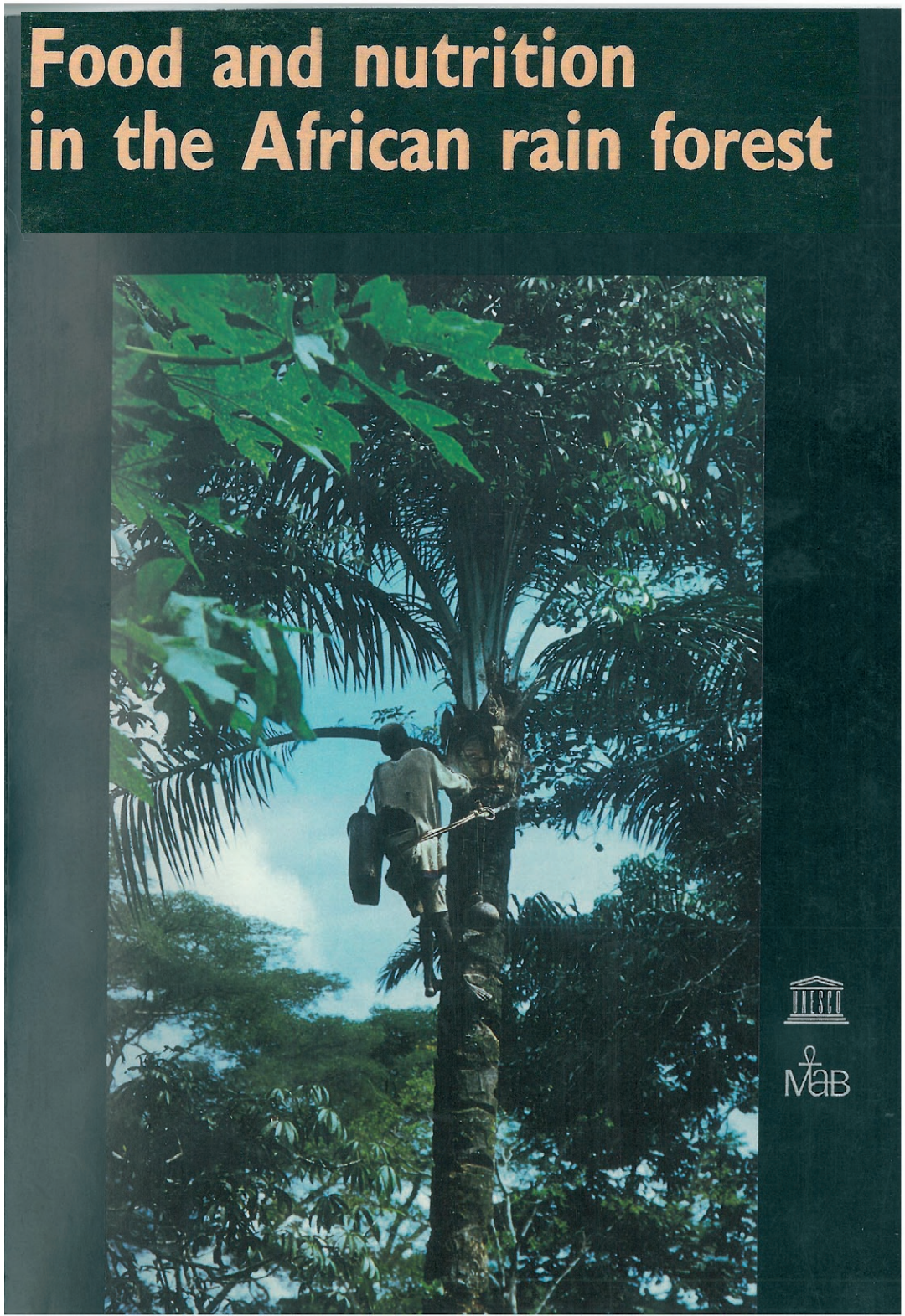

Food and nutrition in the African rain forest

Selected data from the research team in food anthropology "Anthropologie Alimentaire Différentielle" (unit 263, CNRS, France)

Contributors:

BAHUCHET Serge, CNRS, ethnoecology and linguistics (LACITO and unit 263)
DOUNIAS Edmond, associated to ORSTOM, agroecology, and CNRS, unit 263
FROMENT Alain, ORSTOM, anthropobiology, associated to unit 263
GARINE Eric de, associated to unit 263, CNRS, ethnology
GARINE Igor de, CNRS, ethnology, head of unit 263
GUILLE-ESCURET Georges, University of Paris X, ethnology, associated to unit 263
HLADIK Annette, CNRS, tropical botany (ECOTROP and unit 263)
HLADIK Claude Marcel, CNRS, ecology and psychophysiology, unit 263
KABALA Matuka, Unesco/MAB, Department of Ecological Sciences
KOPPERT Georges, ORSTOM, human nutrition, associated to unit 263
PAGEZY Hélène, CNRS, human ecology (unit 221, Aix en Provence) and unit 263
PASQUET Patrick, CNRS, anthropobiology, unit 263, and University of Paris VII

Edited by: C.M. HLADIK, S. BAHUCHET and I. de GARINE.

Unesco/MAB, Paris

CNRS (unit 263) Muséum, Brunoy

Cover: In the Lobaye forest (Central African Republic), a Ngbaka villager collects the sap of the oil palm. This palm species, *Elaeis guineensis*, common at the edge of the forest where shifting cultivation has favoured certain plants, provides wine made of fermented sap as well as oil extracted from the pulp of the fruit; accordingly, it is considered a very important food plant (chapters 3 and 4). A study of its spatial distribution and production raises questions of the relationship between the system of collecting and the social bonds within different human populations (photo by G. Guille-Escuret).

Inside cover: The canopy of the Gabon rain forest, photographed from a tethered balloon, at low altitude, in order to determine spatial distribution and production of the different species (chapter 1). In the centre of the picture, the light yellow fruits of the climbing *Combretum bipendense* delimit the exact area occupied by this liana, which covers tree canopies. Several other species can be identified according to architectural characteristics such as the radiating branch tiers of *Pycnanthus angolensis* (six trees of this species can be seen on this photograph, most of them with russet shoots; one is centered at the top of the picture), or temporary specific colour shades due to the presence of new leaves or flowers (for instance *Piptadeniastrum africanum*, near the upper right corner, with a pinkish tinge). The blueish canopies, near a recently opened trail (lower right) belong to a group of light-demanding trees, *Musanga cecropioides* (photo by C.M. Hladik).

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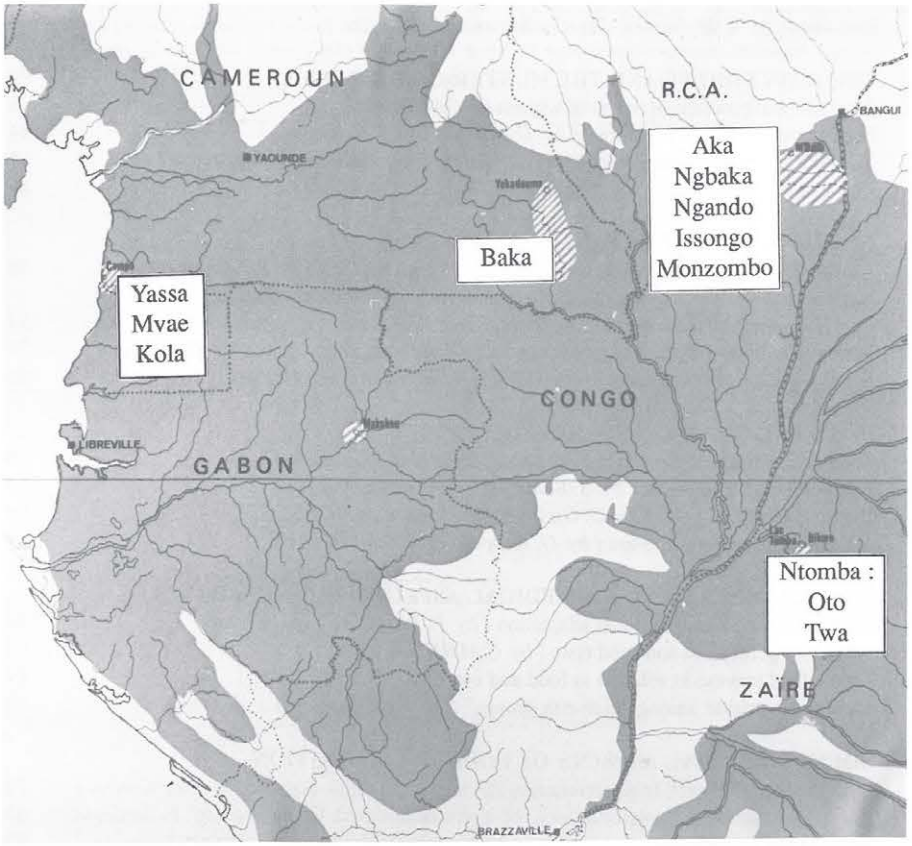
CONTENTS



Location of the ethnic groups studied: The rain forest (shaded) covers the equatorial and tropical climatic zones of central Africa, from the Congo basin to Cameroon, including Gabon and the southern part of the Central African Republic. The different study areas (hatched) are those where data on food and nutrition presented in this book was collected among various populations. Names of the ethnic groups are written in a conventional invariable form, without any prefix (such as the plural "ba" for Bantu groups), and most local terms correspond to the current spelling in the French-speaking areas.

Foreword

The rain forest of the equatorial and tropical zones of Africa is a very complex environment, in which plant and animal species evolved in particular conditions and presently show a surprising number of diversified forms. Feeding strategies of human populations occupying this area also vary a great deal, as a result of past events such as migrations and cultural contacts, and, probably to a lesser extent, the influence of adaptive biological factors.

The documents presented here, selected from the interdisciplinary work of our research team "Anthropologie Alimentaire Différentielle" (C N R S, Paris), illustrate this large range of variations concerning different populations throughout the African forest block (see map opposite). Obviously, this booklet cannot pretend to cover the extensive knowledge in various areas of biology and anthropology. It was designed as an extension of a poster exhibition held in Paris (Maison des Sciences de l'Homme). Our aim is to preserve the visual aspects of this presentation. Basic references are given and, in addition to our published results, we have included data which, although they are as yet incompletely processed, already have a contribution to make towards this first synthesis about the feeding strategies of African forest people.

In order to allow comparisons between and within populations, we based these studies on quantitative data, by measuring natural and cultivated food resources and weighing what is actually consumed, before investigating the biological aspects of nutritional anthropology and energetic balance. Similarly, we complemented our anthropological approach with quantitative data obtained through interviews, in order to compare, for example, food preferences with what is effectively consumed. Methods for obtaining such data on food consumption are particularly expensive, because they need several persons in the field over a long period. Hence we also attempted to develop and test different new techniques which might be useful in the future.

By combining the biological and anthropological dimensions of human food and nutrition, using similar population samples, we hope to provide new insights into the analysis of different subsistence strategies in the African rain forest. Among the results that are presented and discussed in the following pages, seasonal variations in diet appear to play a primary role, even in the rain forest environment where food availability and production was assumed to be reliable and homogeneous. The perception of important changes in diet and the resulting stress could be an important factor affecting biological parameters in conjunction with direct effects of nutritional status. Nevertheless, the dietary balance is not really threatened by protein deficiencies as observed in some suburban areas of the tropics.

This multidisciplinary approach also provides valuable information about the relationships of people to their natural environment. All these elements of knowledge are necessary prior to attempting any development project in the equatorial zone. In fact, the major ideas proposed in the programme "Man and the Biosphere" (MAB) of Unesco, concern the improvement of local economies while simultaneously allowing for the renewal of natural resources. To achieve this aim it is imperative to consider humans in both their biological and cultural dimensions.

With this double purpose of enhancing the perception of the cultural heritage of rain forest peoples, while emphasizing the conservation of natural resources, we have brought out this edition thanks to the financial backing of the French "Ministère de la Coopération et du Développement". Publication, under Unesco sponsorship, in a format we hope to be pleasant, will allow a rapid diffusion of recently acquired knowledge on an environment where people still live in harmony with nature.

Claude Marcel HLADIK
Serge BAHUCHET
Igor de GARINE

Facing page: During a hunting party, in the Lobaye forest, an Aka Pygmy drinks the sap of a freshly cut piece of the liana *Cissus dinklagei*. Several plant species are known for their abundant drinkable sap and can be used when temporary camps are located away from water springs and streams (photo by S. Bahuchet).

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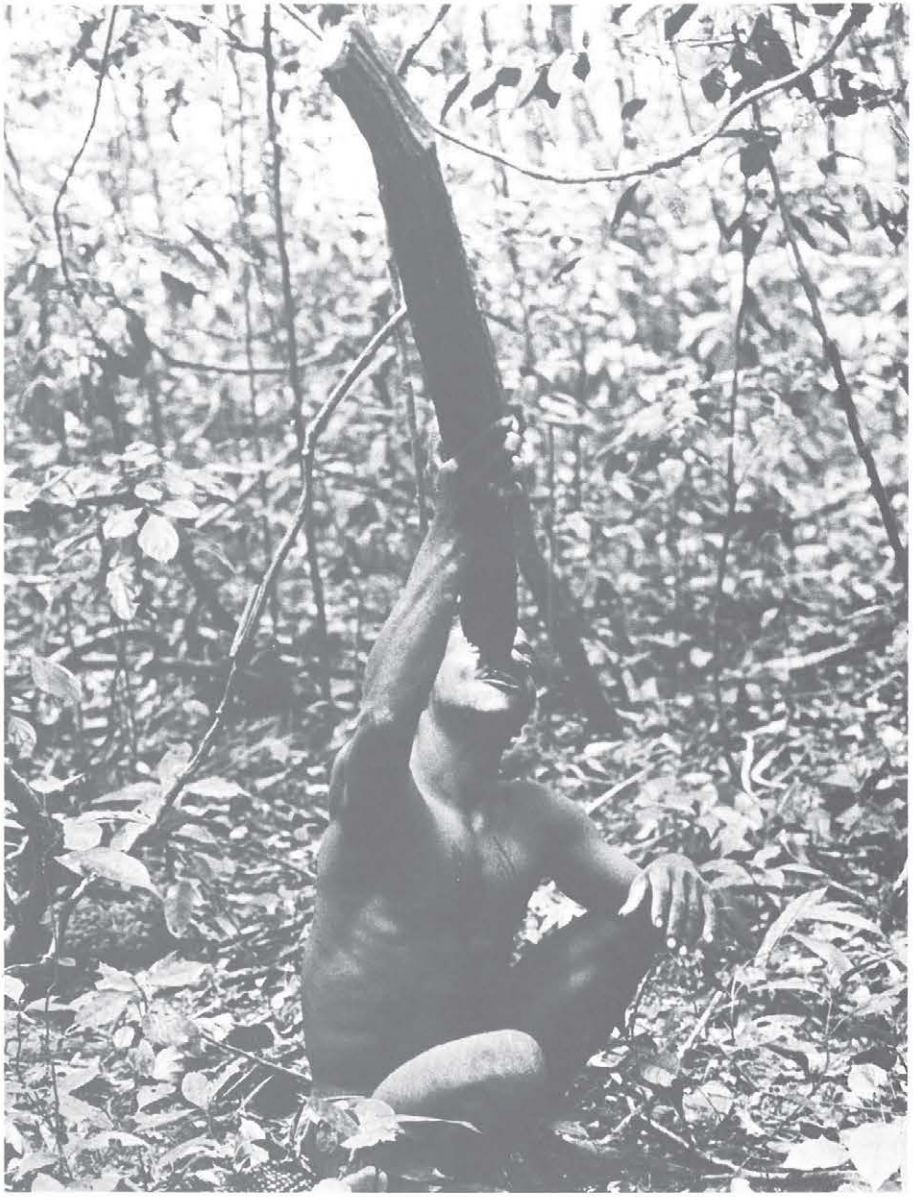
THE RAIN FOREST AND THE HUNTER-GATHERERS



Structure and production of the rain forest

by Annette HLADIK

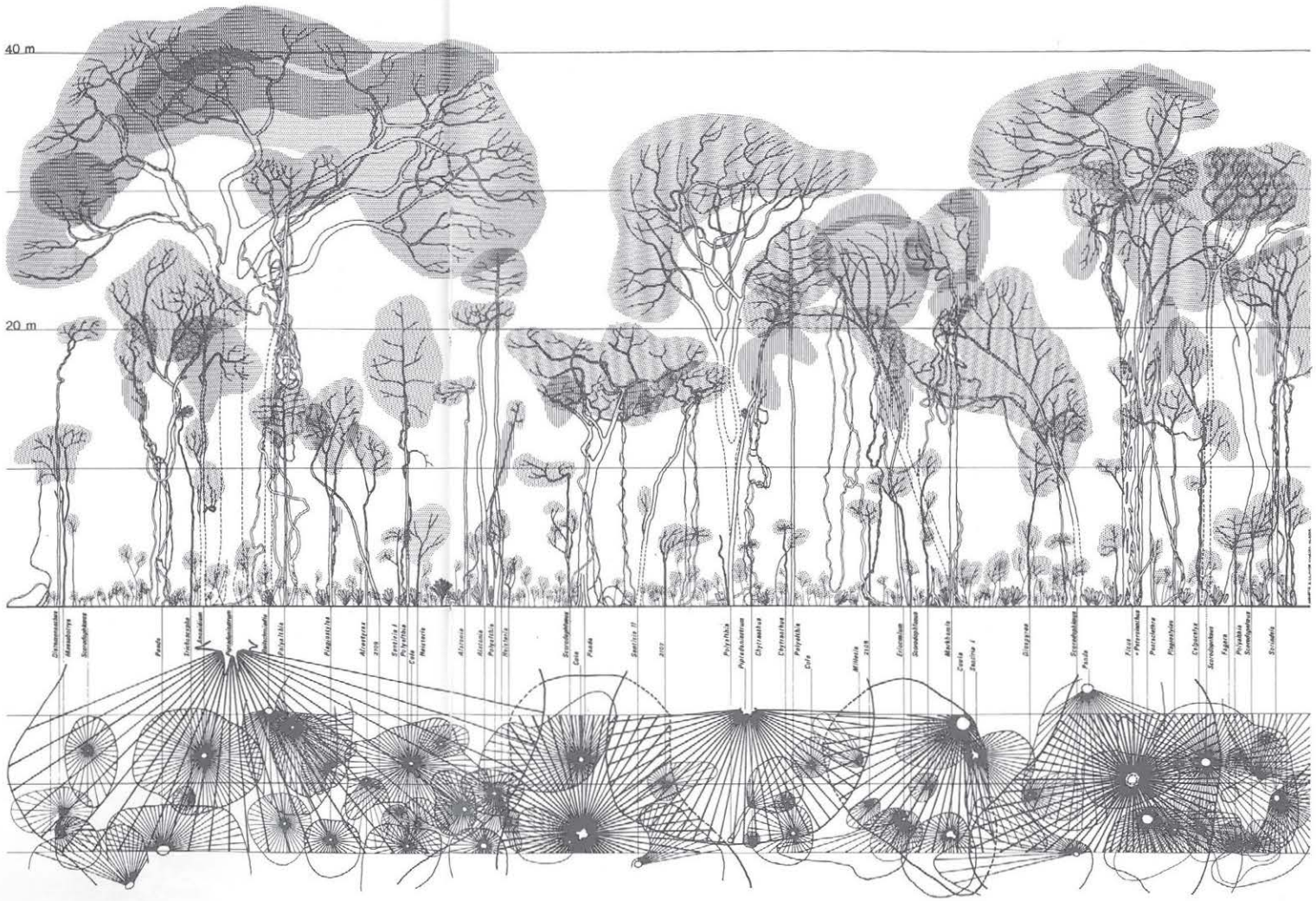
Studies of the natural environment in terms of structure, dynamics and production are the necessary premises for an interdisciplinary approach to food anthropology in the humid tropics.

Indeed, botanical and zoological studies were undertaken a long time before we started our research programme on food and nutrition in the African rain forest, allowing for a good understanding of the interactions between plant and animal populations of the ecosystem. The Makokou area (Gabon), located in the centre of the forest block where our different surveys on food anthropology have been conducted, is presently one of the most researched areas of rain forest: a booklet recently published under Unesco sponsorship in order to summarize the major results obtained at the MAB field station of Makokou (1) presents a list of books and scientific papers including more than 500 titles.

STRUCTURE AND DYNAMICS

The classical ideas of a "storeyed rain forest", which are still widely taught, are now rapidly being revised. The rain forest is not a superposition of "strata" in which emergent trees lie above one or two discrete lower tree strata shading the undergrowth. Such a simplified description was introduced to allow comparison of the structure of the rain forest with that of temperate forests where three strata may actually be observed but are possibly due to human action. In rain forests, the presence of extended strata has never been statistically demonstrated by actual measurements of the height of the different volumes of foliage. The structure is a complex juxtaposition of "biovolumes" whose height and shape characterize the various species of trees and lianas growing together.

The horizontal structure has a similar degree of complexity. Although some plants can form clumps of small numbers of individuals of a given species, most trees species are widely dispersed, often with distances of several kilometres between individuals.



The structure of the rain forest (near Makokou, Gabon) is shown by a detailed profile drawing and map of the volumes occupied by tree canopies and lianas. The profile is a vertical cross-section of a 5 metres wide strip, for a total length of 90 metres, showing a part of the tree canopy (shaded) and liana foliage (hatched). Ground projection, recorded with the help of a plumb line, indicates the exact overlapping of different "biovolumes" on a 10 metres wide strip, the first half of which corresponds to the profile (source: A. Hladik, 1978).

This view inside the rain forest, at the Makokou field station (Gabon), shows the complex structure and species diversity of plant populations, with probably more than one hundred species mixed together within the limits of the small volume visible. In accurate records, in which all plants have been identified within a 10 by 10 metres square, Reitsma (2) found a maximum of 130 species. The number of plant species increases rapidly with the size of the sampling area, but it is practically impossible to identify all plant species of a large plot: for instance, in a strip of 4000 m^2 (a transect of 10 m by 400 m), we recorded 92 tree species (3), taking into account exclusively the stems with a diameter over 5 cm (photo by C.M. Hladik).

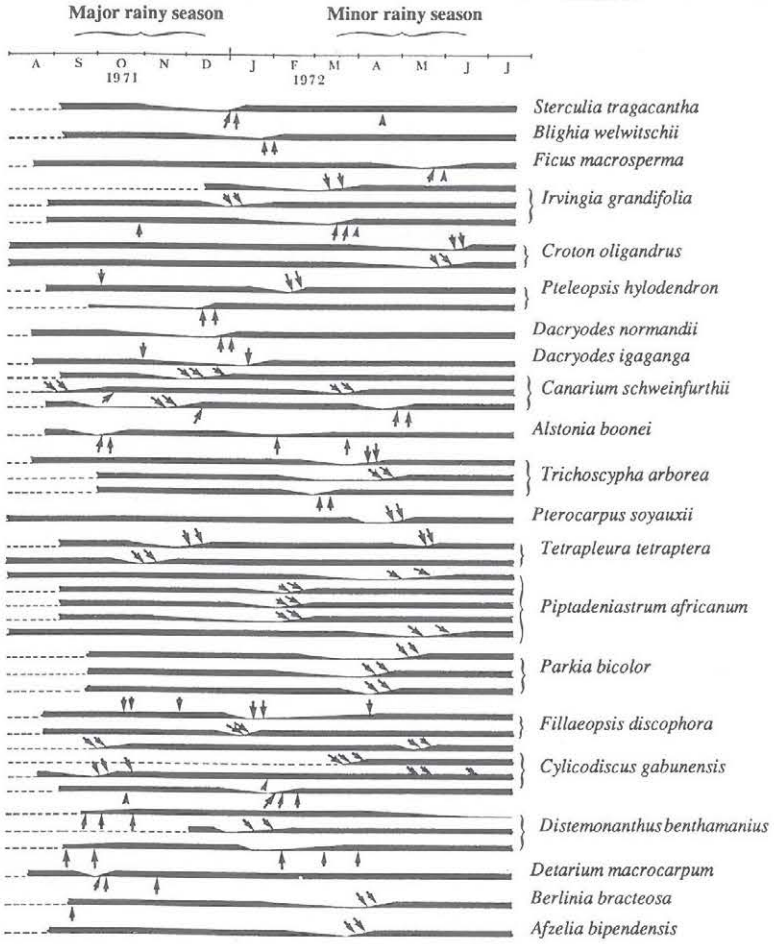
A tethered balloon with a radio commanded gondola is used to photograph forest canopy at low altitude (see inside cover). The gondola carries a large size Polaroid film holder (8 x 10 inches), and the film, after immediate development of a colour print can be used in the field for indentification of various species. Taking such aerial photographs at regular intervals allows the colours that characterize different tree and liana species to be observed at the time of flowering, fruiting, and leaf flushing. This forest survey was presented during the workshop sponsored by Unesco on Agroforestry in the humid tropics, in July 1985, at the MAB field station (IRET) of Makokou, Gabon (photo by C.M. Hladik).

Although it was previously supposed that the African forest was not so rich in terms of species diversity, the number of species per unit area is as high as in tropical America (3). In one hectare there are about 100 different tree species, and this number increases rapidly according to the sampling area and to the minimum size of identified plants. For instance, in the whole northeastern section of Gabon, there may be around 4000 plant species.

A special technique was recently developed at the field station of Makokou to study the spatial distribution of dispersed tree and liana species which form the canopy of the rain forest and produce most of the fruits and other food resources on which people and game depend. Aerial photographs were taken at regular intervals from a tethered balloon filled with hydrogen (4). The colour shades which characterize the flowering and leaf flushing periods of various species allow

the exact area covered by different species to be determined. Production can be then calculated by sampling the average number of fruits falling on the ground in the unit area for each species.

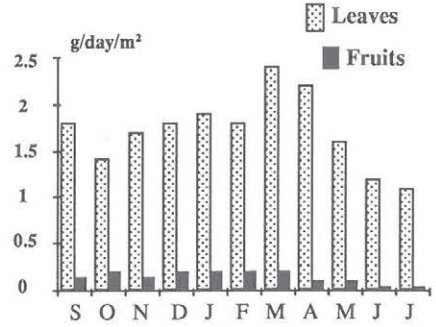
The spatial distribution of trees and lianas is continually changing due to processes of forest growth and regeneration. As shown by Oldeman (5 and 6), the "chablis" formed after any tree fall is a light pit allowing growth of a new generation of light-demanding plant species. In the resulting mosaic of forest patches, the trees of the rain forest can be classified, according to growth potential, into three sets (immature, mature and decaying) that will determine the shape and floristic composition of different parts of this dynamic environment.



Rhythms of leaf shedding and leaf flushing during the seasonal cycle at the field station of Makokou, Gabon (source: Hladik, 1978). For each leaf-shedding tree, the presence of foliage is indicated by a continuous thick line and shedding by a decreasing thin line. The major flushing periods are shown by arrows. Even among different trees of the same species there are important variations of leaf flushing periods. As a result, new leaves (with higher sugar and protein contents than mature leaves), and especially those of Leguminosae (the 10 last species in this list) are available throughout the year.

PRODUCTION RHYTHMS

The evergreen aspect of the rain forest should not hide the fact that most plant species do shed their leaves at various intervals. Moreover, some trees (42 among 300 under observation at the Makokou field station) are totally bare during certain periods, like temperate-zone trees in winter, although the absence of foliage generally lasts for a short time only. This varies for different tree species and for different individual trees, as shown in the graph opposite. Flowering and fruiting also have an irregular periodicity in different tree and liana species.



Monthly mean production of leaves and fruits in litter fall at the Makokou field station (source: Hladik, 1978). Leaf fall occurs throughout the year. The lower leaf fall during the major dry season (June/July/August) which might appear surprising, is due to local weather, with minimum direct sunshine during this dry season. The annual fruit production, calculated with this method, is less than 500 kg (dry weight) per hectare. However, this is only part of the production since most fruits are eaten directly in the canopy by arboreal animals.

A classical method for estimating global production and seasonal variations during the annual cycle (see graph above) consists of collecting and weighing litter fall. This is done using a number of sampling baskets totalling a sufficient area to obtain significant means. Litter can be collected every two weeks and separated into fractions corresponding to leaves of different species, fruits or decaying wood.

Some of the seasonal rhythms which have been observed during this analysis of rain forest production (7), especially those of tree and liana species bearing edible fruits, may play a role in shaping the food strategies of human populations.

Nevertheless, most of the specific plant rhythms have only indirect effects on the annual variation of food choice among forest peoples. For instance, the presence of leaves as food for edible caterpillars restricts their availability to short periods. In this case, the regional climate is an important determining factor. The Aka Pygmies of the Lobaye forest (Central African Republic) collect caterpillars once a year during the rainy season of the tropical climate. By contrast, in Zaire, the Twa and the Oto (see chapter 2), in a forest subject to an equatorial climate with two rainy seasons, can collect different species of edible caterpillars twice a year, the cycle of leaf growth of specific trees determining the life cycle of these Lepidoptera.

Similarly, flowering cycles determine periods of honey production by bees. Since most of the wild hives raided to collect honey in the rain forest are those of the common bee, it appears that an extension of the research on flowering cycles and pollen types recently undertaken in Gabon could help to introduce a new practice of apiculture to a forest rich in melliferous species.

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Food resources of the rain forest

by Claude Marcel HLADIK and Annette HLADIK

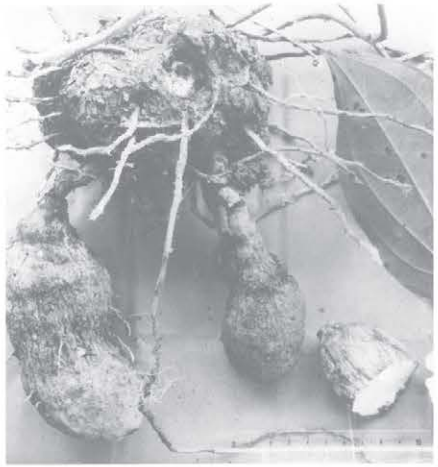
Can one really survive solely on the food resources of the equatorial rain forest ? From the answer to this question follows an understanding of the adaptive response of the ethnic groups at present living in the African rain forest as well as the possibility of developing hypotheses concerning the occupation of this environment by the first ancestors of *Homo sapiens*.

An important point concerning the ability of hunter-gatherers to utilize natural food resources was recently emphasized by the archaeologist John Speth (1). Queries about the diet do not apply to its protein content since animal foods are available. Rather they concern the availability of sufficient quantities of fat or carbohydrates (provided by plant starch) to avoid dietary problems due to excess nitrogen.

In the rain forest, hunting and trapping mammals, birds and reptiles, fishing in streams, and collecting invertebrates such as caterpillars, termites and snails, can provide large amounts of protein and animal fat. For instance the blue duiker, *Cephalophus monticola*, weighing about 5 kg, is an abundant game species: according to the animal population studies conducted at the field station of Makokou, their density exceeds one animal per hectare (2). This forest is also occupied by 128 other mammalian species among which 17 Primates and 12 Artiodactyla make up the bulk of the game.

Wild yams, which were certainly present in the African rain forest long before humankind, provide large starchy tubers. In order to determine whether the quantity of tubers under the ground can supply a group of hunter-gatherers, we counted the number of stems of different species (3). According to these surveys and considering the mean weight of the edible parts, we found that, in the 50 km² corresponding to the collecting area of an Aka Pygmy group, there is a permanent amount of biomass larger than five tons of tubers. People can indeed survive in the rain forest, and there is no risk of shortage !

Since the tubers of the wild yam *Dioscorea semperflorens* grow in sandy soils and descend lower than two metres, the Aka Pygmies have to make a special wooden tool, with sharp blades, to dig a narrow hole in order to reach, piece after piece, the parts of this delicious starchy cylinder (photo by S. Bahuchet).



One the most common wild yams of the forest, *Dioscorea burkilliana*, has globular tubers located at the end of narrow finger-like fibrous stems growing under a woody plateau. This yam species was supposed to be exclusively wild, however we found several cultivated forms, probably recently introduced in fields, in Gabon and the Central African Republic (photo by C.M. Hladik).

Some wild yams which have tubers located just under the ground surface can easily be collected with a stick. In contrast another yam species, *Dioscorea semperflorens*, grows a long cylindrical tuber deep under the ground. Its extraction by Aka Pygmies necessitates the sensitive use of a wooden tool for digging a narrow hole down to a depth of two metres. Tubers of these wild yams are edible, some of them without any cooking. Toxic yam species grow exclusively outside of the forest.

The largest of the forest yams, *Dioscorea mangenotiana*, although edible when young, is only good as elephant food once it has reached a larger size, with fibrous tubers protected by spiny roots. A more common form, Burkill's yam, *Dioscorea burkilliana*, grows spherical tubers under a woody plateau located at ground level.

As a complement to these starchy food plants and the flesh and fat of vertebrates and invertebrates, many sweet fruits, leaves (edible after cooking), seeds (eaten raw or cooked), and several fungous species can be collected in the forest. Fruits may have a relatively high protein content, for instance 12 % of dry weight—a protein content equivalent to that of wheat or corn—in a cauliflorous Annonaceae, *Anonidium mannii*, with each fruit weighing about 5 kg.

Some leaves of lianas and shrubs with higher protein contents (30% of dry weight) may eventually be eaten in large amounts when game is no longer available. Such is the leaf of *Gnetum africanum*, called "koko" in most languages, eaten during the dry season by the Ngando and the Ngbaka inhabiting the rain forest in the south of the Central African Republic (see chapter 2).

Fatty kernels, also rich in protein, can be extracted from the stones of several fruits. For this purpose, the fruits are collected when falling

The largest of the wild yams, *Dioscorea mangenotiana*, can be eaten, after cooking, when the tuber does not exceed 5 kg in weight. During several years (the exact lifespan is not known) this yam grows and can reach a weight of about 200 kg. Then the tuber is very fibrous and protected by superficial thorny roots visible on this picture. Such a protection of the tender parts still growing underneath is a deterrent to large rodents, but not to elephants which are able to turn the whole plant upside-down with their tusks (photo by C. M. Hladik).

nommée pour sa pulpe commestible, mais aussi de *Panda oleosa*, *Antrocaryon micraster* et *Coula edulis*. Les graines de *Pentaclethra macrophylla*, légumineuse arborescente, sont d'un usage moins fréquent actuellement que par le passé. Une huile alimentaire extraite des graines de *Baillonella toxisperma* est encore utilisée dans tout le Sud du Cameroun.

Les champignons peuvent aussi être consommés saisonnièrement en grande quantité; ils procurent des protéines et beaucoup de minéraux.

	Protéines	Amidon	Minéraux (dont Ca)
Dioscoreophyllum cumminsii	9,6	42,8	9,5 (0,15)
Dioscorea dumetorum	9,1	68,2	2,6 (0,22)
Dioscorea mangenotiana	9,0	75,9	3,5 (0,02)
Dioscorea praehensilis	7,1	58,3	3,1 (0,01)
Dioscorea burkilliana	6,8	69,6	2,5 (0,06)
Dioscorea semperflorens	5,5	78,8	2,1 (0,01)
Dioscorea minutiflora	4,6	73,4	2,3 (0,03)

Composition (en pourcentage du poids sec) des tubercules d'une Ménispermacée et de quelques ignames sauvages (d'après Hladik *et al.*, 1984). Les teneurs en protéines des variétés cultivées sont sensiblement plus élevées.

La composition détaillée de tous ces aliments est généralement peu connue et beaucoup des échantillons que nous avons collectés ne figurent pas dans le traité de Busson (4) ni dans les travaux du Centre de Nutrition de Yaoundé (5). De ce fait, nous avons été amenés à entreprendre l'analyse de nombreux fruits et feuillages, ainsi que celle des ignames et d'autres plantes à tubercules.

Les résultats de ces analyses ont montré la potentialité de ressources trop souvent ignorées. Ainsi, les tubercules de *Dioscoreophyllum cumminsii* (Ménispermacée), facilement accessibles en surface et qui sont consommables même à l'état cru, pourraient être introduits dans les cultures et utilisés dans les programmes de recherche sur les aliments nouveaux. Le fruit rouge de cette petite liane, très apprécié des enfants pygmées car très sucré de goût, ne renferme qu'un « faux sucre », la monelline, molécule mimétique apparue dans le milieu forestier où la fréquence des espèces à fruits sucrés est la cause la plus probable de cette étonnante évolution biochimique (voir les commentaires sur la sensibilité gustative, chapitre 4). Un autre produit de ce type a été découvert au cours de nos prospections, chez une autre plante lianescente de la forêt dense : *Pentadiplandra brazzeana* (6). Tout l'intérêt de ces produits sucrés et non glucidiques réside dans leur possibilité d'utilisation par l'industrie agro-alimentaire et ce ne sont là que quelques aspects de la richesse potentielle des forêts denses.

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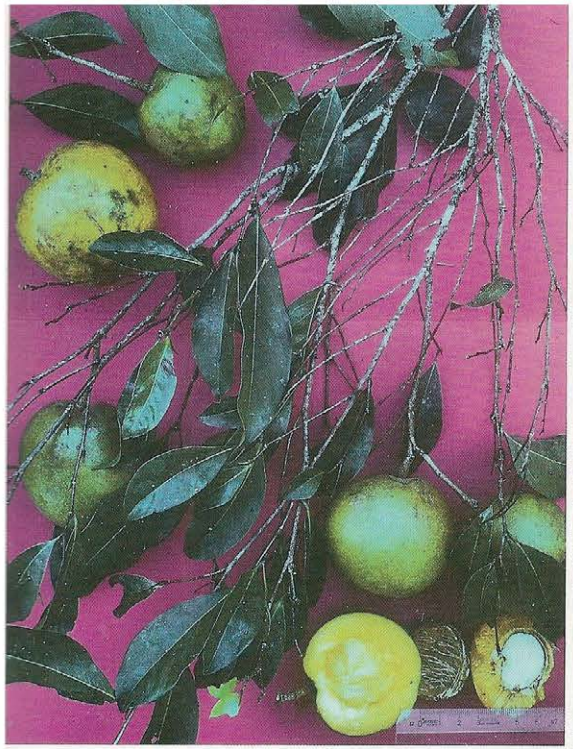
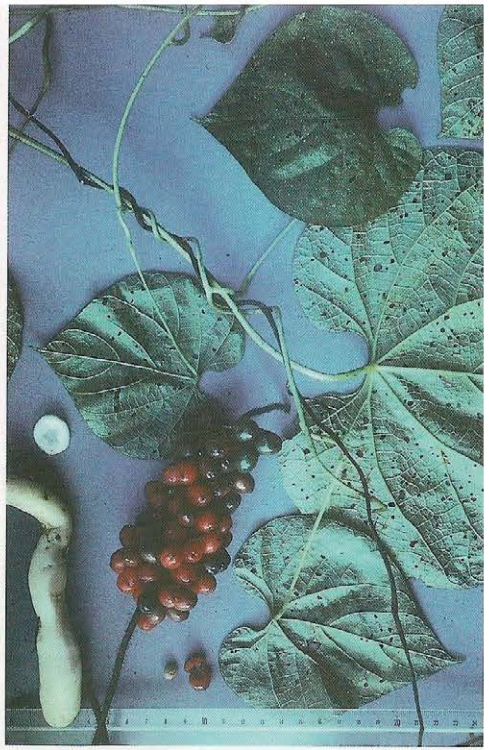




Ci-contre : Parmi les produits de la forêt dense africaine, la racine blanche tubérisée qui se développe près de la surface du sol **(en haut et à droite)** est comestible, même à l'état cru. Elle est produite par une petite plante lianescente, *Dioscoreophyllum cumminsii*, dont les fruits rouges sont également comestibles et très appréciés des enfants Pygmées. Cependant, ces fruits ne renferment pas de sucre mais une protéine, la monelline, qui a un puissant goût sucré et dont on explique la présence par un phénomène de "mimétisme biochimique" dans un milieu où de nombreuses espèces produisent des fruits très sucrés. Ceux de "la mangue sauvage", *Irvingia gabonensis*, **(en haut et à gauche)**, en sont un exemple. Ils ne sont cependant pas beaucoup consommés par l'Homme qui les collecte pour n'en garder que les noyaux dont on extrait une grosse amande, visible sur la coupe. Cette amande sert à la fabrication des sauces qui accompagent les plats de gibier et l'on peut la garder en réserve sous une forme compactée et séchée (voir chapitre 3).

En bas : De nombreuses espèces de champignons sont également collectées par les populations forestières à l'occasion des déplacements, telles ces pleurotes nommées "lèvres de Chimpanzé", par les Pygmées Aka (photos C. M. Hladik).

The Aka Pygmies: hunting and gathering in the Lobaye forest

by Serge BAHUCHET

Food resources of the rain forest, as described in the preceding pages, are used by most of the ethnic groups living in the Congo Basin; however, food strategies may depend in different ways on these natural resources. At present, the most dependant are the Aka Pygmies, a population of hunter-gatherers studied during the last fifteen years in the Lobaye forest (1), the southern part of the Central African Republic.

The Aka, who have no agricultural tradition, may have used wild yams as a staple food during a large part of their long history (2). From our census of wild yam species we have obtained sufficient evidence that these plants could have provided enough food to Pygmies before the arrival of agrarian populations. Nowadays, with the barter practice, the staple food consists of cultivated yams and cassava, for which Pygmies exchange game or hire themselves out as temporary workers for logging and clearing in shifting cultivations. Since the Aka do not practise pottery or metallurgy, they also barter meat for clay pots and iron tools from the agriculturalists (3).

In recent years, however, some Aka groups have established their own cultivations, thus reducing the necessity of bartering with the villagers cultivating at the edge of the rain forest. In other Pygmy populations, such as the Kola of southern Cameroon, the practice of shifting cultivation is not so recent. Although limited, it may imply a change in the diet (see chapter 3).

COLLECTING FOOD RESOURCES

The search for food occupies women and young girls every day for a few hours. Starting from a camp located in the heart of the forest, they look for the characteristic stems of wild yams, for ripe fruit fallen on the ground, especially *Irvingia gabonensis*, *Antrocaryon micraster* and *Panda oleosa*, to collect the kernels, and for mushrooms and the leaves of the "koko", *Gnetum africanum*, which can be cooked as a vegetable.

When a yam stem is detected, they immediately dig at its base with a stick or a machete. For *Dioscorea semperflorens*, a special wooden tool is used, with sharp blades and a long handle that allows the tuber, growing very deep in sandy soils to be extracted. This type of borer necessary for only one species, is also known by the Baka Pygmies, living in southern Cameroon where *D. semperflorens* also grows.

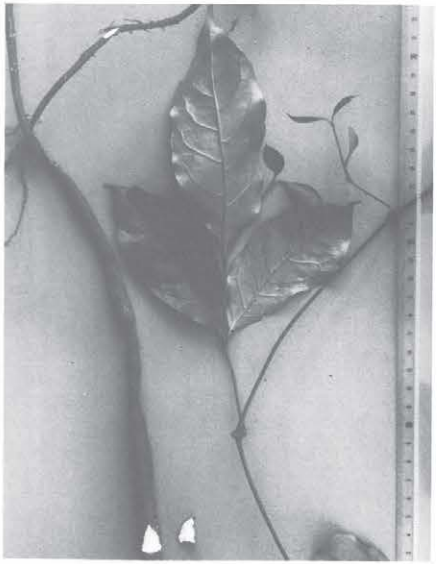
Facing page, upper: At dawn, the Aka Pygmy camp, in the heart of the Lobaye forest. Behind the huts, banana and papaya trees can be seen. These are in small-size plantations recently opened in a new practice, and complementing food resources collected in the rain forest, or bartered for game with villagers. However, the Aka do not utilize the varieties and clones cultivated by other ethnic groups in the area (see chapter 2) and, as it probably occurred for most other civilizations, they are presently integrating various agricultural practices into their own culture (photo by C. M. Hladik).

Lower: The larvae of a large beetle, *Rhynchophorus phoenicis*, that mines palm trees, are extracted by the Aka, to be boiled in water with leaves and served as a nourishing dish (photos by S. Bahuchet).

Fruits of *Antrocaryon micraster* which have been collected and stacked are placed on the blade of a small axe and beaten with a heavy log to crack open the hard stone. A sharp twig is used to extract the seeds which are collected inside the leaf of a Marantaceae in which they are folded and carried to the camp. After crushing in a mortar, these seeds will be cooked with meat to make a fatty sauce (photo by S. Bahuchet).

Fruits with edible pulp are rarely brought to the camp. During short halts, they may provide a juicy snack to hunters moving through the forest. Children, who appreciate the sweet and acid taste, may spend more time collecting fruits. Particularly appreciated are *Synsepalum longecuneatum*, *Pancovia laurentii* or *Gambeya lacourtiana*, to the extent that trees are climbed to cut down branches laden with fruit. The large fruit of *Anonidium mannii*, growing directly on the tree trunk (cauliflory), are rarely left when available. An Aka group may share one of these fruits (which weighs about 5 kg), eating it immediately under the tree where it is found. However, most fruits are not very easy to collect in large amounts since monkeys pick them up directly in the canopy at the beginning of the ripening period; and those falling on the ground are eaten by the antelopes that forage at night.

Animal food resources can also be collected while the Aka are walking through the forest. Most of these occasional catches are invertebrates, but small and slow moving vertebrates such as turtles and pangolins can be caught by hand. Aka look for beetle larvae in decaying wood (especially in palm trees) and for caterpillars of various moth species (*Attacidae*) falling from the canopy at the time of metamorphosis.



Leaves of the "koko" (*Gnetum africanum*, Gnetaceae) have a high protein content (about 30% of dry weight) and are used as a vegetable by all the ethnic groups of the rain forest area. Because of their fibrous texture, these leaves are minced before boiling in water; they can be added to various dishes including meat and mushrooms, with the sauce made of fatty seeds or palm oil. The tuberous root of the plant is also edible but is used exclusively when yams or cassava tubers are not available (photo by C.M. Hladik).

When children can find large achatina snails in the humid litter of the forest, they set up a small fire to cook and eat a little snail snack in the absence of adults (see page 79).

Collecting vegetables or seasonally available caterpillars is a typical women's activity. In contrast, the acquisition of honey is reserved to men, the collector having to climb a tree trunk up to twenty or thirty metres, amidst the excited wild bees, to reach the opening of a hive located inside a hollow tree trunk. Secured by a climbing belt made of a liana, he must widen the opening with his axe, after smoking out the bees with a few embers wrapped in fresh foliage. Then the honeycombs can be grabbed, placed in a basket, and descended to be shared with everybody attending below, or brought back to camp if the quantity is large enough.

Understandably, honey is considered a very valuable food, and its sweet taste is particularly appreciated, although taste sensitivity to sweetness is not as high in the Aka population as in populations living outside the forest (chapter 4).

HUNTING

Meat, which is likewise considered a highly valuable food, is also provided by adult men. Although various techniques exist to deal with game of different size, from the African giant rat to the elephant, the utilization of large nets for hunting parties is presently the most common practice, allowing various duikers (species of the genus *Cephalophus*) to be caught. With a crossbow and poisoned arrows, an individual hunter can bring down monkeys and large birds, the meat of which is also appreciated. Large rodents such as the giant rat and porcupine can be smoked in their dens, and this is done when the whole family wander through the forest, looking for small game and collecting mushrooms and fruits with fatty kernels.

Since most hunting and collecting activities are undertaken by groups of people, the Aka economy can be considered a collective one. Tracking large game such as elephant necessitates five or six hunters; hunting parties with

After the opening of a wild hive located inside a hollow trunk, the collector, secured by a liana belt, descends the honeycombs in a basket made of bark (photo by S.Bahuchet).

nets involve the community at large, including women and children. In some instances, several camps are grouped for a hunting party.

FOOD RESOURCES AND THE SOCIO-ECONOMIC UNIT

A camp including about 30 people can be considered the socio-economic unit of the Aka society. In this group of relatives, the elder holds a position of moral leadership, but without any actual authority. In this society, each of the adults shares the activities for providing food and shelter, without any formal obligation.

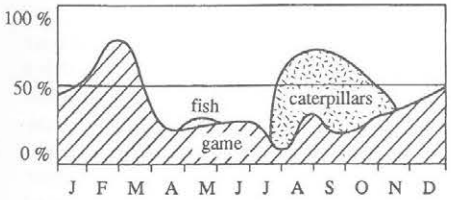
The group moves five to six times a year, setting up camp in various places, but always inside a "territory" which is shared by a few groups. These affiliated groups, once a year, meet together and organize large hunting parties. The average area of such hunting territories shared by about one hundred persons (three groups), is around 400 km^2. As shown in the preceding paper concerning food resources, such an area may contain a permanently available standing crop of edible tubers of more than forty tons.

Therefore, seasonal variation in food resources does not have a large influence on the cycle of hunting and gathering activities throughout the year. Moving camp is determined more by the exhaustion of local resources than seasonal variations. Nevertheless, there are two periods in the annual cycle which are considered of paramount importance (4), the first one at the height of the rainy season (August and September), when caterpillars can be collected, and the second one for the honey harvest, during the dry season. During these short periods, hunting takes second place to collection of these particularly prized foods.

Waiting in the shade of the forest undergrowth at the beginning of a collective hunting party with nets. For efficient hunting, most people from several camps, including women and children, have to gather. Nets are unrolled and hooked to branches in a wide circle into which duikers are driven by people moving noisily from the opposite side. Game caught in the nets is immediately killed. During the dry season (in February), several groups may stay together for a period lasting for a few weeks, in order to conduct such hunting parties (photo by S. Bahuchet).

When the collective hunting party with nets is a failure, the camp elder calls on the spirit of the forest, which appears to humans under a mask of leaves, in order to ensure the return of good fortune for the next hunt (photo by S. Bahuchet).

Uncertainty in food supply is prevented through a cooperative system of sharing between Aka families and communities. In a camp, all the food is shared, before and after cooking. Not following the rules for sharing would cause such turmoil that, according to the Aka, the wrath of ghosts and spirits of the forest would result in the absence of game and starvation for all.



Seasonal variation of animal food consumption frequencies (source: Bahuchet, 1988). Note the importance of caterpillars.

The conceptions of the world and explanations of their daily life given by members of the community allow for a better understanding of food strategies which are more than simple adaptations to ecological constraints. The study of food anthropology would be incomplete without an investigation of the motivations that determine activities.

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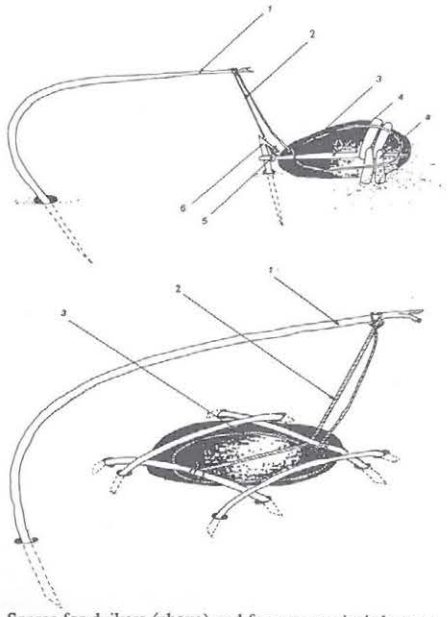
The art of trapping in the rain forest

by Serge BAHUCHET and Igor de GARINE

For non-Pygmies, the bulk of animal food is still provided by the forest. Trapping brings in a large part of the game, since the great collective net-hunts still practised by the Pygmies are becoming obsolete among other forest populations.

A wide range of different trap types is available, and their triggering mechanisms attest to the capacity of forest people to elaborate ingenious techniques (1). The most common model is a snare with a noose made from wire such as is used for bicycle brakes. This essential part of the trap is no longer made of vegetable fibre. A curved sapling unbends itself, pulling the cable that strangles the unwary beast.



Snares for duikers (above) and for a porcupine's burrow (below), including a bent sapling (1) that acts as a spring, the setter (2), the noose (3), the trigger (4), the catch (5) and (6) the ground piece (source: Bahuchet & Pujol, 1975).

This type of trap is placed in the forest along regular pathways covering several kilometres. The Mvae of southern Cameroon lay out more than a hundred simple snares in this fashion. In the Central African Republic, the Ngbaka erect barriers of branches over hundreds of metres, with the purpose of forcing the game through remaining openings, over which snares are hung.

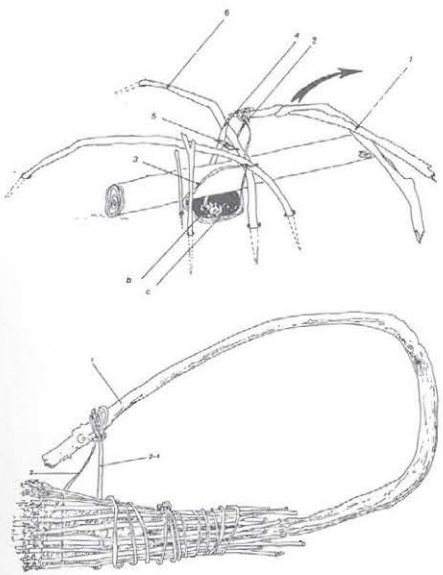
Every adult man owns one or more series of traps, sometimes at quite a distance from his village. He visits them at least twice a week, to avoid having the captive game rot. The most common catches are duikers and porcupine, but it is not infrequent that snakes are also snared.

Children are great trappers too, catching African giant rats, small rodents or squirrels, and birds in different types of snares and "lime" (trapping glue).

The "stun traps" drop a heavy log on to passing animals. They are generally placed in gaps of the enclosures protecting cultivated fields against rodents and other pests.

Two other types of traps with a falling device used to be employed. The first was to catch a panther using a wooden cage with a sliding door in which a goat was tethered. The second, designed especially for elephants, consisted of a heavy log equipped with an immense iron spear.

As with hunting, trapping success is believed to depend on proper respect being shown toward



Two other types of trap, used for the African giant rat (above) and for squirrels (below); see figure illustrating parts on opposite page.

certain taboos that prohibit, in particular, the consumption of foods that have a strong smell. Neglecting such prohibitions is believed to cause failure in trapping, a serious happening which requires special rituals of atonement.

AGRICULTURE AND TRAPPING

Forest plantations located far from villages and left unwatched are especially attractive to wild animals. Elephants and gorillas destroy banana groves, the bush pig eats taros and yams, monkeys descend to the ground to pull up the maize, and large rodents attack every cultivated plant.

A "stun trap" built into the fence that surrounds a cultivated plot of the forest in Gabon (photo by C.M. Hladik).

Consequently, new plantations are often surrounded by a fence pierced with openings sprung with various traps, especially the "falling log" model. Animals that ravage cultivated plants are in turn caught and eaten. This process is a subtle "co-adaptation" in that plantations favour an increase in the population of rodents such as that of the cane rat (*Thryonomys swinderianus*), whose geographical range has lately become extended, making it a dietary supplement easy to obtain.

This reciprocal adaptation between humans and fauna is quite ancient in Africa as well as in Central America, where archaeological research has revealed (2) a change in the types of game consumed before and after the adoption of agriculture by forest-dwelling peoples.

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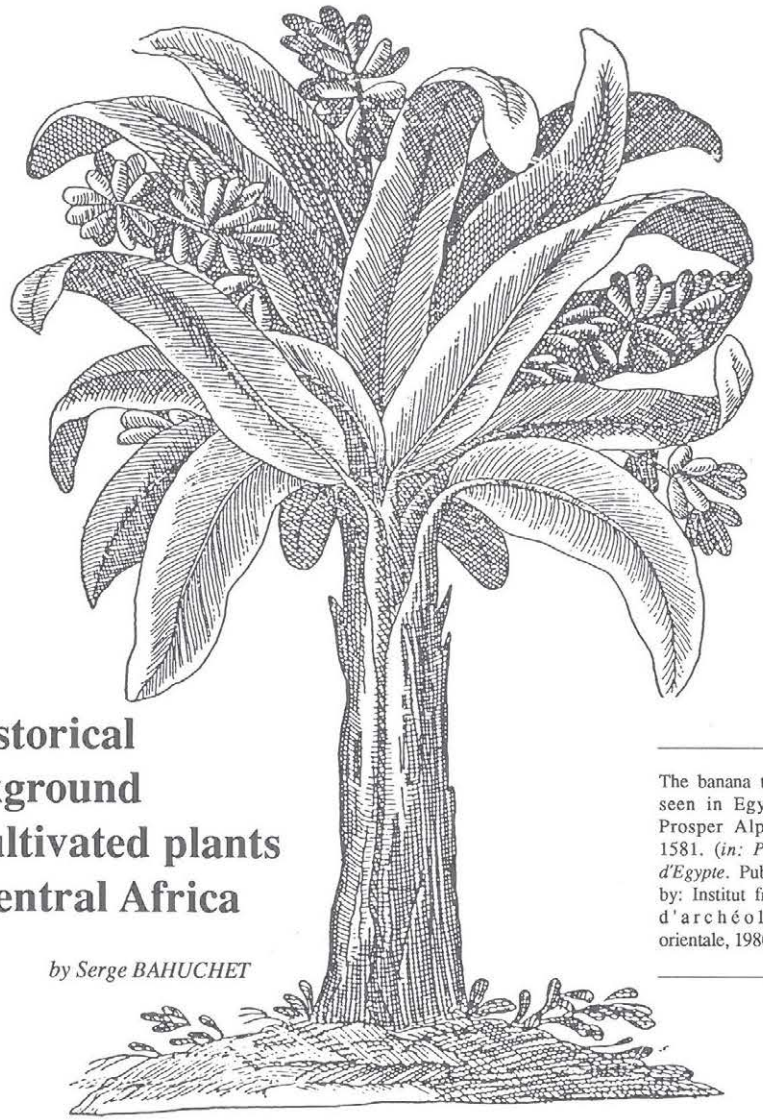
2
CULTIVATING THE FOREST

A Ngbaka cultivated plot in the Lobaye forest, near Mettè (Central African Republic). Trees have been felled at the beginning of the dry season, and fire set to dry wood before the first rains. The fire did not affect the oil palm trees visible at the edge of the forest with recent new leaves, because dried leaves accumulated at their base had been carefully removed: thus, thanks to the care of forest cultivators, these palm trees occur more densely than in the natural environment (see aerial photo inside back cover). The first crops planted when the soil was covered with the ashes of the burnt wild vegetation are species introduced from America (maize) or from Asia (taros and plantains) which have been added to the autochtonous varieties and species (especially the yams). Mixing several species in the same plot is a basic principle of all traditional tropical agrosystems; this allows prolonging production throughout the yearly cycle, thus ensuring a permanent food supply, while allowing flexibility to face biological constraints (risk from pests and wild animals) or irregular rainfall (photo by C.M. Hladik).



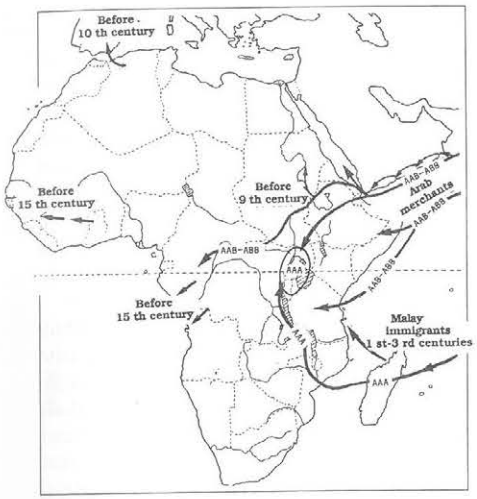
A historical background of cultivated plants in Central Africa

by Serge BAHUCHET

The banana tree as seen in Egypt by Prosper Alpin, in 1581. (*in: Plantes d'Egypte*. Published by: Institut français d'archéologie orientale, 1980)

The major food plants presently cultivated in the forest zones of Africa originated, paradoxically, from other continents. Thus it is difficult to compare agricultural practice of the last two centuries with what is likely to have occurred in prehistoric times.

Yam was the basic food plant in ancient times (including several species with spiny stems). It was domesticated by populations living at the edge of the forest (1); but it was presumably used with plant species now considered of minor importance, such as the genus *Coleus* with edible tubers. Archaeological surveys (2) conducted at the edge of the forest zone during the last ten years have not provided more accurate information about cultivars initially used by Africans.



The spread of *Musa* in Africa. Plantains, which are triploid hybrids, are indicated on this map by the letters corresponding to various chromosome combinations along the likely pathways of introduction (sources: Barrau, 1976; Lombard, 1970).

Plantains (cooking bananas), domesticated in southeastern Asia, were introduced all along the East coast of Africa from the sixth century AD onwards, simultaneously by Arab merchants and by Malay immigrants via Madagascar. This species was rapidly disseminated all over the humid tropics. When the Europeans arrived on the West coast of Africa in the fifteenth century, plantains were everywhere.

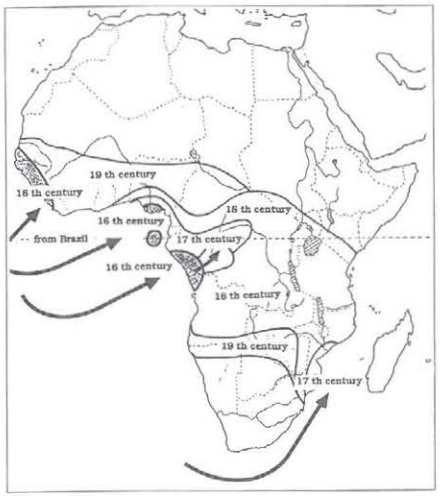
Two other Asian species had already penetrated Africa: Taro or cocoyam (Araceae, *Colocasia esculenta*), well known in Pharaonic Egypt, and the great yam (*Dioscorea alata*, with a winged, non-spiny stem). This species is now partly replacing spiny African yams (3).

The discovery of America had important consequences on the African diet, particularly with the immediate diffusion of maize, imported into Europe after Christopher Colombus' voyage in 1492. It spread to Turkey and Egypt, and to the rest of Africa from either the Nile valley or directly from Portugal via the West coast (4). Maize was mentioned for the first time as being cultivated in the Congo between 1548 and 1580.

Drawing of a maize plant, known as "Turkish wheat", by Adamus Lonicerus in the seventeenth century (source: *Kräuterbuch*, 1679).

Cassava (*Manihot utilissima*), which is not directly edible, took time to be introduced. It was observed being cultivated in Congo for the first time in 1611, but it is known that ships going from Brazil to Congo as early as 1580 were loaded with cassava flour. Cassava was very slow to spread to the forest zones (5), because the tubers requires a laborious detoxification process, and, at first, only cassava leaves were consumed. For a long time, the staple food remained plantains and yams, until cassava was definitively imposed during the colonial period.

Cassava or "mandioka" in Brazil in 1557, as represented in the book by Hans Staden.



Diffusion of cassava in Africa (source: *l'Atlas des plantes vivrières*, by Hermardinquer *et al.*, 1971).

The groundnut—or peanut—(*Arachis hypogea*) is another native American plant introduced in the sixteenth century. At present, it is widely cultivated as a vegetable fat supplement in the humid forest zones where the oil palm is not used. The chilli pepper (genus *Capsicum*), a plant with a great future, was also introduced from America at the same time as maize.

The "Macabo" or arrowroot (an Araceae of the genus *Xanthosoma*), was a late introduction to equatorial Africa during the colonial period. Nowadays, it is particularly important in some areas of southern Cameroon.

Except for the oil palm (*Elaeis guineensis*—see chapter 3) and the "plum tree" (*Dacryodes edulis*), most of the fruit trees cultivated by villagers are also exotic species. The coconut, *Cocos nucifera*, native to the Malayo-Polynesian area, was mentioned during the Middle Ages by Arab travellers as growing on the African East coast. The mango tree (*Mangifera indica*), also native to Asia, as well as orange and lemon trees (genus *Citrus*) were present in the heart of Africa in precolonial times. The papaw, *Carica papaya*, brought from America with the other food plants, is a rapidly growing small tree which became feral around villages. During the colonial era, several other tree species were introduced, such as the breadfruit (*Artocarpus utilis*) from Oceania, and the avocado (*Persea americana*) from South America. Improved varieties of mango and citrus fruits, as well as the common banana, were later on reintroduced by the Europeans.

Nevertheless, most fruit trees remain patchily distributed and underutilized. The opposite situation is true of starchy plants, the staple food, on which forest people base their agricultural strategies.

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(The other historical references are included in ref. 5)

The papaw, *Carica papaya*, is a small native American tropical tree, often planted around human dwellings. In southern Cameroon, its spontaneous seedlings may be transplanted into fields (photo by I. de Garine).

Agricultural strategies as complementary activities to hunting and fishing

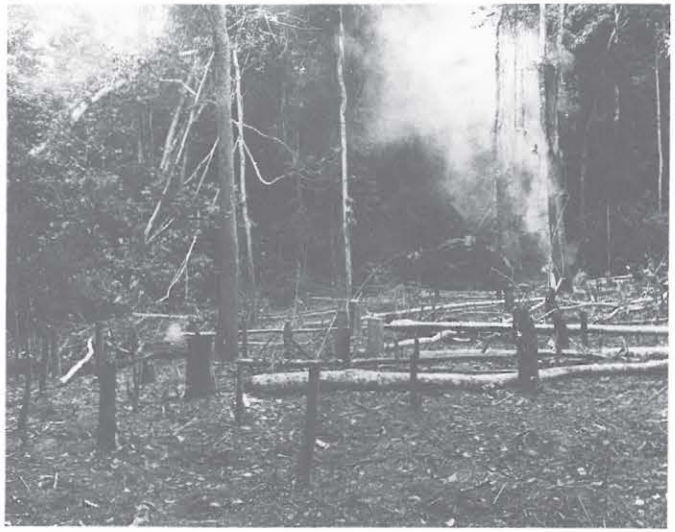
by Serge BAHUCHET, Claude Marcel HLADIK, Annette HLADIK and Edmond DOUNIAS

In the African rain forest, as well as in the tropical zones of Asia and America, agricultural practices differ in many ways from those of temperate zones and savannas. Soil preparation is almost non-existent whereas forest clearing demands most of the energy expended. Trees and shrubs are cut down, left to dry, then burned. Only the largest trees are saved, either because they are too difficult to cut down, or because they yield edible fruits, or because they have medical and/or magical value.

Prior to the first rains, without any systematic hoeing, women bury, after simply digging a hole with a hoe or a machete, pieces of yam tubers, cuttings of cassava, or sprouts of banana plants. Thus cultivation mostly consists of planting live plant parts rather than seeds.

Plants are always intercropped; each field generally includes a dozen or so species, with many varieties of yams, cassava, plantains (cooking bananas), taros and macabos. The majority of these cultivars were introduced from other continents during the past centuries. Essentially they consist of non-seasonal species that produce continuously, without a clear "harvest-period", thus allowing staggered collection throughout the year. Mixing cultivars in the same field enhances this possibility: the plot thus becomes a true "living granary"(1).

Moreover, in the rain forest, herbs and forbs are less common than in the savanna and, therefore, less weeding and care is needed. Cultivators can thus abandon their fields, even



Field preparation among the Ngando. Cutting and clearing must be done during the dry season, using axes and machetes (coupe-coupe). These activities account for the main yearly energetic investment by adult men and women (chapter 4). After a period of about one month, the dried vegetation is burned. Most of the time, burning is only partial; large tree trunks remain. In the earth enriched by ashes, women will plant yams, plantains, cassava and maize (photo by S. Bahuchet).

for long periods. For example, they can join hunting and fishing camps far away from the villages.

Forest agriculture is "nomadic"; each family opens up a new plot every year (2). Whereas maize, yam and gourds are harvested after less than one year, plantains and cassava may produce for several years. Consequently, each family exploits several plots of different ages simultaneously. The decrease in productivity that accompanies the invasion of the field by sprouting stumps and germinating weeds (3) —originating from the "soil seed bank" made up of wind or animal dispersed seeds—brings about its fairly rapid abandon.

Results obtained from various studies in tropical regions (4), show that this system of shifting cultivation can maintain soil fertility as long as population densities are low, thus allowing plots to lie fallow for at least a dozen years before being reused.

The "home-garden" is an additional and complementary system allowing for a range of food plants, spices and medicinal species to be grown near home, in a limited space. Fruit trees are also intercropped; thus the whole cultivated plant complex reproduces forest diversity on a small scale.

One should measure this diversity, including the yields from different plots, in order to determine what resources are actually available to those populations whose nutritional status is under investigation.

TECHNIQUES FOR MEASURING

By using a tethered balloon equipped with a radio-controlled gondola—a technique developed to photograph the forest canopy at low altitude in order to analyse its structure (see chapter 1)—we were able to obtain detailed views of home-gardens and those cultivated plots located relatively near the southern Cameroonian villages where we have conducted various food surveys.

Such a technique is most useful in an overall analysis, particularly to reveal the spatial distribution of tree "biovolumes" in home-gardens, and to determine on a larger scale the general disposition of the land, including the location of trails and fields in relation to the various lineage segments.

Identifying and counting species and varieties within a plot needs to be done on the ground. In order to evaluate similarities and differences among cultivation systems belonging to several populations, we have recorded all plants growing inside a narrow transect cutting across each field. By adding a series of transects of randomly chosen fields we have obtained useful mean values to be compared, among various ethnic groups, with our quantitative data on nutrition (chapter 3). Similarly, we have obtained a mean value for local production, by weighing tubers and bunches of plantains at harvest time.

Measuring a Mvae plantation in southern Cameroon and counting species and cultivars along a transect. The usual topographic instruments (topofil, compass and plane table) are used on this particularly irregular land where fallen tree trunks have been left in place. Counting is done along a one-metre-wide band in order not to omit small plants, including subspontaneous forms (such as those of the genus *Talinum*) that are edible in the form of "cooked spinach" (photo by S. Bahuchet).

The Yassa of Southern Cameroon differ from ethnic groups living in the Lobaye forest of the Central African Republic, as well as from the neighbouring Mvae, by practising a quasi-monoculture of cassava. In the field shown, at Ebodié, located near the sea shore on sandy soil, only three cassava cultivars are grown. However, home-gardens increase the diversity by including fruit trees, bananas and plantains, taros and macabos, and the Marantaceae whose leaves are used to wrap certain foods prior to cooking (photo by C.M. Hladik).

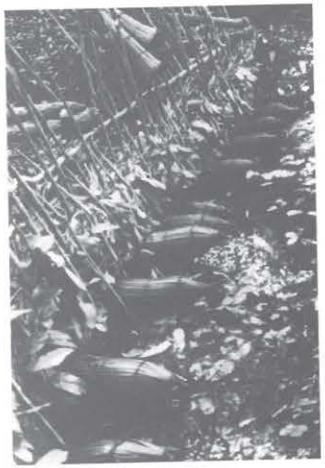
DIVERSITY OF AGRICULTURAL SYSTEMS

The most typical example of our comparative approach concerns the Lobaye forest, in the Central African Republic, where we studied several ethnic groups close enough spatially and living in the same environment to potentially share the same food resources. Each society has developed its own subsistence strategy, leading to clearly differentiated alimentary systems.

Within the Lobaye forest, the Aka Pygmies (described in the previous chapter) live side by side with four non-Pygmy groups of cultivators, namely the Ngando, Issongo, Monzombo and Ngbaka. The latter, who have been the subject of detailed ethnological studies (5 and 6), maintain close relations of exchange with the Aka. Agricultural strategies differ among the four groups: cassava is the staple of the Monzombo, settled along the Oubangui river; plantain is the principal starch of the Ngbaka, complemented by the periodic use of yams and taros. For the Ngando living further south, in the Lobaye forest, plantains, yams and cassava are of equal importance, whereas for the Issongo, living in the forest fringes, cassava is of primary importance, followed by yams.

By investing with cultural values one or more plant species within their food system (see chapter 5), each of these contiguous groups affirms its own ethnic identity. We have observed the same conceptual contrasts in southern Cameroon, between the Mvae and the Yassa. The latter employ a minimum number of cassava cultivars in their fields, while the Mvae maintain a mixture of thirty or so plant species or cultivars, as is the case with the Lobaye forest populations. However, cultural opposition is not always the rule among neighbouring groups. In Zaire, Pagezy (see below) has observed exactly the reverse, with the Twa maintaining the traditional practices of the Oto.

The utilization of natural resources also reveals divergences between groups: in the Lobaye forest, the Monzombo, a riverine people, are exclusively fishermen; the Ngando and the Issongo hunt with nets and trap game in the forest, whereas the Ngbaka specialize in trapping and using hoop-nets to catch fish in the creeks.



In the Lobaye forest, hoop-nets placed along a dammed creek provide the Ngbaka with small fry. This constitutes an important complement to the food-crops grown in the fields (photo by C.M. Hladik).

Life in forest villages is not exclusively focused on cultivation. Numerous vegetables, condiments and all animal food are provided by the forest itself. Some of the cultivated species considered as "living stock" play an important role since they allow prolonged forays into the forest. Thus all village dwellers together, or sometimes men alone, can spend several months each year in forest encampments, especially at the time when caterpillars can be collected, or when game and fish can be trapped.

PRODUCTIVE COMPLEMENTARITY

The most noticeable consequence of the various strategies for farming the forest is prolonging production throughout the yearly cycle, thus ensuring a permanent food supply. The lean period, a constant problem all over the dry tropics, does not exist in the forest because there is no single harvest season and very little food storage (chapter 3).

Obviously, this does not eliminate the need for an annual cycle of agricultural work, since cultivators must clear the land and also plant, at appropriate times, short-cycle crops such as groundnuts, gourds and various vegetables.

The great number of varieties that are mixed in the same field allows cultivators to cope with climatic adversities and sundry parasites by distributing risks. Thus the aim is not to maximize yields, but to achieve a sustained production of complementary foods.

Nevertheless, some periods of minimum food availability occur, during which natural forest products are utilized in larger quantities, together with feral species growing in anthropogenic environments.

These extensive subsistence practices are now being carried out in the context of an intensive market economy. Whereas previously the average area cleared was of the order of a quarter of a hectare, chainsaws now allow for easy clearing of one hectare or more, part of the food production being sold for cash.

Local practice still remains basic to these agrosystems, whose future depends on the improvement of cultivated varieties, and on the maintenance of a biological complexity that has proven resilient enough to face the numerous constraints posed by the tropical environment.

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Facing page: Cultivated plants providing the staple foods for various ethnic groups inhabiting the Lobaye forest (Central African Republic).

Within a single Ngbaka field (**upper left**), near Bobélé, nineteen varieties of plantains and, in their shadow, five yam cultivars and three taro varieties are grown in a mixed stand over a recently cleared area of 7,000 m^2. Such diversity allows for sustained production throughout the year.

The macabo plant (*Xanthosoma sagittifolia*, **upper right**), of American origin, is cultivated in the home-gardens as well as in the fields; it yields an abundant crop of tuberous rhizomes. Here a young Ngbaka transplants a macabo in the home-garden, at the village of Mettè.

Even though cassava tubers (**lower left**) make up the bulk of the cultivated products of the Issongo living in Lobaye, yams are a significant element in the cultivation system of the Ngando, their nearest neighbours. The yam (*Dioscorea alata*, **lower right**), unearthed in a Ngando plantation at Zomia, is a plant of Asiatic origin which, for several centuries, has been cultivated in association with some species of African yams (photos by C. M. Hladik).

Seasonal variation of food supply in the Lake Tumba region of Zaire

by Hélène PAGEZY

The Ntomba are settled near the equator in the flooded forest surrounding Lake Tumba in Zaire. The population is made up of two groups that are genetically distinct: the Oto, descended from cultivator-fishermen, and the Twa who are Pygmies descended from hunter-gatherers. Their villages and fields are located in the only lands that remain unflooded during the rainy seasons. The remaining forest is characterized by a well-developed drainage network made up of the lake, connecting rivers and their affluents, plus marshes and creeks.

While the Ntomba's supply of staple food, cassava, remains constant the year over, in contrast, the accompanying animal food (fish, caterpillars and game meat) is strongly seasonal, and depending upon human activities. In fact, hunting, fishing and caterpillar collecting are synchronized by the bimodal distribution of the rains. Even though from one year to the next, the seasons may be more or less contrasted, the onset of activities is dependent upon an "average" seasonal rhythm as perceived by the Ntomba .

PRODUCTION AND SEASONALITY

Among the Ntomba, both dry seasons are devoted to fishing. As water levels begin to drop, hoop-nets, which are adapted to local water levels and currents, are placed within the flooded forest. They cover large segments of rivers, creeks and marshes. Some of them resemble long funnels open at one end through which currents propel the fish. They are turned over each time the current changes direction, that is to say before the major periods of flooding and water level decline.

As soon as the water level stabilizes and the forest floor allows walking on it, the Ntomba leave for their fishing camps located on the larger rivers and affluents. In the village of Nzalekenga —the focus of our research (1)—the men were distributed among five main camp-sites where they remained during the major dry season (June to September), whereas during the minor dry season (January to March) they occupied only three camp-sites. They draw their nets across rivers, use permanently fixed fishing rods, and place hoop-nets under water. Their wives join them as soon as they finish their planting, to dam creeks and bail out the water, leaving the small fry to be collected from the mud.

From the start of the major rainy season, fishermen begin to return to the village: this is also the caterpillar collecting season, and Nzalekenga continues to be deserted during day time until the month of October. Only a residual population of fishermen remains in the most accessible encampments on the Lolo river. At this time, solely the hoop-nets and lines, in which crocodiles may be caught produce anything.

Facing page: At the Malebela encampment, near Nzalekenga village, a Ntomba fisherman places a hoop-net (**euku**) on the riverbed. The special basket (**ekaloli**) in the front of the pirogue is used to gather shrimps among the aquatic plants. The stick buried in the substrate behind is a fixed rod for fishing (photo by H. Pagezy).

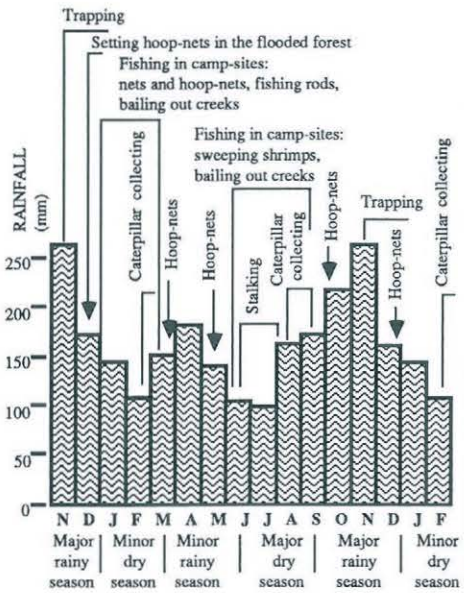
The Malebela fishing encampment, along an affluent of the Lolo River, during the dry season (photo by H. Pagezy).

Taking advantage of the rising waters that drive the game into unflooded areas, the hunters set out traps. Some of them stalk game several days running, in a forest where noise is dulled by humidity.

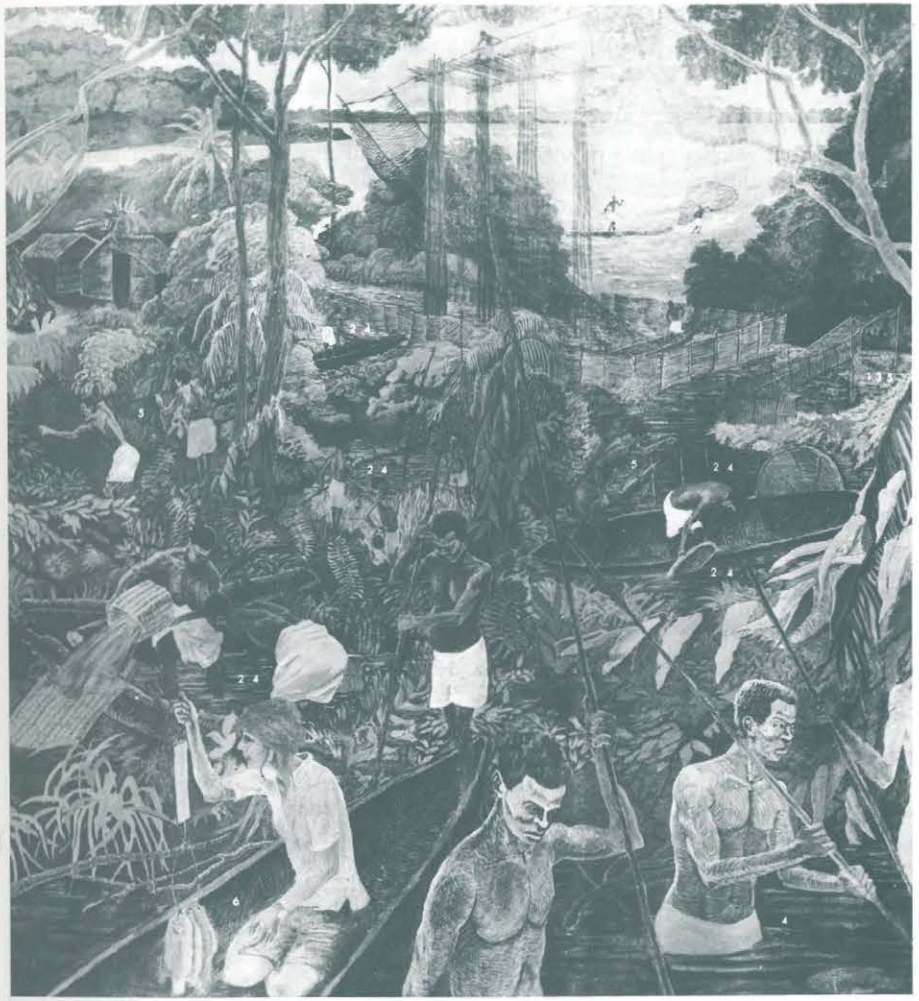
If fishing—the dominant activity during the dry season—seems sufficient to nourish the whole village, trapping—an activity confined mostly to the rainy season—seems insufficient. At that time, the Ntomba suffer from a specific type of hunger, "**nzala** ", defined as the shortage of meat. As soon as production fails to satisfy cultural norms pertaining to food consumption, the perceived deficit has both biological and psychological effects during a lean period which can last for several months.

Thus one finds among the Ntomba the same "seasonal hunger" phenomenom which Miracle discusses (2) and Ogbu mentions as being common in other regions of tropical Africa (3). This concept of seasonal hunger is defined differently in each culture. Hunger can be specifically attributed to the lack of the staple food normally providing the bulk of the energy intake, or to the absence of a culturally valued item such as game or fish.

Oto Ntomba girls using baskets to empty out water from a creek which has been dammed with branches and mud in order to gather fry and shrimps. Although this task requires a very high energy expenditure (chapter 4), it is not perceived to be as exhausting as work in the fields because it takes place in shaded areas within an enthusiastic cooperative context (Photo by H. Pagezy).



Seasonal activities of the Ntomba relative to the rainfall regime: on this graph, which shows the monthly rainfall averages, attention is drawn to the various fishing techniques employed during both dry seasons, whereas the trapping of game is confined to both rainy seasons. The transition between seasons allows the use of hoop-nets. The emergence of caterpillars during short periods announces the arrival of the first rains (source: Pagezy, 1988).



The various fishing techniques employed at Nzalekenga during a seasonal cycle (reconstructed scene designed by Gilles Kerzhero using the documents of H. Pagezy, for the 1981 exhibit at the Muséum National d'Histoire Naturelle, Paris).

1. As the water level drops at the start of the minor dry season (January), hoop-nets are placed in rivers and marshes.
2. During the minor dry season (February/March), the Oto install their fishing encampments in the forest. They are accompanied by the Twa who help them to smoke the fish and set up traps. Oto and Twa women and girls practise fishing by scooping out and completely emptying a pool of water to capture all the small fry.
3. During the minor rainy season that follows (April/May) the Oto activate the hoop-nets.
4. The major dry season (June/July/August) is the moment, for most of the inhabitants of Nzalekenga, to rejoin the encampment in order to participate in different fishing activities, and especially to raise a huge rigid net (**emenu**) kept under watch from the scaffold visible at the back of this picture.
5. In September, when the water rises again, the hoop-nets are used before returning to the village.
6. The field study, including the weighing of the catch, is also illustrated.

SEASONAL CYCLES AND FOOD CONSUMPTION

Food consumption, simultaneously measured among adult men at Nzalekenga village and in the fishing camps, using standard techniques (see chapter 3), is related to seasonal variations in human productive activities.

Seasonal fluctuations concern primarily animal products and are more noticeable in the village than in the camps (see table below).

Whereas the consumption of cassava tubers as a staple food is stable and nearly the same in the village and in the camps, the consumption of leaves and oil palm fruits is much less important in the encampment where these food items are rarely available because they are brought from the village already cooked and are therefore perishable.

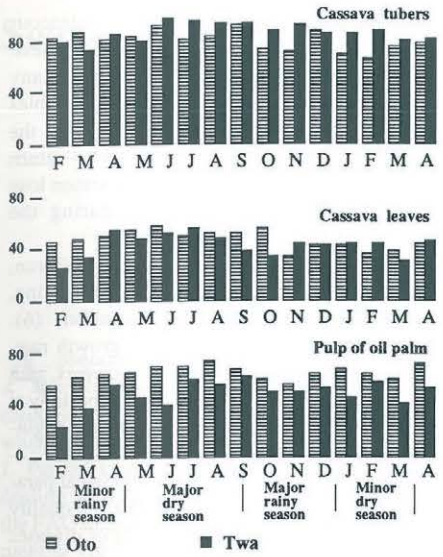
At all times fresh fish and shrimps are regularly included in the diet of fishermen. In contrast, the small fry from marshes is consumed exclusively at the village during the dry season.

Caterpillars, which are most abundant in the transition period between two seasons, only appear in the results of the food surveys in small quantity because the data were collected at the height of the major rainy and dry seasons.

Seasonal variation in daily individual food intake of adult Oto men, given in grammes (fresh weight) and in total calories, at Nzalekenga village and at the encampment (source: Pagezy, 1988-a).

	MAJOR RAINY SEASON 1979		MAJOR DRY SEASON 1980	
	village	camp	village	camp
ANIMAL FOOD				
Game meat (a)	37 g	39 g	19 g	3 g
Fresh fish and shrimps	17 g	221 g	36 g	287 g
Small fry from marshes	8 g	0 g	59 g	0 g
Smoked fish	7 g	21 g	18 g	28 g
Caterpillars	2 g	0 g	4 g	0 g
Meat of domestic animals (b)	10 g	0 g	2 g	0 g
PLANT FOOD				
Cassava tubers	806 g	884 g	844 g	861 g
Other starchy foods (c)	23 g	2 g	30 g	23 g
Leaves (d)	195 g	44 g	175 g	25 g
Pulp of the oil palm (e)	56 g	16 g	66 g	15 g
TOTAL CALORIES	1970 kcal	2086 kcal	2101 kcal	2159 kcal

(a) Game meat eaten in camps is mostly that of aquatic animals (crocodiles, turtles, water-snakes) caught in hoop-nets or on fixed fishing lines.
(b) Meat of domestic animals is essentially that of chickens and, occasionally, goats.
(c) Other starchy foods are: plantains, sweet potatoes, yams, breadfruit, maize and, occasionally, rice (indicated weights correspond in these cases to cooked foods).
(d) This category essentially includes cassava leaves and the leaves of a few other species, as well as mushrooms.
(e) Pulp of the oil palm is prepared as a sauce (**mosaka**) to be eaten with various dishes, or eaten as a snack of roasted fruits, or used in the form of oil (the weight indicated is the pulp equivalent).



Monthly variation of the occurrence of meals including various plants, for 100 observed daily preparations, among the Oto and the Twa (source: Pagezy, 1988-b).

The results of another food survey (4), carried out among 40 Oto and 40 Twa families, reveal a lack of seasonality in the intake of cassava tubers which are eaten daily and prepared on 80 out of 100 days.

Cassava leaves, although less frequently eaten since they are prepared on only one day out of two on the average, never disappear entirely from the weekly menu.

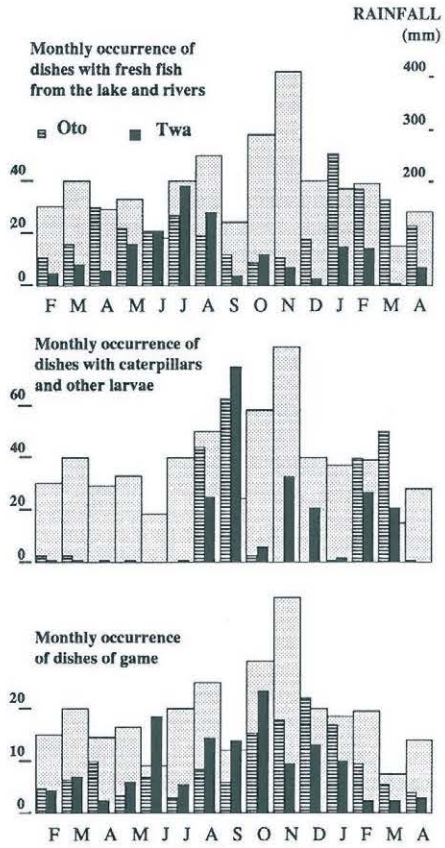
The pulp of oil palm fruits is eaten as a sauce (see page 54) accompaniying leaf and meat dishes. Its consumption reflects fruit production, which, as is the case of most fruits, undergoes a noticeable seasonal variation with a maximum in the dry season.

Monthly variation of the occurrence of meals including various animal foods in relation to rainfall (stippled), for 100 observed daily preparations (source: Pagezy, 1988-b).

Conversely, the same food survey, pursued for 15 months, highlights the strong seasonality affecting animal food consumption.

The near disappearance of dishes of fresh fish from the lake or rivers, small fry from the marshes, caterpillars or game for periods of a few months can be correlated with the rainfall regime.

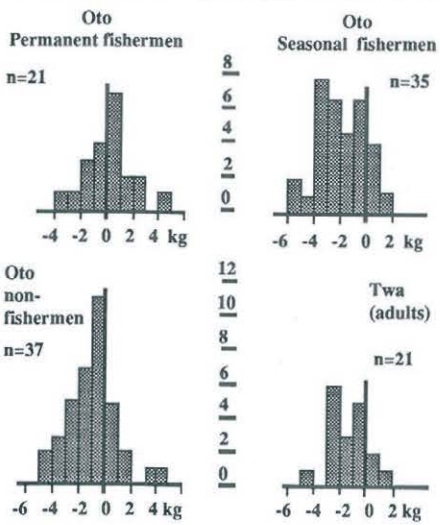
In fact, by determining the levels of the lake, rivers and marshes, rainfall either facilitates or impedes fishing and/or hunting. With respect to caterpillars, the bimodal distribution is a direct result of the phenology of the trees on which they feed (chapter 1).



SEASONAL VARIATION OF PHYSICAL PARAMETERS

The periodic fluctuation of physical parameters such as body weight and fat reserves observed in the Lake Tumba region is one of the consequences of the seasonal variation in both physical activity and food intake.

Seasonal body weight variations, as measured among adult men at Nzalekenga village, demonstrate differences in susceptibility to external environmental factors due to their different lifestyles. Permanent fishermen, staying at the camp throughout the major rainy season, have a higher "ponderal index" and more muscular development in their forearms than do other categories of adult men in the same village. Conversely, they have less subcutaneous fat reserves as measured by skinfold thickness. The Nzalekenga study has not shown any fluctuation in the aforementioned variables among the permanent fishermen (5). On the other hand, cultivator/fishermen who return to the village at the end of the dry season lose approximately 2 kg in weight during the rainy season.



Variation of body weight of the adult men Oto and Twa living at Nzalekenga during the major rainy season (number of subjects in each class of weight, gain or loss, in kg; source: Pagezy, 1982). Although most of the people in the village lose weight during the major rainy season, there are differences related to way of life and activity. Among the Oto, seasonal fishermen who leave the fishing camp during the rainy season are the most affected; in contrast, the fishermen, who stay permanently at the camp, have a relatively stable body weight. The Twa also have a significant body weight loss during the rainy season.

The ponderal growth-curves of children, whether they are of school age or still nursing, is also marked by seasonal variations (6). Compared to the average annual growth rate, Oto and Twa infants aged zero to two years, gain less weight during the rainy season, especially at the end of the major rainy season and the beginning of the dry season.

These seasonal variations of biological parameters reflect, not only the quantity and quality of food consumed, but also periods of diseases and parasitic infections whose agents abound in the humid tropics. Interaction between environmental and socio-cultural factors (subsistence strategies and nutrition versus parasite load) are of overwhelming importance. Thus we have tried to systematically relate the results of our food surveys to the biomedical parameters (chapter 4) recorded at the same time in the field.

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Seasonal hunger or "craving for meat" ?

by Igor de GARINE and Hélène PAGEZY

A phenomenon such as "meat hunger", which includes biological, cultural and psychological aspects, can be comprehended only when a pluridisciplinary approach is used. Since J. Perissé's work in 1966 (1), many publications dealing with food and nutrition in Africa (e.g. the FAO Indicative World Plan for the Development of Agriculture) have contributed towards the stereotype which classifies the diet of the rain forest areas as being composed mainly of carbohydrates, with a permanent protein deficiency.

The observations made by our research team suggest the need for nuances since this notion, which may apply to urban and peri-urban populations, does not correspond to the situation of groups directly exploiting the forest environment for their subsistence. Although game is vanishing in certain areas, it remains a food of paramount importance, and fish is still widely present in rivers and creeks. Complemented by leaves of wild and cultivated plants, they both contribute to the protein content of the diet. It is true, however, that the meat of domestic animals such as goats and sheep, available in most villages, is mainly consumed at feasts held during wedding and funeral celebrations, while domestic fowl constitute a choice meal for honoured guests or for special occasions (see chapter 5).

In most of the languages spoken by the societies under investigation, specific terms are used to distinguish two kinds of food shortage: "hunger" and "lack of meat". What is the biological basis for this distinction ?

Fish and game, obtained by using various fishing and hunting techniques, normally undergo seasonal variations, some of which have been described in the preceding pages. The term "meat hunger" should be considered in this respect, and not as a kind of critical threshold in protein consumption which might eventually lead to cannibalism (which usually has little to do with hunger). Unlike the situation observed among populations living in Sudano-sahelian regions characterized by severe periodic food shortages, this craving does not correspond to a hypocaloric diet, and also occurs in the Central African Republic, for instance, among the Ngbaka and the Ngando where, for several months during the dry season, the staple food (cassava, yams or plantain bananas) is accompanied exclusively by cassava leaves or wild *Gnetum* cooked in palm oil. Although protein makes up 30% of the dry weight of these leaves, such a diet is unlikely to meet protein requirements due to lower absorption and to the deficiencies in essential amino acids of plant protein. Bahuchet observed a similar period of "meat hunger" (2) during the rainy season among the Aka Pygmies.

Conversely, the Yassa and Mvae from southern Cameroon can hardly distinguish which period of the annual food cycle is the least favourable, except in occasional specific cases where a local seasonal shortage may be felt as acutely as among other forest populations (see chapter 4). For them, variation normally corresponds to the moment when cassava, the favourite plant staple, is less readily available and fish supplies diminish.

In Zaire, among the Twa and the Oto (3), seasonal variations observed also correspond to a slight decrease in energy content of the diet and a more pronounced one of animal protein intake.

This qualitative diminution has some impact on the children's nutritional status and is partly responsible for their growth retardation during this critical period. Although these seasonal variations are much milder than those to which savanna populations are accustomed, they are perceived as very dramatically and constitute a definite stress. Among different aggravating factors, mention should be made of various parasitic diseases (chapter 4). Their increase might help to explain why, in the rain forest, the impact of seasonality exceeds the biological effects expected from variations in food availability alone.

From the above observations it would appear that "meat hunger" can best be interpreted as a psychological stress, as defined by Harrison and his collaborators (4 and 5). Here, the stress appears to be linked to a qualitative variation in diet: a decrease in the most culturally valued food. This diminution has much heavier nutritional consequences than would be expected from such a limited constraint over a short span of time. The intake of animal protein is never actually lower than 81 g *per capita* per day, a higher figure than that which can be observed in many "traditional" societies. For example, the Massa of northern Cameroon only consume 37 g of animal food *per capita* per day (6).

The craving for the flesh of game, a luxury commodity for populations living in the forest fringes as well as for town dwellers, should be mentioned in its local cultural context. Rifles and ammunition are often provided for rural hunters by wealthy urbanites, in exchange for the largest share of their quarry. Cured game is considered a delicacy by all. Efficient distribution networks make it available at high cost to urban dwellers as well as to salaried plantation workers.

For many villagers, this trade has a high yield and is more attractive than working in the fields. However, in the long run, it will inevitably contribute to the extinction of the local fauna.

The quest for meat reveals the interactions that can be observed between nutritional, socio-cultural and pyschological aspects of food consumption.

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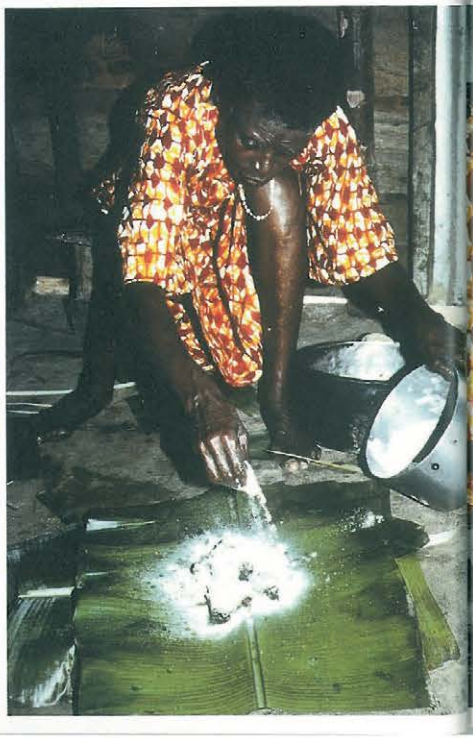
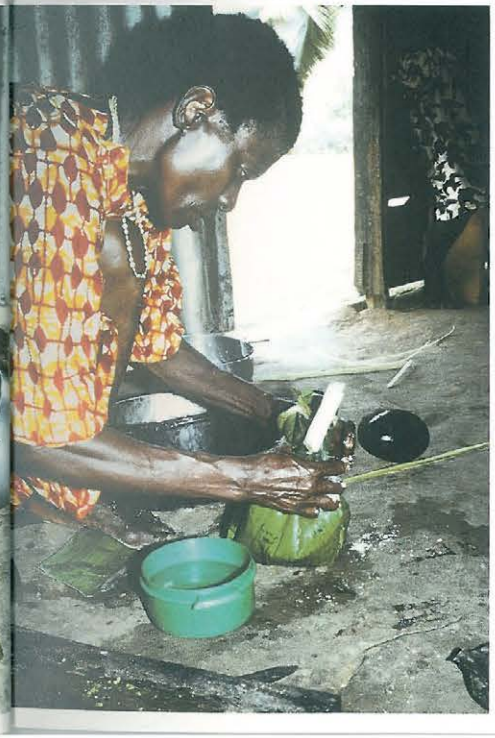
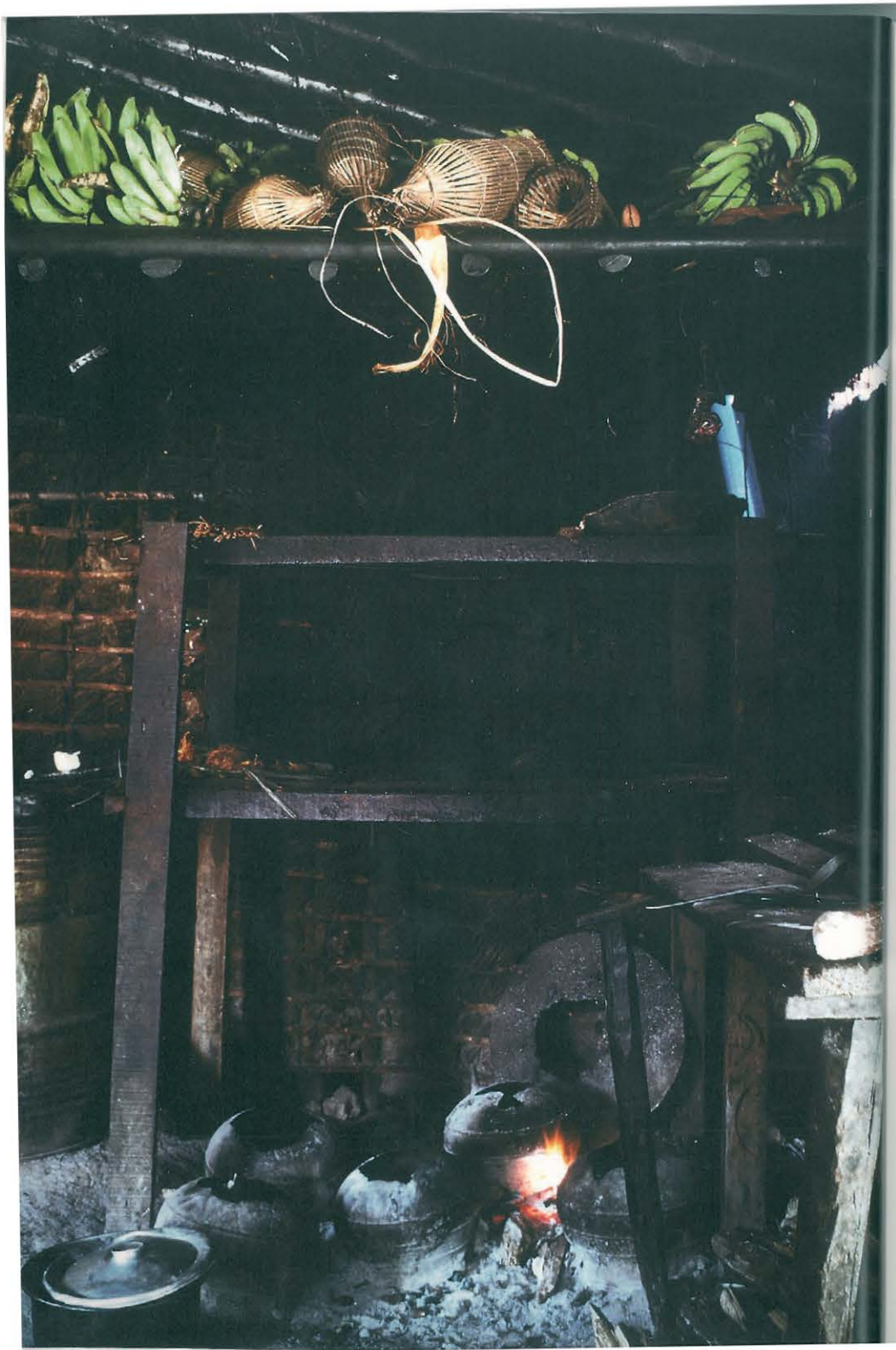
Facing page: A newly-wed Yassa wife of southern Cameroon displays a smoked forest porcupine, which will constitute the main course of the wedding meal. This large rodent *(Atherurus africanus)*, captured in a trap then smoked, is one of the choicest sorts of game. The porcupine's skin, from which the spines have been removed with a machete, gives this dish its characteristic aspect. Roasted, this thick and crunchy "crackling" is a local delicacy. Seasonal variations in the availability of animal foods are much less marked among this sea-fishing population than in most of the Congo Basin. Nevertheless, game retains its high prestige and is an important element in family celebrations (photo by I. de Garine).

Page 46, upper: As soon as they are captured, animals caught in traps are butchered and smoked. In a Mvae hunting camp, duiker meat is smoked for a few days on a large rack. It is an important item for trade between forest villagers and the urban dwellers of southern Cameroon (photo by E. de Garine).







3
FOOD PROCESSING AND CONSUMPTION

Facing page: A Mvae kitchen at Nkoelon (southern Cameroon). The rack placed over the fireplace is used to store foodstuffs, such as **foufou** (cassava balls) and smoked meat, which need complete drying. On the upper rack where there is not much smoke, plantain bananas are stored beside the small hoop-nets which will be used for catching small fry and fresh-water shrimps in creeks and marshes as soon as the water level drops. Various leftovers from the kitchen, especially the fibre of oil palm fruits after the oil has been squeezed out, will serve as bait in these hoop-nets (photo by C.M. Hladik).

Pages 46 (lower) and 47: Successive stages of cooking foods directly on the embers after wrapping inside fresh leaves. This is one of the most characteristic techniques found among forest populations, especially used in hunting camps, but also appreciated at the village for the fine taste it develops in meat or fish. The series of photographs was taken in a Yassa village (southern Cameroon): minced fish is placed on a banana leaf, chilli pepper and cassava flour are added, and the closed leaf envelope is placed directly on the embers (photos by S. Bahuchet).

Page 47 (upper): Preparation of caterpillars in an Aka Pygmy camp of Central African Republic. Roasting over the fire is the necessary first step to get rid of the bristles of this species of the genus *Pseudantherea* (Attacidae), collected at the beginning of the rainy season. Afterwards, caterpillars are dropped in boiling water and can be cooked together with leaves or tubers (photo by S. Bahuchet).

Food preservation and cooking

by Igor de GARINE and Serge BAHUCHET

In rain forest environments, few foodstuffs are preserved, except for kernels extracted from different fruits, notably those of *Irvingia gabonensis*. They are made into a kind of loaf which can be kept for a limited period, stocked above the smoking rack. Vegetable resources "stored" in the forest soil on the very spot where they grow (such as wild yam tubers), or in the plantation (e.g. plantain bananas and cassava tubers), provide a "living store" which can be utilized at any time (see chapter 2).

There are, however, specific periods for harvesting cultivated yams and taros. During the dry season, they are stacked out of reach of rodents in a kind of "granary" built of branches and tree bark in the middle of the field.

Yams and taros, after harvesting by the Ngbaka at the beginning of the dry season, are stored inside a "granary", which is a small hut made of bark located in the middle of the plantation. Before cooking, the top of each tuber is carefully cut off and set aside to be planted before the next rainy season (photo by S. Bahuchet).

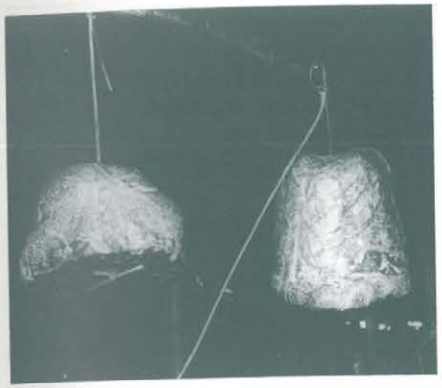
Game and fish, which are often smoked on the spot, can be kept for short periods, allowing them to be transported from their place of capture back to the village. In the kitchen, they are stored on a rack placed over the fireplace.

COOKING

Cooking is a valued task which people readily discuss. Married women are quite willing to devote a large part of their time to it. When asked about the dishes they prefer cooking, the Yassa and Mvae women from southern Cameroon quoted respectively 21 and 17 recipes, among which a sizeable number suggest the existence of an elaborate gastronomy.

The kitchen is an essential part of the compound, usually located apart from the house. It is equipped with several fireplaces for cooking and a smoking rack. Shelves and cupboards provide a larder and storage space for sets of kitchen utensils, among which there are more modern manufactured items than hand-made traditional ones.

Cassava, yams and plantain bananas are the main staples of forest populations. Occasionally they are also used as basic foods together with other secondary carbohydrate foods (such as taros, coco yams...). Pulses, groundnuts and cereals (locally produced maize, rice of external origin), are also present.



The dried "loaf" made of crushed seeds of *Irvingia gabonensis*, and used in the preparation of various dishes, is one of the few long-lasting foodstuffs. It is kept hanging above the fireplace (photo by S. Bahuchet).

Rich relishes are prepared from various types of fat and oil (palm oil, ground wild kernels, animal fats), to which a wide range of flavours is added by incorporating cultivated vegetables or fruit and leaves gathered in the forest. Specific odours play an important part: the leaves in which some dishes are wrapped before cooking, after addition of spices and herbs, are carefully chosen for their smell.

Besides a large variety of spicy dishes, there is a vast range of carefully graduated bitter tastes. This is illustrated by the relish of **ndolé** leaves *(Vernonia amygdalina)* which frequently accompanies meat dishes and has an emblematic value for most southern Cameroonian populations (see recipes in the next account).

Meat and fish, fresh as well as smoked, are eaten as relishes or in stews. They are seldom used barbecued in family meals; this technique is reserved for the snacks consumed on the spot by hunters and fishermen when they are engaged in these activities or during markets.

Cassava tubers are steeped for several days in stagnant water in order to eliminate the toxic principles. Bagandou village, Central African Republic (photo by I. de Garine).

CASSAVA PROCESSING

Cassava is one of the staple foods of rain forest populations, especially in southern Cameroon. Gathering tubers and processing them is one of the landmarks in the weekly schedule of Yassa and Mvae housewives.

Tubers are dug out of the fields then transported to a stream where they are peeled and left to steep for two days in order to eliminate their bitter toxic juices (cyanogenic glucosides). This steeping period lasts longer in other regions, up to 8 days in Zaire among the Oto and the Twa, and in northeastern Gabon. It should not be forgotten that the incomplete detoxification of bitter cassava plays a part in the tendency towards developing goitre observed in rain forest regions located on primary substrata, from which iodine is missing (see chapter 4). Sweet varieties of

cassava, which also contain toxic principles, are steeped as well. In the latter case, the treatment is said to "provide a good taste".

After steeping, the tubers are taken out of the water, drained and crushed (among the Yassa they are also sieved). The pulp obtained is then moulded into oblong shaped sticks—"bâtons" (**chicouangue**)—and carefully wrapped in

The cassava pulp is carefully pounded and the fibres removed. The "chicouangues" are then wrapped in Marantaceae leaves and carefully tied with a fibre obtained from the banana tree. Mvae village of Nkoelon, southern Cameroon (photo by E. de Garine).

leaves from banana trees or Marantaceae and fastened with a fibre obtained from the banana tree. They are then braised.

The preparation of cassava sticks for a family of five takes a whole day. The housewives of southern Cameroon repeat the operation twice a week and feel that it is one of their most demanding tasks (70% among the Yassa, 75%

Balls of cassava (**foufou**) drying on a smoking rack. When needed, they are ground and the flour obtained is sieved and mixed with boiling water to form a paste. It is then shaped into balls and eaten with an accompanying sauce (photo by I. de Garine).

among the Mvae, result of a study carried out on a sample of 65 subjects from each ethnic group).

The cassava paste can also be rolled into balls (**foufou**) which are dried on the smoking rack and will keep for a short time.

Alternatively, the paste can be dried in the sun and stored in the form of starch which is used in numerous preparations. Needless to say, each forest population cultivates its own varieties of cassava. Each group's original food technologies and culinary techniques confer their individuality to the different dishes consumed.

Cassava paste, dried in the sun, is one of the most frequent techniques used for preserving this food. Region of Yokadouma (photo by I. de Garine).

Recipes for a forest menu

by Serge BAHUCHET and Igor de GARINE

During the various food surveys conducted in Cameroon, the Central African Republic and Zaire, processing techniques were recorded. A few selected recipes are presented here.

Apart from the daily stews, one of the most characteristic techniques found among forest populations is the use of heat-resistant leaves for cooking food. The main starchy food can be boiled in water or steamed in its leaf envelope. Alternatively, after seasoning, meat or fish is wrapped up and then cooked directly on the embers. The successive stages are shown on pages 46 and 47.

In addition to the general use of Marantaceae or banana leaves, odorous leaves such as those of the genus *Aframomum* (Zingiberaceae) confer a subtle aroma to the food preparation they contain.

CATERPILLAR ENVELOPES, NGANDO STYLE

Cassava leaves
Mineral salt
Wild garlic
Peanut paste
Caterpillars
Chilli pepper
Aframomum leaves
Marantaceae leaves

Remove the stalks and toss the cassava leaves lightly in a saucepan. Remove and pound in a mortar with mineral salt, chilli pepper and wild "garlic" *(Afrostyrax lepidophyllus)*. Add the caterpillars, which have been soaked for a few hours. Crush the ingredients (1) and mix together. Add the peanut paste and mix by hand. Take a handful of the preparation and roll it in a fresh *Aframomum* leaf. Then, using a Marantaceae leaf, fold into an envelope shape. When all the mixture has been wrapped, prepare the steamer by placing a bed of Marantaceae stalks on the bottom of the cooking pot and adding water (2). Place the caterpillar envelopes in the steamer, taking care to avoid contact with the water. Cover and steam for 45 minutes. Remove from the pot (3) and dry for a few moments on warm embers. Take off the outside envelope and serve.

(photos by S. Bahuchet)

1

2

3

(photos by I. de Garine)

NDOLÉ, YASSA STYLE

Ndolé leaves *(Vernonia amygdalina)*
Peanut paste, ground meat or fish (optional)

The pronounced bitter taste of *Vernonia* leaves implies that they have to be cooked several times in fresh water. Each time they must be washed carefully (1) and squeezed (2) in order to extract the bitter juice. They are chopped (3) before cooking. The degree of bitterness of this dish depends on the quality of the leaves and on the consumer's personal taste. Peanut paste, ground meat or fish can be added to the ndolé before serving, according to taste.

Ndolé is one of the most important dishes for special occasions among the coastal forest populations of Cameroon. It is obtained from the leaves of *Vernonia amygdalina* and has an emblematic connotation for many groups, each of which has its own variation.

MVAE RECIPE: CASSAVA WITH PEANUTS, PALM OIL AND FRESH-WATER SHRIMPS

Cassava tubers
Palm oil
Salt
Crushed peanuts
Fresh-water shrimps
Chilli pepper

Boil the freshly dug cassava tubers in water and wash them thoroughly, several times. Reduce them to a pulp and sieve. Add the crushed peanuts, palm oil, and shrimps and mix well, season with salt and pepper. Divide the mixture obtained into small packets using Marantaceae leaves to wrap them in. Braise until cooked.

This simple dish is very popular and makes the ideal picnic food for hunting parties. It is also called "the witchcraft drum" since it is so highly appreciated that "the villagers quarrel over it".

EXTRACT OF OIL PALM FRUIT

Fruit of the oil palm
Boiling water

Boil the fruit of the *Elaeis* palm in water. Squeeze and then sieve the fibrous pulp. The extract can be used as a sauce to be added to various culinary preparations.

It provides not only a rich, tasty sauce which is highly appreciated, but is also a nutritionally important food. In addition to its high caloric value, it supplies lipids, calcium, phosphorous and, above all, Vitamin A. Derived from a typically African plant, it constitutes a very important part of the forest populations' diet.

Products of the oil palm

by Georges GUILLE-ESCURET and Claude Marcel HLADIK

Palm oil which, as a "sauce", accompanies many dishes is extracted from the pulp of the bright-orange fruit produced by the oil palm, *Elaeis guineensis*. When ripe, large bunches of these palm nuts are collected during the two major periods of production.

Distribution of the oil palm in Africa has been favoured by human activities. Schwartz (1) has argued that in the Côte d'Ivoire palms are found in high density because of the widespread practice of separating the fruits from the spadix before carrying the crop to the village. Seeds that are lost and dispersed germinate, thus building up oil palm populations. Similarly, H. Dijon (2) has shown that, in the Central African Republic, the most productive "wild" populations of oil palm are located on the sites of former villages.

A few ripe fruits are sufficient to make the daily "sauce" (see recipe on preceding page). However, during major periods of production, oil palm fruits are collected in large amounts to produce oil. They are boiled, then crushed in a mortar to separate the fibrous pulp from the kernels. The pulp is squeezed in a wooden press to extract the oil which comes out with a bright red-orange colour due to carotenoids (precursors of Vitamins A). The oil can be stored for several months and part of it is generally sold for cash.

As a major source of fat in the diet of forest populations, this red oil plays an important role in the local economy. In various countries, highly productive—but fragile—varieties of oil palm have been introduced into large plantations with a processing unit. The red colour of the oil they produce is attenuated after refining. Other products or by-products are obtained from these semi-industrial plants, such as cattle food and the oil extracted from the kernels. The latter or "black oil" can be manually extracted by heating the broken nuts and is locally used exclusively in cosmetic and medicinal preparations.

MAKING WINE FROM THE OIL PALM

Besides the "red oil", another edible oil palm product, namely palm wine, made of fermented sap, is widely used throughout the geographical range of this species. Among the Ngbaka and the Ngando populations who inhabit the forest in the Central African Republic, as among many other ethnic groups, the traditional activity of an adult man at dawn and before sunset is to collect the sap of the oil palm.

Of all foods, palm wine is perhaps the most critically appraised: too sweet or too sour, or excessively bitter (a normal taste due to pieces of bark of mahogany or other trees added to the container in which the sap is collected)...

Palm wine is produced daily and must be consumed shortly afterwards. Its use is therefore local and it plays an important role in enhancing the network of social relationships (chapter 5). The relatives of a bride or a newly-married wife get together every day to debate on the merits of the future or newly-acquired son-in-law, based on the taste of the palm wine he provides. In former days, the men of a lineage would gather at night to share the wine and, in the process, would re-affirm their status as a privileged elders' group, while discussing the relative merits of junior lineage members.

Social relationships are also linked to the two techniques presently used to make wine:

- The first of these techniques consists of tapping the sap of a live palm through a cut at the base of the stem of the male flower, and collecting it in a calabash. This method causes little damage to the tree but requires a physical effort and technical skill. A man must climb the palm every morning and evening, with the help of a belt made from a piece of liana (see front cover photograph).
- The second technique requires cutting down the oil palm (generally a young one), and collecting the sap directly from a hole at the top. Every day, the cavity is enlarged and the sap drips through a small piece of bamboo into a calabash or jar (see photo on facing page).

Whatever the method, spontaneous fermentation of the sap is very fast, and the weak alcoholic beverage that results is drinkable immediately.

In the first technique it is generally the spadix of male flowers which is tapped. This is not necessarily in order to spare the female spadix, which will produce the fruit used in making oil and sauces, but rather because, according to the Ngando, the female flowers do not give enough sap, and the wine obtained is not as good as that from male flowers. In the study by H. Dijon (*op. cit.*) it appeared that making wine is beneficial to the palm tree since the old leaves are regularly removed to facilitate climbing—however, an oil palm which is cared for but not tapped produces more fruit. But among the Ngbaka, once an oil palm is tended, it is considered to be the property of the man who exploits it. Such a particular appropriation of a plant without obvious reference to the "owner"—or user—of the land on which it grows shows how deeply the oil palm enters into the traditional social bonds of a society.

In the second technique, killing the tree is not the only drawback. Except during the last day of production, or when the trunk is exposed to direct sunshine, the wine obtained is never as good as when only the inflorescence is tapped. But it allows for a larger production. A great number (up to thirty) of trunks can be visited daily. Despite the destructive aspects of this method, natural regeneration of the oil palm is so rapid and efficient (as a result of seed dispersal) that there is little risk of decreasing most subspontaneous populations of *Elaeis guineensis* (see aerial photo inside back cover).

The two techniques are quite different from a sociological point of view, as in the case of other food products which can be used as cash crops (3). The first procedure, with its socially prescribed forms of consumption, reinforces lineage and marriage bonds as the personal qualities of the person providing the wine (such as strength and fidelity) are projected through the quality and quantity of the product. The second technique tends to erode traditional solidarity as the wine is usually sold and is thus consumed outside the kinship network. In fact, the meaning and social bonds conveyed by a beverage (4), vary considerably from one culture to another.

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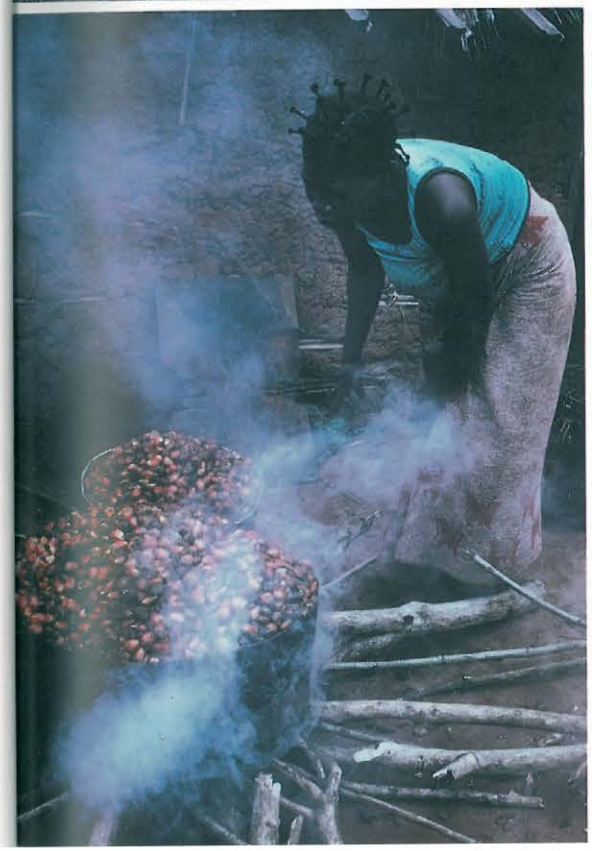
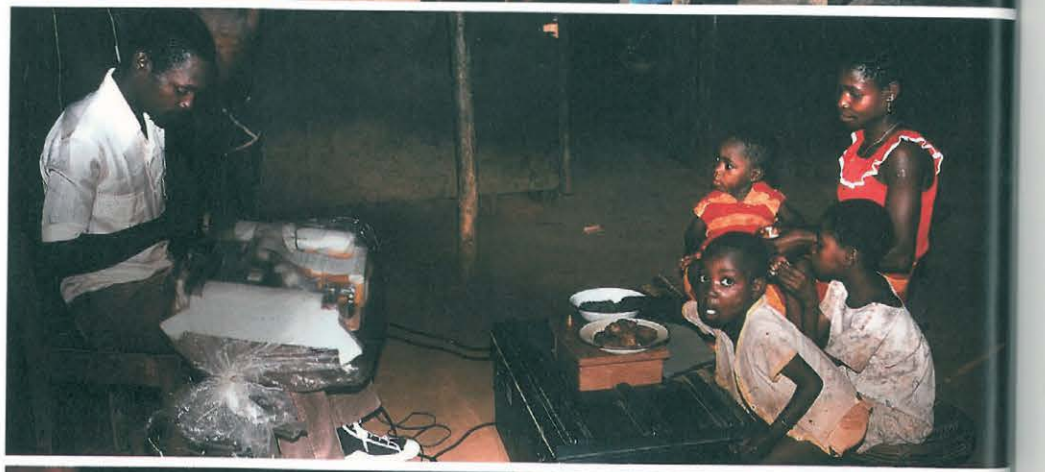
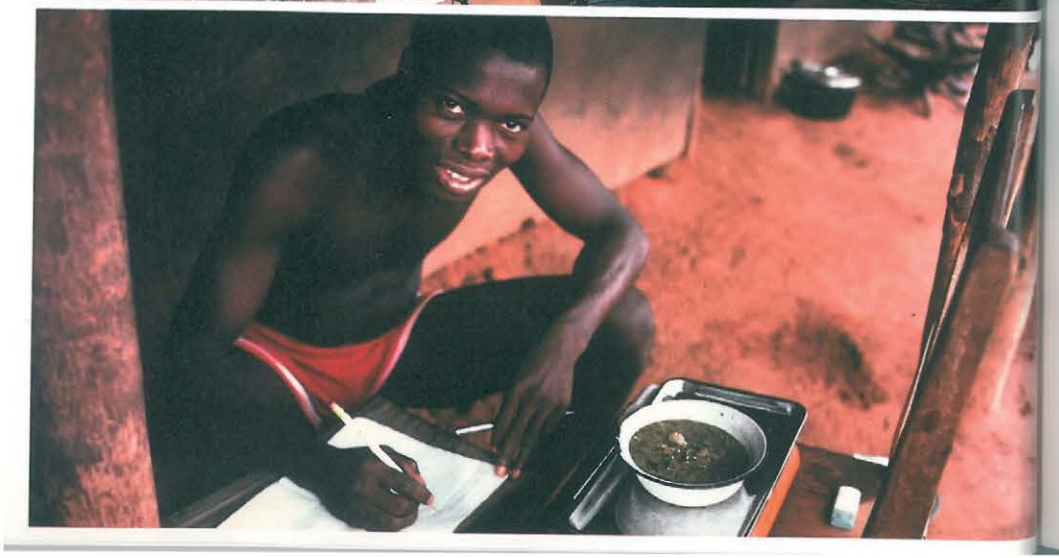


Facing page: Techniques for obtaining the major products of the oil palm, *Elaeis guineensis*, in the Central African Republic, around a Ngbaka village:

The oil is extracted after boiling the fruit (**lower left**). The kernels are separated from the fruits after crushing in a mortar. The fibrous pulp is then placed inside a soft basket and squeezed against a large plank attached to a tree trunk (**lower right**). A lever made of long sticks allows extraction of the oil which is collected in a bowl.

Wine is made from the sap which flows into a bottle from the trunk of an oil palm that has been felled (**upper left**). The hunting bag belongs to the Ngbaka villager who comes twice a day to refresh the cavity in the trunk. Another method (**upper right**) is to tap the male inflorescence of the oil palm and hang a calabash to collect the sap (photos by C.M. Hladik and S. Bahuchet).





Measuring food consumption

by Georges KOPPERT and Claude Marcel HLADIK

Food consumption surveys aim at determining the nutritional value of the diet. The standard approach (1) consists in weighing the total amount of foodstuffs used for cooking in a number of families, which implies that a team of local assistants has to be hired and trained. This method is the most accurate but very costly as it has to be applied to a sufficiently large sample and be repeated to take account of seasonal variations.

In southern Cameroon, in each of the forest populations, Yassa, Mvae and Kola Pygmies, a sample of at least 30 families were visited at three characteristic periods of the year. As these communities respect a weekly schedule, it was necessary to weigh their food consumption for seven consecutive days (resulting in a total of 1,900 survey days), and to estimate with reasonable accuracy the amount of food consumed in between meals.

In the Central African Republic, in order to simplify this method, the total amount of food entering a Ngbaka village was weighed at characteristic periods of the seasonal cycle, and, at the same time, food consumption was measured in a small subsample of families. This method, derived from one that Lee (2) used with the Kalahari hunter-gatherers, allows a global estimate of the food consumption of a community to be made.

As we are interested in individual food consumption, a methodological problem arises when, as happens frequently (see chapter 5), several persons eat food from the same dish. A fast electronic scale connected to a micro computer permitted the accurate assessment

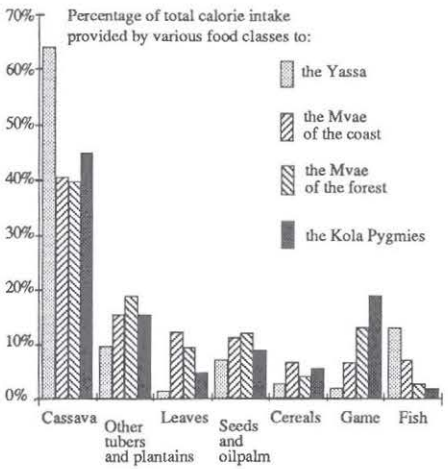
Facing page, upper: An indirect method for measuring food consumption by weighing all food entering the Ngbaka village of Mettè (in the Lobaye forest, Central African Republic). The particular spatial organization of this village favoured development of this method: as just one track links the fields to the houses, our team of local assistants could, with the voluntary participation of the whole population, record the exact origin and quantity of all food in the Ngbaka women's baskets at the entrance of the village. As this food is consumed within the next couple of days, a sample of six days per month allows for calculation of the average consumption of different family groups.

Centre: An accurate measurement of the individual food intake has been performed in the same Central African Republic village, in some family units, by studying the sharing of a communal dish. The dish is placed on a precision scale (one gramme for 30,000 g), this fragile instrument being protected in a trunk and totally wrapped in a thin PVC sheet with dessicator. The operator, whose micro computer is also protected against humidity by a large plastic bag, records the weight of each helping for each participant. Records show the exact quantity eaten by each consumer as well as individual patterns of food eating and food sharing. First results (3) specifically demonstrate that, within a family group, the communal dish system is adapted to the requirements of the youngest who, by choosing less carbohydrates, generally obtain the protein-rich diet they need for normal growth.

Lower: The standard method of food survey, by weighing all foods prepared in a household, is a necessary compromise in most cases, in order to study a sufficiently large sample of families. This last photograph shows the routine work of an enumerator weighing a dish in a compound where he stayed for one week, also in the village of Mettè where the two other survey methods were applied (photos by C. M. Hladik).

of the amount of food eaten by each participant from such a communal dish. This method was developed by our research team and the first results (3) show that the communal dish tends to provide food for everybody according to his or her needs rather than individual portions in which the amount given is necessarily and visibly influenced by the social status of the recipient.

These various methods of measuring food consumption allowed us to calculate the energy and nutrient content of the diet using standard food composition tables. Unfortunately, the composition of many foodstuffs, especially those which are gathered, is unknown and we have had to analyze samples obtained locally (see chapter 1). The same is true for varieties of cassava and plantain: though specific values were given in the tables, analyses had to be carried out because slight differences in their content can have a great impact on the nutritional value of the diet as these are staple foods consumed in large quantities.



Relative importance of different food classes in four populations of southern Cameroon, expressed as percentages of the total energy content of the diet (source: preliminary results of the surveys conducted with the Institute of Human Sciences of Yaoundé).

FOOD CONSUMPTION IN FOUR GROUPS IN SOUTHERN CAMEROON

In southern Cameroon, depending on environment, history and culture, each ethnic group adopts a specific food strategy (as shown in chapter 2). The Yassa, living on the Atlantic coast, fish at sea and grow mainly cassava. The Mvae have a more elaborate agricultural system, based on various tubers and vegetables; they also hunt and fish in rivers and streams, and, depending on whether they live near the coast or inside the forest, they barter cassava "sticks" and flour for fish with the Yassa and game with the Kola Pygmies. The latter, though traditionally hunters, are nowadays growing more and more cassava themselves.

The graph above illustrates these differences in food choices. The main staple is the "bâton de manioc", bitter cassava soaked, ground, wrapped in leaves in a baton-like shape and cooked by steaming. This is the main food item for the Yassa, and, to a lesser degree, for the Kola Pygmies. The Mvae, however, have adopted a diet in which other tubers, plantain and fatty foods (oil palm, groundnuts and other seeds), together contribute as many calories as cassava. The Mvae use cassava flour (prepared from soaked cassava, dried as egg-shaped balls on a rack over the fire) to barter for game meat with the Pygmies. The Yassa use plantains to obtain meat from the Pygmies.

	YASSA	MVAE OF THE COAST	MVAE OF THE FOREST	KOLA PYGMIES
ANIMAL FOODS				
Game	26 g	86 g	201 g	288 g
Fish	220 g	120 g	45 g	19 g
PLANT FOODS				
Cassava tubers	660 g	412 g	438 g	520 g
Other tubers and plantains	129 g	212 g	275 g	250 g
Leafy vegetables	7 g	59 g	76 g	20 g
Seeds and oil palm	30 g	75 g	83 g	10 g
TOTAL CALORIES	1940 kcal	1710 kcal	1930 kcal	1905 kcal

Annual mean food consumption (in grammes *per capita* per day) and caloric intake observed in four ethnic groups of southern Cameroon. Preliminary results of the surveys conducted with the Institute of Human Sciences of Yaoundé.

Kola Pygmy woman returning to camp carrying in her basket a bunch of plantain bananas she just bartered with the Yassa for game (photo by A. Froment).

The differences in food choices also apply to animal foodstuffs. Although the Yassa eat almost exclusively sea fish, the coastal Mvae may use half fish and half game and the Mvae of the forest eat mainly game with some fresh water fish. Finally the Kola Pygmies consume game almost exclusively. For all of them, the total amount of animal food is quite high, with respectively 246, 206, 246 and 307 grammes of fish or meat *per capita*.

These ethnic groups of southern Cameroon enjoy a very high quality diet based on locally produced food, with a calory intake close to 2,000. The situation is better than in other parts of the Cameroonian rain forest previously surveyed (4), such as Evodoula, Center Province (1634 kcal), Batouri, East Province (1611 kcal), and Douala city (1714 kcal).

SEASONAL VARIATIONS OF FOOD CONSUMPTION

A comparison of the results from Cameroon with those obtained in Zaire by H. Pagezy (see table, page 40) shows a striking similarity in the distribution of caloric sources for various populations.

Seasonal variation of the food supply has also been observed in Cameroon, with apparently less drastic consequences than in Zaire. Although cassava, the staple, is available throughout the year, plant products such as "cucumber" seeds, groundnuts, and, to a lesser extent, palm nuts, are subject to seasonal production cycles.

As a result, there are variations of different degrees throughout the year in meeting the recommended caloric requirements (5) among the ethnic groups of the African rain forest. These variations are very small among the Yassa (from 93% to 98% of caloric requirements); but more obvious for the Mvae, with a low at 80% in July and August for those living near the Atlantic coast. However, *per capita* consumption does not reflect the differences which exist between age groups within a population. These will be detailed in the next chapter.

Such seasonal differences in the caloric adequacy of the diet, also observed in the Central African Republic, do not explain by themselves fluctuations in the nutritional status. In fact, variation in seasonal activity leading to large fluctuations in energy expenditure, and the periodicity of diseases, have to be taken into account as well.

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Facing page: Since the energy obtained from the diet shows seasonal changes, an accurate measurement of metabolic efficiency—on which work capacity depends—is necessary in understanding the energy balance. For this purpose, the food surveys carried out among the Yassa population of southern Cameroon were complemented by measurement of oxygen consumption during standardized tasks: here, a submaximal test on the ergocycle. After measurement of volume and analysis of the expired gases collected in a Douglas bag, the consumption of oxygen per minute is calculated. Furthermore, with concomitant monitoring of heart rate, the estimate of maximum oxygen consumption ($V0_2$ max)—a standard criterion for working capacity—can be carried out (photo by C.M. Hladik).

4
PHYSIOLOGICAL AND BIOMEDICAL ASPECTS OF FOOD SURVEYS

Energy balance and nutritional adaptation

by Patrick PASQUET

The efficiency of various food strategies of rain forest populations needs to be evaluated. More specifically, the relationship between nutritional status and functions such as growth, reproduction, working capacity, health and well-being have to be taken into account (1). These different aspects were surveyed in parallel with the measurement of food consumption in the Yassa, Mvae and Kola ethnic groups from southern Cameroon (chapter 3).

Energy balance was explored for an analytical approach to nutritional adaptability. Whether reversible or not, nutritional adaptability has to be considered at different levels: genetic, physiological, social and behavioural (2). Accordingly this approach was focused at both the individual and population levels.

Indeed, nutritional status of individuals or populations can include short-term variations (seasonal cycles or pregnancy/breast-feeding cycles for women) as well as long-lasting changes (e.g. morphological, such as those of elders).

The aim of this approach is to contribute to an advance of knowledge on the nutritional requirements of human populations. This would provide new data for establishing minimum nutritional allocations.

METHODS

There are two major standard methods for the measurement of energy expenditure in free-living people:

- One is the measurement of carbon dioxide production using stable isotopes of oxygen (^{18}O) and hydrogen (deuterium) in water ingested by the subject. This so-called "double labelled water method" (3) allows, after urine analysis, an accurate measurement to be made of total energy expenditure over periods varying from 10 to 15 days. Unfortunately, it is expensive—thus generally applied on small samples—and gives no information about the activity patterns.

Time-budget study: the local enumerator who follows a Yassa woman during the whole waking day records minute-by-minute the activities, postures, paces, and loads carried. From these data, activity profiles are built, and estimates of total energy expenditure can be made, with reference to activity energy-cost tables, including our own measurements (photo by P. Pasquet).

- The other standard technique, the so-called "factorial method", following Durnin *et al.* (ref. 4 and 5) is a computation of total energy expenditure with the data from a time-budget study, in reference to energy-cost tables.

The latter technique was used in southern Cameroon, in an attempt to study energy balance and to find possible behavioural strategies corresponding to the changes in activity patterns.

RESULTS

Data from minute-by-minute counts of daily activities of 40 women and 35 men in the Yassa and Mvae populations include more than 1000 one-day observations, at the peak of three characteristic periods of the agricultural cycle. Activity profiles for different groups (age, sex, socio-economic) were built up from these data, and seasonal variations of body weight were analyzed in relation to these profiles.

Measurement of the oxygen consumption of a Yassa woman during the clearing of a new field. The analysis of the expired gases collected in the Douglas bag allows an accurate calculation to be made of the energy cost of this exhausting activity. The nose clip was preferred by most subjects to the respiratory mask, because it causes less discomfort during the test (photo by P. Pasquet).

Household activities make up 50% of the time budget of Yassa and Mvae women, a large part of which is devoted to cassava processing. Accordingly, energy expenditure was measured during the successive phases of cassava processing among the Yassa population (photo by P. Pasquet).

Since the energy cost of specific activities of these populations—some of them very frequent—were not included in available activity-cost tables (5), measurements had to be made. The examples given in the table below show the mean energy expenditure during current activities of Yassa women (in kcal per minute, for a body weight of 55 kg).

Activity:	Subjects observed:	Mean energy cost:
Clearing a new field	17	3.8
Hoeing	15	3.6
Woodcutting (with machete)	16	3.5
Planting cassava stems	12	3.3
Uprooting cassava tubers	10	3.3
Pounding cassava	14	2.5
Mashing cassava	13	2.4
Sieving cassava	11	2.2
Wrapping up cassava sticks	6	1.6
Peeling cassava tubers (after steeping)	10	1.6

These unpublished results can now be added to the available activity energy-cost tables used for calculation of habitual energy expenditure (5). Similarly, we made measurements of fishing activities in dug-out canoes among the Yassa population. The energy expenditure, which is as low as 2.2 for mending fishing nets, varies between 3.1 and 4.2 for laying and hauling in the nets at sea, and may reach 5.3 while the fisherman paddles standing in the canoe (in kcal per minute for a body weight of 65 kg).

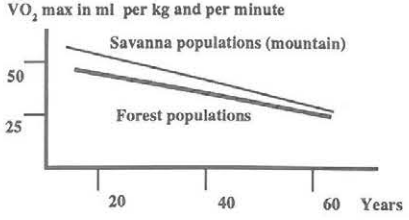
In all instances, both for Mvae and Yassa, men and women, the major energy investment occurs when preparing the land for planting, which requires a sustained effort over several weeks.

ADAPTABILITY OF ENERGY EXPENDITURE

One of the goals of this research was to study the possible differences in and between populations. In the "Food Anthropology of the Cameroonian Populations Research Program" (Institute of Human Sciences of Yaoundé/CNRS/ORSTOM) studies have been carried out on both forest populations of southern Cameroon and the ethnic groups of northern Cameroon (including, in the latter case, both lowland and lower mountain savanna ecosystems).

At the level of accuracy of the field techniques, we did not find any significant difference in metabolic efficiency (i. e. the energy cost of standardized tasks on the ergocycle, as shown on page 63) among groups or populations with different nutritional status.

Nevertheless, the estimation of work capacity obtained from submaximal tests shows differences between populations (see graph below).



The mean maximal oxygen consumption (VO_2 max), used as a criterion of endurance working capacity, is significantly higher in populations of lower mountain savannas than in forest populations. In fact, these differences result from a differential rate of aging in working capacity, as shown on the graph. A critical review of the methods (6) leads to a questioning of the effect of the level of habitual energy expenditure (training effect) in determining these differences.

Indeed, most adaptations concern "individual strategies" and biomechanics that can minimize some energy expenses. A recent example (7) was found about load carrying among African populations: the actual energy cost was not as high as the expected theoretical cost. Similarly, in Zaire, H. Pagezy recorded (see chapter 2) extremely high performances in Oto and Twa women who are able to carry currently a load exceeding 90% of their body weight. The observed high efficiency could result not only from biomechanical adjustments, but also from an adaptation of the time-budget. The successive micro-phases of sustained effort and rest (8) appear to be a good individual strategy for other normally exhausting tasks such as bailing out the water of a dammed river to collect small fry.

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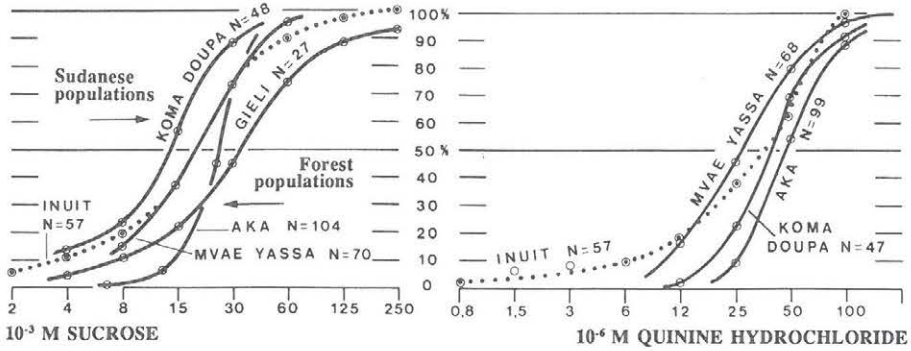
Gustatory perception and food taste

by Claude Marcel HLADIK

Comparing gustatory perception within a population or between different groups may provide—though within limits probably as restricted as in the comparison of adaptations to energy expenditure—a clue to food choices and consumption directly dependent upon biological parameters. The perceived quality of the food is obviously related to the gustatory ability of the consumer; nevertheless, for the *Homo sapiens* species, the cultural dimension has such a large impact on food choice (see chapter 5) that separating the psychological from the physiological aspects of food perception is a difficult task.

This difficulty was foremost in our mind when we started analysing the results of gustatory tests (1) conducted among the populations where food surveys have been carried out. The testing procedure consisted of administering diluted solutions of different sugars, salt, organic acids, and bitter products to subjects, to determine the lowest concentration at which the item is tasted and recognized. Since the solutions were presented at random, a simple statistical test allowed us to determine what the significant differences are between groups and populations.

Forest populations (mostly Pygmies) have less sensitivity to sugar than Sudanese populations such as the Koma and Doupa living in northern Cameroon, far away from the rain forest. Differences in sucrose perception also apply, with minor adjustments, to fructose and glucose. These simple sugars are the most common and occur in large amounts in the fruits of trees and lianas of the rain forest (chapter 1).



The curves show, in different populations, cumulative percentages of people able to discriminate the sweet taste of sucrose (left graph) and the bitter taste of quinine hydrochloride (right graph). Dilutions are indicated along the horizontal axis, respectively in millimoles (10^{-3} M) and in micromoles (10^{-6}M). Note that forest populations, especially Kola Pygmies (Gieli) have a lower sensitivity to sucrose than populations living in the Sudanese environment of northern Cameroon (Koma and Doupa). In contrast, the differences concerning bitter substances are not significant (source: Hladik *et al.*, 1986).

This could mean, in evolutionary terms, that outside of the rain forest, where fruits are not as abundant (and contain less sugar) as in the equatorial zone, selective pressures have favoured sensitivity to sugars. In the rain forest, high species diversity (chapter 1) and the presence of birds and mammals consuming fruits and dispersing seeds, result in such an abundance of fruits with a high sugar content that there is no necessity to develop a high sensitivity to sugar (2). The fruits are so varied that, in some instances, plants containing products with a very sweet taste such as monellin and thaumatin—the sugar mimics—compete with true sugary fruits.

This hypothesis about the evolution of taste response according to the abundance of sugar in the natural environment would require a genetic basis to taste sensitivity. The mechanisms behind a taste response to sugar are not yet totally understood, since there is a large number of sweet-tasting chemicals (3). Moreover, the genetic basis for taste sensitivity has only been demonstrated for a few bitter substances such as thiourea and PTC (with the gene of "taster" or "non-taster"). Recent work by Lush (4), concerning other substances, suggests a wider base to the genetics of taste sensitivity. This would explain differences between forest populations and those who lived in a different environment for 4000 years or more.

The significance of the bitter taste of many plant products, mainly alkaloids, appears to be fairly obvious: most of them are poisonous, as a result of the adaptation of plants to potential plant-eaters. The unpleasantness of a bitter taste is also the result of the adaptation of animal species, including humans, to the potential danger of such plant products.

Surprisingly, the potentially harmful alkaloids are not proportionally as frequent in the African rain forest as in most environments (5). In fact, rain forest plant species are not often exposed to predators since most are not clustered. We have also explained in the same terms the occurrence of toxic forms of wild yams exclusively outside or at the edge of the forest, where they are particularly exposed to animals.

Considering the uneven distribution of poisonous bitter substances, one wonders why, in the response to bitter taste, there is no difference between forest populations and those living outside the forest area, as there is with responses to sugar. Sensitivity to bitter taste is always high: we observed no significant differences, probably because the poisonous plants of the edge of the forest are potentially dangerous, even to forest populations. For instance, the yam species *Dioscorea dumetorum*, which is present around most forests, contains dioscine, a lethal poison.

Nonetheless, in different ethnic groups, reaction to bitter taste is modulated by food habits. **Ndolé** (a dish made of leaves of *Vernonia amygdalina*) is appreciated even though the bitter products are not totally extracted from the leaves (see chapter 3).

Food perception may also vary during the seasonal cycle, the impact of which has been stressed in other chapters of this booklet. Seasonal variation is a paramount factor in the diet of most Primates (6). Together with taste perception, it determines the biological background upon which cultural differentiations of human populations have been built up, and present feeding behaviour results from a merger of these biological and cultural factors.

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Biomedical surveys in relation to food and nutrition

by Alain FROMENT

Food consumption surveys, if conducted without taking into account the medical context, would miss important aspects of the interactions between an environment including pathogens, likely to follow seasonal variations (chapter 2), and the energy intake. Working capacity is a result from such interactions.

In fact, nutritional pathology is related either to nutrient deficiency or to transmissible diseases (due to viruses, bacteria, and intestinal or blood parasites). The moist equatorial environment, as well as local practices for handling domestic waste, increase the risk of contamination. Furthermore, the immune response can be seasonally depressed by an impairment of the nutritional status, which periodically enhances epidemic (measles, bronchitis) as well as endemic infections (malaria, helminths, diarrhoeas).

Accordingly, we conducted food surveys in southern Cameroon (chapter 3) together with a seasonal evaluation of health status, using the standard techniques recommended by the International Biological Programme (1). A similar approach—although a smaller set of parameters was controlled—has been used by H. Pagezy in the Central African Republic (Lobaye forest) and in Zaire. Based on clinical and biological data, the health survey includes various aspects:

- Nutritional anthropometry: body weight and height, skinfolds, limb circumferences and body proportions measurements enable determination of nutritional status, its seasonal variations, as well as a follow-up of child growth.
- Clinical examination: besides the recording of blood pressure and liver or spleen enlargement by a physician, spirometry and measure of hand strength is an approach to physical ability.
- Biological investigation: blood, urine and stools are screened for parasites; anaemia prevalence is determined by haematological techniques. Serum biochemistry addresses protein and fat profiles. Antibody screening allows an assessment of the major transmissible diseases.
- Demographic survey: fertility and mortality are calculated according to retrospective questionnaires and longitudinal observations. Since we deal with small populations, classical demographic estimators cannot be applied, but a systematic updating of our census provides data as accurate as those collected on large population samples.

Nutritional anthropometry carried out at regular intervals in the Central African Republic: measuring skinfolds, body weight and stature (photo by C.M. Hladik).

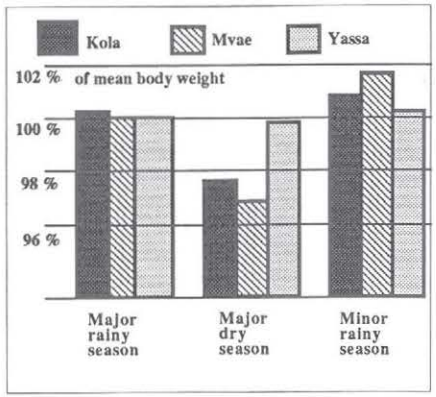
The measure of bioelectrical impedance was introduced as a field method in the Central African Republic by R. Hellegouarch. After connecting subcutaneous electrodes, the measure of imperceptible high frequency currents of low intensity provides an overall measure of body fat, instead of the estimate of superficial body fat given by the classical method of measuring skinfolds (photo by C.M. Hladik).

We recently introduced a new technique for field studies of body composition: the measure of bioelectrical impedance. It allows a direct estimate of total body fat, based on its high resistivity to a high frequency and low intensity electric current (2). The results are still to be validated according to standard techniques based on skinfolds (3), presently in use, and laboratory methods such as underwater weighing or stable isotopes dilution. Because of its easy use in the field, "impedancemetry", utilized in strictly standardized conditions, will probably be introduced into most food surveys in the near future.

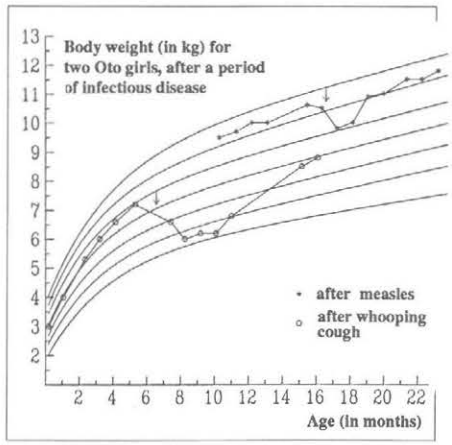
VARIATION OF NUTRITIONAL STATUS

Seasonal variations of the nutritional status, observed among populations of southern Cameroon, the Central African Republic, and Zaire, are obviously much milder than those of savanna populations. They seem to result essentially from increased energy expenditure for clearing new fields, rather than from a decrease in food availability. Cassava, which generally provides most of the energy, is available throughout the year. However, some important foods that contain lipids and protein (oilpalm fruit, caterpillars, game and fish) are subject to important fluctuations and may seasonally influence the nutritional status. But "seasonal hunger" observed in Zaire by H. Pagezy (chapter 2) can be best defined as the result of a frustrating perception rather than a food shortage. Nevertheless, the stress resulting from the perception may also have a physiological side-effect, with an increased susceptibility to infectious diseases.

Infantile malnutrition is not totally absent among forest populations, in spite of an overall balanced diet. For instance, among the Yassa and the Mvae aged from 12 to 18 months, one child out of five does not meet WHO norms in terms of body weight; but the main cause of such infraclinical malnutrition is infectious diseases, especially diarrhoea aggravated by polyparasitism, rather than the diet itself. The effect of a long-



Seasonal variations of mean body weight recorded among the Mvae and Kola populations have a wider amplitude than those (non significant differences) observed among the Yassa fishermen (source: preliminary results of the surveys conducted in southern Cameroon, in collaboration with the Institute of Human Sciences of Yaoundé).



The effect of infectious diseases on infant body weight: the individual growth curves of two Oto girls are compared to the mean growth of Oto population (with P50 corresponding to the median value). Intensity and duration of growth depression are linked to those of the disease (beginning indicated by the arrow). The children catch up after a few months (source: Hauspie & Pagezy, 1989).

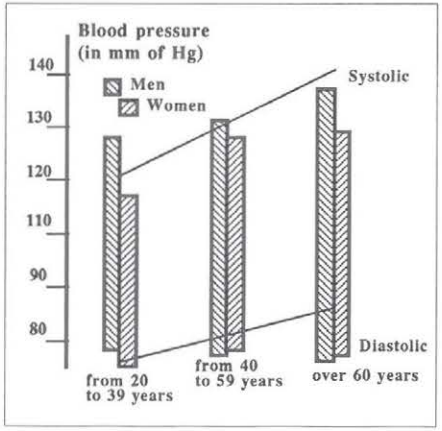
lasting infectious disease on the subsequent growth of two Oto infants (5) is illustrated by the above graph.

For the adult, in spite of a body weight and size smaller than those of savanna populations, the nutritional status as defined by body fat and the weight/size ratio is quite close to WHO norm (4). Nevertheless, in southern Cameroon, Kola Pygmy women have lower fat reserves (19% of body mass, with a mean tricipital skinfold of 8 mm) than those of non-Pygmy women (25%, with a mean tricipital skinfold of 12 mm for Yassa and Mvae women). Such a difference is probably due to the excess of energy expenditure for agricultural practices in a society where gathering is still a necessity. The body mass varies between the age of 25 and 75, with a progressive loss of about 6 kg among the Yassa and the Mvae of both sexes. In contrast, during the same period of life, there is a mean increase of 8 kg among the populations of industrialized countries (6). The decrease of fat reserves is explained by a persistently high level of activity among elders, rather than a poor diet, since traditional food sharing favours elders (chapter 5).

High blood pressure—although the increase that accompanies aging is not as high as among populations of industrialized countries—was observed in all age classes, with a 12% total occurrence frenquency for the Mvae and the Yassa. During tests on taste perception (see preceding account by C.M. Hladik) it was remarked that most persons suffering from high blood pressure were also less sensitive to sodium chloride. By using too much salt in their food (just to taste it) they might increase the risk of heart diseases. But this possible effect needs further investigation.

In forest populations, moderate increases of total cholesterol, uric acid, creatinine and urea in blood are partly due to beneficial dietary factors. But the regular use of cassava can result in the development of goitre, as demonstrated in Nigeria and Zaire (7). Roots and leaves of all cassava varieties, either bitter or sweet, contain cyanogenic glucosides, mainly linamarin, which can be transformed into hydrocyanic acid. Its effect on depleting iodine stores can, however, be corrected by increasing iodine supply: this explains why in the iodine-rich coastal areas of southern Cameroon, although cassava provides 65% of total calory intake, no hypothyroidism or goiter has been detected. By contrast, among the Ngando and Ngbaka women of the Lobaye forest, H. Pagezy and M.F. Couilliot observed a 97% occurrence of a goitre, at least detectable by palpation.

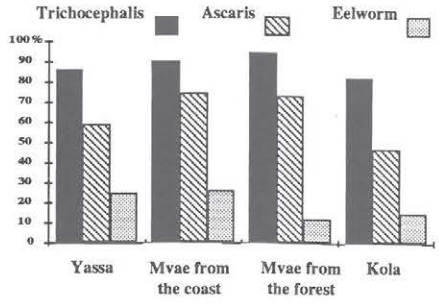
The increase of blood pressure that accompanies aging among the forest populations (bars for women and men in a sample of Yassa + Mvae) is not as acute as among populations of industrialized countries (shown by lines).



THE PARASITE LOAD

Chronic diseases such as arthrosis are common in rain forest areas; however, infectious diseases are the real burden of most forest people. Among those transmitted through insect vectors, malaria, filariosis and sleeping sickness are very serious threats. Among those directly transmissible, hepatitis B and AIDS, which have a relatively similar epidemiology, have been carefully scrutinized. Hepatitis B is remarkably frequent in southern Cameroon (17% of the whole population with active viruses) and this infection often results in cirrhosis or liver cancer. Fortunately, in this region, the HIV 1 virus (responsible for AIDS) is still rare or absent, since only four subjects (out of 350) have antibodies for one or two proteins of the virus (and have been in good health for several years after detection). They were probably in contact with a retrovirus belonging to the same family (8).

Intestinal helminths are frequent and reflect the faecal pollution of the environment, with oral infections (as for ascaris and trichocephalis) or direct transit through the skin (as for hookworm and eelworm). In southern Cameroon, 92 % of the whole population is contaminated by at least one of these agents. Differences are small between the Yassa, Mvae and Kola Pygmies, as shown in the graph below. Pygmies are slightly less contaminated than the agricultural populations, and this situation contrasts with what H. Pagezy and her collaborators have observed in the Central African Republic, where 58 % among the Ngando and 71 % among the Aka Pygmies of the Lobaye forest suffer from hookworm during the rainy season. Differences in habitat (whether



In this group of Yassa children (Bouandjo village, southern Cameroon) the swollen belly, a symptom generally considered as an evidence of intestinal parasite load, is noticeable (photo by I. de Garine).

sedentary or not) and in behaviour (places for defaecation) explain such variations in parasite load. One of the consequences is anaemia (with a mean of 11.7 g of haemoglobin in 100 ml of blood, in southern Cameroon) which can considerably accentuate the effect of dietary deficiencies of iron or folic acid.

Thus an investigation of infectious diseases,in additon to studies on protein and energy balances, provides an understanding of nutritional status.

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Food and nutrition among "high-risk groups"

by Hélène PAGEZY and Igor de GARINE

"High-risk groups"—a term proposed by epidemiologists—are, by and large, composed of those individuals in a community who are likely to face health problems because of environmental constraints. These groups include pregnant and lactating women, infants with increased nutritional requierements, and elderly persons facing other types of nutritional risks.

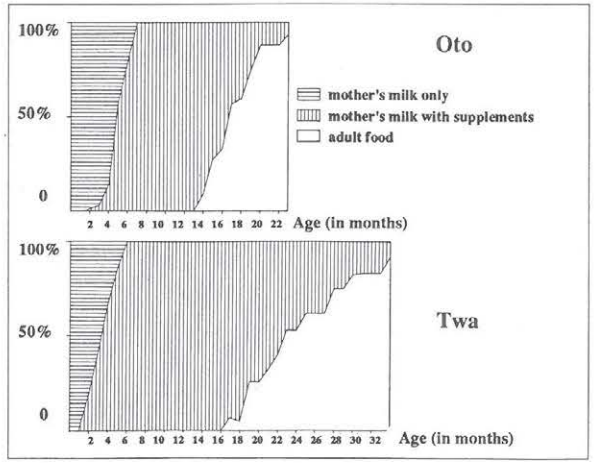
Infants who are breast-fed on demand seldom leave their mothers' arms and are progressively introduced to an adult diet. Among the Mvae and the Yassa of southern Cameroon, babies are given baby foods such as "cassava porridge" specially prepared for them. This supplementary food is introduced before the age of three months among the Yassa and between three and six months among the Mvae. Today, milked porridge is available, as well as rice and maize paps used especially by the Mvae. Introduction of protein-rich foods happens later. The Yassa mothers try fish or fresh meat from eight months on; the Mvae wait until the child is 13 months old. Smoked fish or game are offered to a child who is about 21 months old.

Conversely, in Zaire, Ntomba babies are never given special infant preparations. Fresh fish and leaves are first introduced, then tubers when infants are around 8-10 months. Complete weaning happens at 18 months among the Oto and six months later among the Twa (1).

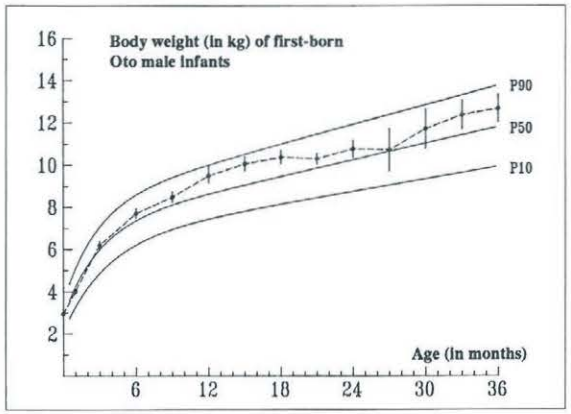
The right time for complete weaning is determined on the basis of the child's development rather than by a new pregnancy: the mother waits until the child can walk (Yassa and Mvae) or looks after itself when drinking water or taking food from the communal dish (Ntomba).

The earliness with which infants are introduced to the adult diet and the relatively late date of weaning contrast with what is usually observed in other African regions.

In the equatorial forest of Zaire, meals are organized in such a way (see chapter 5) that



Comparison of the Ntomba Oto's and Twa's weaning patterns, based on monthly check-up of infants and nursing women. One notices that 50% of the infants receive early on complementary foods (broth, fish and fruits) followed by cassava leaves, sweet potatoes, yams and mashed cassava tubers. Lastly, when the infant is 10 to 12 months old, it is introduced to more compact food preparations and the tender parts of game; smoked meat and fish are introduced later. Complete weaning takes place late: around 18 months among the Oto, and 24 months among the Twa (source: Pagezy, 1983).



Variation of the mean body weight (mean ± standard deviation) of first-born Oto male Ntomba children. This growth curve is superimposed on that of the entire population (P50 corresponding to the median value) of similar sex and age. First-borns, who are lighter at birth, catch up before the age of three months, and overcome the mean children's weight from six months onwards. This impressive phenomenon is likely to be due to the special care devoted to the mother (source: Pagezy & Hauspie, 1988).

young children have enough time to share food equally (2) among themselves, avoiding competition with adults. If children suffer from growth retardation and display clinical signs of mild malnutrition, it appears to be caused primarily by infectious diseases and the parasite load rather than by a major nutritional deficit due to an imbalanced diet. Our biomedical observations carried out in Cameroon, the Central African Republic and Zaire all agree on this.

As long as the mother is nursing, she has to obey food and sexual taboos. Malnutrition and sometimes kwashiorkor are considered to be supernatural consequences of ignoring these taboos or due to sorcery.

Because of their low birth-weight, twins and first-borns are particularly vulnerable. Among the Ntomba, they are cuddled constantly thus benefiting from a favourable psychoaffective atmosphere. First-born infants benefit from the special care devoted to their mother (chapter 5), a fact that explains the impressive catch up in their growth curve (3). Twins take longer to catch up: their growth curve follows the 10th percentile curve until they are three years old. Nonetheless, twins, who are "favoured by the spirits", occupy a special place among the Ntomba.

Although cultural practices may, in some cases, aggravate the potential risk incurred by vulnerable groups (4), they often act in a way that is beneficial to health.

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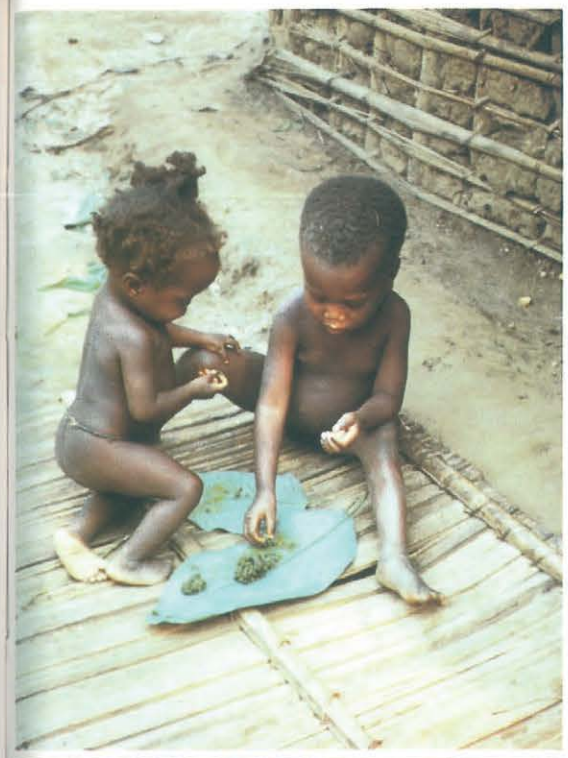

Facing page: Categories of persons within Ntomba society in Zaire who are potentially exposed to nutritional problems: two weaned Twa infants (**upper left**) whose mother has previously distributed their food so they can eat at their own pace the cassava leaves laid out on a large leaf of Marantaceae. A Twa infant (**upper right**) is looked after by its grandmother, as its own mother has gone to the fields. Although the full nursing baby goes everywhere with its mother, just after it is weaned it is taken care of by its grandmother who, in this instance, has given it a piece of sweet cassava. Twins (**lower**) belong to a highly vulnerable category, but benefit from a privileged status inside Ntomba society: favoured by the Spirits, they are pampered by society and given special rituals during the first months following their birth. Her body sprinkled with white lime or clay, the mother presents her twins in front of the house every day, to dance with her relatives the special "twin songs" tapped on drum rhythms (photos by H. Pagezy).

5
SOCIO-CULTURAL ASPECTS OF FOOD AND NUTRITION

Facing page, upper: Yassa women sharing a communal meal in southern Cameroon. Individuals who are either friends or socially related may gather to eat together: neighbourhood groups are often constituted through such a mechanism. Although a very frequent dish for the Yassa forest population living by the sea shore, fish (shared in this photo by three young ladies), is a high-ranking food in terms of prestige and preference. The skill involved in taking a whole bite—fish bones and all, which are separated in the mouth and spat out—attests to the long practice of fish consumption. The wide choice of fish species available to the Yassa provides a necessary protein complement to a diet based on cassava tubers (photo by E. de Garine).

Lower: A group of Oto children (Ntomba of Zaire) helping themselves to a communal dish of cassava leaves. They have received separately their nearly equal portions of cassava tubers. Before the meal, the cassava leaves cooked with oil palm sauce, were distributed by the mother in separate communal dishes intended for groups of men, women and children. Often children sort themselves into age and sex classes. When the group is heterogeneous, as in the photo, the youngest children are forced to compete with the oldest. Having less skill and speed, they are likely to end up with a nutritionally poor diet whereas, before weaning, they benefited from a rich diet shared by their watchful mother (photo by H. Pagezy).

Organization of meals, food preferences and socio-economic aspects

by Igor de GARINE

The most interesting aspect of the interdisciplinary approach is that it allows relations to be established between the quantity and quality of food, the various consumer categories and the seasonal variations in food availability through the use of models of food consumption, food patterns and energy content of the diet. To a large extent food intake is dependent on social organization at meal times. We shall therefore be dealing first with the features that societies living in a forest environment have in common when regarded as food consumption groups. Then, in a broader sense, we shall attempt to look at some of the aspects of socio-economic evolution which our various consumption studies show to be interfering with food intake.

It is also necessary to consider the way individuals, whether they are taken as members of a society or as a specific social group, perceive various foods. This cultural dimension is important in conditioning people's adaptation to the food resources of their environment. It also has a bearing on the way various types of food are distributed between different consumption groups and biological categories (especially in relation to age and sex). The importance of these aspects has already been shown in the last account on "high-risk groups".

MEALS

There are many ways of organizing meals. Often, in forest populations of Africa, adult men eat separately, usually in their meeting place (a kind of shed), where the various dishes are sent to them from their household. The food is shared in an informal way between the men present.

In some cases (among the Yassa, for instance), men of the same family group eat together. If a problem arises concerning the choice pieces, the sharing is done according to seniority rather than according to the socio-economic position of the individual.

Women, together with their small children, constitute another food consumption group, often at neighbourhood level. Children, before they reach puberty, receive their personal helping of staple but sometimes they all share one portion of relish. Adolescents of both sexes often use independent dishes. The elderly, the physically and mentally sick and those suffering from leprosy eat alone.

The case is different among the Aka Pygmies, where meals are taken with the whole family group. This type of nuclear family gathering at meal times can be observed quite often among other groups living in their vicinity such as the Ngbaka of the Central African Republic. In the hunting camps, however, they also adopt a collective organization whereby meals are shared by the men present (see also the picture on the back cover, showing a group of Kola Pygmies in Cameroon, sharing cassava and sucking the sauce of game meat with a "spoon" made of a curved leaf). The children, who hunt and trap small animals such as snails, tortoises or birds, also occasionally form an independent food-consuming group. While "nibbling" does not have a major nutritional importance in most forest populations, it allows children to create a socio-economic environment distinct from that of the adults.

Light snack taken by a group of Aka Pygmy children in the Lobaye region, while their parents are away. They have gathered snails, which they barbecue over a fire. The instant use of the products they obtain through hunting and gathering is a special feature of their small group. It puts them in a socio-economic environment which is distinct from that of the adult world (photo by S. Bahuchet).

FOOD PREFERENCES AND PRESTIGE

By means of the quantitative food consumption survey using the weighing method, it was possible to determine noticeable differences between consumer behaviour, the range of dishes people prefer and those they consider prestigious (1). These differences are indicative of the cultural adaptation of a given population to its food system and the feeling of well-being derived from it, which may in turn have some influence on its biological status.

The results obtained after processing the questionnaires on food preferences in southern Cameroon show that, on the whole, the Yassa and Mvae seem to be happy with their food. What they actually eat corresponds to what they say they eat (which is not always the case elsewhere) and to what they value most. As far as the staple dishes are concerned, those most frequently consumed by both ethnic groups are indeed the ones they feel they eat most regularly. These staples also rate high in terms of food preferences and esteem. For instance, this is the case for cassava sticks. It also applies to meat, which receives the highest rating in all fields among the Mvae—together with fish among the Yassa. But, at the same time, foods which are consumed rarely may also have a prestigious connotation. For instance, among the Mvae (who are not fishermen), fish is highly prized. The plantain banana, whose use is not widespread, is often awarded a good rating in terms of preferences and prestige in both groups. It is the kind of dish that is offered to in-laws or distinguished guests when they come to pay a visit. Cereals are rarely used on such occasions. However, rice, a commodity which is bought outside, is a highly appreciated item and could be considered as the first step towards the preference for city foods.

Conversely, similarities can be observed between items which have a negative connotation and the foodstuffs which are consumed during famines. This applies to the produce of the bread-fruit tree which, among the Yassa and the Mvae, represents the laziness and agricultural inefficiency of those who have to resort to it. A sharp contrast can be observed between the groups with respect to the consumption and evaluation of arrow root *(Xanthosoma sagittifolium)*, groundnuts, pumpkin seeds, various leaves and other green vegetables, all of which demonstrate the definite agricultural orientation of the Mvae.

As can be expected in a forest environment, meat is the prized food, especially that of domestic animals, which are costly. The same applies to alcoholic drinks (red wine and spirits), where the most expensive ones are the most prestigious.

	QUANTITY CONSUMED:		FREQUENCY OF CONSUMPTION:		INDIVIDUAL PREFERENCE:		PRESTIGE VALUE:	
	YASSA	MVAE	YASSA	MVAE	YASSA	MVAE	YASSA	MVAE
Cassava sticks	48.9	35.4	94	91	56	71	40	12
Dried cassava balls	15.2	4.3	81	21	64	16	64	0
Other tubers	9.7	18.9	24	65	13	55	12	39
Plantain bananas			22	45	45	47	90	62
Breadfruit			53	11	0	0	0	0
Rice and other cereals	2.7	4.0			24	23	35	42
Nuts and seeds			0	37	4	33	0	0
Meat	1.8	13.2	8	83	13	68	83	95
Fish	13.0	2.8	99	76	82	67	75	41
Beer			74	56	74	40	73	27
Red wine			20	32	20	36	87	69
Palm wine			39	39	25	29	7	12

Food consumption and perception of main foodstuffs among the Yassa and Mvae of southern Cameroon (source: preliminary results of surveys conducted with the Institute of Human Sciences of Yaoundé). Consumption is expressed as a percentage of the total caloric content of intakes, calculated from a total of 2700 meals among the Yassa and 5100 among the Mvae. Consumption frequency, preferences and prestige value of foods are expressed as percentages of answers made to the questionnaire on food behaviour motivations (N = 146 among the Yassa, N = 114 among the Mvae).

Rather than offering a guest local products, a host tries to provide the expensive commodities obtained from commercial circuits outside. Rice will be purchased to honour a guest even though it is not considered to produce the same feeling of satiation as cassava.

When questioned about their motivations concerning food preferences and dislikes, Yassa and Mvae refer first to their personal taste, secondly to considerations about health and digestibility of foods, then to their ability to satiate and give strength, and finally the traditional origin is mentioned. These tendencies would be useful in developing nutritional education activities if this was considered necessary. Attention should be drawn here to the positive rating obtained by alcoholic drinks which, unfortunately, are valued because "they are intoxicating and heat up your body in the evenings". It is also believed that red wine "gives you blood", following the principles of sympathetic magic.

The food style of a population contributes to its self-identification and, owing to a certain degree of xenophobia, allows frontiers (e.g. linguistic) to be drawn between groups which are comparable. Neighbouring ethnic groups define each other by mutual stereotypes about their food habits. In southern Cameroon, the Yassa consider their Mvae neighbours as "land-locked, leaf-eating peasants, who come to the coast to beg for fish". To the Mvae, the sea-going Yassa appear as mediocre agriculturalists who consume breadfruit and crabs, inferior foods in the Mvae's opinion. Studying the complementarity of resources and the attitudes towards them opens a complex but dynamic field towards the improvement of food systems. Like most traditional populations, those dwelling in the dense forest have a special craving for what Jelliffe called the "cultural superfood" (2). This term applies not only to the staple food but to meat and fish as well. A respected guest will be offered chicken, plantain bananas and rice, together with wine and alcohol among the Yassa and the Mvae. When questioned, they reply that, if they were rich, they would consume abundant quantities of beef, chicken and large fish washed down with wine and spirits. Mention should be made here of the thick relishes and fatty meat, such as the flesh of the giant pangolin *(Manis gigantea)*, which are highly esteemed. The foods that are served in honour of visitors reflect the socio-economic status of the hosts; therefore individuals, families and lineages do not wish to appear unduly thrifty.

It would be a mistake to believe that forest people live in a totally closed food economy. Urban food products (rice, pasta, tinned foods, beer, red wine and spirits) are widely appreciated and bear heavily on family budgets.

THE FESTIVE CYCLE

Besides informal invitations, most of the events punctuating the life cycle of individuals (births, christenings, weddings, funerals, end of mourning periods) are traditionally accompanied by supplies of food and palm wine. Nowadays beer, red wine and spirits are constantly part of interfamily gifts and token exchanges, and present at meetings of age groups, clans and "tontines". Being able to afford alcoholic drinks is the sign of economic affluence, as well as of manhood. Here lies a serious danger for the low-income strata in many populations. Its social cost is probably as high as in many industrialized countries.

Among the Yassa of southern Cameroon, food and drinks are an important part of the bride-wealth a man has to offer his prospective in-laws in order to obtain a wife. The first step, "knocking at the door", is materialized by a gift of palm wine or red wine to the father of the future bride. During the second part of the process, "publishing the banns", both the paternal and maternal families of the future groom have to offer the fiancée's family two cartons of cigarettes, two wads of tobacco, two bottles of whisky. The future bride's family prepares a banquet during which the brideprice will be fixed. During the last phase of the wedding process, "the bringing in", the bride's mother receives abundant gifts of choice food, e.g. meat and drinks—which she shares with her own family—in addition to her share of presents and money. Then a feast brings the two families together. Later the training and acclimatization period begins for the young bride: working and cooking under the supervision of her mother-in-law.

Among the Mvae, the relationship between the bride and her mother-in-law permits a certain degree of conviviality but not as far as food is concerned. The relations between the groom and his mother-in-law imply, on a more formal basis, a total mutual respect, intended to avoid any promiscuous contact (which would be considered shameful). In most forest populations, they both have to avoid consuming food together or in front of each other. A milder food prohibition is extended to the relations between the bride and her father-in-law. However, ritual meals organized on the initiative of the parties involved may overrule these prohibitions, making the relationship more convivial. Once she is pregnant, the wife often goes back to her own family to give birth. After a few months, she is given back, with her new child, to her husband's family which has prepared food and presents for the occasion. H. Pagezy describes (page 89) a similar custom among the populations of Lake Tumba. It may be a common feature among forest populations, demonstrating reproductive wisdom.

In southern Cameroonian populations (Yassa and Mvae), a married woman is expected to contribute choice foods when a member of her husband's family dies. She also participates in the same way within her own lineage when a girl gets married or a man dies, which adds to her burden of agricultural tasks and food preparation. Food obligations are just as important and complex during funerals and the celebrations which mark the end of mourning. Among the Yassa and the Mvae, attention should be drawn to the specific role played by the nephew on the occasion of the death of his mother's brother, with whom he was on joking terms. This uncle has to cope with the witty remarks or puns made about him by his sister's son. He cannot refuse him delicacies and small gifts and is also supposed to give his nephew the head (the choice morsel) of any large animal and fish he catches. Naturally, when he dies, these privileges disappear but, at the funeral, the nephew is allowed to act as a ritual thief for the last time. In a playful atmosphere he "steals" the poultry, sheep, goats and bunches of bananas which belonged to his deceased uncle. The nephew's reciprocal role entails a number of ritual and social duties with regard to his uncle's funeral feast, to which he makes a large contribution.

The goods which circulate during such family ceremonies materialize the links between the different lineages and their mutual position as debtors and creditors. Their bountiful hospitality asserts their prestige and represents a heavy economic and financial burden. The role of married women is to act as feast providers on each of these occasions.

SYMBOLIC VALUE OF FOOD

The events of the individual life cycle, national commemorations as well as religious festivals all generate conspicuous food consumption. Today, there are very few public occasions where offerings of food are made in relation to traditional religious offerings, libations or sacrifices. The only surviving practices take place during therapeutic rituals (see opposite page). It is no longer possible to observe the various food offerings which took place during initiation rites or the activities of the secret societies which flourished in most forest people's cultures.

The **indende** ceremony, however, which is still practised among the Yassa, gives an idea of how food was used in these rituals. The **indende** is decided upon at the initiative of the women's secret society. When a period of food shortage sets in, the men's society is asked to participate. During a whole week, the women's society gathers offerings which are displayed publicly (to prevent the men from helping themselves for their personal benefit): a crate of beer, one of carbonated drinks, two cooking pots full of rice, two of sugar, doughnuts, sweets and cigarettes. In the old days, the **indende** offerings consisted of a red-coloured "soup" containing plantain bananas, a dead fish picked up on the beach, groundnuts, cucumber seeds, palm oil, "magic grasses" and grated bark from the Paduk tree (*Pterocarpus soyauxii*). These offerings were taken out to sea in a dugout canoe and dropped into the water at specific ritual locations off the coast. The whole ceremony was accompanied by singing and was intended to placate the angry spirits so that they would restore abundance.

Similarly, to put an end to a period of unsuccessful hunting, the Pygmies (3) invoke the spirits of the ancestors, symbolized by masks, which have to be appeased through complex rituals.

Nowadays, we are witnessing the modernization and rationalization of food practices among African societies living in the rain forest environment. However, this field remains a highly emotional one in which symbolic values are ready to surface again.

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Ritual food consumption during an exorcism among the Yassa of southern Cameroon. The healer places a portion of the therapeutic preparation in the patient's mouth and pronounces a blessing. The rest of the preparation is then divided between the members of the patient's family : this commensality shows that the cure is taking place within a reconciled social group (photo by E. de Garine).

Food and traditional medicine among the Yassa of southern Cameroon

by Eric de GARINE

Anthropological research in the field of ethnomedecine has recently shown an interest in the tropical regions (1), but few studies have documented the interactions between the medical and nutritional systems of African societies. Fieldwork done in southern Cameroon shows that beliefs and practices concerning illness and health on the one hand, and food on the other, have to be understood as a whole. These interactions can be studied through a few ethnographic examples concerning the representations of body and health in relation to nutrition (including those aspects which are treated in the account dedicated to nutritional concepts, page 92) and through medical practices where food is used in the treatment of illnesses.

Some practices of traditional medicine use nourishment as part of the treatment. The therapeutic dish (**mosuka**) is a special kind of culinary preparation made from meat or eggs, plantain bananas, marrow seeds *(Cucumeropsis manii),* palm oil and medicinal plants. It is used to cure victims of witchcraft, those guilty of transgressing prohibitions or possessed patients nearing the end of their healing session. The medicinal plants added to the dish, and the ritual artifacts of the consumption of the meal, constitute a magical protection for patients helping them to recover. Many food plants are used in the traditional pharmacopœia, such as the leaves of guava

The only difference between the preparation of the therapeutic dish and everyday cuisine is the addition of medicinal plants to the remedy (photo by E. de Garine).

Among the Yassa of southern Cameroon, the ingestion of the medicinal preparation is accompanied by a ritual which is considered an indispensable part of the therapeutic process (photo by E. de Garine).

(Psidium guayava), or the red pepper *(Capsicum sp.)*, used to cure diarrhoea. The multicontextual use of plants and the technical knowledge of their processing is an important feature of traditional medicine.

Among the Yassa of southern Cameroon, mild gastro-intestinal diseases (such as diarrhoea) are said to be caused by the bad quality of food. The herbal remedies which are used to cure these disorders may be prepared by the sick persons themselves or by one of their relatives. If symptoms persist or are combined with other dysfunctions, they may be interpreted as the sign of a magical disease caused by witchcraft, possession or the non-respect of a taboo, in accordance with the Yassa's complex etiological system. When such a diagnosis is made, the patient has to be treated by a specialized healer (**nganga**). In this case, a gastro-intestinal infection is no longer linked to food but interpreted as one of many signs of a general disorder.

In the representations of the etiology of diseases caused by sorcery, food may be used metaphorically, e.g. the symbolic devouring of the victim by the sorcerer. A special substance contained in the sorcerer's stomach (**evu**) enables him to carry out his evil deed (2). The **evu** leaves his body at night and "eats" his victim. For example, fractures are not accounted for by a shock received in the natural world; the limb is thought to be devoured in the supernatural one.

Food is used in various ways during rituals dedicated to the treatment of possession by the **mindi** (spirits of the water or ancestors). During exorcism rites, a special preparation (made of medicinal leaves and fruits) is distributed to the participants in the ritual: patients, drummers and the public. It is a protection that makes the consumers invisible to their enemies or to sorcerers. To ensure the participation of the healer's allied spirits, a special beverage made with honey, egg, and pieces of *Costus* stalk is drunk by the **nganga.** This offering, considered as the **mindi**'s food, is to incite their benevolence or calm their excessive energy, which would otherwise result in a particularly violent trance.

As in all social events, palm wine is a necessary part of the ceremony. A little of it is poured on the ground to thank the spirits, but human beings consume the largest part. All of the precious liquid is shared between the participants in the ritual. The communal consumption of palm wine is thus a sign of solidarity between the patient and members of his social environment.

In the forest regions of Africa, food and medicine are areas in which people have knowledge both of themselves, as human beings, and of their environment. Among the Yassa, where both the biological reality and the symbolic aspects of health are taken into account, medical treatment concerns not only the individual but also the society to which he or she belongs.

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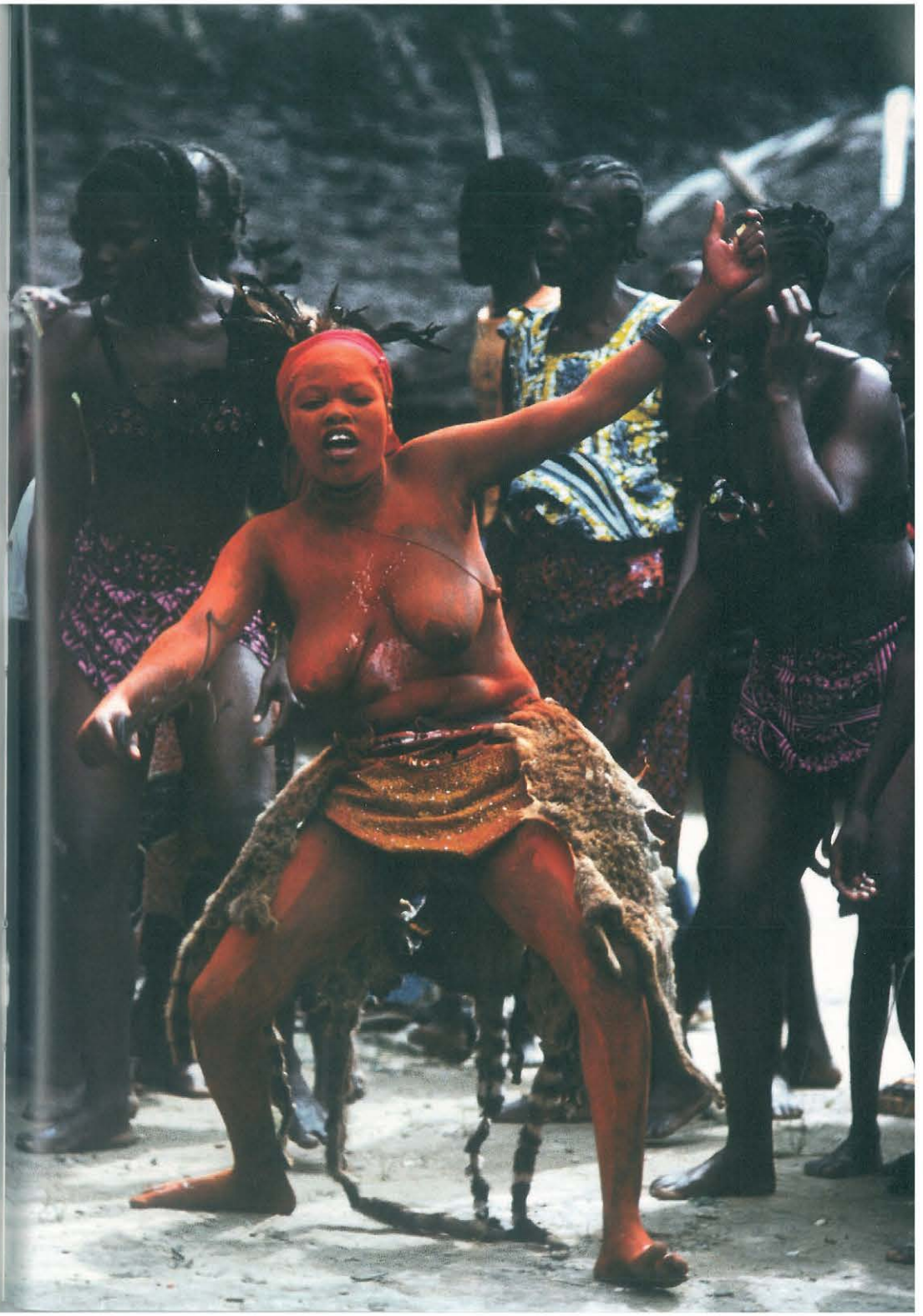
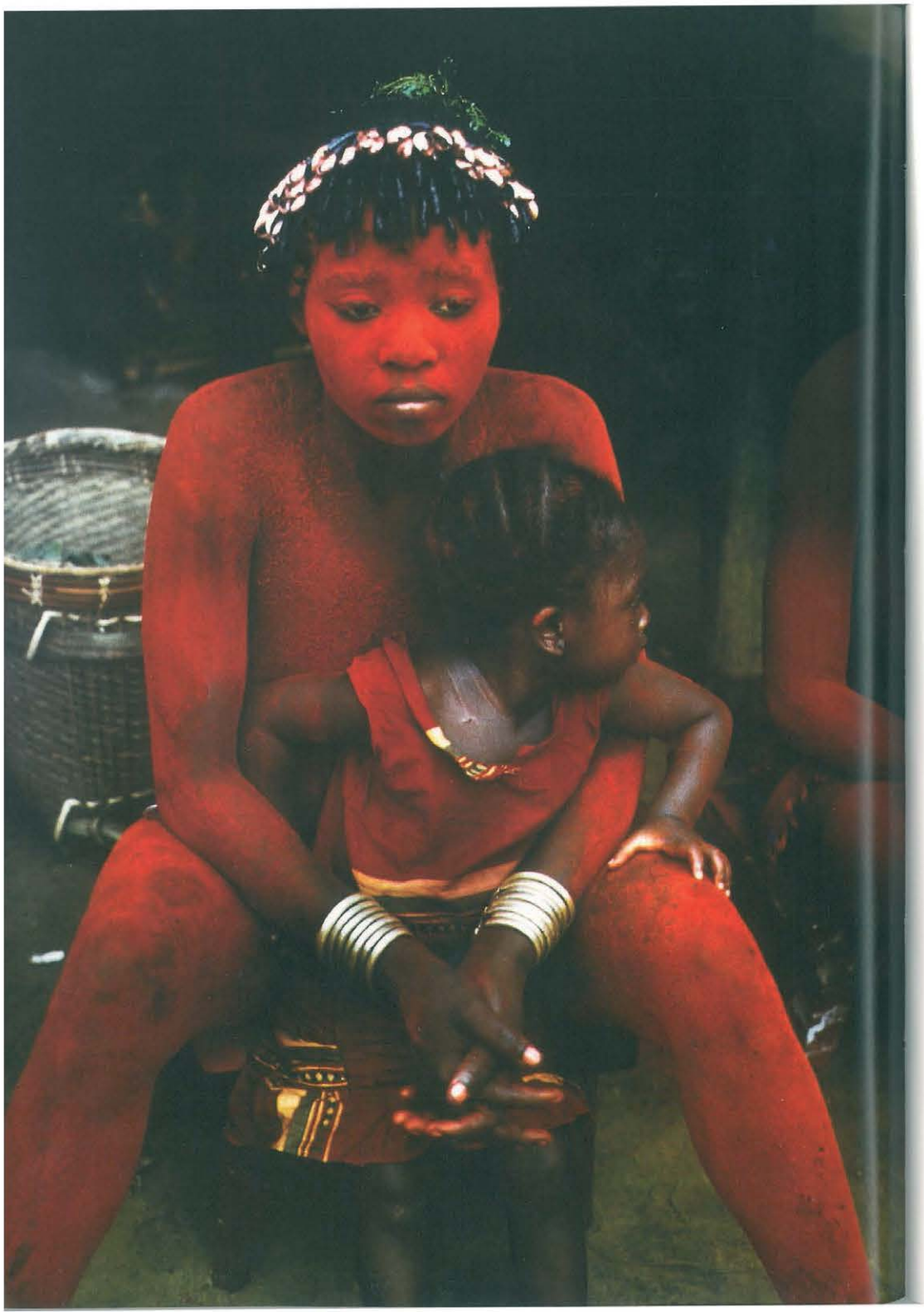
Facing page: A profusion of food and palm wine accompanies any large social festivity such as the one on this photo. It closes the period of mourning among the Aka Pygmies of the Lobaye forest (Central African Republic) when the spirit of the forest dances in the form of a mask of palm fronds. For some weeks, large amounts of food were accumulated in the expectation of several Pygmy groups coming from dispersed camps. Ngando villagers provided palm wine for this special event (photo by S. Bahuchet).

Page 86, upper: During a collective healing session, the ingestion of plant extracts can lead to trances. This is the case for the potion made from the roots of Iboga (*Tabernanthe iboga*) which, among the Fang of northeastern Gabon, is consumed under the strict control of the healer conducting the "Bwiti" cult. The properties of the various active chemicals contained in the Iboga extract—among them ibogain—have been the focus of recent pharmacological research. How it actually affects the person is nevertheless far from clear. Traditional medicine should be considered as the general attitude towards a patient and his illness prevailing within his social environment (photo by C.M. Hladik).

Lower: The preparation of remedies among the Yassa is related to food processing. In the village of Ebodié, during a possession ritual, the healer prepares a mixture which will be distributed to each of the participants as a protection against the ill-doings of witchcraft (photo by E. de Garine).





Feeding the primiparous mother among the Ntomba of Zaire

by Hélène PAGEZY

Among the Ntomba a young mother, just after her first delivery, has to follow specific rules related to nutrition and physical activities. This period of intensive care has beneficial consequences on the health status of the mother and her infant, the first-born being generally of low body weight. In fact, in the region of Zaire where the Ntomba live, marked seasonal variations affect the quality of the diet (chapter 2). Nursing women experience the most acute weight losses during the rainy season. Although of short duration, this period also affects the children's growth (chapter 4).

At 15 to 18, a girl just emerging from adolescence—and not yet having achieved full growth—experiences her first delivery. A few days later, escorted by relatives, the young mother returns to her own mother's house, generally located in another village. She will stay there for two to four years and will benefit from very special care. Her mother (and more recently her grandmother) will stay with her and be in charge of initiating her into her new social role. As long as they inhabit the seclusion hut, both women are subject to strict sexual taboos, the transgression of which is believed to have severe consequences on the child's health. Even when she sits, the young mother must use her own stool, lest she be contaminated by the sperm of someone who, after having sexual intercourse, employed the same stool. During seclusion, the primiparous mother must not perform any physical activity related to food production and preparation. For the first few months, she will not even be allowed to walk outside the hut.

Every day, the young mother engages in an elaborate toilette designed to focus everyone's attention on her (1). She spreads a red preparation, a mixture of powder of **ngola** wood (*Pterocarpus soyauxii*, the Paduk tree) with palm oil, over her whole body. Her hair-style consists of plaits adorned with cowries or beads.

The primiparous mother's food is abundant. Considering that she is not allowed to perform any intense physical activity, she will soon become fat but not obese. Wearing a short loincloth which does not cover her breasts, she displays her full forms to the sight of the entire community. At this point, she incarnates a nursing mother—i. e. a "true mother". The closer her shape corresponds to this image, the prouder her relatives will be, especially after returning to her husband's village, when she will dance at the festival ending her long period of seclusion.

Page 87: Traditional dance (**nsambo i makolo**) during the festival that ends the period of seclusion of a primiparous mother. She is ostentatiously displaying the shape of a fat—but not obese—woman, as evidence of the care she received during her period of seclusion, and of the nutritional value of her diet. The short red loincloth she wears, adorned by skins of spotted carnivores, reveals her thick skinfolds.

Facing page: A primiparous mother who has not yet finished her seclusion period is attending a festival, accompanied by her three-year old daughter. Her body is covered with red **ngola** wood powder and her plaits are adorned with cowries. The brass anklets and bracelets that she wears show, as well as the age of her child, that the celebration ending her own period of seclusion will take place soon (photos by H. Pagezy).

A Ntomba primiparous mother (Twa Pygmy) weaving a basket during her period of seclusion. After several months of total inactivity, the young woman can at last spend her days making the baskets she will need to handle foodstuffs when she rejoins her husband's household and assumes her duties as provisioner of the daily fare (photo by H. Pagezy).

The Ntomba consist of two distinct populations settled in the same villages, the Oto and the Twa Pygmies (see chapter 2, page 37). They speak the same language and respect the same traditions. With reference to practices surrounding primiparity, a slow evolution can be observed among the Oto whereas the Twa behave as keepers of the tradition.

The prescriptions followed by the young mother meet nutritional, psychological and social needs. It seems so important to conform to such traditions that a Ntomba family whose daughter has married a foreigner, or who are engaged towards a modern life-style, goes on with these practices although the duration of the seclusion period is shortened.

Mean food consumption (in grammes per person and per day ± standard error of the mean) of 12 Nzalekenga primiparous nursing mothers with breast-fed infants, as compared with the mean food consumption of 12 adult men (household heads) and their spouses with whom the primiparae stayed (source: Pagezy, 1988).

	Primiparous mother and her infant:	Household head:	Spouse of household head:
Animal foods (a)	150 (±48)	122 (±26)	84 (±22)
Starchy foods	986 (±68)	893 (±51)	719 (±35)
Leaves (b)	272 (±30)	208 (±34)	196 (±29)
Pulp of oil palm fruit (c)	101 (±14)	72 (±08)	66 (±07)
TOTAL CALORIES	2494 (±213)	2146 (±144)	1731 (±066)

(a) This category includes smoked fish (equivalent weight of cooked food), plus the weight of groundnuts generally eaten as a snack.
(b) Mainly cassava leaves (equivalent weight of uncooked leaves), plus a few other leafy species and mushrooms.
(c) The pulp of the oil palm fruit is eaten as a sauce accompanying most dishes (**mosaka**), in snacks, or as oil (equivalent weight of pulp of the fruit)

The energy intake of the primiparous mother far exceeds her biological needs. The surplus allows her to build up body fat stores even while she is a nursing mother. This seems paradoxical, since milk production requires high amounts of energy that exhaust fat stores. A Ntomba woman will never again, during her life, be as fat as when she was primiparous (3).

Indeed, with the birth of her successive children, the nursing mother will periodically suffer a negative energy balance, especially during the rainy season. Expending more energy than she obtains from her diet, she will draw upon the body fat she stored during her seclusion. Hence, this initial period of inactivity, coupled with the overfeeding taking place at the start of her reproductive life, becomes crucial in subsequent years.

The first-born also profits from his/her mother's seclusion by being fed large amounts of highly nutritive milk. Although in a low birth-weight category at first, the primiparous' infant catches up and overtakes, within three months, the mean weight of rural Ntomba infants of similar sex and age (see page 74).

Among the Ntomba, cultural practices related to primiparity have obvious adaptive implications. They appear as a long-term strategy for regulating the energy provided by food. They confer upon the mother a special status and focus attention and care on her. Thus rules surrounding primiparity contribute to the well-being of a biologically at-risk group.

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A modern version (**inio**) of the dance ending the period of seclusion of a primiparous mother, in a Ntomba village of Zaire. She wears a fashionable embroidered long dress instead of the traditional short red one, imported necklaces and bracelets instead of the traditional ones made of brass and cowries, worn with the red **ngola** wood powder ointment. Seclusion is still considered an important event, even among families following modern life-styles (photo by H. Pagezy).

Nutritional concepts: perception, food prohibitions and prescriptions

by Igor de GARINE and Claude Marcel HLADIK

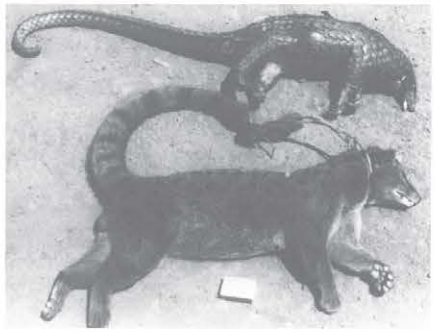
Food perception results from multiple interactions between cultural attitudes, which are the product of a global conception of the environment, and biological phenomena such as taste responses and physiological adaptations. Together they determine food preferences and dislikes, not only among the forest populations on which this booklet is focused, but in industrial societies as well (1).

Food prohibitions, which have an obvious bearing on the choice or rejection of foods in a given cultural context, appear as a negative aspect of implicit nutritional and philosophical conceptions. It would be rash to consider these beliefs as a product of inborn traditional wisdom, born of an empirism heralding scientific knowledge, but it would also be a mistake to credit them with symbolic value only, devoid of any practical efficiency. Each of these aspects has to be taken into consideration and should be credited with nutritional as well as emblematic value. Prohibitions and taboos—the latter being the term used for the most rigorous cases—can be classified according to how long they are to be applied and the size of the group they concern. However, each society has its own criteria and differentiates particular aspects considered as the most important.

Permanent prohibitions do not usually have serious physiological consequences; temporary ones, on the contrary, bear on high-risk groups and may have a sizeable impact on nutrition. There may be physiological grounds for expectant mothers not consuming salty or sugary foods but there is no objective reason why they should avoid the meat of a gravid female animal, a fish cut in half or the flesh of partly-eaten game found in the forest (as is the case among the Yassa and the Mvae). In the latter case, it is believed that negative influences from outside the secure microcosm afforded by the village would cause the forthcoming baby to be born incomplete. Many of these prohibitions are based on the principle of sympathetic magic, according to which objects which look alike have similar properties and a part of an object, a plant or an animal incarnates the object in its entirety.

This also applies to prescribed foods. The Yassa offer pregnant women potto *(Perodicticus potto)* meat, so that the expected child will be born with the unusual grasping strength of this

The tree pangolin or scaly ant-eater (*Manis tricuspis*) and the African palm civet (*Nandinia binotata*) are favourite game among hunters but both are forbidden as food for pregnant women. The curled position adopted by the former is considered unsuitable for giving birth, and the spotted skin of the latter to leave marks on the future baby (photo by I. de Garine).



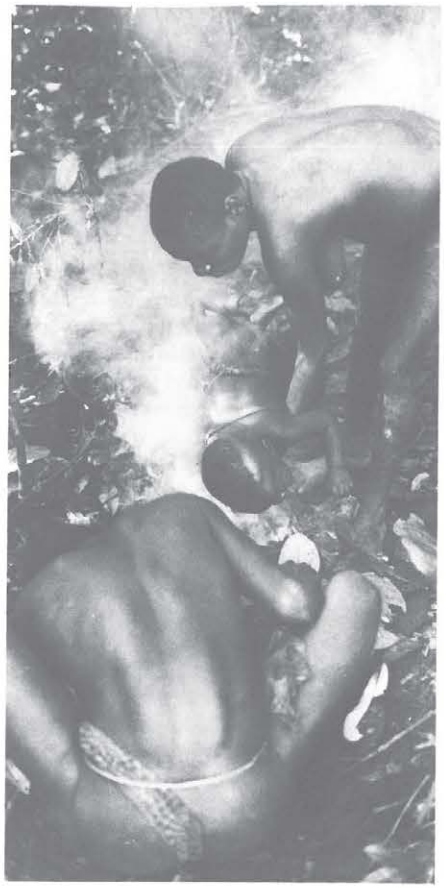
small animal. Among the Mvae, the newly-confined mother receives python meat, so that her back regains the strength of this powerful snake, and, for the same reason, one of the snakes's vertebrae is tied to the baby's waist. A similar belief applies to the meat of the chimpanzee which is also very sturdy.

Conversely, pregnant mothers are forbidden the meat of the tree hyrax *(Dendrohyrax arboreus)*. It is believed that the forthcoming baby would be born with only three fingers (like the hyrax) and would be unsuccessful later on in life, since this animal spends the daytime—which, among mankind, is normally dedicated to work—hidden in a hollow tree. It is recommended that pregnant mothers should avoid consuming the meat of the scaly ant eater *(Manis tricuspis)*, as this animal curls itself up, which would result in a difficult birth. Ingesting elephant meat would give the child a very wide mouth and a long nose. A long list of picturesque prohibitions could be quoted which, although they are still present in traditional memory, are not necessarily respected nowadays.

The consequences of breaking food avoidance prescriptions are also perceived at a symbolic level. For instance, a child's sickness may be interpreted as the result of a forbidden food being consumed by mistake by one of its parents, in which case the child would be treated for the transgression.

Food prohibition systems are, however, influenced by daily events. Taboos may be the consequence of a dislike or of a specific event undergone by an ancestor in relation to an animal which he or she vowed never to consume again. Such prohibitions may be transmitted to the descendants. They may also denote membership of a secret society, a healing circle, or be the expression of a revelation experienced during a possession trance.

In a more modest way, a prohibition may simply apply to a specific biological group of the society: children, youths or adults of both sexes, or the elderly exclusively. Among the Yassa and the Mvae, certain varieties of meat are associated with bad luck. Those with a repulsive smell (for instance, the meat of carnivorous animals),



Among the Aka Pygmies of the Central African Republic, if a food taboo broken by one of the parents is held to be responsible for their child's sickness, the prescribed cure may consist in exposing the patient to the smoke of a woodfire (photo by S. Bahuchet).

or the flesh of the land tortoise—which has the same wrinkled skin as elderly people and whose tail does not stand erect—are not, for obvious reasons, recommended to those at the period of their life when they can indulge in love-making. Similarly, male youths and adults should avoid consuming the tail of the bushpig, or cassava sticks which have been wrapped in the leaf of a Marantaceae with a soft petiole.

In most of the tropical forest societies on which we have focused our research, the meat of dangerous animals is reserved for those persons who are old and "strong" enough (i. e. have symbolic power) to withstand its consumption. Among the Mvae, the meat of the buffalo and the elephant is only eaten by elders. Among the Yassa, another population of the forest zone, the meat of the Gabon viper *(Bitis gabonica)*, a dangerous animal, is set aside for respected elders who need not fear that this reptile's spots will appear on their own skin after ingestion. Considering prescriptions and taboos as an expression of symbolic projections is a justifiable approach to this complex field, which does not lend itself to generalizations. Symbolic analyses must never lose sight of the cultural constructs that are particular to each local group.

PERCEPTION AND COLLECTIVE REPRESENTATIONS

This symbolic dimension generates, to a large extent, food preferences and dislikes; but it is itself contingent upon other perceptive domains. Notably, there is a paradox concerning the "super-food" notion referred to in previous pages. Yams, plantains and cassava are all starchy staples providing the bulk of the energy intake. The choice of one rather than another depends on the past experiences and/or recent history of each of the groups. It is this staple that determines the feeling of being "full"—i. e. satiated—at the end of a meal.

Satiation has recently been explored by psychophysiologists, who have demonstrated that, at least in some circumstances, novel food can be preferred to the routine food consumed in abundant quantities during previous hours or days and leading to rapid repletion (2). This phenomenon, called "oral satiety", is accompanied by a specific response of certain neurons in the orbitofrontal cortex (3). By signalling oral satiation before any physiological effects can be felt, the system helps to avoid excessive consumption of a specific food and thus permits real physiological needs to be anticipated. But there is an apparent paradox between the biological trend towards new foods with a novel taste, and the observed responses of all populations for whom a particularly valued food can be eaten in large amounts without any loss of motivation. Two distinct phenomena at least appear to overlap, depending upon the lapse of time between food intakes. The short term and long term responses may be influenced differently by the gustatory perception eliciting immediate neural feedback, and by the cultural aspects associated with food prohibitions and preferences.

The results of the various studies conducted by our team among several ethnic groups, with a simultaneous approach of taste perceptions and cultural preferences, should allow advances to be made in deciphering human feeding behaviour. The model derived from the animal world (4) is indispensable to the comprehension of biological processes. In the social science context, the joint results of the qualitative observations and the quantitative studies we were able to carry out on different groups permit a deeper understanding of a phenomenon which is, by its essence, both biological and cultural. The anthropology of food is an approach (5) that takes into account measurable parameters, thus allowing statements to be made about the "fitness" or adaptive success of populations vis à vis their environments. At the same time, our approach constitutes an insight into the vision that each society has of its own culture and behaviour.

Such research, focused on food and nutrition, also yields basic data on the natural environment. Taken in conjunction with biocultural factors, this knowledge is essential in the formulation of sound development projects.

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Concluding remarks: the interrelationship between food production, forest regeneration and management

by Claude Marcel HLADIK, Igor de GARINE, Annette HLADIK, and Matuka KABALA

The results presented in various parts of this booklet emphasize the interdisciplinary nature of field studies on food and nutrition. The essays are the product of long term cooperative efforts between the scientific institutes of the countries where the various studies have been conducted, and the authors whose papers have been referred to and who have commented upon unpublished results. Following programmes determined by local authorities in Cameroon, the research team of the Institute of Human Sciences (IHS), associated with our CNRS unit and with ORSTOM, contributed to various surveys on rain forest food and nutrition. In the Central African Republic, Gabon and Zaire, Institutes located respectively at Mbaïki (ISDR), Makokou (IRET) and Mabali (IRS), provided the field stations where we conducted studies on cultivated plants, forest ecosystem production and biomedical aspects of food and nutrition.

International cooperation is also necessary to maximize the benefit that such input of knowledge may have in development projects. Nevertheless, in a modern context in which the media have overwhelming power, and in which urban models of behaviour or foreign values coming from the industrialized world are overvalorized, it would be futile to conceive a return to Nature in a naive ecological sense.

The regional workshop on agroforestry organized at Makokou (1), in the context of the "Man and the Biosphere" (MAB) programme of Unesco is an example of a joint effort to bring together various experiences in integrated rural development (with participation of the local population) in the hope of utilizing the latest scientific results. Similarly, a recent attempt to synthesize data about the Mayombe forest in Congo (2) provides a rational basis for the conservation and sustainable utilization of forest resources, with the aim to improve the relationship between humans and their environment.

In this booklet, we have insisted upon the underlying diversity and heterogeneity of the rain forest, where each population—not to say each social group—makes its own alimentary choices according to various criteria, irreducible to a straightforward biological adaptation.

The principles underlying traditional intercropping methods of cultivation in the tropics, which tend to maintain diversity, buffer against climatic risks and limit insect damage, are integrated into the new approach to agroforestry science. The example provided by the subspontaneous population of the oil palm on vast areas of the Central African Republic (see photo inside back cover) shows that a form of traditional management could serve as a model for putting into effect more efficient agroforestry practices.

With respect to animal food, there is an uneasy feeling that wildlife is being overexploited in some parts of the tropics. As a prestigious food item, game is sold in large amounts, risking its extinction in the short term. Clearly, the fauna should not be omitted when planning new agroforestry systems (3). For instance, maintaining plant species that contribute to the balanced diet of wild animals is one of the long-term solutions to maintaining a viable "living stock" of game.

The same applies for the potential contribution of freshwater fish to a balanced diet; pisciculture should also be an important constituent of agroforestry management projects.

The Food and Agricultural Organization (FAO) published, as long ago as 1968, an issue entitled "Forests, Food and People" (4). And "Forests For Food" was one of the leading themes of the 8th World Forestry Congress held in Djakarta in 1978. Therefore, for several decades, the various agencies of the United Nations have recognized the importance of no longer considering the rain forest as an inexhaustable supply of extractable resources for the industrialized world, but as a crucial source of food for local populations (5). It should also be considered as a reservoir of genetic material, a long-term insurance bank reducing the risk of depending upon a limited number of food species that have become dominant throughout the world.

These aspects of the nutritional problem are legitimate but, as we have tried to point out, it is not a matter of promoting food self-sufficiency and a dietary balance in local populations as if these were isolated from the world market. It is a matter of recognizing the valuable contributions made by forest people to their own nations and humanity at large. In so doing, they will continue to be assured of their own worth and pursue their life in full conscience of its inestimable value.

Hopefully we have shown, in each of the populations we have considered, how deeply food is embedded in the most diverse cultural processes. The attitudes, values and concepts that surround feeding behaviour influence the ways the forest is utilized and managed.

Development projects, as they should be conceived at the present time from the standpoint of sustainable forest resources (6), would necessarily contribute to food security as well as cultural survival.

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Facing page: Aerial photograph of the Lobaye forest in the Central African Republic. The high density of oil palms (identifiable by their star-shape) which have profited from shifting cultivations (see chapters 2 and 3) is noticeable. Alongside the "natural" forest (upper right), an agroforestry system with one dominant subspontaneous African species has existed for a long time, with obvious positive implications for the local diet (photo by C.M. Hladik).

Back cover: A group of Kola Pygmies of southern Cameroon dining in the forest, using spoons made out of the folded leaves of a Marantaceae to pick up the sauce from a communal dish of game (Photo by I. de Garine).

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Editor's addresses in 2012

Claude Marcel HLADIK
Emeritus Professor
Muséum national d'Histoire naturelle
Eco-Anthropologie USM 104
4 avenue du Petit Château
91800 Brunoy (France)

Serge BAHUCHET
Professor
Muséum national d'Histoire naturelle
Eco-Anthropologie USM 104
CP 135
57 rue Cuvier
75231 Paris CEDEX 05 (France)

Igor de GARINE
Emeritus Professor, CNRS
Pargade
64290 Laseube (France)