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SEASONAL CHANGES IN THE SUBSISTENCE ACTIVITIES AND FOOD INTAKE OF THE AKA HUNTER-GATHERERS IN NORTHEASTERN CONGO

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ABSTRACT In central Africa, a close relationship exists between the cultivators and the hunter-gatherers (Pygmies), who depend on agricultural foods exchanged for forest products or labor. In northeastern Congo, the Aka hunter-gatherers lead a dual mode of life in the forest and the village. They mainly depend on wild animal and plant food in the forest, whereas on agricultural food in the village. Their subsistence activities are influenced by the fluctuation in the availability of wild food resources that does not fall into a simple annual cycle, but fluctuates from year to year. The subsistence activities of the Aka are more complex than the other hunter-gatherers, and dependent on the ecology of the tropical rain forest and the local economy in northeastern Congo.

Key Words: Aka hunter-gatherers; Tropical rain forest; Wild food resources; Semi-nomadic life; Local economy.

INTRODUCTION

The subsistence activities of the so-called "Pygmy" hunter-gatherers in the Congo basin have been described in detail, in particular, those of the Mbuti in the Ituri Forest of Zaire and the Aka in Lobaye of Central African Republic (Turnbull, 1965; Harako, 1976; Tanno, 1976; Terashima, 1983; Bailey & Peacock, 1988; Bahuchet, 1975, 1985, 1988; Hudson, 1990). These studies have reported a close eonomic relationship between hunter-gatherers and cultivators. Agricultural foods from the cultivators, such as cassava and plantain, provide the hunter-gatherers with the bulk of their food. The hunter-gathrers obtain those agricultural foods in exchange for forest products, such as meat, or for agricultural and other manual labor (Hart, 1978; Ichikawa, 1983; Bahuchet, 1985).

Based on the quantitative data collected in over a one-year time period, this paper analyzes the subsistence activities and food utilization of the Aka hunter-gatherers in northeastern Congo, while in the forest and around a village of cultivators. In previous studies of the hunter-gatherers in the Congo basin, hunting activities were studied intensively, whereas collecting activities, especially those of wild plants, were not paid much attention. The reason for this is that most of the hunter-gatherers studied so far depended on agricultural foods as major plant foods. In contrast, the Aka in the northeastern Congo use wild plants more frequently than agricultural foods in the forest. Unlike the hunter-gatherers who specialize in hunting, the Aka in this area procure food from various sources. One purpose of this paper is to describe the life of the hunter-gatherers performing such

generalized subsistence activities.

It is reported that subsistence activities of the hunter-gatherers in the Congo basin show a marked seasonality. In order to grasp the range of subsistence activities, observation over different seasons is indispensable. There are some studies in which seasonal shifts in the subsistence activities are described (Bahuchet, 1988). Also, recent ecological studies have shown that the phenology of the plants in tropical forest varies from year to year (Mabberley, 1992). There is also a study on the hunter-gatherer subsistence activities that are influenced by the multiple-year fluctuation in the yield of agricultural food (Bailey & Peacock, 1988). However, no study has been made on the relationship between multiple-year fluctuations in wild food resources and hunter-gatherer subsistence activities. In this paper, the multiple-year fluctuation in the food availability is discussed, although the data covers only a part of the long-term fluctuation.

Recently, researchers have questioned whether humans have ever lived in the tropical rain forest independently of domesticated plants and animals (Bailey et al., 1989; Headland, 1987; Headland & Bailey, 1991). It has been argued that to live in the tropical forest depending solely on wild food is difficult, because there are not enough sources of energy. This idea probably derives from the studies on the hunter-gatherers who depend on agricultural foods for half of their energy intake. However, the full potential of human food in the tropical forest has not been explored. My data obtained from the northeastern Congo may provide a different view of hunter-gatherer subsistence in the tropical forest.

THE RESEARCH AREA AND SUBJECTS

1. The Study Subjects

Field research was conducted from October 1991 to November 1992 in the vicinity of Linganga-Makaou village, the uppermost village on the Motaba River (Fig. 1) of Dongou District, Likouala Region of Congo (2°55'N Lat. and 17°10' E Long.). Linganga-Makaou village was founded by Kaka slash-and-burn cultivators who speak a Bantu language.[1] It consists of two hamlets, Linganga and Makaou, 600 m apart. There are approximately 160 Kakas in Linganga and 60 in Makaou. Hereafter, the Kaka are called "the villagers." Besides cultivation, they practice hunting in the forest with guns, fishing with nets, hooks, traps and poison in the Motaba River and its tributaries.

The Aka live in the forest area of northeastern Congo, southern C.A.R. and on the eastern bank of the Oubangui River in Zaire. Their population is estimated to be from 15,000 to 30,000 (Bahuchet, 1985, Bahuchet & Thomas, 1986). They speak a Bantu language belonging to the C 10 group, according to the classification by Guthrie (1967). While there are at least 22 different ethnic groups of cultivators belonging to several different linguistic families in the Aka area, none of them speak the same language as the Aka (Bahuchet, 1985).

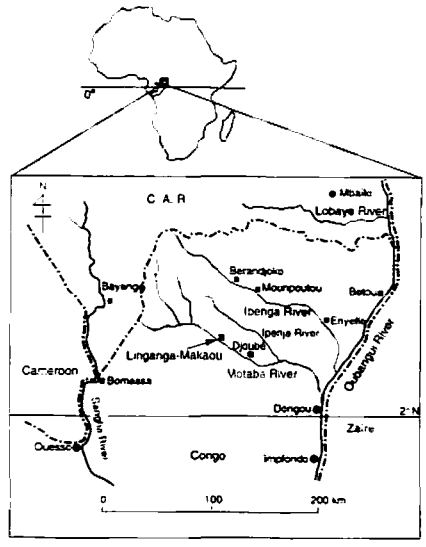

Fig. 1. The study area.

2. Economic Background

There are paths connecting Linganga-Makaou with other villages along the Motaba, but they do not reach the Oubangui River. There is a small boat (vedette) service from Dongou to Linganga-Makaou village twice a month. This service, however, stops from January to June when the water recedes in the Motaba River. In this period of suspension, the villagers travel mainly by canoe. Most of the villagers have canoes, whereas the Aka do not. Some merchants of Dongou and Impfondo visit the village by out-board motor canoe, but the villagers do not have such equipment. There are no shops in the village, and the villagers buy manufactured goods, such as clothing, salt and cigarettes, from peddlers coming by vedette or canoe. Otherwise, they buy such goods when they visit Dongou or Impfondo. The Aka seldom buy or sell with cash, and seldom directly exchange forest products for manufactured goods with traders in the village (Kitanishi, 1994).

It has been reported that hunter-gatherers in the tropical forest of Africa have an interdependent economic relationship with the neighboring cultivators (Turnbull, 1965; Hart, 1978; Bahuchet & Guillaume, 1979; Cavalli-Sforza, 1986; Hudson, 1990; Terashima, 1991). The Aka of Linganga-Makaou are no exception. The Aka provide the villagers with forest products and manpower for agricultural work, whereas the villagers supply starchy agricultural food, cigarette, salt, clothes and ironwork (Kitanishi, 1994).

In the Ituri Forest of northeastern Zaire and in Lobaye of southern C.A.R., meat is one of the most important forest product that hunter-gatherers exchange with cultivators (Hart, 1978; Ichikawa, 1983; Bahuchet, 1985). In the northeastern Congo, however, meat hunted by the Aka with their own tools (spears, nets,

Table 1. Monthly rainfall (mm) from January 1980 to December 1990 at Impfondo.

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1980	82.8	189.4	162.8	141.0	177.9	356.7	147.0	240.7	270.8	?	217.9	118.5	?
1981	0.0	115.8	179.0	97.0	243.0	?	?	?	?	?	155.1	191.5	?
1982	5.3	42.2	117.3	191.7	318.4	?	178.0	?	142.8	?	?	86.4	?
1983	0.0	43.1	87.9	58.4	?	273.7	133.1	123.2	163.2	175.0	75.0	124.3	?
1984	?	74.8	152.4	130.4	201.1	225.2	306.1	114.9	121.2	147.5	198.0	56.0	?
1985	102.3	45.0	106.2	199.8	126.2	110.0	121.8	124.6	363.8	250.7	126.5	?	?
1986	0.0	51.4	206.3	98.0	92.2	81.6	52.5	119.2	231.2	236.7	?	30.5	?
1987	26.1	63.8	78.4	25.5	24.3	116.5	101.2	372.5	122.3	173.2	150.9	95.2	1349.9
1988	59.3	51.1	153.4	223.4	176.5	134.8	119.5	227.1	160.1	232.7	181.5	37.1	1756.5
1990	22.8	34.0	97.4	185.5	117.3	204.3	89.6	210.4	?	191.9	85.6	127.4	?
Mean	33.2	71.1	134.1	135.1	164.1	187.9	138.8	191.6	196.9	201.1	148.8	96.3	1698.9

Note: Underlined characters show the months in the dry season.

crossbows, and traps) is rarely exchanged with cultivators for crops, cigarette, clothes and other manufactured goods. The introduction of guns to the cultivators may be one of the reasons for the lack of meat exchange (Tanno, 1991; Takeuchi, 1991, in prep. a). The villagers provide guns and ammunition to the Aka for hunting, and, thus, have come to obtain a greater part of the meat. The meat has become an important source of cash income for the villagers as well as being an important food. The newly introduced gun hunting has had a profound impact on the Aka life, which will be examined later in this paper.

3. Climate and Vegetation

The mean annual rainfall at Impfondo, the capital of Likouala Region, about 145 km south-east of Linganga-Makaou village, is 1,698.9 mm (Table 1). The mean monthly rainfall in the dry season from December to February is less than 100 mm, whereas that in the rainy season from March to November is more than 100 mm.[2] The rainfall is heaviest in September and October with approximately 200 mm.

Monthly rainfall, however, varies considerably from year to year. Cultivation and wild food production in the forest are particularly influenced by the onset and duration of the dry season (Bailey & Peacock, 1988; Dove, 1993), which also varies from year to year. While there was only one month from 1980 to 1981 with rainfall less than 100 mm, there were as many as 6 months with less than 100 mm from 1986 to 1987. While I have no direct record of rainfall in the study area, the percentage of rainy days for each month at Linganga-Makaou was not different from that of mean percentage at Impfondo (Fig. 2).

Another factor influencing both agricultural and forest food production is temperature. However, it tends to be relatively constant and, therefore, imposes minimal effect on the tropical forest in the Congo basin (Bailey & Peacock, 1988). The mean annual temperature at Impfondo is 25.4°C, relatively constant throughout the year, with little fluctuation from year to year.

The land around the village is mostly flat with the altitude of 300 m above sea-

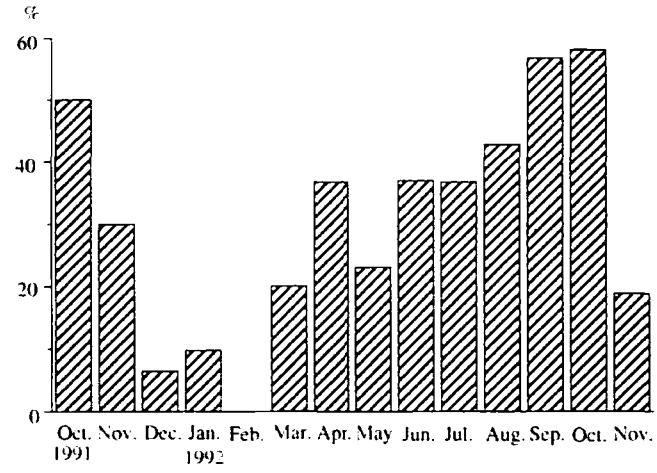

Fig. 2. Percent of rainy days to total days from Oct. 1991 to Nov. 1992 around Linganga-Makaou village.

level. The vegetation of the study area is classified by the Aka as follows:

(1) Thick growth of *Raphia* sp. (*mo.sende*[3]), PALMAE, along the Motaba River and its tributaries.

(2) Swamp forest (*bo.jamba*) several kilometers wide, beyond the thick growth of *Raphia* sp. along the Motaba River.

(3) Dry land primary forest (térra firma) further inland (*ndima*).

a. Semi-deciduous forest of *Celtis* sp. (ULMACEAE), *Manilkara* sp. (SAPOTACEAE), *Petersianthus macrocarpus* (LECYTHIDACEAE), *Entandrophragma cylindricum* (MELIACEAE) etc.

b. Single-species dominant evergreen forest of *Gilbertiodendron dewevrei* (CAESALPINIACEAE) scattered in the primary forest, mostly along the watercourses.

(4) Grassland patches (*e.jaba*) on sandy soil scattered near the watercourses.

(5) Secondary forest (*njuku*) on the northern side of the Motaba River within a radius of 3–4 km from the village.

The classification of vegetation in Lobaye by Bahuchet (1985) and that around Moumpoutou village at the middle of the Ibenga River by Takeuchi (in prep. a) is similar to that of this area. The grassland patches in northeastern Congo is noteworthy. Although the Aka burn the grassland several times a year to make walking easy, the grassland does not seem to have originated artificially as abandoned village or cultivation sites. The importance of this grassland to the Aka life is discussed later.

THE RESEARCH PERIOD AND METHOD

The Aka of Linganga-Makaou spend four to eight months a year in the forest,

Table 2. The village camp size.

*kombeti**	place	married		unmarried		Total
		male	female	male	female	
Babala	Linganga	9	14	10	5	38
Bebanga	Linganga	10	12	13	6	41
Boanga	Linganga	5	6	7	4	22
Basongo	Linganga	9	15	9	3	36
Boata	Linganga	5	5	1	6	17
Mataka	Linganga	1	1	4	0	6
Boka	Linganga	15	16	10	9	50
Kondoki	Linganga	6	8	9	7	30
Botima	Makaou	4	4	5	5	18
Molongo	Makaou	17	21	23	20	81
Total		81	102	91	65	339

Note: Researched in July 1992.
*: Central person in a camp (see text notes).

while staying around the village during the remaining months. There are two kinds of settlements around the village. A semi-sedentary settlement is used whenever the Aka return from the forest, and a mobile, temporary settlement (camp) is newly made whenever they return from the forest. In this paper, both the semi-sedentary and temporary settlements are called the "village camps," whereas camps made deep in the forest are called the "forest camps." The village camps are located behind villager houses, near fields or in the secondary forest within 30 minutes' walk from the village.

There are 9 village camps around Linganga-Makaou village with a total Aka population of approximately 340 (Table 2). The village camps around Linganga are semi-sedentary, except for one Boata camp[4] whose members came in October, 1991 from Bangui-Motaba village in the upper Motaba. These Boata Aka first made their own camp around Linganga, then joined with the Basongo group in January, 1992, and moved to the forest on the southern side of Motaba River in April. They did not return to the village until the end of the study period in November 1992. The members of two Makaou camps made new temporary camps whenever returning from the forest. They had, until September 1991, a semi-sedentary camp around Makaou, which was abandoned because several camp members died at this camp. Besides these, two groups from other village stayed for several weeks in Linganga.

I conducted field research mainly among the Molongo group (hereafter, called M group), who had a village camp around Makaou. It consisted of 81 members, the largest among the camps in the Linganga-Makaou. M group members moved between the forest and village, sometimes splitting into small groups and sometimes merging into a large group.[5] The data for this study were collected from the M group, except for those of food intake in the village which were obtained also from several other village camps. Continuous observation was made for the M group from October 1991 to November 1992, except for March and from July to August, when I was away from the field site.

The Aka life can be roughly divided into three dimensions; life at the forest

Table 3. Study periods in the forest camp.

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
location of camp	Camp 2	Camp 3	Camp 5	Camp 6	Camp 6	Camp 6	
period from	11 Nov. 91	15 Dec.	10 Feb.	29 Jun.	25 Aug.	10 Oct.	
to	16 Nov.	10 Jan. 92	22 Feb.	9 Jul.	13 Sep.	24 Oct.	
days	6	27	13	11	20	15	92
camp size	74	39–85	19–22	15–18	24–62	57–61	
average camp size	74.0	66.6	20.6	15.8	41.7	59.5	
total man-days	444	1,798	268	174	834	892	4,410
total man-days energy intake*	312	1,251.5	189	130	610.5	667	3,160

*: An adult over 12 years old is calculated as one person, an infant or juvenile from 2 to 12 as half an adult, and a baby under 2 as 0.

camp, life at the village camp and life during the gun hunting expedition with villagers. The Aka themselves clearly distinguish the life in the forest (*ndima*) from that in the village (*mboka*). Life during the gun hunting expedition is different from that of forest camp in that the Aka stay with villagers to hunt the game with guns, led by the villagers.

Field research with M group in the forest camp was conducted in six periods (Table 3). Period 1 just before the end of rainy season; Period 2, early dry season; Period 3, late dry season; Period 4, early rainy season; Period 5 and Period 6, late rainy season with the heaviest rain in a year. These six periods covered almost all the seasons of the year.

Field research on the foods in the village camp was conducted from November 1991 to November 1992. That on the subsistence activities in the village camp was conducted from January 1992 to November 1992.

I recorded the followings at the forest camps:

(1) Names of individuals staying at each forest camp and the duration of their stays.

(2) Everyday subsistence activities of adults.[6]
The subsistence activities of the Aka were divided into five types: hunting, the collecting of invertebrates, the collecting of wild plants, fishing, and transportation of village food. The frequency of each subsistence activity was calculated. If a person engaged in only one type of subsistence activity in a day, this was given one point. For engagement in two types of subsistence activities, each activity was given a half point; i.e. a half work-day. The total number of work-days for each activity was divided by the total man-days of stay, providing the rate of each subsistence activity during their stay.

(3) The kinds of food and their quantities consumed at the forest camps.
All food brought into the forest camps were weighed with either of two hand-held spring balances; a two kg balance (50 g scale) or a 20 kg balance (1 kg scale). The value was then converted into the weight per man-day of stay and the energy per man-day of consumption, analyzed in this paper. The consumption for babies less than two years of age was counted as zero. The consumption for children from two to twelve years of age was counted as a half man-day (Hart, 1978; Ichikawa, 1986).

(4) The food prepared for the meal (except Period 1 and Period 2).

The major Aka meal is served in the style of "pot-au-feu," a stew of animal foods (meat, fish, caterpillar), edible leaves, and oil. Wild tuber is also boiled in a pot-au-feu, while cassava is steamed separately, and served with the pot-au-feu. Mushrooms can also be added. Red pepper is usually used at the village camp, but not at the forest camp. Salt is precious for the Aka, and rarely used (see Bahuchet, 1972, 1985).

A comparison was made among the three pairs of wild vs. cultivated food to analyze the relative importance of wild food in Aka diet.

Similar investigations were also made at the village camps.

I spent a few hours in the village camp every morning, and inquired about the subsistence activities, which included clearing the fields, planting fields, fishing, and hunting with spears, nets, and guns. The frequencies of other activities may be underestimated, particularly for those practiced before my arrival to the camp or after my departure from the camp, hence those activities were excluded from the analysis.

Also recorded was the food observed at the village camp in Linganga-Makaou. The frequency and ratio of each food item at the village camp was calculated. If a certain food was observed at a village camp in a day, it was counted as one camp-day. To calculate the ratio, the total camp-days on which each food was observed were divided by the total number of camp-days observed.

With these data, this paper compares the life of the Aka in the forest and in the village, and describes the seasonal changes observed over one year period.

SUBSISTENCE ACTIVITIES

1. Hunting of Larger Animals

(1) Spear hunting

The subsistence activities of the Aka are comprised of hunting, the collecting of invertebrate animals and wild plants, fishing, and agricultural work. As each of these has been described in detail by Demesse (1980) and Bahuchet (1985), a brief account of the characteristics of each activity is given in this chapter.

The Aka have several methods of hunting: spear, net, trap, crossbow, gun, and capture with bare hands. The Aka capture with hands land tortoises, immature birds and eggs in the nests. They also capture pangolins and other small animals by hitting them with machetes or sticks. Meat obtained through these methods accounts only a small part of Aka diet, hence omitted in the following description.

Spear hunting is practiced by a group consisting of adolescent and adult men. There are two types of Aka spear hunting: one-day hunting (*e.sondo*) and expedition hunting over several days (*njango*). The group sizes for *e.sondo* observed at forest camps were from three to thirteen men (mean $=5.8$, $\sigma=3.3$, $n=24$). *Njango* was once observed with a group of 8 men for three days and another of 10 men for four days. In a M group camp, 15 adult men among the 16 possessed their own spears (*ngongo* and *ndaba*).

In spear hunting, the Aka first trace animal footprints, then they find the animal, and spear it. The major game is bush pig (*ngua*). Gorillas (*e.bobo*) are also hunted with spears, but only occasionally. The Aka had once hunted elephants with spears, though not at present.

(2) Net hunting

Net hunting (*bo.kia*) is practiced by a group of young and old men as well as women. The hunters set the nets, beat the bush and kill the entangled animals, and rewind the nets, then move on to the next site. After several hunting attempts, they return to the camp. Generally, adult and adolescent men set the nets and beat the bush, whereas women capture the animals caught in the net, waiting around the nets (Bahuchet, 1985; Takeuchi, in prep. a).

In the study area, women also handle the nets and beat the bush, when there are not enough adult and adolescent men. Occasionally, women lead net hunting when no adult man participates in the hunt.

M group had a total of 6 nets, with an average length of 30 m. The net owners were adult men. A third of the adult men (6 men among 18) owned nets. In other groups, however, only a quarter of the adult men (11 men among 43) owned nets.

The first hunting attempt was made 20 to 40 minutes walk from the camp. The number of net hunting attempts in a day was from 6 to 10 (average=7.7, n=9). Major game were small- or medium-sized duikers, such as blue duiker (*mboloko*), Peters' duiker (*mo.some*), and bay duiker (*ngbomu*).

The group size of net hunters upon setting out from the forest camp was from 21 to 31 (mean=25.4, σ=3.0, n=11). Net hunting with other camp members was observed once in Period 5.

The size of net hunting groups from the village camp was from 7 to 41 (mean=26.1, σ=10.7, n=8). As each camp (except M group) did not have enough nets to perform hunting independently, hunting groups from the village camp were often formed of members from several camps.

(3) Trapping

The Aka use several kinds of traps (*e.sombo*), but mainly the spring trap in the study area.

Only men set the traps and patrol them. When an animal is too large to carry alone, women are called from the camp for help.

Steel wires (*waya, kabule*) are mainly used for loops of the spring trap at present. However, strings twisted from the fiber of *Raphia* sp. (*uondo*) or *Manniophyton fulvum* (*mo.kosa*) are also used for loops when wire is not available. A half of the adult men of M group (9 out of 18) owned trapping wires (the average, 17).

The spring traps were set within 10 to 40 minutes' walk from the camp. Patrolling the traps took 1 to 1.5 hours a day, which was quite short, compared with the time needed for spear hunting or net hunting. Major game are duikers, such as yellow-backed duiker (*bemba*) and Peters' duiker, bush pigs and giant forest hogs (*mbiya*).

(4) Crossbow hunting

Crossbow (*mbano*) hunting is usually performed by a lone hunter. The major targets are arboreal monkeys hunted with a poisoned arrow. Eighty-five percent of

Table 4. Gun hunting expeditions by M group members.

period from	to	No. of days	adult		child		Total size
			male	female	male	female	
29 Jan.	14 Mar.	46	4	5	7	3	23
3 Mar.–29 Mar.?	23 Apr.	26–51	4	5	8	6	19
20 Mar.	10 Apr.	21	2	0	1	0	3
2 Apr.	8 May	37	?	?	?	?	?
1 May	8 May	9	2	0	0	0	2
8 May	4 Jun.	27	3	0	0	0	3
4 Sep.	12 Sep.	9	?	?	?	?	?
11 Jul.–17 Aug.?	?	?	3>	4>	2>	6>	15>
11 Jul.–17 Aug.?	?	?	1>	1>	1>	?	3>

adult men of M group owned crossbows. However, the skill of each hunter varied, and only 6 men practiced crossbow hunting frequently.

(5) Gun hunting

No Aka had a gun, while most of the villagers had shotguns. A few villagers also owned rifles to hunt large-sized mammals. There are two types of gun hunting: one-day hunting with a shotgun, gun hunting expedition led by the villagers over several weeks. In one-day hunting, the villagers ask Aka men staying in the village camp to hunt, giving them a shotgun and bullets. The gun owner claims the ownership of the game, which he or his family butcher. The Aka hunter is given its head, neck, internal organs and two cigarettes. When a villager asks Aka men staying in the forest camp to hunt, the Aka lop off the head, neck and internal organs of the game and bring the rest to the owner.

Gun hunting expeditions by the villagers were practiced in the upper Motaba area or Ipenja area (midway between Linganga-Makaou village and Berandjoko village, Fig. 1) at location farther away than two days walk or canoe paddling from the village. The villagers usually go hunting expedition with a rifle and shotgun, because their target includes large-sized mammals.

Gun hunting expeditions in which M group members participated were observed 9 times in the study period (Table 4). Hunts usually continue until the bullets are gone. The duration of each gun hunting expedition varies depending on the number of bullets and the chance of encountering game.

There is no seasonality in gun hunting. The villagers practice gun hunting when bullets are obtained. Although shotgun bullets are easy to obtain, rifle bullets are difficult to obtain. Rifle bullets are sometimes brought into the village by the merchants from Impfondo and Dongou or even from Brazzaville. Therefore, the timing of gun hunting expeditions is influenced by the external factors.

According to the information obtained from interviews, while men hunted with guns, women collect wild food resources during the expedition. The majority of food is, however, comprised of the hunted meat and agricultural foods transported from the village.

2. Collecting of Honey,[7] Caterpillars and Other Small Animals

(1) Honey

The Aka collect honey of the honeybees (*Apis mellifica adansonii*, *nzoi* or *boi*[8]) and more than 7 species of stingless bees (Trigoninae).

The Aka fell a tree with an ax and the beehive is opened on the ground to extract honey. Sometimes, they climb a tree to cut open the beehive in the tree, and honey is brought down in a container (*pendi*) made on the spot of wild vines and barks. Another container (*mo.kobe*) made of the bark of *Gilbertiodendron dewevrei* is used to carry honey to the camp.

The person who first finds the beehive becomes the owner of the honey. If honey is not collected immediately, a few shrubs around the tree with the beehive are broken to notify other persons that the honey there has already been found. This mark is called *mo.panje*. Only men collect honey, although both men and women can be the owner of honey. Honey is partly eaten on the spot by all the people who are present, and the remainder will be brought to the camp. All the honey is occasionally consumed on the site when the quantity is small. When the owner has other Aka collect the honey, the collectors bring some portion to the camp for the owner. In any case, the amount of honey consumed (weighed) at the forest camp is less than that actually eaten by the Aka.

(2) Caterpillar (larva of Lepidoptera) collecting

Six species of edible caterpillar were observed during the study period. In addition, there were a few other edible species, not actually observed. Each caterpillar species breeds on specific trees, such as *Entandrophragma cylindricum*, *Triplochiton scleroxylon*, *Petersianthus macrocarpus* in the specific season. Caterpillars fall from the canopy to the ground just before metamorphosis into chrysalises. The Aka collect the fallen caterpillars around the trees, and this work is very easy. Usually women collect the caterpillars, while men help only when there is a large amount.

(3) Other small animals

The Aka also collect termites, the larvae of beetles and snails.

Once a year, the nymphs of termites at the final stage cast off the skin, and transform into winged adults. They fly off the termitary in a group to mate. The Aka, mainly women and children, then collect the flying and crawling termites with hands.

Edible white beetle larvae of various kinds are found in dead trees of *Celtis* spp., oil palm and raffia palm. The Aka cut the log with axes to extract them. Imagoes of these beetles are also frequently found in the same logs. They are edible, but are mainly used as toys by children.

3. Collecting of Wild Plants

(1) Tubers

The Aka distinguish about 10 kinds of edible wild yam (*Dioscorea* spp.). The tuber of *Dioscoreophyllum cumminsii* (*mo.la*) is also gathered. These tubers are dug with a machete or stick (*mo.fana*). The thin and long tuber of *D.*

semperflorens (*e.suma*), extending about three meters deep under the ground, is dug with a special digging tool, called *jo*. For making *jo*, the thicker end of a wood shaft of about 4.5 m is split lengthwise into four and expanded to form a cone (50 cm long, 20 cm in diamter). Four thin pieces of wood are inserted in the cone, then tied with wild vine cords. *Jo* is thrust into the ground, then pulled up with broken pieces of tuber of *D. semperflorens* in the mud. The cone is beaten with a stick to remove the mud and pieces of yam. This operation is repeated until the entire tuber is dug out.

Wild tubers are gathered mainly by women, while that of *D. semperflorens* are dug by both men and women with *jo*.

(2) Leaves

The Aka eat the leaves of *Gnetum bucholzianum* (*koko*) and *G. africanum* (*e. kali*). Although they regard several other species as edible, the use was not directly observed. *Gnetum* spp. leaves are added to pot-au-feu after shredding. Only women gather them.

(3) Seeds

The Aka eat many kinds of seeds. The seeds of *Panda oleosa* (*mo.kana*), *Irvingia grandifolia* (*mo.sombo*) are eaten raw, while *Chytranthus* seeds (*ma.tokodi*) are boiled. *Treculia africana* (*fusa*), *Ricinodendron heudelotii* (*e.jongo, e.kopo*) are eaten roasted. The cotyledons of *Irvingia gabonensis* (*mo.payo*), *I. robur* (*mo.kombeli*), *I. wombulu* (*mo.bolu*) are dried, roasted, and pounded, then put in pot-au-feu, giving it a unique savory taste. They often make cakes with these seeds, which are sometimes exchanged with villagers (Kitanishi, 1994).

Most of these seeds are gathered and transported to the camp by women, while men occasionally help women when the seeds are abundant.

(4) Fruit

All kinds of fruits are eaten fresh, and a great portion is consumed on the gathering spot, except *ma.fondo* (general term for sweet and sour edible fruit of APOCYNACEAE, such as *Landolphia* spp.) and *Annonidium mannii* (*mo.be*), which are gathered in large quantitites and carried to the camp.

Men, especially young men, climb high up the vines to pick and throw down the fruits of *ma.fondo*, while others on the ground collect the dropped fruits. Other kinds of fruits fallen to the ground or growing on shrubs are gathered by both men and women.

(5) Sap

The most important plant for sap use is raffia palm. There are two species of raffia, *mo.sende* (*Raphia* sp.) growing along the Motaba River, and *uondo* (*Raphia* sp.) growing in the inland forest. Raffia sap ferments into palm wine. Both the Aka and villagers gather a large quantity of *mo.sende* wine around the village. The Aka, adult men in particular, staying at the village camp frequently drink *mo. sende* wine. Because palm wine is generally consumed on the gathering spot, it is excluded from the food items studied at the village camp.

(6) Mushroom

The Aka eat many kinds of mushrooms (*bo.kombo*) (Bahuchet, 1985), in the pot-au-feu after shredding. Mainly women, occasionally men, gather them.

4. Fishing

The Aka of Linganga-Makaou, M group in particular, did not fish frequently. They sometimes fished with fish-poison or by bailing out water from a pool.

Fruits of *Brenania brieyi* (*mo.lonju*) and *Ericoelum macrocarpum* (*toko*) are used as fish-poison. Women crash the fruit with machetes for men to scatter them into the stream, and both men and women capture the fish with machetes or sticks. Poison fishing is practiced collectively, even by children.

In fish-bailing, the Aka dam a pool or stream, bail out the water, and capture fish, small crawfish and crabs hiding in the mud. This is mainly done by women (singly or in groups), while men occasionally participate when there are a large number of fish.

Some of the Linganga-Makaou Aka stayed for several months on the southern side of the Motaba River, where they fished by bailing out the water. The Aka in the lower part of the Motaba River and Ibenga River frequently fish in the swamp. Fishing comprises one of the most important subsistence activities in these areas (Hanawa, per. com.; Takeuchi, per. com.). Regional difference in the importance of fishing calls for future research.

5. Agriculture

While most of the Aka are in some way involved in slash-and-burn cultivation, only three Aka households in Linganga-Makaou cultivated crops in the study period. Two households had fields behind the village camp. These fields were formerly owned by some villagers. The Aka, upon receiving the fields, cleared and replanted them for their own use. The Aka fields were much smaller than those of the villagers, less cared for, and not even weeded. Another household had a field 20 minutes' walk away from the village. It had also belonged to a villager, who probably had moved out. This field was better cared for and as large as those of villagers. Apart from these fields, agricultural products claimed by the Aka were not much more than a few patches of plantain and papaya around the village camp.

None of the M group member had his own field with crops in the study period. Five households received some land from a villager, and began to clear fields in February 1992. However, only one of them actually finished clearing, burning and planting. Other households abandoned the fields halfway. Another small group of M group men started clearing the secondary forest in February, but they also abandoned the endeavor halfway.

The major crop planted by the Aka is cassava (*boma*). Plantain (*ngondo*) is also planted, but maize (*mbombo*) is planted by only one household, because it was difficult for the Aka to obtain the maize seeds.

Agricultural food from Aka fields accounted for only a small part of the food they consumed in the village camp. They ate mostly food from the villagers' fields.

The principal crop planted in the villagers' fields is also cassava. Maize is the next largest crop to cassava, and most of it is used to make spirits. The villagers also plant plantain, taro, yam, okra, pineapple, sugar cane, and melon (only the

seed is edible). Peanuts are planted only by one household, and cacao, by a few households, in both cases, as cash crops.

Both the villagers and Aka clear the fields in the dry season from December to February, and burn the fields at the end of the dry season in February and March, then plant in the beginning of the rainy season from March to May. The harvest of cassava starts after 14 months and continues for more than one year. Maize can be harvested after 3–4 months.

The Aka help the villagers with all kinds of agricultural work. Both Aka men and women clear the villagers' fields. Women usually cut the undergrowth with machetes, while men cut down large trees with axes. Aka women also help villager women cook the meal served for the Aka who help the clearing. Only women plant and harvest.

In exchange for their assistance to clear and plant, the Aka are given palm wine, spirits of maize and cassava, cigarettes and marijuana during the work, and meals after the work. They are occasionally given clothes, dishes, pots and machetes. In harvesting the cassava, each Aka woman harvests a basketful of cassava for the villager, carries it to the village, and peels and soaks it in running water. After preparing the villager's portion, she returns to the field to harvest a basketful of cassava for her own.

Aka women are free to gather cassava leaves (*jabuka*) from the villagers' fields. Oil palms (*mbila*) grow in abundance in the secondary forest and the abandoned palm grove near Linganga-Makaou. Although the villagers do not cultivate oil palm, they were supposedly brought in by the cultivators originally. Therefore, I classified oil palm as agricultural food in this paper. These oil palms have no owner, and anyone, including the Aka is free to gather them. The Aka exchange the palm fruit and oil with villagers for cigarettes, marijuana and cassava.

CHANGES IN THE SUBSISTENCE ACTIVITIES AND FOOD INTAKE

1. Semi-Nomadic Movement of M group

The Aka of Linganga-Makaou lead a semi-nomadic life. Figure 3 and Figure 4 show the moves of the M group camp. The group moved the camps several times along the Sombo River from October 1991 to January 1992 (Camp 1–4). The majority of M group returned to the village camp on 11 January, when the rest moved to Camp 5. Some went on to join a gun hunting expedition with the villagers for 1.5 months from the end of January. Others also went gun hunting expedition in March. Those who stayed at the Camp 5 returned to the village camp in March. They did not go to the forest camp in April and May, and stayed at the village camp except when for gun hunting expeditions. In June, some moved to the Boundi grassland camp (Camp 6) and Berandjoko village (Fig. 1), where they participated in the dance performed specially for a deceased relative. Then almost all the members of M group moved to Boundi in the middle of August, and stayed there until the end of October.

The Aka forest camp was generally built near the river, for easy access to water.

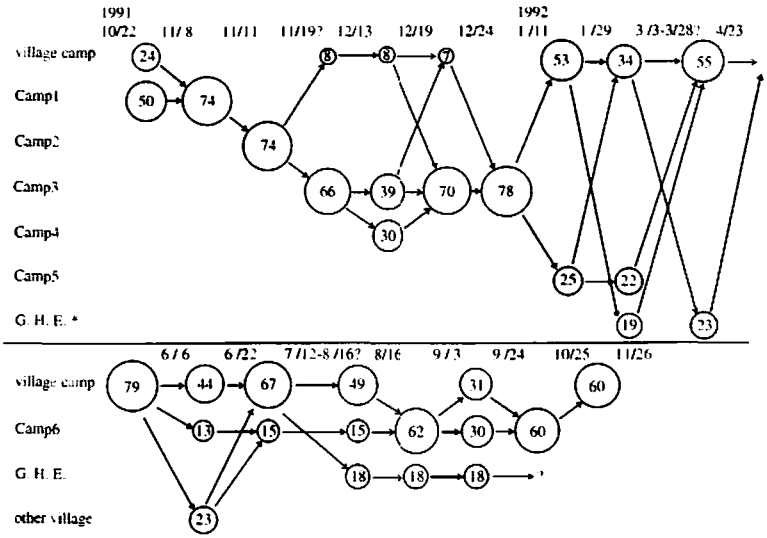

Fig. 3. Changes in the camp size and its location.
*: Gun hunting expedition with villagers.

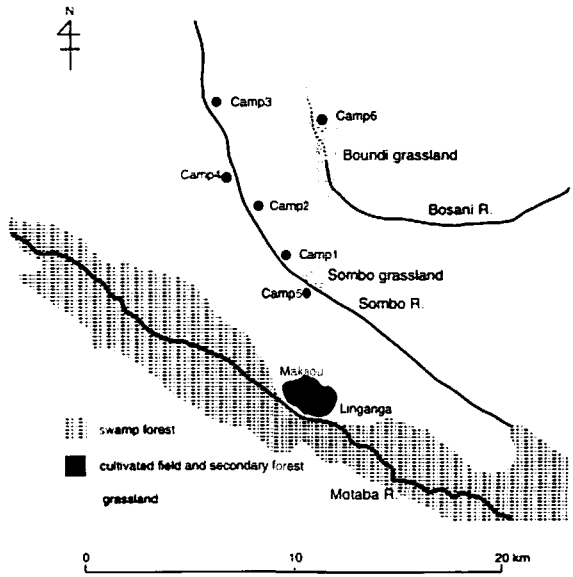

Fig. 4. Location of the forest camps.

Although there was no river around Camp 6, it was near the source of the Bosani River, and they dug a water hole near the camp.

M group utilized the upper Sombo area than the Sombo grassland and the area

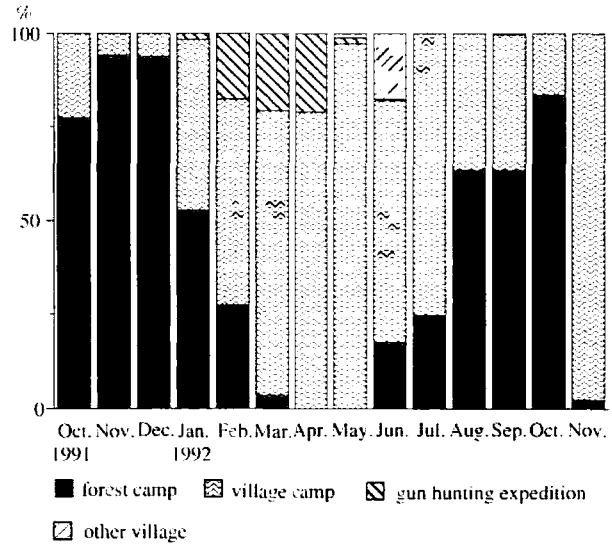

Fig. 5. Monthly change in the proportion to total man-days of man-days spent in different places.

around Boundi grassland. Other groups mostly utilized the lower Sombo area than the Sombo grassland, the Bosani area and the southern side of the Motaba River, with the exception of the Boanga group, who made their camp in the Boundi grassland near Camp 6 from August to September 1992. M group and Boanga group conducted net hunting and spear hunting together then. This was the only occasion when M group hunted together with other groups in the forest.

Each Aka group in Linganga-Makaou utilized a different area in the forest, although its boundary was not clear. Each group had a path extending from the village into the interior forest. The members of each group went to the forest on their own path, and the forest camps were located along this path.

The area M group used for subsistence activities extended from the camps where they stayed. Gathering and trapping were practiced within a radius of 2 km, or 40 minutes' walk from the camp, and net hunting within 3–4 km. The Aka occasionally spent several days in spear hunting, but the exact distance from the camp was unknown. They used an area of about 70 km^2 for gathering and trapping, and 150 km^2 for net hunting.[9] I presume that M group used more than twice as large an area for spear hunting as that for net hunting. The population density of M group in gathering and trapping was 1.2 person/km^2, that in net hunting is 0.54 person/km^2, that in spear hunting was less than 0.3 person/km^2, a figure not much different from that for the Lobaye (0.25 person/km^2) (Bahuchet, 1985).

Figure 5 shows the monthly distribution of M group members by different camps. There are two peaks of residence in the forest camps from October 1991 to February 1992, and from June 1992 to October 1992. In the former period, they lived in the camps along the Sombo River, while, in the latter, in Boundi grassland for five months without shifting the camp.

Table 5. Locations of M group members.

	adult		child		Total (n=57)
	male (n=11)	female (n=15)	male (n=18)	female (n=13)	
forest camp	42.7	43.5	40.1	44.7	42.6
village camp	49.3	52.1	53.5	50.4	51.6
gun hunting expedition	7.2	2.9	3.4	3.8	4.3
other village	0.8	1.5	2.2	1.1	1.6

Note: Proportion (%) of man-days spent in each place to the total number of man-days observed.

The movement pattern of M group in 1991 was quite different from that in 1992. In November 1991, for example, the members stayed almost all the time at the forest camp, while in November 1992, they were at the village camp almost all the time. This indicates that M group does not repeat the same movement pattern from year to year, which I will discuss later.

There was no statistically significant difference in the residence place between men and women, nor between adults and children (Mann-Whitney U-test, $p>0.05$), because the household formed the unit of residential movement (Table 5). Adult men seemed to participate in gun hunting expedition more frequently than other groups, which was probably due to the high participation frequency (about 20%) of two adult men (father and son). These two men were good gun hunters and often asked by the villagers to accompany gun hunting expeditions.

2. Life in the Forest Camp

(1) Seasonal change in each subsistence activity and food

a. Hunting

As shown in Figure 6 and Figure 7, the proportion of the men engaging in hunting activity to the total man-days of stay is 40–70% throughout the year, whereas that of women was lower (0–20%). As stated before, men hunted with different methods, but women performed only net hunting and transported the game hunted with traps (Fig. 8, Fig. 9). Spear hunting by women was once observed in Period 6. This hunt was accidental. It took place when the men had gone spear hunting for several days (*njango*). A women encountered a bush pig near the camp, and the women at the camp chased it with spears.

Major methods of hunting by men in the dry season (Period 2, Period 3) was trapping, in the late rainy season (Periods 1, 5, 6), spear hunting, and in the early rainy season (Period 4), both trapping and spear hunting. Spear hunting was practiced frequently during the rainy season, because the hunter can trace and approach the game more easily when the animals leave clear footprints and hunters can walk more quietly on the wet ground (Bahuchet, 1985). Trapping was possible throughout the year, but traps were not frequently patrolled during the late rainy season when spear hunting was practiced frequently. Traps were not set at Camp 2 in Period 1, because the stay was too short.

The proportion of the men engaging in net hunting to the total man hunt-days was lower than that of spear hunting or trapping. Net hunting was generally per-

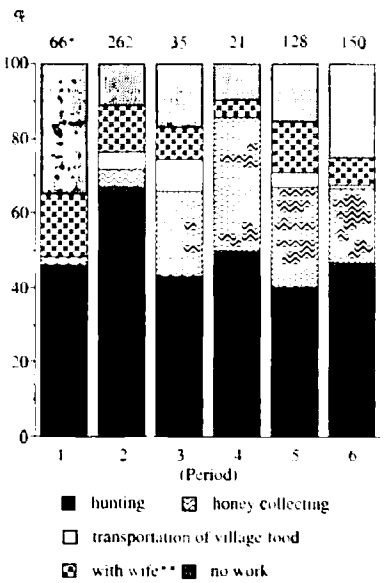

Fig. 6. Change in the proportion (%) of men's subsistence activities.
*: Figures above the graph indicate the number of total man-days observed; **: Proportion of man-days on which man left the camp with his wife, but what he did is unknown.

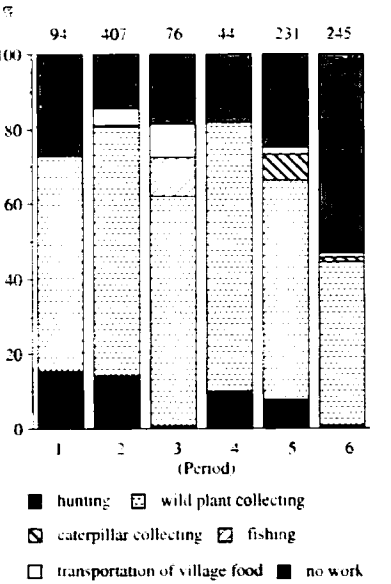

Fig. 7. Change in the proportion of woman's subsistence activities.

formed by a group of a few dozen. The camp size was, therefore, one of the important factors affecting the frequency of net hunting. While the camp size in Periods 1, 2, 5 and 6 was large enough for net hunting, the proportion engaging in net hunting in Period 5 was quite low, even zero in Period 6. This was because it rained frequently in these periods. The Aka keep the nets dry in such weather because wet nets rotted easily. The proportion engaging in net hunting to the total man hunt-days was higher for women than for men, because women sometimes performed net hunting independently of the men who went out for spear hunting. There were also several men who did not participate in net hunting at all. The men of M group did not regard net hunting as an important activity.

The proportion engaging in crossbow hunting also varied for each period, but did not show a seasonal fluctuation. Crossbow hunting showed large individual variation, because specific men hunted frequently with crossbows.

Gun hunting in Periods 5 and 6 comprised a low proportion of 2 or 4%. The villagers usually gave two or three shots, five at the most to the Aka, which the Aka used up only in a few days.

Although the proportion of the men engaging in hunting activities to the total man-days of stay did not vary much, the quantity of game was highly variable (Fig. 10), because the yields from traps and spears, the major methods in the study area, were unstable. Although spear hunting was practiced freqeuntly in Period 1, no

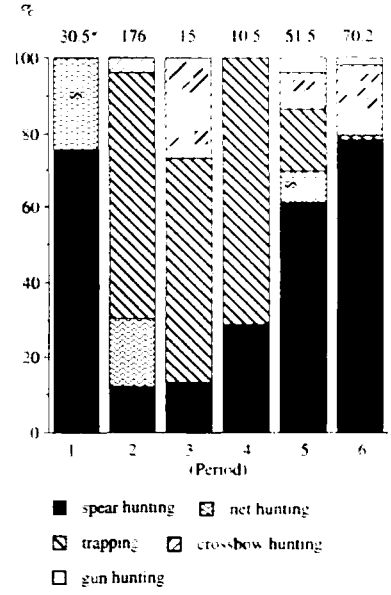

Fig. 8. Change in the proportion of men's hunting activities.
*: Figures indicate the number of total man hunt-days observed.

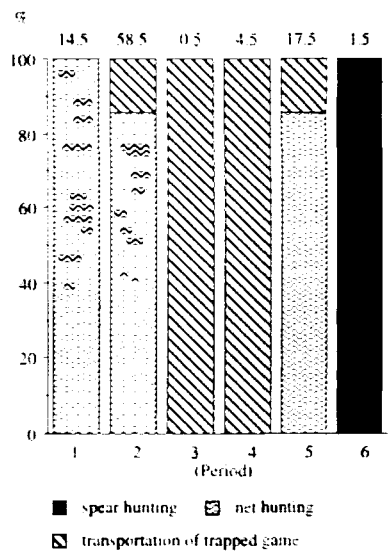

Fig. 9. Change in the proportion of women's hunting activities.

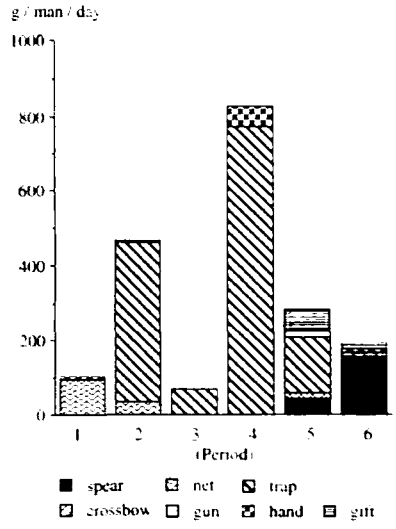

Fig. 10. Change in the meat yield (g/man/day) by each hunting method.

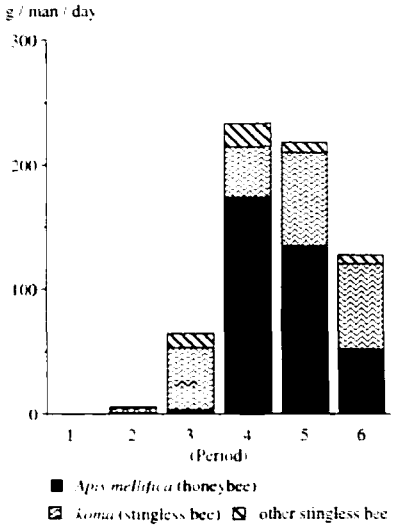

Fig. 11. Change in the honey supply (g/man/day).

game was captured. In Period 3, trapping was the major hunting method. However, only one Peters' duiker (about 20 kg) was captured. In contrast, two yellow-backed duikers and a bush pig (both about 50 kg/head) were captured by traps in Period 4, when the stay was short and the camp size, small.

There was a clear difference in the hunting efficiency between spear hunting and trapping. The yield per man-hunting day was 4.7 kg for trapping, and 1.3 kg for spear hunting. As the working hours for trapping was shorter than that for spear hunting, the difference in the hunting efficiency for the two types of hunting methods per hour would be even greater.

The reason for the Aka practice of spear hunting in spite of its low efficiency during the late rainy season is that spear hunting is highly appreciated as a male activity. Capturing many bush pigs with a spear is the requirement to be regarded as "an adult man" (*bayanji*). Such values attached to a particular hunting method can influence the choice in hunting activities.

b. Collecting of honey and caterpillars

(i) Honey

The proportion of honey collecting to the total man-days of stay clearly varied (Fig. 6). The proportion from the late dry season (Period 3) to the late rainy season (Period 6) in 1992 was 20–40%, with the peak in the early rainy season (Period 4). Honey collecting was seldom observed in the end of the rainy season (Period 1) and early dry season (Period 2). It should be noted that there was a considerable difference between the two successive late rainy seasons in 1991 and 1992.

Honey from two kinds of bees, African honeybees and stingless bees called *koma*, accounted for 93.9% of the total yield of honey.

The honey collected from honeybees per man-day was very small in the late 1991 rainy season and early 1992 dry season, and reached a peak in the early rainy season, then gradually decreased toward the end of the rainy season in 1992 (Fig. 11). The honey collected from *koma* was more stable than that from honeybees, except during the end of the 1991 rainy season and early 1992 dry season.

According to Bahuchet (1985), honeybees begin collecting nectar and pollen in November. Honey saved in the beehive reaches its maximum in June. Then, the bees "hibernate," and begin consuming the stored honey, until they use it up in November, when they begin collecting again. The frequency of honey collecting for the Aka is influenced by the chance of locating the beehives, as well as by the quantity of honey stored in the beehive. Therefore, honey is collected from the dry season to the early rainy season, when bees are most active (Bahuchet, 1985). Table 6 shows the change in the collected quantity of honey per man-collecting day in each period. Honey in a beehive increased rapidly from the late rainy season in 1991 to the early rainy season in 1992, then decreased gradually until the late rainy

Table 6. Fluctuation in the honey yield.

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
honey collected (A)	0.30	11.35	17.40	40.70	175.15	111.55	356.45
man-collecting days (B)	2	15	6	10	44	35	112
A/B	0.15	0.76	2.90	4.07	3.57	3.19	3.18

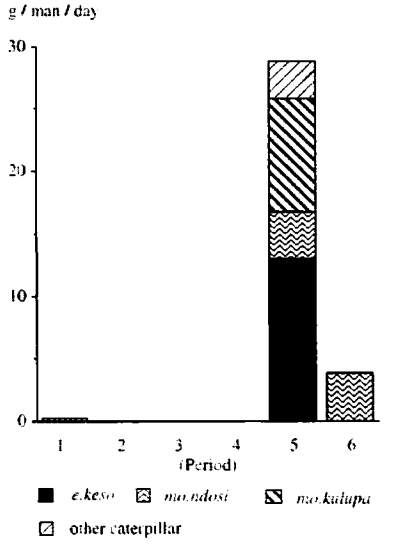

Fig. 12. Change in the caterpillar supply (g/man/day).

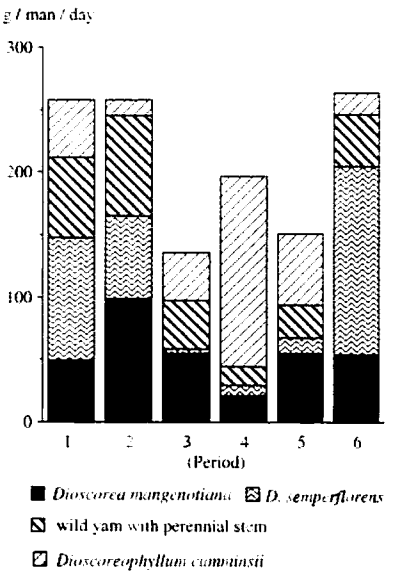

Fig. 13. Change in the wild tuber supply (g/man/day).

season. The frequency of honey collecting was highest at Period 4, the early rainy season when the quantity of honey in a beehive reached its maximum.

While there was almost no honey in the beehives in November 1991, honey was still available in October 1992. In contrast, honey was not observed at Camp 1 in October 1991. There seemed to be a considerable difference in the availability of honey between the two late rainy seasons in 1991 and 1992.

Two reasons may be responsible for this difference: the location of the camp and fluctuation in the quantity of honey from year to year. According to the Aka, there is usually more honey around Boundi grassland and the village than in the Sombo area. Also according to them, honey was more plentiful in 1992 than in 1991. Such fluctuation must be, therefore, related to the distribution and phenology of the nectar-bearing trees. M group moved to places where many beehives were spotted, when there were large amounts of honey stored in beehives.

(ii) Caterpillars

Caterpillars were collected during only the late rainy season (Periods 1, 5, 6), with the peak in August and September (Period 5) (Fig. 7). The daily yield also showed a similar fluctuation (Fig. 12). Six kinds of caterpillars were consumed at the camp in Period 5, three of which were brought from the village camp with agricultural food. Three other kinds (*e.keso, mo.kulupa, mo.ndosi*) were collected around the forest camp.

According to the Aka, the caterpillars are abundant in the late rainy season. But in 1992, far fewer caterpillars were found than the average year. Such multiple-year fluctuations in the availability of caterpillars are also reported in Lobaye, southern C.A.R. (Bahuchet, 1985, Hudson, 1990). The caterpillars feed on the

leaves of species-specific trees. Therefore, the growth of these specific leaves is liable to influence the availability of caterpillars.

According to the Aka, caterpillars are more abundant in the secondary forest near the village. On September 2, 1992, caterpillars became available around the village. Next day, half of the M group members moved to the village. This was the only occasion in which a large quantity of caterpillars were collected around the village in 1992.

c. Wild plant collecting

(i) Frequency of collecting

Gathering wild edible plants is the major subsistence activity for women (Fig. 7). The proportion of women engaged in gathering wild plants to the total man-days of stay showed little fluctuation, with an average of 65%, except in Period 6, when the proportion was only 45%. The reason for this was social. An adult man of M group died of a disease in this period, and women seldom went out to collect plants before and after his death.

(ii) Tubers

The wild yams of the area are divided into two ecological types, one with a perennial stem and the other with an annual or biennial stem (Hladik & Dounias, 1993). Perennial tubers have perennial stems, and include *Dioscorea burkilliana* (*ngange*), *D.* sp. (*ndiki*), and *D. smilacifolia* (*bobaka*). *D. mangenotiana* (*e.kule*) has a biennial stem and a perennial tuber, whereas *D. semperflorens* (*e.suma*) has an annual stem and an annual tuber.

The yield from the yams with perennial stems showed seasonal fluctuation (Fig. 13). The amount of exploitable tuber decreased during the early rainy season (Period 4), probably because they germinated then. But their phenological cycles are longer than one year (Hladik & Dounias, 1993).

D. semperflorens showed a marked seasonal fluctuation in terms of yield per man-day. It was frequently gathered in Periods 1, 2, 6, but seldom in Periods 3, 4, 5 (Fig. 13). The yield of *D. mangenotiana* was small in Period 4 and large in Period 2, but its seasonal fluctuation was not marked.

The yield per man-day for *D. mangenotiana* and *D. semperflorens* were smaller in the early rainy season (Period 4), because nutrients stored in the tubers were consumed for germination and quick growth. The seasonal fluctuation of *D. mangenotiana* was less than that of *D. semperflorens*, probably because the former has a biennial stem, whereas the latter has an annual stem.

According to Bahuchet (1972, 1978, 1985, 1988), the tubers become dry or rotten in September, hence, the best collection season is from the end of October to June of the next year. This is not in accord with my data. The phenology of wild yam has not been studied well, however.

The yield from *Dioscoreophyllum cumminsii* was the largest in Period 4 throughout the study periods (Fig. 13), which suggests that the phenological cycle of *Dioscoreophyllum cumminsii* is quite different from that of *Dioscorea*. Tubers of *D. cumminsii* may have been gathered as a substitute for *Dioscorea* tubers during the early rainy season.

The harvest of *D. semperflorens* tubers requires a special implement. The gathering of other wild tubers is more or less occasional: if an Aka finds a tuber in the

forest, he or she digs it with a machete or a stick. For gathering *D. semperflorens*, they usually carry their digging tool called *jo*. Otherwise they make *jo* on the spot, and exploit a large amount in one place. They know where *D. semperflorens* grow in large quantities. The average weight of the *D. semperflorens* tubers in one man-collecting day in Periods 1, 2, 6 when the Aka gathered them with a *jo*, was much larger than that in other periods (2.3 kg per collecting-may day in Periods 1, 2, 6, $n=131$, against 0.6 kg per collecting-man day in Periods 3, 4, 5, $n=21$. Mann-Whitney U-test, $p<0.05$). Also, the yield from *D. semperflorens* in Periods 1, 2, 6 was about two times as much as that of *D. mangenotiana* in the same periods (1.1 kg per collecting-man day, $n=225$, Mann-Whitney U-test, $p<0.05$). *D. semperflorens* tubers were gathered very efficiently, because the Aka knew where they grew in abundance.

The tubers of *D. mangenotiana* and *D. semperflorens* grow largest in the dry season just before germination. However, these tubers were not exploited much in the late dry season of Period 3 (Fig. 13), when other starchy foods were abundant. As Camp 5 was not far from the village, the Aka transported a large amount of cassava from the village (described in detail later), and they did not gather much *D. semperflorens*. Only wild tubers found by chance in the forest were harvested. Cassava was the major starchy food when transportation from the village was not laborious.

(iii) Leaves

The only edible leaves systematically collected by the Aka was *Gnetum* spp. (Fig. 14). The yield of *Gnetum* spp. per man-day decreased in Period 6, when women did not gather wild plants frequently before and after a death. The leaves of *G. bucholzianum* were observed throughout the study period, whereas those of *G. africanum* were seen only in Periods 5 and 6. The habitats of these two species are different. *G. bucholzianum* is mainly found in the mature forest, while *G. africanum* in disturbed forest (Mialoundama, 1993). The leaves of *G. africanum* were, in fact, mainly collected on the forest fringe, and its fluctuation was due to the location of the camp than the season.

(iv) Seed

The most important seeds, *Irvingia gabonensis* seeds, accounted for 86% in weight of the total seeds collected for food (Fig. 15). According to Bahuchet (1985), its fruiting period is from March to January of the next year, and the collecting season is from March to November. However, it was collected throughout the year in the study area. The yield of seeds from *I. gabonensis* decreased considerably in Period 6, to about a tenth of that in Period 1, although these two periods fall under the same climatic season. A large amount of seeds of *I. gabonensis* was observed at Camp 1 in October 1991. Average weight per man-collecting day, except Period 6, was 1.1 kg ($n=215$), whereas in Period 6, was it 0.24 kg ($n=28$), which is significantly smaller (Mann-Whitney U-test, $p<0.01$). The major factor for this decrease in Period 6 may be the lessening availability of the seeds fallen on the forest floor.

Because of its long fruiting duration, the production of *I. gabonensis* seeds may fluctuate over a longer time span, for example, a few years, than the climatic season. In fact, according to the Aka and my own obsevation, *I. gabonensis* bore

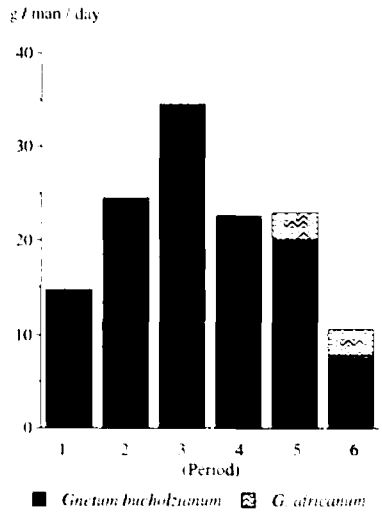

Fig. 14. Change in the wild leaf supply (g/man/day).

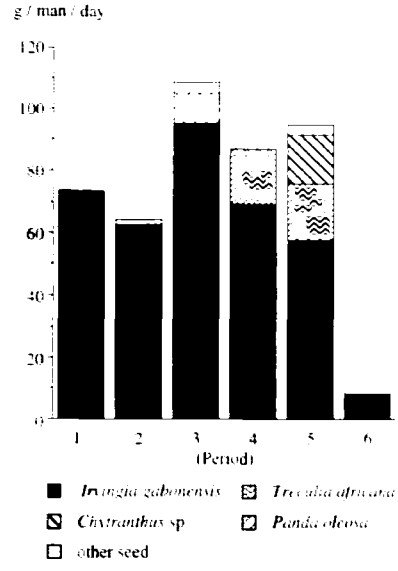

Fig. 15. Change in the wild seed supply (g/man/day).

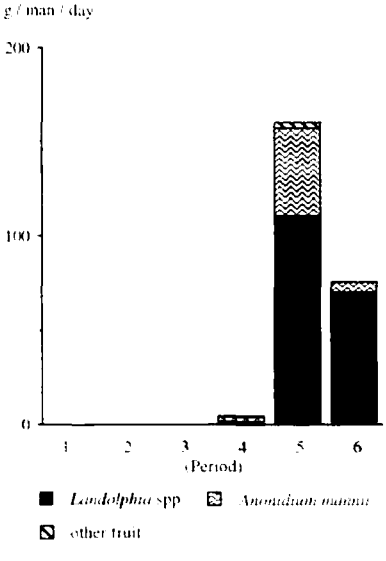

Fig. 16. Change in the wild fruit supply (g/man/day).

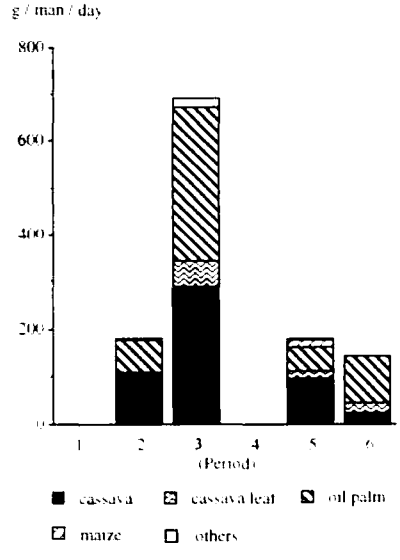

Fig. 17. Change in the agricultural food supply (g/man/day).

more fruits in 1991 and the first half of 1992 than in the late half of 1992.

The seeds of *Panda oleosa* were observed on the forest floor throughout the year. However, they were collected in large quantities and brought to the camp

only once in Period 3. The Aka collected the seeds of *Treculia africana* in the rainy season (Periods 4, 5), and *Chytranthus* sp. in the late rainy season (Period 5).

(v) Fruits

Various fruits were observed throughout the year. However, they were carried to the camp only during the late rainy season, when several kinds of fruits become available in quantity (Fig. 16). The major edible fruit was *Landolphia* spp., which accounted for 76% by weight of total fruits. The camp in the late rainy season was located in Boundi grassland with abundant *Landolphia* spp. vines on the forest fringe. *Anonidium mannii* was another important fruit (accounting for 22% by weight of total fruits), which fructified in the late rainy season.

d. Fishing

Fishing was observed only in the dry season (Periods 1, 2) (Fig. 7). The principal method is bailing out water from a pool, which is suited for the dry season when the water recedes, and the fish become concentrated in small places. It was practiced more frequently in Period 3 than in Period 2.

e. Agricultural food

Transportation of village food was observed in Periods 2, 3, 5 and 6 (Fig. 6, 7). Both men and women transported the village food more frequently in Period 3 than in other periods. The major food brought from the village was cassava and oil palm (Fig. 17). The leaves of cassava were also brought from the village, but did not amount to much in weight. A small amount of maize was observed in Period 5, when maize was harvested. These village foods are rich in energy, containing abundant starch or oil (except cassava leaves).

At least some agricultural food was observed throughout the study periods. Although agricultural food was not transported in Periods 1 and 4, the Aka used cassava and oil palm which had been brought from the village before these periods.

The amount of agricultural food observed in the camp changed considerably with the peak in Period 3. This reflected the frequency of transportation from the village, because cassava and oil palm were abundant in the village throughout the year.

Agricultural food increased in Camp 5 in Period 3, as the camp was only 1.5 hours walk from the village. It took 4–5 hours from the village to Camp 3 and 6, which made it quite laborious to transport a basketful of agricultural food weighing 20–30 kg. As Camp 1 was also located near the village, cassava and oil palm were abundant.

Aka dependence on agricultural food showed inverse correlation to the distance from the village to the camp. Harvesting cassava from the fields and cutting oil palm fruits in the secondary forest was easier than collecting enough wild plants in the forest, hence the Aka depended on agricultural food when the transportation was not hard.

(2) Inflow and outflow of food to and from the camp

The food obtained by the Aka in the forest camp were usually consumed at the camp, except for *Irvingia gabonensis* seeds, some of which were processed into cakes and exchanged with the villagers in Periods 1, 2 and 3.

There were three times when the meat of game hunted without a gun was ex-

changed with non M group members. About 1.2% (17 kg) of the total meat supplied to the forest camp in the six periods,[10] were exchanged once with a villager, twice with the Aka. The former was observed in Period 2. Aka men exchanged the fur of a large carnivorous animal and three limbs of a medium-sized duiker about 15 kg, with a villager's 1.35 kg of plantain and 13 kg of cassava. Leaving this fur out of consideration, the Aka received as little as a half or a third of the agricultural food the Mbuti in Zaire or the Aka in southern C.A.R. obtained in similar exchanges (sources, Bahuchet, 1985; Ichikawa, 1986). In addition, the fur of the large carnivorous animal could be sold for more than 5,000 CFA[11] in the village, and a limb of a medium-sized duiker for 300–500 CFA. The above exchange, therefore, appears to be quite disadvantageous to the Aka. However, this transaction should not be interpreted as a balanced reciprocity (Sahlins, 1972), but something like a gift. These Aka themselves had predicted before leaving for the village that the villager would give him no agricultural food in return.

The two examples of exchange of meat hunted by M group with members of other Aka groups took place on the same day. Two Aka women visited the M group camp, one with caterpillars, the other without anything. It was a day when two bush pigs were killed with traps, and M group members gave them a part of the meat. While the former woman had not intention of barter beforehand, she consequently exchanged her caterpillars for the meat. These examples may be better described as gift giving. The Aka seldom barter foods in the forest camp.

The Aka of M group were often given food when they visited other camps. Or, other camp members visited M group's camp with some food. However, such food accounted for only 0.7% of the total food (34.2 kg). Major gift items thus brought into the camp were the Aka's favorite food, such as meat (5 times), honey (4), caterpillar (2), cassava (2) and palm oil (1). The visitors were mainly relatives of M group members.

There were three times when a villager brought to the Aka camp the meat of a game hunted with a gun (42.2kg, 2.9% of the total meat). When the villager dropped by the Camp 6 on his way to a gun hunting expedition, he gave away a part of an agile mangabey, a buffalo hunted at Boundi grassland,[12] and a yellow-backed duiker. Meat is, however, rarely brought to the Aka by the villagers in the forest camp.

(3) Wild food and agricultural food

Pot-au-feu, the major type of the Aka meal, consists of animal ingredients such as meat, fish and caterpillars, starchy ingredients such as wild tubers and cassava, the oil from *I. gabonensis* or oil palm, and the leaves of *Gnetum* or cassava. While all the animal ingredients are wild, the others may be agricultural food.

As mentioned above, a large amount of agricultural food was supplied in Period 3, when the camp was near the village. The wild tubers reduced its importance in Period 3 although wild tubers were available in the forest (Fig. 18).

The yield of *I. gabonensis* for cooking oil decreased, while that of oil palm increased in Period 6. Yields of both *I. gabonensis* and oil palm in Period 3 were the largest among the six periods (Fig. 15, Fig. 17), but the proportion of *I. gabonensis* actually used for meals was low (Fig. 19). This was because the Aka consumed the

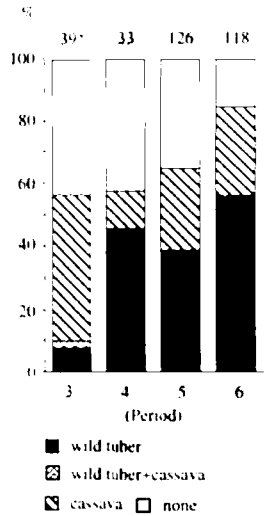

Fig. 18. The proportion of meals with starchy food to the total number of meals.
*: Total number of meals observed.

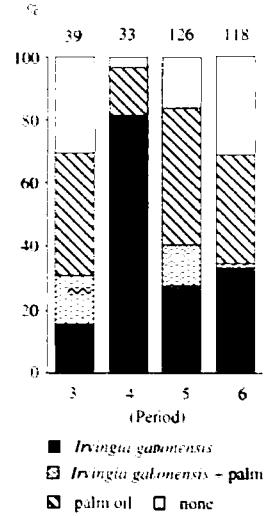

Fig. 19. The proportion of meals with cooking oil to the total number of meals.

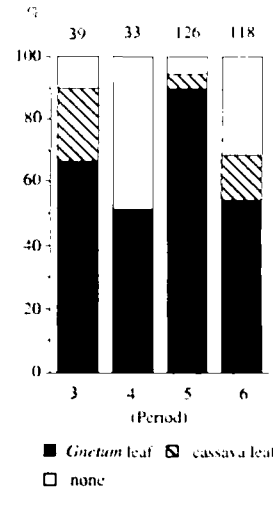

Fig. 20. The proportion of meals with edible leaves to the total number of meals.

oil palm brought from the village, whereas they processed *I. gabonensis* into cakes for exchange with the villagers. A large quantity of oil palm and *I. gabonensis* was observed in October and November 1991 at Camp 1, and *I. gabonensis* seemed have been processed into cakes as in Period 3.

The supply of both *Gnetum* and cassava leaves in Period 3 were the largest among the six periods (Fig. 14, Fig. 17), and it corresponded to the proportion actually consumed (Fig. 20). A large amount of leaves were eaten in Period 3 as a source of protein.

(4) Energy and protein sources

The important sources of energy in the forest camp were wild tubers, seeds of *I. gabonensis*, honey, meat, cassava and oil palm. The importance of each food to the total energy intake varied from time to time (Fig. 21). For example, the ratio of agricultural food increased in Period 3, that of meat was highly variable, that of honey was high in Periods 3, 4, 5 and 6, but almost zero in Periods 1 and 2. Because about 2,000 kcal is necessary for an adult Aka a day (see, Bailey & Peacock, 1988), the energy intake was enough in Periods 2, 3, 4 and 5, while it was as little as a half of the necessary amount in Period 1, and less than three fourths in Period 6.

The major energy sources in Period 1 were wild tubers and *I. gabonensis* seeds. The cassava brought to the camp before the study period was also eaten. However, even if the 500 kcal from the cassava was added, the energy intake still fell quite short in Period 1. This energy shortage was due to the failure in spear hunt-

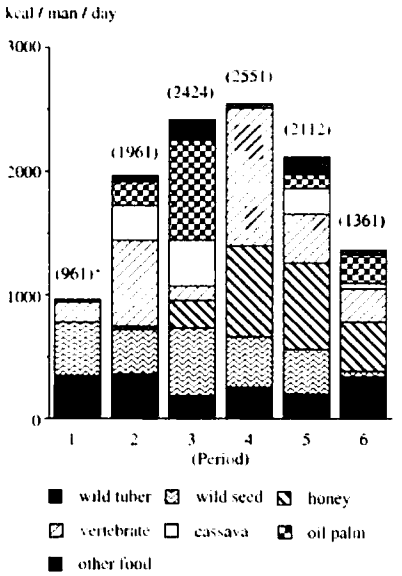

Fig. 21. Change in the composition of energy source supplied to the forest camp (kcal/man/day).
*: Figures in the parenthesis show the total energy intake (kcal/man/day).

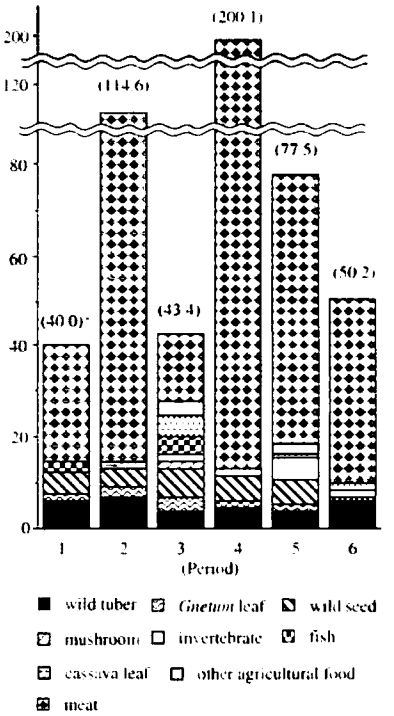

Fig. 22. Change in the composition of protein source supplied to the forest camp (kcal/man/day).
*: Figures in the parenthesis show the total amount (g/man/day) of protein intake.

ing, although spear hunting itself was performed quite frequently. Owing to this energy shortage, M group members stayed at Camp 2 for only 8 days, after which some part of them went to the village to obtain agricultural food, and the others moved to the inner part of the forest where there was more game.

The actual energy intake of the Aka in Period 6 was larger than the value in Figure 21, if we included the energy of fruit, and some honey as well, consumed in this period. They comprise an additional 200–300 kcal, which still falls a little short of the requirement. The shortage in this period was due to the decrease in the *I. gabonensis* seeds and honey. As the food became scare in the end of October, M group returned to the village from Camp 6, where they had stayed for 5 months.

Fluctuation in protein supply was larger even than that of energy (Fig. 22), but it always remained above the requirement, which is about 40 g a day for an adult Aka (see, Bailey & Peacock, 1988). The most important source of protein was meat, which accounted for 81% of the total protein intake. However, the yield of meat is not stable, changing from as much as four times of the requirement in Period 4, to less than 40% (15 g) in Period 3.

The shortage of protein from the meat was supplemented by other sources in Period 3, which boosted the total protein intake. Various kinds of food served as a source of protein, such as *Gnetum* leaves, mushrooms, fish, wild seeds, white beetle larvae extracted from the rotten logs of *Celtis* spp. and cassava leaves.

Thus, I hypothesize that energy is the major ecological factor influencing when and where the Aka camps move, because they seem to obtain enough protein in the forest, but not always enough energy.

3. Life in the Village

(1) Frequencies of food items observed in the village camp

a. Agricultural food

There is little monthly fluctuation in the major food in the village camp. Cassava was observed for more than 70% of the total camp-days, oil palm for more than 80%, cassava leaves for 50–70% (Table 7). The Aka obtained cassava in exchange for agricultural work, for the forest products such as *I. gabonensis*, and as a gift from the villagers. Cassava leaves and oil palm were freely collected in the villagers' fields and the secondary forest. Maize was frequently observed in the harvest season from August to October. The Aka frequently received maize in return for harvesting maize in this period.

b. Wild plant

Wild tubers were far less frequently observed than cassava, ranging from less than 10% to 20–30% in May and June. *Gnetum* leaves were used throughout the year, and showed the highest proportion among wild plants. However, it was lower than that of cassava leaves. Two kinds of fruit, *Myrianthus arboreus* (*e. diki*) and *Gambeya lacourtiana* (*mo.bambu*), were observed for 20–30% of the total camp-days in May and June. A tree of *Myrianthus arboreus* existed in a village camp, and fructified in May and June. *Gambeya lacourtiana* fructified in the forest, and the Aka frequently collected this fruit. Although the season for *Landolphia* spp. and *Anonidium mannii* was from August to October in the forest, most of the fruit was eaten on the gathering site, hence, it was seldom observed in the village camp.

Seeds were often observed in May, June and August. The Aka frequently gathered *I. gabonensis* in May, *I. gabonensis*, *Treculia africana* and *Tetracarpidium conophorum* (*mo.kaso*) in June, *Chytranthus* sp. and *Afrostyrax lepidophyllus* (*mo.ngemba*) in August. *Tetracarpidium conophorum* fruiting in June, and *Treculia africana* from June to August, were frequently eaten in the village camp because they mainly grew in the secondary forest. *Chytranthus* sp. was also eaten in the forest camp in August. The seeds and the skin of the root of *Afrostyrax lepidophyllus* were used as a seasoning for the taste similar to garlic. The root was collected throughout the year, but the seeds only in August and September.

The reason for that wild tubers, fruit and seeds were frequently observed in May and June was frequent net hunting from the village camp in this period. Aka women usually collect wild plants in their spare time during net hunting. The reason for the decrease in the cassava and cassava leaves was also the increased fre-

quency of net hunting. The Aka could not go to the fields when they went net hunting. However, even in this period, cassava and oil palm were far more frequently observed than wild tubers and seeds.

c. Honey and caterpillars

Honey was observed from May to October in the village camp, as well as in the forest camp. The Aka actually ate more honey than the value in Table 7, because honey was often consumed up on the collecting site, and because it was immediately consumed after it was brought to the camp.

Caterpillars were observed from August to October, with the peak in August.

Table 7. Percent of the camp-days when each food item was observed in the village camp.

	1991		1992								
	Nov.	Dec.	Jan.	Apr.	May	Jun.	Aug.	Sep.	Oct.	Nov.	Total
observed camp-days	21	22	6	16	50	74	17	37	18	6	267
wild tubers	4.8	4.5	0.0	6.2	22.0	25.7	5.9	0.0	5.6	0.0	13.1
wild leaves	57.1	36.4	83.3	50.0	54.0	41.9	23.5	21.6	33.3	83.3	42.7
Gnetum bucholzianum	57.1	31.8	50.0	50.0	54.0	37.8	23.5	13.5	16.7	50.0	37.5
G. africanum	14.3	9.1	33.3	0.0	4.0	8.1	0.0	13.5	16.7	33.3	9.4
wild fruit	0.0	0.0	16.7	0.0	30.0	21.6	0.0	5.4	0.0	0.0	12.7
Myrianthus arboreus	0.0	0.0	0.0	0.0	12.0	17.6	0.0	0.0	0.0	0.0	7.1
Gambeya lacourtiana	0.0	0.0	0.0	0.0	18.0	6.8	0.0	0.0	0.0	0.0	5.2
other fruit	0.0	0.0	16.7	0.0	6.0	4.1	0.0	5.4	0.0	0.0	3.4
wild seeds	9.5	0.0	0.0	12.5	58.0	53.9	47.1	8.1	5.6	0.0	31.5
Irvingia gabonensis	9.5	0.0	0.0	0.0	50.0	27.0	5.9	0.0	5.6	0.0	18.7
Treculia africana	0.0	0.0	0.0	0.0	2.0	23.0	5.9	0.0	0.0	0.0	7.1
Tetracarpidium conophorum	0.0	0.0	0.0	0.0	8.0	16.2	0.0	0.0	0.0	0.0	6.0
Afrostyrax lepidophyllus	0.0	0.0	0.0	0.0	12.0	2.7	17.6	2.7	0.0	0.0	4.5
Chytranthus sp.	0.0	0.0	0.0	0.0	0.0	0.0	29.4	2.7	0.0	0.0	2.2
other seeds	0.0	0.0	0.0	12.5	6.0	1.4	5.9	2.7	0.0	0.0	4.1
mushroom	14.3	50.0	16.7	25.0	42.0	28.4	35.3	18.9	27.8	33.3	30.3
honey	0.0	0.0	0.0	0.0	12.0	6.8	5.9	2.7	0.0	0.0	4.9
caterpillar	0.0	0.0	0.0	0.0	0.0	0.0	41.2	24.3	11.1	0.0	6.7
vertebrate	33.3	54.5	33.3	43.8	26.0	25.8	23.5	40.5	33.3	16.7	32.2
fish	4.8	4.5	16.7	12.5	0.0	0.0	0.0	2.7	0.0	0.0	2.2
reptile and bird	0.0	4.5	0.0	0.0	0.0	1.4	0.0	2.7	0.0	0.0	1.1
mammal	28.6	45.5	16.7	37.5	26.0	24.3	23.5	37.8	33.3	16.7	29.6
agricultural food	100.0	100.0	100.0	100.0	94.0	94.6	100.0	100.0	100.0	100.0	97.4
cassava	81.0	86.4	100.0	93.8	74.0	74.3	82.4	91.9	94.4	100.0	82.4
cassava leaves	66.7	68.2	50.0	56.2	54.0	54.1	64.7	62.2	66.7	50.0	58.8
plantain	9.5	4.5	33.3	0.0	0.0	2.7	11.8	2.7	0.0	0.0	3.7
maize	14.3	4.5	0.0	0.0	0.0	14.9	70.6	67.6	44.4	33.3	23.2
oil palm	81.0	90.9	100.0	100.0	82.0	82.4	82.4	86.5	88.9	100.0	85.8

Table 8. Acquisition method of the meat observed in the village camp.

Method	spear hunting	net hunting	trapping	capture with hand	gun hunting*	given from villagers**	unknown	Total
No. of times	1	9	9	5	33	19	10	86
percent	1.2	10.5	10.5	5.8	38.4	22.1	11.6	100

*: Meat given from villagers in reward for gun hunting; **: Meat given from villagers but not in reward for gun hunting.

Caterpillars comprised an important source of protein, supplementing meat. A large amount of caterpillars emerged around the village from the end of August to the beginning of September 1992, when each person collected one or two basketfuls of caterpillars. Caterpillars were abundant only at this time. The Aka exchanged one or two basketfuls of caterpillars for manufactured goods such as a plate and glass with the villagers and traders.

d. Meat

Table 8 shows the proportion of the meat acquired by each hunting method to the total number of meat acquisition. All meat received from the villagers had been hunted with guns, accounting for 60.5%, whereas the proportion of meat hunted with Aka's own tool is as low as 27.9%.

Meat was observed for 29.6% of the total camp-days. As game was hunted in the forest camp on 48 among 92 days (52.2%), the rate of meat consumption in the forest camp was significantly higher than that for the Aka in the village camp ($\chi^2 = 15.3$, $p < 0.001$). They mainly obtained parts of animals from the villagers or from gun hunting, therefore, the amount of meat actually consumed in the village camp was even smaller than that in the forest camp.

(2) Subsistence activities in the village

a. Agricultural work

The Aka in the village camp collect oil palm and cassava leaves, and obtain cassava in return for helping the villagers throughout the year. These activities basically support the life in the village camp, and mainly performed by women.

In addition to cassava harvesting, clearing fields and planting are the Aka's main agricultural work. I did not observe maize harvesting by M group in 1992, because most members stayed in the forest camp during the harvest season. Other camp members staying in the village camp frequently helped the villagers with the maize harvest.

Most of the M group members stayed in the forest camp in November and December 1991, some of whom returned to the village camp on 11 January 1992. When they left the forest camp, they stated the intention of clearing the villager fields. These members actually cleared the villager fields, the men for more than 50% of total observed man-days, and the women for about 25%, during the dry season (Table 9).[13] The villagers generally offer these workers a meal after work. This meal is usually pot-au-feu, consisting of meat and cassava leaves seasoned with palm oil and salt, and cassava porridge (*mbala*). The Aka like this kind of meal because meat is scarce in the village camp, and salt is precious to them. This meal is, combined with alcoholic drink, cigarettes and marijuana, necessary to en-

Table 9. Frequency of work when M group members stayed in the village camp.

		dry season			early rainy season					late rainy season			
		Jan.	Feb.	subtotal(%)	Mar.	Apr.	May	Jun.	subtotal(%)	Sep.	Oct.	Nov.	subtotal(%)
observed days		14	13	27	1	20	13	15	49	4	1	5	10
total observed man-days	(A)	104	56	160	5	198	148	87	438	24	11	60	95
	(B)	158	95	253	8	313	233	128	682	32	17	67	116
clearing villager fields	(A)	54	33	87(54.4)	1	3	0	0	4(0.9)	0	0	0	0 (0.0)
	(B)	45	20	65(25.7)	0	5	0	0	5(0.7)	0	0	0	0 (0.0)
clearing Aka fields	(A)	0	3	3 (1.9)	0	0	0	0	0(0.0)	0	0	0	0 (0.0)
	(B)	0	3	3 (1.2)	0	0	0	0	0(0.0)	0	0	0	0 (0.0)
planting villager fields	(B)	0	0	0 (0.0)	0	25	12	5	42(6.2)	0	0	0	0 (0.0)
planting Aka fields	(B)	0	0	0 (0.0)	0	0	2	0	2(0.3)	0	0	0	0 (0.0)
spear hunting	(A)	0	0	0 (0.0)	0	0	0	0	0(0.0)	0	0	11	11(11.6)
net hunting	(A)	0	0	0 (0.0)	4	0	25	0	29(6.6)	0	0	0	0 (0.0)
	(B)	4	1	5 (2.0)	7	0	35	0	42(6.2)	0	0	0	0 (0.0)
gun hunting	(A)	9	4	13 (8.1)	0	13	6	1	20(4.6)	1	0	3	4 (4.2)
fishing	(A)	0	1	1 (0.6)	0	1	0	0	1(0.2)	0	0	0	0 (0.0)
	(B)	0	7	7 (2.8)	0	30	0	0	30(4.5)	0	5	0	5 (4.3)

(A): male; (B): female.

tice the Aka to clear the fields. The meal, thus offered by the villagers once in two days for men, once in four days for women, occupied the important part of the food in this period.

In contrast, the Aka spent less time clearing their own fields (Table 9). M group members began clearing their own fields in the middle of February. This work was, however, observed only for one day, because I was then in the forest camp. Clearing seemed to take only three or four days, as Aka fields had been abandoned recently, and were smaller than those of the villagers without any big trees.

When clearing and burning the villager fields were completed in April, planting, a women's work, followed. It started in April, and gradually finishing in the end of June. The villagers offered a meal and some alcoholic drink this time also, in reward for Aka help.

The Aka also planted their own fields. However, only one household completed planting, and other fields were abandoned before clearing or were not planted at all. The reason for this would be that the Aka moved into the forest for gun hunting expeditions, and it was troublesome for the Aka to obtain cassava stems.

b. Hunting

While the Aka actually practiced several hunting methods at the village camp, only spear hunting, net hunting and gun hunting are analyzed here. The trap patrol and crossbow hunting were generally performed in the morning or evening, and it was difficult to observe their frequencies accurately.

Although the ratio of gun hunting to the total man-days of stay does not exceed 10%, it was observed in almost all months (Table 9). Gun hunting did not show a clear seasonality, and the villagers obtained meat fairly stably.

Gun hunting was more frequently performed in the village camp than in the forest camp, although there were more game in the interior forest. This was because the villagers wanted to exert ownership of the hunted meat. If no villager was present at the forest camp, the Aka might eat the whole meat. The villagers

thus preferred to let the Aka either hunt with the villagers or hunt from the village camp.

Spear hunting was observed in the village camp only in the late rainy season in November 1992 (Table 9), although the frequency was as low as a half of that in the forest camp. Net hunting was carried out on two days among 27 in the dry season. However, adult men did not participate. They did not need to hunt much because they could obtain meat from the villagers in return for clearing the fields. Net hunting was frequently performed in May because clearing and planting villager fields was nearly finished. Other camps carried out net hunting in June. However, M group did not, because some net owners left for the forest camp or other village.

In general, the Aka preferred hunting with guns when they stayed at the village camp to hunting with nets and spears. They even asked the villagers for a gun and ammunition in return for clearing the fields.

I suppose that hunting efficiency was lower around the village than around the forest camp, because of the high hunting pressure of the former. Actually, the average yield from net hunting per hunting day in the forest camp was almost twice as much as that in the village camp (11.2 kg, $n=11$ in the forest camp, 5.8 kg, $n=8$ in the village camp). The average yield per hunter-day in the forest camp was also about twice as much as that in the village camp. Net hunting or trapping were practiced within the range of one-hour walk from the camp, whereas gun hunting and spear hunting were done far away from the camp. Guns were much more effective than spear or crossbows. The Aka hunters seldom failed if they had two shots. Thus they preferred to hunt with guns.

c. Fishing

Fishing by M group was rarely observed, except in April when fish-bailing was performed on 8 days among the 20 days observed. In April, clearing the fields had already finished, and the water level had not risen, hence fishing was often practiced. Other fishing methods included poison-fishing which was carried out only once in the dry season.

DISCUSSION

1. Comparison of the Aka with Other Hunter-Gatherers in the Congo Basin

(1) Hunting

Compared with the other hunter-gatherers in the Congo basin, the Aka in Linganga-Makaou depend more on other hunting methods than net hunting. Net hunting is the most important hunting method of the Mbuti (except the Efe, whose major hunting method is the bow and arrow hunting) and the Aka in Lobaye (C.A.R.), and Ibenga (Northeastern Congo) (Tanno, 1976; Hart, 1978; Ichikawa, 1983; Bahuchet, 1985; Takeuchi, in prep. a). The observed frequency of net hunting in the forest camp was quite low, and the average yield was also quite small (Table 10). The nets of the Aka in Linganga-Makaou were neither enough in number nor in length for effective hunting (Table 10: Ichikawa, 1983). The Aka in

Table 10. Comparison of net hunting in the Congo basin.

hunters	data source	frequency of hunting (%)	average yield of a hunt day (kg)	average length of nets (m)	number of nets
Mbuti	Tanno, 1976	?	63.3	80.0	10–14
Mbuti	Hart, 1978	98/142 (69)	25.3	?	?
Mbuti	Ichikawa, 1983	25/27 (93)	35.8	63.5	10–11
Aka	Takeuchi, in prep. a	26/43 (60)	43.5	49.3	12–20
Aka	this study	11/92 (12)	11.2	30.0	6
Aka	this study (Period 1+2)	9/33 (27)	12.3	30.0	6

Linganga-Makaou seemed to be interested neither in making longer nets nor in net hunting itself.

The average amount of meat supplied to the forest camp throughout the study period was 0.36 kg per man-day, not much different from the Aka in Ibenga 0.31 kg (see, Takeuchi, in prep. a). However, the Mbuti in Ituri are reported to yield 0.74 kg per man-day (Ichikawa, 1983), which is about twice as much. As 46% of meat hunted by the Mbuti was traded with the neighboring cultivators or meat traders, the actual amount consumed by the Mbuti would be 0.4 kg per man-day, an amount again similar to that of the Aka in Ibenga and this study, who seldom exchanged meat with the cultivators. The Aka in Linganga-Makaou acquired the meat mainly from traps, which accounted for 75% of the total meat supplied in the forest camp. In addition, the Aka also obtained meat from spear hunting and net hunting, which together made the amount of meat eaten by them equal to that eaten by the other hunters with different principal hunting methods.

The target game of net hunting is different from that of trapping and spear hunting. Almost all the game from net hunting is small — or medium-sized duiker. The proportion to the total catch as reported by Tanno was 98% (1976), and 85% by Ichikawa (1983), 91% by Hart (1978), 98% by Takeuchi (in prep. a) and 100% in this study. In contrast, the game from spear hunting consisted solely of bush pig, and 37% of that from trapping was wild boar (bush pig and giant forest hog), about 40% of the total meat in this study.

Meat without enough energy-rich fat is an inefficient source of energy and imposes a physiological strain if eaten for a prolonged period as a source of energy (Speth & Spielman, 1983). As the meat of forest duikers is lean except in the dry season, it is not adequate as a source of energy (Hart & Hart, 1986; Bailey et al., 1989). However, the meat of wild boars contains abundant energy-rich fat, and is good source of energy.

(2) Dependence on wild food or agricultural food

While dependence on agricultural food in the village is reported for all the hunter-gatherer groups in Central Africa, the Aka in Linganga-Makaou were less dependent on agricultural food in the forest camp than others (Table 11). Wild plants and animal accounted for 82% of the total amount of food consumed in the six periods, or 78% of total energy. Agricultural food accounted for only 18% by weight, or 22% by energy. In contrast, agricultural food accounted for about 50% of total energy intake for other hunter-gatherers, except the Mbuti reported by

Table 11. Percent of energy source in the forest camp of the hunter-gatherers in the Congo basin.

people	season	animal	wild plant	honey	Agri.*	oil palm
Mbuti (1)	early rainy season	6.7	0.5	81.9	11.0	0.0
Mbuti (2)	dry season	32.6	4.1	0.0	63.3	0.0
Efe (3)	randomly selected days	7.0	19.5	23.1	40.7	9.6
Efe (4)	late rainy season	31.9	9.3	15.9	33.9	3.3
Aka (this study)	Period 1–6	26.8	36.1	14.9	11.1	11.1

*: Agricultural food except oil palm.
Source: (1) Ichikawa, 1981; (2) Ichikawa, 1986; (3) Bailey & Peacock, 1988 (Calculated from Table 5.5 and Fig. 5.2); (4) Sawada, 1990.

Ichikawa (1981), who depended mainly on honey in the honey season. For other Aka groups, the frequency of food items observed in meals in Lobaye was reported (Bahuchet, 1988), according to which, agricultural food also accounted for about a half of total food intake (agricultural food 55%, wild food 45%).

The proportion of agricultural food except oil palm to the total food intake in Linganga-Makaou was quite low compared with other areas (Table 11). This means that the Aka in Linganga-Makaou depend least on agricultural food obtained from the villagers. Instead, the proportion of oil palm in Linganga-Makaou, which was almost equal to that of cassava, was higher than in other areas. The high proportion of agricultural food among total food items in Period 3 in this study was mainly due to the increase in oil palm; the proportion of agricultural food was 51.4%, and that of oil palm was 33.6%.

It is reported that the Aka dependence on agricultural food in Lobaye is related to the distance from the village to the camp (Bahuchet, 1988). When the camp was far from the village (5–8 hours' walk), the frequencies of *I. gabonensis* and *Gnetum* leaves in meals were high, whereas when the camp not so far (3–4 hours' walk), the dependence on agricultural food such as oil palm and cassava leaves increased. This corresponded to the fact that a large amount of oil palm and cassava leaves were carried in Period 3 to the forest camp which was near the village.

However, the dependence on starchy food showed a remarkable difference between the Aka in Lobaye and in Linganga-Makaou. In Lobaye, when the camp was far away from the village, the frequency of cassava, which can be easily transported, in meals was high, whereas when it was not so far, that of the plantain became high. The frequency of cassava and plantain combined remained always 40–80%, and that of wild tubers was quite low (average 4%), independently of the distance from the village. In Linganga-Makaou, however, the proportion of wild tubers accounted for 34–100% in energy of the total starchy food. Wild tubers consumed even at the remote forest camp in Lobaye were much less than that at the camp near the village in Linganga-Makaou.

2. Contrastive Dual Modes of Life in the Forest and in the Village

Life in the forest camp is quite different from that in the village camp. The Aka depend on hunted and collected wild food in the forest, whereas in the village, they provide agricultural work to the villagers, and mainly eat agricultural food and the

meat from game hunted with guns. The Aka in Linganga-Makaou eat much more wild food than the other groups of hunter-gatherers in the Congo basin. Both ecological and socio-economic factors are involved in their heavy dependence on the forest products.

First, the bulk of energy intake is the forest in supplied by wild plants, such as wild yams and oleaginous seeds of *I. gabonensis*. According to Bailey et al. (1989), the edible food in the tropical forest are widely dispersed in both space and time. The seeds and fruits often have hard outer coatings, and tubers entail considerable digging and preparation. These factors tend to make foraging and handling costs of vegetable foods relatively high. However, this was not applicable to the study area. Here, all the edible wild tubers have no poison, and can be eaten after boiling or baking (Bahuchet et al., 1991). All edible tubers, except *D. semperflorens*, can be easily dug with a simple digging stick or machete. The tubers of *D. semperflorens* are collected efficiently with the special digging tool, *jo*. Although the seeds of *I. gabonensis* have hard outer coatings, the Aka easily crack them with an axe or machete.

According to Hart & Hart (1986), most, if not all, food plants in the tropical forest in northeastern Zaire are light-demanding species. They cannot grow under undisturbed mature forest. It is possible that there is a difference in the density of food plants between the semi-deciduous forest where the Aka live, and the evergreen forest where the Mbuti live. A typical light-demanding food species is wild yam. It is reported that the density of wild yam in the evergreen forest is lower than that in semi-deciduous forest; wild yams require relatively open or disturbed environments (Hladik et al., 1984; Hart & Hart, 1986). There are scattered grasslands in northeastern Congo. Many *Dioscorea* species, in particular, *D. semperflorens*, favor the fringe of such grasslands. *Landolphia* spp. are also frequently found on the fringe of grasslands.

The foregoing discussion on ecological difference between the evergreen forest in Ituri and the semi-deciduous forest in northeastern Congo and southern C.A.R. is not relevant to the difference between in Lobaye and in Linganga-Makaou, since both are in the semi-deciduous forest. Rather, the hunting method is one of the reasons for this difference. In Linganga-Makaou, trapping and spear hunting provide the Aka with energy-rich fatty meat of wild boar, which composes important sources of energy along with wild plants.

Trapping and spear hunting have another advantage over net hunting. Women's participation is required for net hunting, whereas men alone can perform trapping and spear hunting. Therefore, women can collect wild food during that time. Men can help women collect food after the patrol of traps. They dig up long tubers of *D. semperflorens* as they go, an activity not limited to women. These factors also allow high dependence on wild food.

For subsistence by hunting and gathering, the ecological condition in northeastern Congo is better than that in Ituri. However, this alone cannot explain why the Aka in Linganga-Makaou depend so heavily on wild food. Almost similar ecological conditions of Lobaye and Linganga-Makaou, except for the hunting method, suggests that the ecological factor may not be so important as an explanation. Moreover, the Aka in Ibenga, whose major hunting method is net hunting,

reportedly collect wild plants in the forest frequently (Takeuchi, in prep. a, although no quantitative data available).

At present, the villagers acquire meat from the hunting with their own guns, asking the Aka to hunt. The meat hunted by the Aka with Aka's tools is not exchanged with the villagers. Meat acquired in large amounts from gun hunts is sometimes brought to the towns along the Oubangui River for sale. The hunts with less efficient tools of the Aka are inefficient as commercial hunts, although they are efficient enough for subsistence hunts. Even if traders buy meat from the Aka and transport it to the town for sale, they cannot expect much profit, with all quite laborious work of transportation. Therefore, meat hunted from hunts with the Aka's tools is less part of the local economy than meat from gun hunts. Thus, almost all meat acquired by the Aka's own tools is consumed by the Aka.

Tanno (1991) has reported that the Aka in northeastern Congo cannot obtain much agricultural food from the exchange of meat, because the villagers themselves acquire meat with guns. The Aka, therefore, frequently collect wild plants and oil palm instead. In contrast, about half the meat hunted by the Mbuti is exchanged with traders and neighboring cultivators. Meat thus exchanged accounted for 38% of total meat in Hart (1978), and 48% in Ichikawa (1986). In Lobaye, the Aka exchange 38–50% of meat with the neighboring cultivators, who sell it to traders from the towns (Bahuchet, 1990). The viability of such a trade seems to rest on the short distance from a large town and the ease of transportation.

The Mbuti net hunters do not depend heavily on wild plants. This specialization is reinforced by the commercial trade which connects the forest life with large population centers (Ichikawa, 1986). There may be a similar situation in Lobaye. The current situation of local economy in northeastern Congo is quite different from that in Lobaye and in northeastern Zaire. This probably leads to the difference in the dependence on agricultural food in the forest camp.

However, low dependence on agricultural food does not seem to be caused by the spread of guns only. According to Takeuchi (in prep. a), guns rapidly spread among the cultivators only in the last ten years. It is unlikely that the subsistence activities of the Aka drastically changed in such a short period. The exchange rate of meat for agricultural food was quite disadvantageous to the Aka in Ibenga even before the spread of guns, compared with the Mbuti or the Aka in Lobaye. It is doubtful, therefore, whether the Aka in Ibenga could obtain enough agricultural food in exchange for meat.

There were only one or two guns in Linganga-Makaou at the independence of Congo (1960). Almost all households have at least one gun at present. The villagers now can easily obtain meat from gun hunting. The Aka probably exchanged meat for agricultural food with the villagers before the introduction of guns, although never a large amount. At present, the forest products used by the Aka for exchange in large quantities are *Irvingia* seeds and caterpillars. One or two basketfuls of caterpillars are collected for exchange. Or, a large amount of seeds of *I. gabonensis* is collected to make cakes. While small amounts of caterpillars and *Irvingia* seeds are exchanged for agricultural food, rich cakes and basketfuls of caterpillars are exchanged for manufactured goods, such as plates

and clothes. The villagers decide what is to be offered to the Aka for exchange, but they also know the Aka's preference for manufactured goods. However, the details of meat exchanges before the introduction of guns are still waiting to be studied to reconstruct the history of the economic relationship between the Aka and the villagers.

The life at the village camp of the Aka in Linganga-Makaou is also different from that of the other hunter-gatherers in the Congo basin. For the Aka of Linganga-Makaou, the meat from game hunted with guns occupies an important part of the meat eaten in the village camp. Since owners of guns are the villagers, who by custom own the meat, they usually have more meat than the Aka. According to Hudson (1990), the Aka in Lobaye from 1986 to 1987 depended on the meat acquired with villagers' guns as well as the meat coming from the interior forest, because the game was over-exploited around the village.

In the study of hunter-gatherers in the Congo basin, the exchange of food between hunter-gatherers and cultivators has been regarded as an interdependent system between protein producers and energy producers (Ichikawa, 1986). In Linganga-Makaou, however, there is no exchange of meat at the forest camp, and it conversely flows from the villagers to the Aka in the village camp. The Aka has a contrastive dual modes of life, in the forest as opposed to in the village. They are independent of the villagers in both energy and protein in the forest camp, whereas they are dependent on both agricultural food and meat from the villagers in the village camp.

Although the Aka began to depend on villagers' meat in the village camp recently, their dependence on wild food may well date back prior to the introduction of guns to the area. The present Aka case may shed new light on the history of economic relationship between hunter-gatherers and cultivators in the Congo basin.

3. Seasonality of Subsistence Activities and Food Intake

Camp movement and change in subsistence activities are partly influenced by the availability of food resources, energy intake in particular, in the forest. Major sources of energy in the forest camp consisted of wild tubers, *Irvingia* seeds, honey, meat and agricultural food such as cassava and oil palm.

Another cause of camp movement is related to the availability of forest products for exchange with the villagers. The most important forest products for exchange in Linganga-Makaou were the *Irvingia* seeds and caterpillars (Kitanishi, 1994).

In tropical forest, water stress stimulates the flowering and leaf shedding of most plants (Mabberley, 1992). The onset and duration of the dry season vary from year to year in the study area. Influenced by these variation, the time of flowering and leaf shedding varies from year to year, which in turn affects the activities of bees collecting pollen and nectar, and caterpillars feeding on the leaves. Fruit-eating duikers and omnivorous wild boars are also likely to be influenced. In Borneo, "mast fruiting," the synchronized fruiting of Dipterocarpaceae species, occurs once in several years, which influences the migration of bearded pigs (Dove, 1993). Human activities depend on all of the above factors.

Caterpillars were collected in a large amount in the secondary forest around the

Table 12. The change in camp location, energy source and exchange items in the study period.

	location of camp	distance*	major energy source	exchange item
1991				
Oct.–Nov.	Camp 1 (Sombo)	near	Agri. food,** *I. gabonensis*	*I. gabonensis*
Nov.	Camp 2 (Sombo)	far	*I. gabonensis*, wild tuber	*I. gabonensis*
1992				
Dec.–Jan.	Camp 3 (Sombo)	far	*I. gabonensis*, wild tuber, meat from trapping	*I. gabonensis*
Jan.–Feb.	Camp 5 (Sombo)	near	Agri. food, *I.gabonensis*	*I. gabonensis*
Jan.–Feb.	village camp	village	Agri. food, villager meal***	
Apr.–Aug.	village camp	village	Agri. food	
Jun.–Sep.	Camp 6 (Boundi)	far	honey, *I. gabonensis*, meat from trapping	
Sep.	village camp	village	Agri. food	caterpillar
Oct.	Camp 6 (Boundi)	far	honey, wild tuber, meat from spear hunting	
Nov.	village camp	village	Agri. food	

*: Distance from the village; **: Agricultural food; ***: Meal offered from the villagers in reward for clearing the villager fields.

village, but they were less abundant in 1992 than in an average year. There were many sources of honey around the village and Boundi grassland, and honey was scarce in 1991, but plentiful in 1992. The seeds of *I. gabonensis* were collected in a large amount around the Sombo River and Boundi grassland. There was much fruit in 1991 and the first half of 1992, but not much in the latter half of 1992. It is, however, unknown to me whether other important food sources fluctuate from year to year.

Table 12 shows the shift in subsistence activities and major food resources during the study period, in conjunction with the camp location and exchanged items. I hypothesized that the availability of honey, *I. gabonensis* and caterpillars (also wild yam?) influenced the seasonal change in the subsistence activities, food, and the location of the camp. Observation was made twice for the months of October and November, but the location of the camp and major foods showed complete difference between the two months of successive years. The yields of honey and *Irvingia* seeds in 1991 were different from that in 1992. The subsistence activities of the Aka could not be represented by an annual cycle of a simple calendar.

The subsistence activities of the Mbuti show a clear seasonal cycle. The Mbuti are engaged in net hunting during the dry season, honey collecting and net hunting during the early rainy season, and agricultural work at the village during the late rainy season. Yearly fluctuation results only from the availability of honey (Ichikawa, 1978). According to Bailey & Peacock (1988), the subsistence activities of the Efe archers exhibit a similar seasonal change to that of the net hunters. However, it is reported that their subsistence activities also vary from year to year. This fluctuation depends on the success or failure of the cultivators. If cultivators have a bad crop, the Efe, depending on agricultural food for their energy, move to another village where more agricultural food is available.

The subsistence activities of the Aka in Lobaye during the dry season change from year to year, clearing the cultivators' fields in one year, net hunting another. They move to the areas with a high density of caterpillar-yielding trees during the rainy season. Thus, their activity cycle is stable if two years are regarded as form-

ing one cycle.

The Mbuti and the Aka in Lobaye both have staple agricultural foods as major sources of energy, meat as a major source of protein and exchange item, and honey and caterpillars as temporary supplements. In contrast, the Aka in Linganga-Makaou use many kinds of food as sources of energy, such as wild tubers, wild seeds, meat, honey and agricultural food, and use *I. gabonensis* and caterpillars as exchange items.

The subsistence activities and food of the Aka in Linganga-Makaou are diverse and generalized. The Mbuti show specialization, concentrating on net hunting in the dry season, honey collecing in the early rainy season. In order to understand the spectrum of subsistence activities in the Congo basin, we need further ecological, economic, social and historical studies.

The ecology of wild animals and plants and the subsistence activities of the hunter-gatherers in the tropical rain forest show a longer term of fluctuation than a single annual cycle, that has not been studied enough. Recently, several researchers have argued that humans may never have lived in tropical rain forest independently of domesticated plants and animals. In order to answer this problem, the long-term fluctuation in food availability should be investigated.

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NOTES

(1) At present, people classified as Kaka by the colonial administration live in the several villages of upper Motaba. Among them, Zingo and Likombo villages speak Gbaya, an Ubangian language, having migrated from C.A.R.; Bangui-Motaba Bantu language of A group (Guthrie, 1967), Seke Gbanzili-sere of Ubangian language, from Lobaye in C.A.R., Linganga-Makaou, Pape, Bei and Bonzanda Bantu language C group, from the neighborhood of Bayanga in C.A.R. (Takeuchi, in prep. b). Thus several groups with different languages and different origins are classified as Kaka, and as such, the name "Kaka" is acknowledged both by themselves and others.

(2) For the distinction between the dry and rainy seasons, mean monthly rainfall of 100 mm is adopted in this paper.

(3) Italics (except scientific name) denote the Aka language, however, phonetic transcription is not always completely accurate. A prefix and a stem are divided by period.
(4) The Aka camp has a central person called *kombeti*, whose name is used to denote the village camp.
(5) Residential groups in Linganga-Makaou are quite different from that in Lobaye and Ibenga area (Bahuchet, 1979; Takeuchi, in prep. a), on which another paper is being prepared.
(6) Married persons are defined as adults, and unmarried persons as children in this paper.
(7) Gathering activities by men, except for honey collecting, are not included because it is not frequent. In honey collecting, only the cases where honey was extracted were included in the analysis. The Aka frequently look up trees, searching for beehives, when they walk in the forest. But such searching activities are not analyzed here.
(8) Honeybee is called *nzoi*, and honey of honeybee is called *boi* by the Aka.
(9) The village sites, fields and the eastern side of Sombo grassland that M group did not use are excluded from the calculation.
(10) The distribution of meat hunted collectively with other camp members is not included.
(11) 50 CFA = 1 French Franc = 25 Yen in 1992.
(12) The villager let the M group members transport to the village the legs, which can be sold in the village, and he gave the head, neck and internal organs (about 40 kg) to M group members.
(13) Cooking meals by the Aka women for the Aka workers was included in the labor of clearing the fields.

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Appendix 1
Food (weight (g)/man/day and energy (kcal)/man/day[1]) supplied to the forest camp in each period.

food	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total	edible ratio[2]	kcal/ 100 g
wild tubers	257.65 (351.99)	257.88 (355.67)	136.57 (185.91)	196.84 (252.92)	150.90 (197.90)	263.68 (338.52)	229.04 (306.86)		
Discorea mangenotiana	49.10 (67.08)	98.80 (136.27)	54.85 (74.67)	21.26 (27.32)	54.26 (71.16)	53.20 (68.30)	70.42 (94.34)	0.8	120
D. semperflorens	99.10 (135.39)	66.82 (92.16)	3.17 (4.32)	8.05 (10.34)	12.83 (16.83)	152.02 (195.17)	70.91 (95.00)	0.8	120
D. burkilliana	19.59 (26.76)	45.49 (62.74)	5.78 (7.87)	4.60 (5.91)	24.40 (32.00)	17.43 (22.38)	29.20 (39.12)	0.8	120
D. sp. (*ndiki*)	39.08 (53.39)	31.42 (43.33)	30.04 (40.89)	6.32 (8.12)	1.14 (1.50)	21.58 (27.71)	23.40 (31.35)	0.8	120
D. smilacifolia	4.50 (6.15)	1.56 (2.15)	3.92 (5.34)	4.02 (5.17)	1.20 (1.57)	2.35 (3.02)	2.19 (2.93)	0.8	120
D. sp. (*e.busu*)	0.00 (0.00)	1.20 (1.66)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.49 (0.66)	0.8	120
D. sp. (*e.pange*)	0.00 (0.00)	0.22 (0.30)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.09 (0.12)	0.8	120
Dioscoreophyllum comminsii	46.28 (63.23)	12.37 (17.06)	38.81 (52.83)	152.59 (196.07)	57.07 (74.84)	17.10 (21.95)	32.34 (43.33)	0.8	120
wild leaves	14.75 (21.62)	24.46 (36.20)	34.51 (50.40)	22.70 (31.29)	22.96 (32.31)	10.48 (14.44)	20.91 (30.06)	1	103
Gnetum bucholzianum	14.75 (21.62)	24.46 (36.20)	34.51 (50.40)	22.70 (31.29)	20.14 (28.34)	7.96 (10.96)	19.93 (28.65)	1	103
G. africanum	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.82 (3.97)	2.52 (3.47)	1.04 (1.49)	1	103
wild fruit	0.00	0.00	0.00	4.60	160.85	75.45	45.85		
Landolphia sp. (*e.lebe*)	0.00	0.00	0.00	1.44	19.36	0.56	3.83		?
Landolphia sp. (*pembe*)	0.00	0.00	0.00	0.00	30.46	0.00	5.76		?
Landolphia sp. (*ndembo*)	0.00	0.00	0.00	0.00	60.73	69.17	25.48		?
Anonidium mannii	0.00	0.00	0.00	2.59	46.88	5.72	10.12		?
Myrianthus arboreus	0.00	0.00	0.00	0.00	1.50	0.00	0.28		?
Trichoscypha ferruginea	0.00	0.00	0.00	0.00	1.50	0.00	0.28		?
Gambeya lacourtiana	0.00	0.00	0.00	0.57	0.00	0.00	0.02		?
Aframomum sp.	0.00	0.00	0.00	0.00	0.42	0.00	0.08		?
wild seeds	73.65 (421.33)	64.21 (368.53)	108.85 (549.09)	87.07 (408.58)	94.77 (359.01)	8.35 (40.57)	63.16 (315.111)		
Irvingia gabonensis	73.65 (421.33)	62.93 (363.45)	95.34 (543.47)	69.25 (372.61)	57.85 (317.69)	7.40 (39.78)	54.04 (303.17)	0.6	670
Treculia africana	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	17.82 (35.97)	17.87 (36.81)	0.39 (0.79)	4.16 (8.75)	0.4	377
Chytranthus sp.	0.00	0.00	0.00	0.00	15.83	0.22	3.04		?
Panda oleosa	0.00	0.06	9.70	0.00	0.00	0.00	0.51		?
Ricinodendron heudelotii	0.00 (0.00)	0.72 (2.19)	1.87 (5.62)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.41 (1.21)	0.4	530
Afrostyrax lepidophyllus	0.00	0.00	0.00	0.00	2.16	0.00	0.41		?
Irvingia robur	0.00 (0.00)	0.50 (2.89)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.20 (1.12)	0.6	670
I. grandifolia	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.82 (4.50)	0.00 (0.00)	0.15 (0.84)	0.6	670
Eribroma oblongum	0.00	0.00	1.94	0.00	0.00	0.00	0.12		?
? (*li.belu*)	0.00	0.00	0.00	0.00	0.00	0.34	0.07		?
? (*mo.ngojo*)	0.00	0.00	0.00	0.00	0.24	0.00	0.05		?
mushroom	0.23 (0.10)	0.39 (0.18)	99.25 (45.04)	1.15 (0.49)	16.43 (7.18)	0.06 (0.03)	9.38 (4.19)	1	32

honey	0.56 (1.86)	6.32 (21.18)	64.93 (214.75)	233.91 (730.26)	219.01 (697.86)	128.04 (399.40)	83.12 (270.57)	0.75 311
Apis mellifica adansonii	0.56 (1.86)	0.70 (2.35)	3.36 (11.11)	175.00 (546.34)	134.89 (429.82)	52.30 (163.14)	43.54 (141.73)	0.75 311
stingless bee (*koma*)	0.00 (0.00)	3.98 (13.34)	50.19 (166.00)	39.66 (123.82)	75.66 (241.08)	68.95 (215.08)	34.49 (112.27)	0.75 311
stingless bee (*syako*)	0.00 (0.00)	0.44 (1.47)	1.49 (4.93)	11.49 (35.87)	2.40 (7.65)	4.71 (14.69)	2.13 (6.93)	0.75 311
stingless bee (*mange*)	0.00 (0.00)	0.78 (2.61)	6.16 (20.37)	0.00 (0.00)	6.06 (19.31)	1.35 (4.21)	2.11 (6.87)	0.75 311
stingless bee (*e.bodo*)	0.00 (0.00)	0.14 (0.47)	3.73 (12.34)	0.00 (0.00)	0.00 (0.00)	0.73 (2.28)	0.43 (1.40)	0.75 311
stingless bee (*oba*)	0.00 (0.00)	0.28 (0.94)	0.00 (0.00)	7.76 (24.23)	0.00 (0.00)	0.00 (0.00)	0.42 (1.37)	0.75 311
invertebrate	0.23 (0.23)	0.17 (0.17)	10.82 (10.56)	1.72 (1.58)	28.84 (27.11)	3.81 (3.51)	7.05 (6.77)	
larva of beetle (*e.soko*)	0.00 (0.00)	0.11 (0.11)	10.82 (10.56)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.70 (0.67)	0.8 86
caterpillar (*e.keso*)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	13.07 (12.28)	0.00 (0.00)	2.47 (2.37)	0.8 86
caterpillar (*mo.ndosi*)	0.23 (0.23)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.66 (3.44)	3.81 (3.51)	1.49 (1.43)	0.8 86
caterpillar (*mo.kulupa*)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	9.05 (8.51)	0.00 (0.00)	1.71 (1.64)	0.8 86
caterpillar (*beta*)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.78 (0.73)	0.00 (0.00)	0.15 (0.14)	0.8 86
caterpillar (*boyo*)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.24 (0.23)	0.00 (0.00)	0.05 (0.05)	0.8 86
caterpillar (*mo.kekene*)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.84 (0.79)	0.00 (0.00)	0.16 (0.15)	0.8 86
caterpillar (unidentified)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.20 (1.13)	0.00 (0.00)	0.23 (0.22)	0.8 86
snail (*bembe*)	0.00 (0.00)	0.06 (0.06)	0.00 (0.00)	1.72 (1.58)	0.00 (0.00)	0.00 (0.00)	0.09 (0.09)	0.8 86
vertebrate	121.29 (164.31)	466.57 (701.37)	91.98 (122.60)	818.61(1,125.63)	281.42 (400.72)	193.05 (267.13)	332.89 (481.09)	
fish	16.33 (13.25)	0.11 (0.09)	21.08 (17.04)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.93 (2.33)	0.6 95
reptile and bird	6.76 (4.33)	2.75 (1.77)	0.00 (0.00)	57.18 (34.45)	4.14 (2.99)	4.93 (2.97)	5.83 (3.80)	0.7(3) 150
mammal	98.20 (146.73)	463.71 (699.51)	70.90 (105.56)	776.43(1,091.18)	277.28 (397.73)	188.12 (264.16)	324.13 (474.96)	0.7 150
agricultural food	0.00 (0.00)	180.62 (478.04)	690.11(1,245.58)	0.00 (0.00)	180.46 (389.84)	142.66 (297.84)	178.80 (404.54)	
cassava	0.00 (0.00)	31.42 (40.36)	288.99 (366.35)	0.00 (0.00)	0.00 (0.00)	10.09 (12.06)	32.41 (40.44)	0.6 149
fermented cassava (dry)	0.00 (0.00)	33.70 (146.85)	0.00 (0.00)	0.00 (0.00)	12.65 (52.41)	5.16 (20.93)	17.18 (72.72)	0.9 337
fermented cassava (wet)	0.00 (0.00)	42.16 (81.22)	0.00 (0.00)	0.00 (0.00)	83.03 (152.11)	8.52 (15.28)	34.61 (64.77)	0.9 149
dried cassava	0.00 (0.00)	0.95 (4.79)	0.00 (0.00)	0.00 (0.00)	0.54 (2.59)	0.00 (0.00)	0.49 (2.40)	1 351
oil palm fruit	0.00 (0.00)	66.63 (167.52)	328.17 (814.35)	0.00 (0.00)	49.58 (118.53)	94.62 (221.44)	75.68 (184.83)	0.2 875
palm oil	0.00 (0.00)	2.78 (34.95)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.50 (5.85)	1.43 (17.46)	1 875
cassava leaf	0.00 (0.00)	0.28 (0.29)	55.41 (57.20)	0.00 (0.00)	14.15 (14.07)	22.42 (21.83)	10.69 (10.86)	0.8 91
plantain banana	0.00 (0.00)	1.31 (1.58)	2.80 (3.32)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.70 (0.82)	0.62 135
maize	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	15.47 (46.25)	0.00 (0.00)	2.93 (8.95)	0.62 353
papaya	0.00 (0.00)	1.22 (0.43)	8.40 (2.93)	0.00 (0.00)	0.78 (0.26)	1.35 (0.44)	1.43 (0.49)	0.77 32
pumpkin	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.26 (3.61)	0.00 (0.00)	0.80 (0.69)	0.85 73
pineapple	0.00 (0.00)	0.17 (0.06)	4.29 (1.43)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.33 (0.11)	0.5 47
stamen of oil palm	0.00	0.00	2.05	0.00	0.00	0.00	0.12	?
Total	468.36 (961.44)	1,000.62 (1,961.33)	1,237.02 (2423.93)	1,366.60 (2,550.76)	1,155.64 (2,111.92)	825.58 (1,361.42)	970.20 (1,819.17)	

(1): Figures in the parenthesis show kcal/man/day; (2): Edible ratio (edible weight/total/weight) for *I. gabonensis* is derived from the values I measured at the field, the others are from Ichikawa (1981) and (1986), Bailey & Peacock (1988), Sawada (1990) and The Society of Resource Research of the Science and Technology Agency Japan ed. (1986). The values for energy and protein per 100 g is from Leung (1968); (3): Edible ratio of land tortoise is 0.3.

Appendix 2
Weight (kg) of animals acquired by each hunting method in the forest camp*.

	spear	net	trap	cross bow	gun**	hand	gift	Total
bush pig	179.60 (5)	0.00 (0)	212.20 (5)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	392.00 (10)
giant forest hog	0.00 (0)	0.00 (0)	185.00 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	185.00 (2)
blue duiker	0.00 (0)	102.25 (23)	18.50 (4)	0.00 (0)	0.00 (0)	0.75 (1)	3.00 (1)	124.50 (29)
bay duiker	0.00 (0)	0.00 (0)	40.20 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	40.20 (3)
Peter's duiker	0.00 (0)	16.60 (1)	209.00 (13)	0.00 (0)	2.30 (1)	0.00 (0)	6.15 (1)	234.55 (16)
Gabon duiker	0.00 (0)	0.00 (0)	18.30 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	18.30 (2)
yellow-baked duiker	0.00 (0)	0.00 (0)	327.50 (7)	0.00 (0)	10.00 (1)	0.55 (1)	2.20 (1)	340.25 (10)
African buffalo	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	40.00 (1)	40.00 (1)
giant forest squirrel	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.30 (1)	0.00 (0)	0.30 (1)
squirrel	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (1)	0.00 (0)	0.05 (1)
black-footed mongoose	0.00 (0)	0.00 (0)	4.00 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	4.00 (1)
leopard	0.00 (0)	0.00 (0)	26.00 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	26.00 (1)
agile mangabey	0.00 (0)	0.00 (0)	8.00 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	8.00 (1)
greater white-nosed	0.00 (0)	0.00 (0)	0.00 (0)	3.35 (2)	1.00 (1)	0.00 (0)	0.00 (0)	4.35 (3)
monkey	0.00 (0)	0.00 (0)	0.00 (0)	5.60 (1)	0.00 (0)	0.00 (0)	4.25 (1)	9.85 (2)
moustached monkey	0.00 (0)	0.00 (0)	0.00 (0)	1.25 (1)	0.00 (0)	0.00 (0)	0.00 (0)	1.25 (1)
monkey (unidentified)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	2.50 (1)	2.50 (1)
land tortoise	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	25.10 (11)	0.00 (0)	25.10 (11)
bird	0.00 (0)	0.00 (0)	0.00 (0)	0.25 (1)	0.00 (0)	0.40 (3)	0.00 (0)	0.65 (4)
Total	179.60 (5)	118.85 (24)	1048.70 (39)	10.45 (5)	13.80 (3)	27.15 (18)	58.10 (6)	1456.65 (100)

Note: Refering to Haltenorth & Diller (1980), the auther identified animals; *: Figures in the parenthesis show the number of animals; **: Weight of head, neck and internal organs are shown. Other parts were taken by the villagers.