FOOD CONSUMPTION AND PREFERENCES OF THE BONGANDO PEOPLE IN THE DEMOCRATIC REPUBLIC OF THE CONGO

Ryota YAMAGUCHI
Graduate School of Asian and African Area Studies, Kyoto University

ABSTRACT People living in the Congo basin forest have developed a variety of ways to use natural resources. Thus, the increase in conservation projects must be accompanied by efforts to clarify the livelihood-related conditions of local people. This paper provided a detailed investigation of the utilization of natural resources by the Bongando people living in the great ape habitat of the Democratic Republic of the Congo (DRC). Specifically, the paper examined food acquisition and consumption based on direct observations and measurements, and also discussed the adequacy of food assessment approaches. Quantitative data on food acquisition and consumption at the study site showed that the amount of carbohydrates consumed was adequate; however, less animal protein was consumed by those living at the study site than by people living in great ape habitats in Africa. This suggests that availability of animal protein fluctuates, and that the Bongando people follow a dual village/forest lifestyle. Cassava leaves and other vegetables are also important protein sources. Data on the food preferences of the Bongando indicate that they strongly prefer cassava as their staple, and that they engage in sophisticated ways of cultivating leaves for consumption as food. The data also reflect the Bongando people's strong preference for wild animals, and the fact that some people avoid eating livestock. Food preferences are important factors in the success of conservation projects, as it is crucial to find ways for local people to maintain adequate caloric and protein intake that are acceptable to the people themselves and to the projects. Therefore, research based on a food assessment approach should occur in parallel with research based on direct observations. Quantitative food assessment is useful because it provides data for an entire year for a large-scale population. However, it is also necessary to conduct preliminary research to obtain basic information about a population and its use of natural resources. Research designs must be developed based on the analysis, screening, and correction of data by researchers with a deep knowledge about the local livelihoods to prevent human error.

Key Words: Food acquisition and consumption; Food preference; Bongando; Democratic Republic of the Congo; African tropical rain forest.

INTRODUCTION

The Congo Basin Forest, which is one of the largest tropical rain forests in the world, is rich in biological diversity, contains many indigenous species, and is important for carbon sequestration (CBFP, 2005; Debroux et al., 2007; FAO, 2011). In addition, many local people living in this forest depend on its rich natural resources for their livelihoods. Residents acquire essential foods by gathering, hunting, and fishing in the forest. They build houses using the natural resources in the forest, such as wood, leaves, and vines. They also cultivate their fields in the forest, growing agricultural products.

However, these rich natural resources are currently threatened by social, economic,

and political problems, including the sedentarization policies implemented by the government, population increases, commercial logging and labor migration, poaching and bushmeat-related problems, and disputes. These problems have reduced the availability of natural resources in the African tropical rain forest (FAO, 2010; Megevand et al., 2013). Many conservation projects, such as national parks and reserves, have been sponsored by international non-governmental organizations (NGOs) and nations to enable the sustainable use of the natural resources in forests. However, these efforts have generated conflict between the projects and the local people. For example, forced evacuation plans have accompanied the creation of protected areas, and local people's livelihood activities in/around the protected areas have been restricted (Cernea, 2006). These conflicts render conservation projects difficult to implement.

Thus, it is important to understand the actual conditions under which local people earn their livelihoods to develop plans that are acceptable to both residents and program sponsors (Yasuoka et al., 2012). The field of ecological anthropology can contribute to efforts to address this issue. Indeed, several quantitative studies regarding food near the habitats of African great apes, bonobos, chimpanzees, and gorillas have been conducted. Yasuoka et al. (2012) performed a quantitative livelihood assessment in the bonobo habitat in Luo Reserve, the Democratic Republic of the Congo (DRC; this paper's study site) and in a chimpanzee habitat in Kalinzu, Uganda. Matsuura & Moussavou (2015) also conducted the same research in gorilla and chimpanzee habitats in the Moukalaba-Doudou National Park (MDNP) of southwestern Gabon.

Yasuoka et al. (2012) found that people living in Luo depend heavily on the forest, whereas those in Kalinzu depend on the market. Thus, the authors concluded that restricting use of the forest may be more acceptable in Kalinzu than in Luo. Matsuura & Moussavou (2015) found that the food variety was poor, and the nutritional status was inadequate in MDNP. They also noted that, compared to previous research, the consumption of bushmeat had substantially decreased, whereas that of fish had increased. Based on these results, the authors suggested that people living in MDNP adopt a conservation policy; however, conservation projects have a negative effect on the ability of residents to sustain their livelihoods.

The aforementioned studies were based on a food diary approach that involved asking informants to record what they ate during each meal. This quantitative approach can be applied to large populations and is able to provide basic information that can be used to plan projects that may be acceptable to both conservation activists and local populations. However, this methodology only provides an overview of local livelihoods and the use of natural resources, and cannot provide the kind of detailed information on food consumption and preferences that require extended interviews or detailed records maintained by informants. In addition, the resulting data tend to be analyzed by ecological anthropologists primarily in terms of caloric or protein intake.

The present study provided detailed information about the utilization of natural resources by the Bongando people in the DRC based on direct observations and measurements, focusing primarily on food acquisition and consumption. Quantitative data on food acquisition and consumption were analyzed in terms of the following

categories: carbohydrates, animal proteins, and other foods. I also gathered data regarding the food preferences of the Bongando people given the fact that effective conservation practices must be based on considerations of both the amount of food available to local people and the types of food they prefer. The validity of the quantitative livelihood assessment approach was also discussed.

RESEARCH AREA AND METHODS

Research Area

The field research was conducted in one of the 10 *localités* of Iyondje,[1] located in the Equatorial Province of the DRC. Since 1973, a Japanese research team has been conducting research on bonobos (*Pan paniscus*) in the neighboring village of Wamba, located 30 km west of the study site. The minimum and maximum temperatures range from 20°C to 30°C throughout the year. The rainy season lasts from September to November, and the dry season lasts from December to February (Vuanza & Crabbe, 1975). The annual rainfall is about 2000 mm.

The main inhabitants in this area are Bongando, a Bantu-speaking people whose population is estimated to be around 450,000–500,000 (Kimura, 1992). The residents of this area speak Longando as their mother tongue, and Lingala to communicate with other ethnic groups. Although their principle food is cassava, which is harvested using slash-and-burn farming, they are a "multi-subsistence people" rather than "cultivator" (Kimura, 1992), because they tend to spend more time hunting, fishing, and gathering than engaging in agricultural work.

This area is far from the administrative and economic centers, and access to cash income is limited. Specifically, the study site is located 80 km from Djolu, the nearest small airstrip, and about 400 km from Boende, the district capital. The main cash crop in this area before the Congo Wars in the 1990s was coffee (Kimura, 1998), but this crop was abandoned during the war, because there was no way to transport it and no buyers who wanted to visit this area (Kimura et al., 2012). At present, the local people travel the long distance to Kisangani, which is about 400 km along the forest route, by foot or bicycle to engage in commerce.

The activities of conservation projects sponsored by international and local NGOs have received increasing attention in recent years (Lingomo & Kimura, 2009; Kimura et al., 2012). A number of small-scale local associations related to agriculture, fishing, and breeding livestock also operate in this area (Matsuura, in this volume).

Informants and Research Periods

The population of the research village was 179 in 2011 (Table 1), and residents tended to live close to members of their patrilineal lineage. According to Kimura (1992), several extended families comprise a lower-level lineage known as *losombo*,[2] and several *losombos* comprise an upper-level lineage that loosely

Table 1. Population of Yalisanga

	Age							Total
	1–10	11–20	21–30	31–40	41–50	51–60	>61	
Female	17	23	25	14	6	7	3	95
Male	17	27	19	8	4	5	4	84
Total	34	50	44	22	10	12	7	179

corresponds to the *localité*.[3] Specifically, Yalisanga corresponds to the *localité* level (Kimura, 1992), and there are two upper-level *losombos* in Yalisanga: the larger one has five lower-level *losombos*, and the other has three.

I conducted field research on three occasions since 2011, yielding a total of 3 months of research: (period I: late September to middle October 2011; period II: middle April to middle May 2013; period III: early September 2014). During period I, I surveyed the food acquisition of all members of eight *losombos* daily (except Sunday) for 1 week to collect general information about food acquisition and habits in the village. Two of the eight *losombos* were excluded from the analysis, because it was difficult to calculate the exact number of family members as there were too many temporary visitors. Two families were also excluded because they did not express a positive attitude towards this research. The research period coincided with the beginning of rainy season. During period II, I focused on one family for 22 days to collect more detailed data. The main members of this family were a man in his 60s, his wife in her 60s, one unmarried son in his 20s, one daughter in her 30s, and the daughter's two children. Rainfall was infrequent during this period. Men clear the forest in preparation for agricultural activities from January to March (Kimura, 1998), whereas women plant cassava and other crops during this period. In Period III, two families were observed for 6 days to collect supplementary data. The main members of one family were a man in his 30s, his wife in her 30s, and their children. Members of the other family included a man in his 40s, his wife in her 30s, and their seven children. This period coincided with the end of caterpillar season (Takeda, 1990; Kimura et al., 2012).

Data Collection

I asked all of the participants to inform us every time they returned to their houses with any kind of food. All of the food was identified in interviews with each informant, and was weighed using a digital kitchen scale and a spring scale before being processed. Food items bought in the market or from villagers or given as gifts were also included. Measurement was conducted 12 h per day from 6:00 to 18:00.

Data Analysis

The calculation of adult-days treated a child of 2–11 years of age as half an adult, and those younger than 1 year were excluded from the count (Yasuoka et

Table 2. Number of days of data collecion and total adult-days in six *losombo* in period I

	No. of days data collected	No. of members			Adult-days
		Younger than 1 year	2–11 years old	Over 12 years	
losombo 1	7	1	2	9	70
losombo 2	6	1	0	9	54
losombo 3	6	1	7	30	201
losombo 4	6	1	5	12	87
losombo 5	6	0	2	3	24
losombo 6	6	0	1	6	39
Total					475

al., 2012). The converted total-adult numbers in each period were as follows: period I, 77.5 persons and 475 total adult-days (see also Table 2); period II, 4.5 persons and 99 total adult-days; and period III, 9.0 persons and 54 total adult-days. Converted adult-days are used for estimation of consumption per person.[4]

Food items were categorized based on Yasuoka et al. (2012): carbohydrates foods, animal proteins foods, and other items. Water, firewood, and local alcohol were excluded from the calculations.

RESULTS

Livelihood Activities and Natural Resource Usage in the Study Site

The Bongando engage in agriculture, hunting and gathering in the forest, and fishing in the river as subsistence activities. The men slash and burn the forest primarily during the dry season, from January to March, followed by women planting cassava and other crops in the fields. They use both secondary and primary forests for new fields, but the former is preferred because the trees are easy to fell, although the latter is also important for its fertility.

The Bongando also engage in hunting and gathering in the forest. According to informants, various hunting methods were used in the past, but residents relied primarily on snare traps, which were set in both primary and secondary forests, during the research period. Owners of traps, who must check them at least every 2 or 3 days, pick edible forest products along the route, such as wild vegetables, wild fruits, and mushrooms. They also fish in the river, and fishing hooks and nets, which are found in the local market, are common in this area (Fig. 1). They also use traditional fishing traps made from plants and wood.

Carbohydrate Foods

Table 3 shows the quantity of carbohydrate foods obtained in each period. During 1-week survey of six *losombos* (475 adult-days) in period I, five kinds of carbohydrate foods were observed: cassavas, other tubers (sweet cassavas and yams), cooking bananas, maize, and rice. The total net quantity of carbohydrate

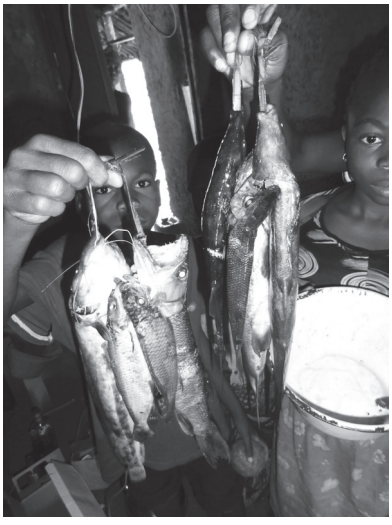

Fig. 1. Fish harvested by local residents.

Table 3. Acquisition and consumption of carbohydrates (g)

Item	Period I[1]			Period II[2]			Period III[3]		
	Harvest	Commercial	Total (%) /capita/day	Harvest	Commercial	Total (%) /capita/day	Harvest	Commercial	Total (%) /capita/day
Cassava	747,837	0	747,837 (93.7) 1,574.4	129,700	0	129,700 (86.0) 1,310.1	85,550	2,000	87,550 (87.1) 1,621.3
Yam	30,854	0	30,854 (3.9) 65.0	6,735	0	6,735 (4.5) 68.0	6,241	0	6,241 (6.2) 115.6
Cooking bananas	11,000	0	11,000 (1.4) 23.2	7,090	0	7,090 (4.7) 71.6			
Sweet cassava	6,668	0	6,668 (0.8) 14.0	7,200	0	7,220 (4.8) 72.9	1,900	0	1,900 (1.9) 35.2
Maize	1,024	0	1,024 (0.1) 2.2						
Rice	0	632	632 (0.1) 1.3				4,800	0	4,800 (4.8) 88.9
Total	797,383	632	798,015 (100.0) 1,680.0	150,745	0	150,745 (100) 1,522.7	98,491	2,000	100,491 (100.0) 1,860.9
(%)	99.9	0.1	100.0.	100.0	0	100.0	98.0	2.0	100.0

[1] Six *losombo*, 475 adult-days.
[2] One family, 99 adult-days.
[3] Two families, 54 adult-days.

foods obtained was 798,015 g, and estimated consumption was 1,680.0 g per capita per day (dividing 798,015 g by 475 adult-days). Cassava accounted for 93.7% of the total net quantity of carbohydrate foods obtained. Subsequent to harvesting, cassavas are soaked in a small river; after several days they are steamed and pounded. The processed cassava, called *kwanga* in Lingala or *bomita* in Longando, is served with side dishes. There are two kinds of yams, *efusu* (*Dioscorea minutiflora*) and *lito* (*Dioscorea dumetorum*), and two kinds of sweet cassava, *bekuho* and *goolubu* (not identified). These yams and sweet cassavas are planted in the fields and consumed as snack foods. They are prepared simply, by boiling or steaming, and are not served with side dishes. Although cooking bananas was observed, they are not frequently obtained (1.4% of total net quantity of carbohydrate foods obtained). Maize is planted primarily to produce local alcohol, but only maize used for eating was counted in this study.

According to data collected from one family during 22 days (99 adult-days) during period II, three kinds of carbohydrate foods were observed, constituting 150,745 g in total and estimated consumption was 1,522.7 g per capita per day. All of the food items were harvested by the informants, and none were obtained from a commercial source. Cassava[5] was obtained 129,700 g in total, or consumed 1,310.1 g per capita per day in estimation, accounting for more than 86.0% of the total amount of carbohydrate food obtained in this period. Two types of yams, *ehusu* and *esambu*[6] (*Dioscorea baya*), and one kind of sweet cassava, *bekuho*, were also observed. According to data collected during the 1-week survey of two families (54 adult-days) in period III, four kinds of carbohydrate foods (cassavas, sweet cassavas, yams, and rice) were observed. The net quantity of such foods obtained amounted to 100,491 g in total (87.1% of carbohydrate foods obtained in this period) and estimated consumption was 1,860.9 g per capita per day.

Although data-collection methods differed across research periods, it is clear that cassava tubers were the primary staple food of the Bongando, accounting for about 90% of carbohydrate foods obtained, and providing about 1,500 g per capita per day in estimation. Although the amount is relatively small, sweet cassavas and yams were also important as snacks. Carbohydrate foods were rarely obtained commercially. Both rice and pounded and steamed cassavas (*bomita* in Longando) were purchased on only one occasion. A few families cultivated rice in their fields for self-consumption or sale in the local market.

Animal Protein Foods

Table 4 shows the quantity of animal protein foods observed during each period. According to the 1-week survey of six *losombos* (475 adult-days) conducted during period I, seven categories of animal protein foods were observed: fish (including shellfish and tadpoles obtained by bail fishing), wild mammals, domestic birds, insects, eggs, and wild birds. The total net quantity of animal protein foods obtained was 29,923 g in total, and estimated consumption was 63.0 g per capita per day.

Fish accounted for 54.6% and wild mammals accounted for 35.2% of animal protein foods, and these two categories accounted for almost 90% of the total

Table 4. Acquisition and consumption of animal proteins (g)

Item	Period I[1]			Period II[2]			Period III[3]		
	Harvest	Commercial	Total (%) /capita/day	Harvest	Commercial	Total (%) /capita/day	Harvest	Commercial	Total (%) /capita/day
Fish	14,641	1,740	16,381 (54.7) 34.5	3,235	0	3,235 (54.9) 32.7	1,060	678	1,738 (35.8) 32.2
Wild mammals	7,975	2,561	10,536 (35.2) 22.2	0	1,250	1,250 (21.2) 12.6			
Insects	947	0	947 (3.2) 2.0	408	0	408 (6.9) 4.1	2,812	306	3,118 (64.2) 57.7
Domestic birds	2,000	0	2,000 (6.7) 4.2						
Reptiles				1,000	0	1,000 (17.0) 10.1			
Eggs	32	0	32 (0.1) 0.1						
Wild birds	27	0	27 (0.1) 0.1						
Total	25,622	4,301	29,923 (100.0) 63.0	4,643	1,250	5,893 (100.0) 59.5	3,872	984	4,856 (100.0) 89.9
(%)	85.6	14.4	100.0	78.8	21.2	100.0	79.7	20.3	100.0

[1] Six *losombo*, 475 adult-days.
[2] One family, 99 adult-days.
[3] Two families, 54 adult-days.

net quantity of animal protein foods obtained. About 85% of these items were harvested by the informants themselves, and 14.4% were purchased. About 44% of the total amount of fish obtained was caught with fishing nets, and fish bailing performed by women and children was also responsible for a significant quantity (27.5%) of these items. Approximately 10% of the net quantity of fish obtained was purchased.

In total, 11 species of wild mammals were observed during period I: African giant rat (*botomba*: *Cricetomys emini*); green squirrel (*ekotsi*: *Aethosciurus poenis*); two kinds of small rats, *etiti* and *lihoko* (not identified); bay duiker (*kuluha*: *Cephalophus dorsalis*); lord derby's scaly tailed squirrel (*lokiyo*: *Anomalurus derbianus*); blue duiker (*boloko*: *Cephalophus monticola*); wolf's guenon (*mbeka*: *Cercopithecus wolfi*); tree pangolin (*ngaa*: *Manis tricupsis*); brush-tailed porcupine (*eiko*: *Atherurus africanus*); and red-tailed monkey (*solia*: *Cercopithecus ascanius*). Approximately 67% of wild mammals were caught using two kinds of snare traps, *nilo* and *bombuka*. *Nilo* is made with a nylon cord, set on the ground, and covered with

leaves to catch small animals. *Bombuka* consists of a wire loop placed perpendicular to the ground to catch the neck or body of an animal. In addition to snare traps, the use of *ekuata* (a kind of deadfall) was observed on one occasion. This device is made primarily by children to catch small animals such as rats and squirrels. About 24% of wild mammals were purchased.

Four kinds of insects were observed during period I: soldier termites (*bakaalo*), *pose* larvae (*Rhynchophorus phoenicis*) (Fig. 2), *ilanga* larvae (*Anaphe infracta*) (Fig. 3), and *besake* larvae (Nymphalidae). These insects are cooked as *liboke*,[7] wrapped with *nkongo* leaves (*Megaphrynium macrostachyum*), and placed near a fire. *Bakaalo* and *pose* are the most popular edible insects in this area, and are consumed as a side dish or snack.

Our investigation of one family for 22 days (99 adult-days) during period II revealed four categories of animal protein foods: fish, wild mammals, reptiles,

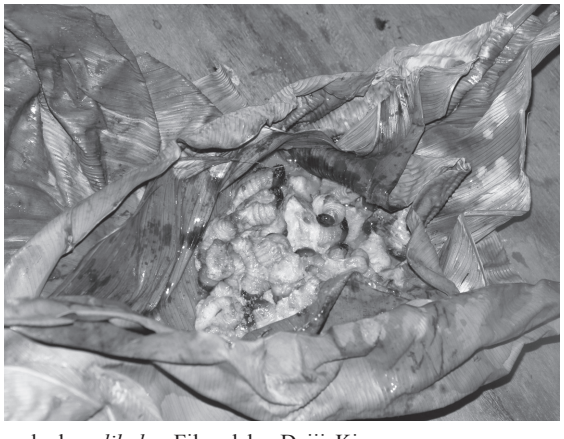

Fig. 2. *Pose* larvae cocked as *liboke*. Filmed by Daiji Kimura.

Fig. 3. *Ilanga* larvae with its dupion (upper left).

and insects. The total amount of animal food obtained was 5,893 g or consumed 59.5 g per capita per day in estimation.[8] Fish accounted for more than 50% of the total net quantity of animal protein foods obtained. The principal means for obtaining fish involved fishhooks, because members of this family did not have a fishing net.

Wild mammal was observed only one time in period II: red-tailed monkey (*solia*). It was only animal protein food obtained by purchase during this period. A hinge-backed tortoise (*eulu*: *Kinixys erosa*), which is usually cooked as *liboke*, was the only reptile observed in this period. According to the informants, tortoises should not be cooked in a pot because "the meat will never be tender in this way." Two kinds of insects were observed: soldier termites (*bakaalo*) and the larvae of a dragonfly (*todada*). *Todada*, captured by fish bailing, is also cooked as *liboke*, but is not a popular edible insect. An informant in his 60s noted, "I do not eat *todada* because our ancestors did not eat it. But, nowadays some people have got into the habit of eating it."

According to data collected in the 1-week survey of two families (54 adult-days) conducted during period III, two categories of animal protein food, fish and insects, were observed. The total net quantity of animal protein foods obtained was 4,856 g or consumed 89.9 g per capita per day in estimation. In terms of insects, four caterpillars were observed (43.9 g per capita per day): *boona* (*Pseudantherea discrepans*), *lingunju* (*Lobobunaea goodi*), *isusu* (Noctidae), and *lihakala* (*Saturnia* sp.). Caterpillars are cooked in various ways (e.g., *liboke* with *befili* leaves and red pepper, with cassava leaves or other vegetables). These caterpillars were primarily obtained by the informants themselves in the primary forest (*ngonda*), but they were sometimes purchased. In this period, 306 g (12.9% of caterpillars) of dried *tosusu* and *bangunju* were purchased. Dried caterpillars were also important commodities in town.

During these three periods, fish was the most popular animal protein food, accounting for about 50% of the total net quantity obtained, followed by wild mammals (20–30%). Insects are acquired on a seasonal basis. A total of 10–20% of animal protein food was purchased, and this percentage was much higher than that in other categories. Among the means for acquiring fish, the use of fishing nets produced more than 30% of the fish obtained, but the quantity obtained from fish bailing by women and children was not negligible (25.1%).

Other Foods

Eleven categories of food items were observed during period I: vegetables, oil palm, cassava leaves, domesticated fruits, wild vegetables, wild fruits, mushrooms, sweet bananas, sugar cane, honey, and coffee, in decreasing order. Net quantity of other foods obtained was 346,741 g in total, and estimated consumption was 730.0 g per capita per day (Table 5).

Vegetables included various kinds of domesticated plants. Of these, *lisingo/basingo* (*Phytolacca dodecandra*) was the most heavily obtained (estimated consumption was 103.1 g per capita per day), followed by *litembele* (*Ipomoea batatas*, sweet potato leaves: 42.4 g per capita per day), and *koto* (Araceae:

Table 5. Acquisition and consumption of other foods (g)

Item	Period I[1]			Period II[2]			Period III[3]		
	Harvest	Commercial	Total (%) /capita/day	Harvest	Commercial	Total (%) /capita/day	Harvest	Commercial	Total (%) /capita/day
Vegetables	102,502	0	102,502 (29.6) 215.8	16,210	0	16,210 (27.9) 163.7	15,510	0	15,510 (46.5) 287.2
Oil palm	92,398	1,004	93,402 (26.9) 196.6				2,706	0	2,706 (8.1) 50.1
Cassava leaves	45,354	0	45,354 (13.1) 95.5	16,608	0	16,608 (28.5) 167.8	8,933	0	8,933 (26.8) 165.4
Domesticated fruit	32,663	393	33,056 (9.4) 69.6	12,260	0	12,260 (21.1) 123.8	1,502	0	1,502 (4.5) 27.8
Wild vegetables	24,381	888	25,269 (7.3) 53.2	592	0	592 (1.0) 6.0	1,570	0	1,570 (4.7) 29.1
Wild fruit	21,265	0	21,265 (6.1) 44.8	109	0	109 (0.2) 1.1	1,600	0	1,600 (4.8) 29.6
Sweet bananas	9,500	0	9,500 (2.7) 20.0	9,000	0	9,000 (15.5) 90.9			
Mushrooms	9,854	0	9,854 (2.8) 20.7	623	0	623 (1.1) 6.3	1,118	0	1,118 (3.4) 20.7
Sugar cane	4,572	0	4,572 (1.3) 9.6				409	0	409 (1.2) 7.6
Honey	1,500	0	1,500 (0.4) 3.2						
Coffee	467	0	467 (0.1) 1.0						
Total	344,456	2,285	346,741 (99.7) 730.0	58,191	0	58,191 (100.1) 587.8	33,348	0	33,348 (100) 617.6
(%)	99.3	0.7	100	100	0	100	100	0	100

[1] Six *losombo*, 475 adult-days.
[2] One family, 99 adult-days.
[3] Two families, 54 adult-days.

19.2 g per capita per day). These three items accounted for 76.4% of the total net quantity of vegetables obtained in this period. These vegetables were used as side dishes, cooked simply with meat or fish and mushrooms, and palm oil. More *lisingo* was obtained than cassava leaves (95.5 g per capita per day), although the latter was one of the most popular side dishes.

In terms of wild vegetables, *bekau* (the pith of *Ancistrophyllum secundiflorum*)

was the most heavily obtained item (estimated consumption was 22.0 g per capita per day), followed by *befili* leaves (*Scorodophloeus zenkeri*: 7.7 g per capita per day), *beiye* (shoots of *Megaphrynium macrostachyum*: 6.8 g per capita per day), *befe* leaves (*Histiopteris incise*: 5.5 g per capita per day), *kumbokumbo* leaves (young leaves of *Leonardoxa romii*: 5.3 g per capita per day), and *bangoolo* (not identified: 3.4 g per capita per day). *Bekau* is consumed as a side dish, but is not cooked with meat or fish. *Befili* are young leaves of the *bofili* tree, and are cooked in *liboke* style or used as a seasoning because of their garlic- or onion-like flavor. Although not consumed in large quantities, it is one of the most essential wild vegetables in the Bongando diet. *Beiye* is a popular side dish in Wamba, a neighboring village, but is not frequently consumed in Yalisanga because it grows in a distant section of the forest. It was the unique wild plant purchased in this period. *Befe* leaves, which are preferred because of their slightly bitter taste, are cooked simply as *liboke*, and are eaten with palm oil. They can also be cooked with fish. One informant noted, "*Befe* is vitamin. It makes blood in your body." *Kumbokumbo* leaves have a sour taste and are cooked with fish. Trees with these leaves can be found in cassava fields, because the local people intentionally preserve them when they clean the field. *Bangoolo* is a kind of fern that can be found in the forest, especially near the water. It is also found in fields, as it grows spontaneously after clearing. Young *bangoolo* leaves are cooked with fish.

Three kinds of wild fruits were observed during this period. *Litofe* (*Landolphia owariensis*: estimated consumption was 30.0 g per capita per day) was the most heavily obtained in this period, followed by *bolingo* (*Anonidium mannii*: 14.3 g per capita per day), and *mbimbo* (*Treculia adiricanum*: 0.4 g per capita per day). *Basel'a'toi* (ear-shaped *basele*) accounted for 60.9% of mushrooms obtained during this period. This item is cooked with fish and meat, or is dried for selling. It has become an important trading item in Kisangani since coffee lost its status as a primary cash crop. Indeed, only a few people currently have coffee plantations, growing this crop for consumption at home and to sell in small quantities at the local market.

Eight categories of food were observed during period II. The total net quantity obtained was 58,191 g and estimated consumption was 587.8 g per capita per day. Nearly equal quantities of cassava leaves and other vegetables were obtained, accounting for more than 50% of total net quantity obtained during this period. Two kinds of cassava leaves, *bekinja* and *benunua* were observed. The former are normal cassava leaves, and the latter, according to informants, are young leaves that sprout from cassava seeds. Although they are differentiated locally, they are called *pondu* in Lingala and are cooked in the same way. *Lisingo* accounted for almost half of all vegetables obtained (estimated consumption: 82.8 g per capita per day), followed by *litembele* (36.7 g per capita per day), and *yamangele* (not identified: 24.3 g per capita per day). *Yamangele*, which has edible leaves, is planted in a cutting in the field in the same way as cassava. The domesticated fruits observed in this period were pineapples and papayas.

Eight categories of food were observed in period III, and net quantity obtained was 33,348 g or consumed 617.6 g per capita per day in estimation. Vegetables

accounted for 46.5% of this total; 175.1 g per capita per day of *lisingo* was consumed, followed by *litembele* (65.8 g per capita per day).

Data for the three periods show that planted vegetables, cassava leaves, wild vegetables, and mushrooms were the primary side dishes eaten by the Bongando. Of these, cassava leaves were the most popular. However, many other vegetables were obtained as well, and *lisingo* and *litembele* were the second and third most popular, respectively.

Of the wild vegetables, the largest quantity of *bekau* was obtained. *Befili* leaves, *kumbokumbo* leaves, and *befe* leaves were also obtained. Although these wild vegetables, especially *befili* and *kumbokumbo* leaves, are not obtained in large quantities as vegetables in the field, they are essential elements of the Bongando diet and recipes as seasonings, and because they have an appetizing aroma. Participants expressed a preference for a variety of foodstuffs in the "other food" category. According to one informant, "If you eat only one kind of food, then you will get sick." It is thought that dietary variety contributes to nutritional health, including maintenance of an amino acid balance. It is also possible that this dietary variety reflects local people's preferences for diverse tastes. Indeed, participants' cooking styles also varied, as evidenced by recipes using cassava leaves, which can be cooked in different ways: *bekinjo'oluho* is simply pounded; *bekinjo'okonga* is cooked with *engange* salt;[9] *bekinja'a'kalinga* is cooked after roasting; *bekinja'a'tokoto* is wrapped in *besomboko* leaves and escalloped. The effort devoted to cooking is not only derived from nutritional concerns, but also from a desire to avoid the boredom that would presumably ensue as a result of eating only one kind of cassava dish.

DISUCUSSION

Comparison with Previous Research

According to data gathered in the present study, local people consumed approximately 1,600 g per capita per day of carbohydrate food in estimation, which corresponds to approximately 1,250 kcal in terms of a calorie base (edible ratio of 0.6, and 1.3 kcal/g in Yasuoka et al., 2012). This is slightly lower than the results of a previous study in the same area (Yasuoka et al., 2012) and in Kalinzu, Uganda (Yasuoka et al., 2012), but is larger than the comparable data for MDNP, Gabon (1,196 kcal; Matsuura & Moussavou, 2015). Cassava was the most heavily obtained item during all three periods. Carbohydrate food was rarely purchased, as it was almost all harvested by the participants themselves, which means that they were self-sufficient in terms of one type of staple food.

Approximately 60–90 g per capita per day, or 36–54 g per capita per day (edible ratio of 0.6), of animal protein foods were consumed in each three period. Fish accounted for more than half the items in this category, which is consistent with the results reported by Yasuoka et al. (2012). According to Kimura et al. (2012), "fish appears to have overtaken bushmeat as an important protein source." However, the estimated quantity of animal protein foods consumed was relatively low

compared to the quantity reported by a previous research study in the same area (535 g per capita per day, or 320 g per capita per day for an edible ration of 0.6; Yasuoka et al., 2012), and was also lower than that in other areas (147 g per capita per day in Kalinzu, Uganda [Yasuoka et al., 2012]; 371 g per capita per day in MDNP, Gabon [Matsuura & Moussavou, 2015]). The estimated quantity of animal meat consumed per capita per day in Africa is 100–200 g (Nasi et al, 2008). These data raise questions about why there is a significant difference between data from this study and previous research regarding the quantity of foods consumed that are rich in animal proteins.

Several possible explanations can be proposed. First, animal protein foods may be acquired occasionally, and their availability may fluctuate. Sato's (1984) quantitative research on food acquisition of the Boyela, an ethnic group neighboring the Bongando in the DRC, revealed that the total weght of wild animals killed in 1 week in his research village (about 30 inhabitants) ranged from a minimum of 1.0 kg to a maximum of 79.0 kg (Sato, 1984). The following example, drawn from our field research, suggests that the same situation may apply in the case of the Bongando. One inhabitant killed an adult red river hog (*Potamochoerus porcus*).[10] The animal was cut into pieces, and different parts were consumed by the family, smoked for keeping, given to relatives as gifts, and sold. Future research regarding the consumption of animal protein foods by the Bongando should consider fluctuations in the availability of such resources.

Second, the dual forest/village lifestyle of the Bongando may be relevant in this regard. The Bongando sometimes stay in forest camps, called *nkumbo*, for hunting and fishing, and some establish semi-permanent settlements with cassava fields, called *behetsa*, in the forest (Takeda, 1996; see also Kimura et al., in this volume). The time that people stay in forest camps ranges between short visits of a few days to longer ones of several months. Many informants noted, "If you go to the forest camp, you will eat fish and meat until you get tired." They also brought fish and animals acquired in the forest to their families in the village. After their stay in the forest camps, they often returned to the village with dried fish and meat to keep as stock and to sell (Fig. 4).

For these reasons, the actual quantity of animal protein foods should be larger than that found by this study. Although village-based direct observations enable the acquisition of more detailed information than a quantitative food assessment approach, they make it difficult to understand the overall lifestyle of the Bongando, because data are collected in a particular place. In other words, the results of this paper suggest the importance of forest life for the Bongando people; restricting their activities in the forest due to a conservation project would have a negative impact on their nutritional situation. Further research studies on the activities in the forest camp are needed.

In terms of the nutritional situation of the Bongando, the role of vegetable protein is not trivial. For example, protein-rich cassava leaves (Sato, 1984) are considered to be the primary side dish of the Bongando, and they also consume considerable quantities of cassava tubers as a staple food (Takeda, 1990). In addition, large quantities of other vegetables are also consumed. This preference for a variety of foods can compensate for the fluctuating availability of animal

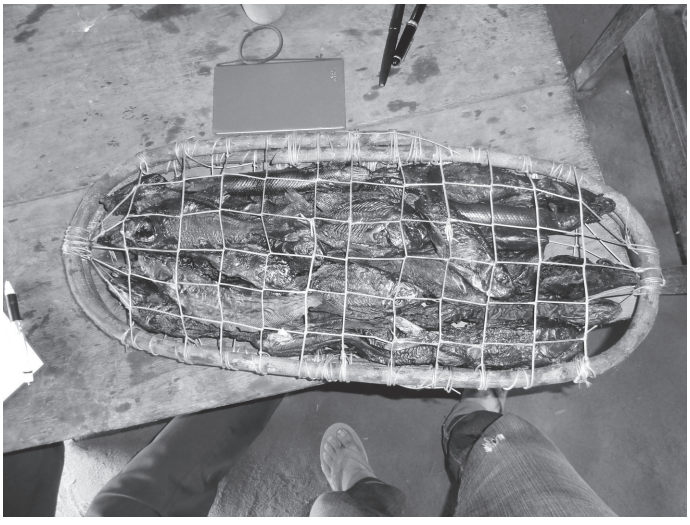

Fig. 4. Dried fish for sale.

proteins. This indicates that both animal-based and vegetable-based sources should be considered in the analyses of protein acquisition.

Food Preferences of the Bongando People

This paper discussed the food preferences of the Bongando people. In terms of carbohydrate foods, they depended heavily on bitter cassava. An informant in his 30s noted, "If I do not eat *bomita* (steamed and pounded cassava), I cannot work well." The informants also described cassava as a part of the ethnic identity of the Bongando. Referring to the Topoke people, the neighboring ethnic group to the east, one informant said that, "Their *bomita* is very dirty because they do not know how to cook it. They eat rice." In this narrative, *bomita* acts as an ethnic marker of the Bongando.

Their utilization of plant food also reflects their food preferences. Apart from carbohydrate foods, edible leaves found in the field, such as those of the cassava, *lisingo*, *litembele*, and wild vegetables, accounted for more than 50% of the quantity of plant food obtained. The Bongando differ from other ethnic groups living in the Congo basin forest in this regard. Although hunter-gatherer groups in the Congo basin consume a variety of plant food, they primarily eat wild fruits and tubers and do not eat large quantities of leaves (Ichikawa, 1993; Hattori, 2012). However, we observed 17 kinds of vegetables and 5 kinds of wild vegetables more than once during our research, and 13 kinds of vegetables were observed once. The difference between the Bongando's utilization of plant food and that of hunter-gatherers suggests that the Bongando have a highly developed cultivation system for edible leaves.

Animal protein foods were primarily obtained in the forest. Takeda (1990) noted

that the Bongando thoroughly utilize the animal resources surrounding them, and their use of *liboke*-style cooking is one example of this pattern. In contrast to wild animals, livestock do not play an important role in the daily consumption of the Bongando, and these animals are primarily kept for rituals, gifts, bride prices, and selling in town. Some people believe that animals in the village[11] are "very dirty" because they eat trash from houses. Swine and duck are frequently mentioned as dirty animals, because the former eats everything, including human feces, and the latter eats millipede.[12] These residents do not eat livestock, and only eat bushmeat. Indeed, there is generally a strong preference for wild animals among the Bongando, and some people avoid eating livestock.

Proposals for a Quantitative Food Assessment Approach

Although data regarding food preferences are important for understanding dietary habits, investigations of food consumption tend to focus on the acquisition of carbohydrates or proteins, and whether the supply of such foodstuffs are sufficient. Calorie-based or protein-based investigations are essential for enabling conservation NGOs and agencies to understand the local diet, but an exclusive reliance on this approach presents several difficulties.

First, foods that do not contain large quantities of protein or carbohydrates tend to be considered less important. In the case of the Bongando, wild vegetables are a good example of this tendency. Although less than 10 g per capita per day of these leaves were consumed in estimation, it is not appropriate to treat them as nutritionally useless, because it is difficult to imagine Bongando dishes without them. A total restriction on the forest activities of the Bongando by conservation projects would cause serious problems in their ability to cook, because these leaves are primarily found in the forest.

The second difficulty concerns attempts to introduce livestock. Many local NGOs near the study site have been trying to breed livestock, such as swine, goats, and chickens, because they are expected to provide a protein source that can substitute for bushmeat. However, this approach will not be acceptable to all inhabitants. As described above, some people do not eat (or even hate) livestock animals, and this is not related to protein acquisition or nutritional status. The development of dietary plans that are acceptable to both local people and conservation projects must place as much importance on food preferences as on caloric and protein intake. Therefore, research based on both a food assessment approach and on direct observations should work in parallel.

Quantitative food assessment approaches are useful because they can provide data for an entire year for a large-scale population. However, preliminary research to obtain basic information about populations and their use of natural resources is also necessary. In addition, researchers with profound knowledge about local livelihoods must screen and correct data to compensate for the inevitable human errors in data collection.

In addition, the adequacy of the measuring equipment should be considered during the research design process. Indeed, it is possible that previous research overestimated the quantity of animal protein food because of inadequate equipment.

Yasuoka et al. (2012) noted, "The weights of some items were recoded as 'under 1 kilogram' because it was difficult to obtain precise weights under 1 kg with the 30 kg scale. I converted these records to 0.5 kg" (Yasuoka et al., 2012). During the three study periods, it was rare for more than 1 kg animal protein food to be acquired at one time. In addition, the average weight of fish obtained at one time was lower than that of wild mammals, and fish were obtained more frequently than wild mammals. This may have been the result of providing informants with scales suitable for big objects. In the case of the Bongando, a 30 kg scale was adequate for weighing carbohydrate food such as cassava, and a 1–2 kg scale was sufficient for other foods, such as plants and animal protein foods. General information about the utilization of natural resources by local people should be considered when a research project is still in the initial planning stages.

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NOTES

(1) Iyondje is known as *Groupement d'Iyondje* from an administrative perspective. *Groupement* is the name for administrative units above *localité*.
(2) In Longando, the singular and plural forms of nouns are distinguished by the prefix (e.g., *bo-to*: a person/*ba-to*: persons). In this paper, local terms are usually described in the singular form; when the term is usually referred to in the plural, it appears in the plural form.
(3) This is a French word for an administrative unit, because there is no corresponding term in the Bongando language (Kimura, 1992)
(4) The food stuffs which were sold, or given to someone else as gift are not included in this estimation. Actually such amounts were not observed in the study period. Even they were passed over, they can be neglected, because (1) According to Yasuoka et al. (2012), food stuffs are seldom sold, and (2) During the study period, food stuffs received from someone else were not observed, which suggests that food stuff exchange as gift were not so frequent in general.
(5) Cassava was recorded nine times during this period; in three of these instances, the informant had already started cooking so I could not record the amount. In those cases, I recorded the average amount of cassava according to the rest of the data (an average of 14,400 g on six occasions).
(6) *Esambu* is also known as *ipotsu* (pl. *topotsu*).
(7) *Liboke* is a Lingala name. This is a very popular cooking method in the DRC.

(8) One member of this family went to kill fish with a machete at night during this period. The amount was not included in this analysis because I was informed of this event the next morning, and all of the fish had already been distributed and cooked. The name of this kind of fishing in the Longando language is not clear. According to our informants, they go to the river at midnight and use a LED head torch to light the water. This enables them to find fish that seem to be sleeping, and then easily kill them with a machete. According to one informant, this method of killing fish became popular as the availability of LED head torches increased.
(9) Traditional salt made with plant ash.
(10) An adult red river hog weighs 45–115 kg (Kingdon, 1997).
(11) "Animals in the village" are called "*nyama na mboka*" in Lingala, which means livestock animals. "Wild animals" are called "*nyama na zamba*" in Lingala, and this literally means "animals in the forest."
(12) Millipede is the most disliked insect among Bongando people. They even hesitate to kill millipede because its sticky blood smells very bad. When they find it in the house, they throw it away in the forest with stick.

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Author's Name and Address: Ryota YAMAGUCHI, *Graduate School of Asian and African Area Studies, Kyoto University, 46, Shimoadachi-cho, Yoshida, Sakyo-ku, Kyoto 606-8501, JAPAN.*

E-mail: ryota [at] jambo.africa.kyoto-u.ac.jp