

DIACHRONIC CHANGES IN PROTEIN ACQUISITION AMONG THE BONGANDO IN THE DEMOCRATIC REPUBLIC OF THE CONGO

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ABSTRACT A comparison of data obtained in the 1970s, 1980s, and 2000s revealed diachronic changes in protein acquisition among the Bongando people living in the Wamba region of the Democratic Republic of the Congo. The main protein source changed from bushmeat to fish due to depletion of the game animal population. This shift occurred for two main reasons. First, hunting pressure around sedentary villages had increased even before the 1980s. Second, a civil war in the 1990s resulted in changes in the structure of cash earning in this region, consequently accelerating commercial hunting for cash income. To preserve the ecosystem and ensure a stable protein supply, it is important to promote the aquaculture and animal husbandry that have been implemented by some local nongovernmental organizations.

Key Words: Animal husbandry; Aquaculture; Bongando; Democratic Republic of the Congo; Protein acquisition; Tropical rainforest.

INTRODUCTION

In the tropical rainforest, protein acquisition is a main limiting factor in farmers' subsistence. In the Wamba region of the Democratic Republic of the Congo (DR Congo; Fig. 1), most protein is acquired by hunting, fishing, and gathering. However, as in other areas of the Congo basin (Wilkie & Carpenter, 1999), protein acquisition in the Wamba region has changed dramatically in the last few decades. Additionally, political and economic confusion caused by the Congo Wars from 1996 to 2003 have affected the supply and demand of protein resources.

Continuous hunting activities around villages have depleted the population density of forest animals, resulting in a regional 'empty forest syndrome' (Redford, 1992). To preserve the ecosystem and ensure the sustainable use of resources, protein-acquiring activities need to be regulated. However, if regulations are implemented without investigating the reality of local people's livelihoods, the regulations may result in unduly heavy burdens on local lives and traditional value systems. This would have negative consequences, both direct and indirect, for conservation projects, and would ultimately result in failure. Therefore, conservation agencies usually evaluate the actual livelihoods

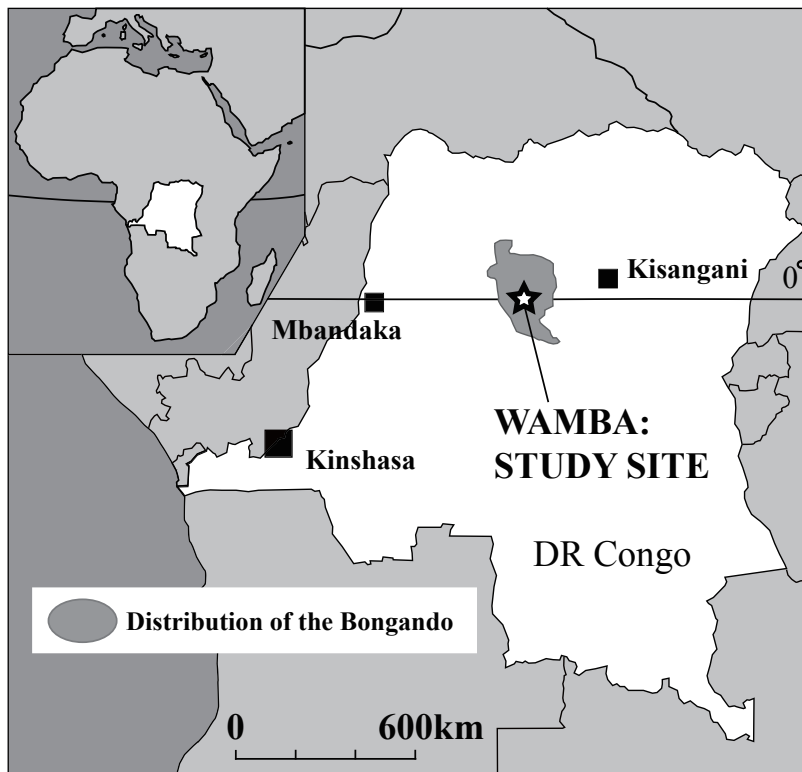


Fig. 1. Study site.

of local people to develop appropriate regulations.

This process has occurred in the Wamba region. Since 1973, a Japanese team has conducted research on bonobos (*Pan paniscus*) at the village of Wamba. Although the Luo Scientific Reserve was established in 1990 for the conservation of bonobos⁽¹⁾, the bonobo population continues to decline. In addition to the general trend of increased hunting, bonobo hunting increased as a result of the civil war. Fig. 2 shows the decline in the bonobo population in the Wamba region since 1991.

In this study, we analyzed long-term diachronic changes in protein acquisition based on data obtained in the 1970s and 1980s and our recent livelihood assessment, with the goal of determining a desirable strategy for future protein acquisition in this region. Following the above-mentioned primatological studies, we conducted ecological anthropological research among the Bongando people living in this area, specifically by collecting basic data about their food intake (Takeda, 1996; Sato, 1983; 1984; Kano, unpublished manuscript; Kimura, 1992). Additionally, in 2006 and 2007 we conducted a systematic quantitative assessment of their livelihood (see also Yasuoka et al., 2012).

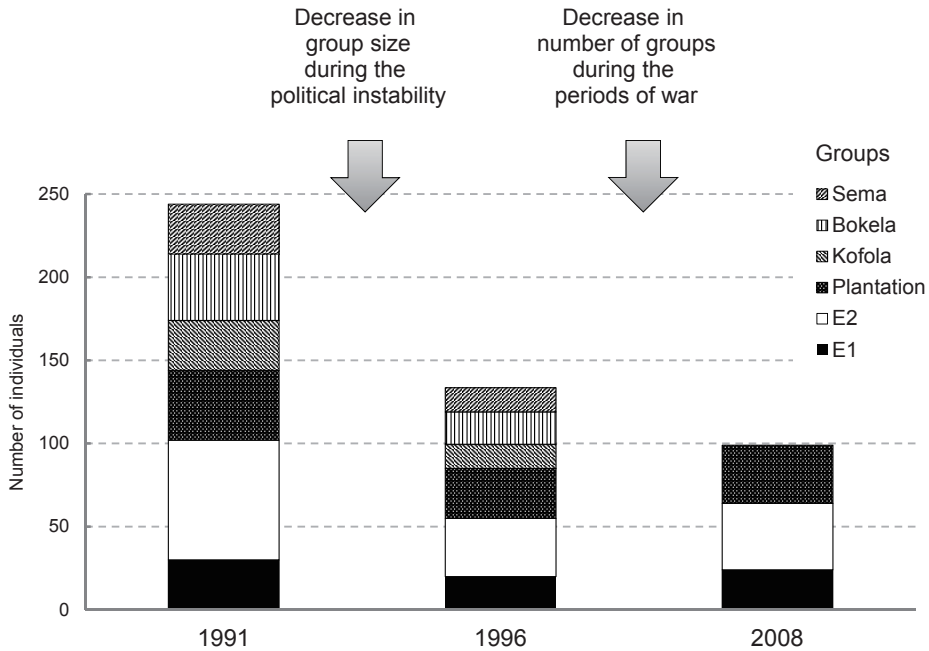


Fig. 2. Depleted bonobo population near Wamba (Furuichi et al., 2008).

HISTORY OF DR CONGO AND RECENT CONGO WARS

Before describing recent changes in the Wamba region, it is important to provide a brief history of the DR Congo. In 1960, the Belgian Congo achieved independence under the name ‘Republic of the Congo.’ However, shortly thereafter, a civil war called the ‘Congo Crisis’ broke out due to copper disputes in the Katanga region. After a long period of fighting, Joseph Mobutu (later Mobutu Sese Seko) seized power and became president in 1965. He changed the name of the state to ‘Republic of Zaïre’ in 1971, and promoted an ideology of ‘authenticity.’

During Mobutu’s dictatorship, the economy of the state gradually diminished as copper prices fell. Pressure to democratize increased, and riots broke out in the Kinshasa region in 1991. Once again, the state was in politico-economic turmoil. By 1996, tensions from the neighboring Rwandan Civil War spilled over into Zaire. The Alliance of Democratic Forces for the Liberation of Congo (ADFCLC), led by Laurent-Désiré Kabila, took control of the Kinshasa region in 1997 (the First Congo War). Mobutu escaped to Morocco, where he later died. As the new president, Kabila changed the state name back to ‘Democratic Republic of the Congo.’

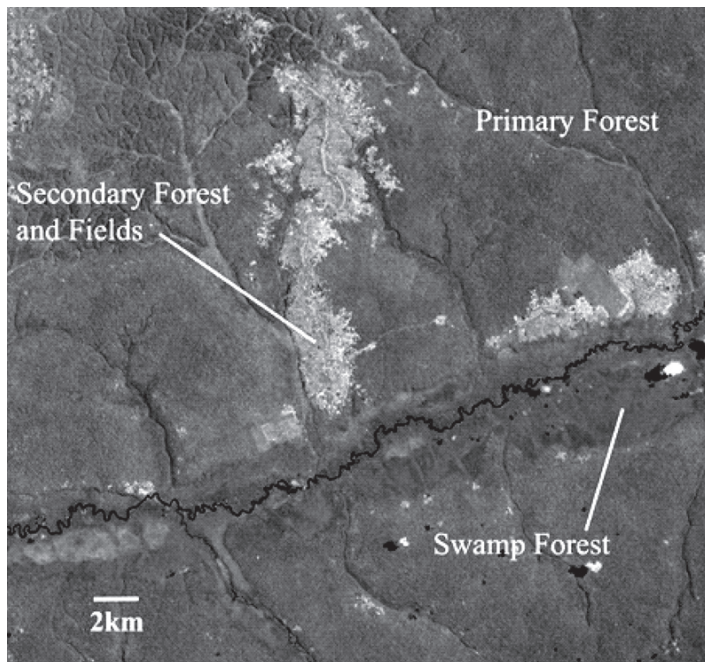


Fig. 3. Satellite image of the study site.

Even after the DR Congo was established, it was impossible to prevent confrontations between military powers. The ‘Second Congo War’ began, involving neighboring countries. President Kabila was assassinated in 2001 and was succeeded by his son Joseph Kabila. In 2002, the Pretoria Accord to promote peace was signed in South Africa. Joseph Kabila’s transitional government continued until the next presidential election, which was held in October 2006. Kabila won the election by a majority, and since that time the political situation in the western regions of DR Congo (including Wamba) has been generally calm, with the exception of some small-scale conflicts.

THE BONGANDO PEOPLE AND CHANGES IN THEIR SUBSISTENCE

I. The Bongando People and Their Subsistence

The Bongando are a Bantu ethnic group belonging to the Mongo cluster (Murdock, 1959; Hulstaert, 1961; 1972). They usually speak Longondo (the Bongando mother tongue) and use Lingala, a lingua franca spoken throughout northwestern DR Congo, to communicate with outsiders. Their population is estimated at about 450,000–500,000 (Kimura, 1992).

The study area is located at 0°11’N, 22°43’E (Fig. 1), an area 300–400

m above sea level and surrounded by tropical rainforest. The mean annual temperature is 24.5°C, and annual rainfall is about 2,000 mm (Vuanza & Crabbe, 1975). As shown in Fig. 3, forest vegetation is classified as primary forest, swamp forest, and secondary forest containing fields (Kano & Mulavwa, 1984). Bongando settlements extend along roads constructed in the 1930s by the Belgian colonial government. Agricultural fields and secondary forests extended up to 1–2 km on both sides of the village, with vast primary forest lying beyond. A few people live in *behetsia* (forest villages with cassava fields), and some temporary hunting/fishing camps (*nkumbo*) have also been established.

Cassava is the most important crop cultivated by the Bongando people. The tubers are the staple of the Bongando diet, and the protein-rich leaves are served as a side dish. Other crops include plantain, yam, maize, rice, and several kinds of vegetable. Coffee was planted as a cash crop, but it has not been cultivated since the beginning of the war.

According to Takeda (1990), the Bongando consume at least 65 species of mammals, 48 species of birds, 20 species of reptiles and amphibians, 104 species of fish, 50 species of insects, and 95 species of plants⁽²⁾. Because of their diverse hunting and gathering activities, the Bongando can be said to pursue multiple subsistence strategies rather than being classified simply as agriculturists. Although they raise goats, pigs, chickens, ducks, and pigeons for food, these animals are rarely eaten and are mainly exchanged as dowries or consumed during ceremonies⁽³⁾ (Kimura, 1992).

II. Changes in Protein Acquisition in the 20th Century

Our Bongando informants said that before the roads were constructed in the 1930s, they used to live in the forest and would move the village site every few years. After they began to settle near the roads, forested areas around villages were subjected to increased hunting pressure, and large mammals such as elephants, African buffalos, and bushpigs have disappeared.

Before the 1980s, collective hunting was usually undertaken in the primary forest using nets (*botai*) or bows and arrows (*bakimano* or *bakula*) (Kano, unpublished manuscript; Takeda, 1990). These hunting methods have not been used since the 2000s; hunters now actively use snares made of nylon string (*nilo*) or steel wire (*nzeki*) to hunt near the village. Large mammals are also hunted with shotguns at hunting camps far from the village.

In addition to subsistence hunting, ivory poaching using rifles has considerably reduced the elephant population. Kano (1992) noted that in the early stages of his bonobo research in the 1970s, he encountered an elephant at least once a day in the forest. However, no elephant has been seen near the study village since the mid-1980s.

III. Socioeconomic Changes During and After the Congo Wars

During the war in the 1990s, soldiers from Kabila's government army were posted in the Wamba region. These soldiers came from various countries,

including Angola, Rwanda, Burundi, Mozambique, Zimbabwe, and Namibia. Other forces stayed in nearby towns [e.g., *Rassemblement Congolais pour la Démocratie* (RCD) at Ilongo and *Mouvement de Libération du Congo* (MLC) at Lingomo]. Soldiers sometimes made forays into the villages, but no locals were fatally wounded in battle in the Wamba region. Some villagers moved temporarily into the primary forest to avoid the soldiers⁽⁴⁾. During this war, soldiers sometimes had villagers use their guns to hunt for food. When the soldiers retreated, they left behind a number of shotguns and bullets; the locals have since used these for hunting.

The war had a serious impact on the local economy and logistics; trucking, shipping, and air networks collapsed. Roads and bridges in the Wamba region were not maintained, and even now only a few vehicles are functional. River transportation also ceased; ships stopped coming to Befori, a nearby port town facing the Maringa River (a tributary of the Congo River). Scheduled air service to Boende (a city 400 km from Wamba) also ceased. Because of the lack of transportation and the danger of conflict, Europeans and Americans drew off from Christian missions and plantation companies in the area.

As a result, locals were left with no means to sell coffee beans, their main cash crop. One informant said that he had purchased 20 tons of coffee beans to sell at an increased price, but they spoiled because no channels were available to sell them during the wars. Although coffee was planted in about one-quarter of local fields in the 1980s (Kimura, 1998), only a few coffee trees have been observed recently around the village.

Locals also had no way to buy commodities such as cloth, soap, salt, kerosene, and notebooks. In 2005, one of the authors (Kimura) revisited the village of Yalisanga, where he had conducted research in the 1980s. He took 5 liters of kerosene with him and distributed them among the villagers. Looking at a flickering lamp, one villager told Kimura that this was the first time the younger children had ever seen kerosene lamplight.

To trade goods, villagers have begun to journey to Kisangani, the capital city of Oriental Province (Fig. 1). The straight-line distance from Wamba to Kisangani is 280 km, but the journey is 400 km by foot or bicycle⁽⁵⁾ and takes about 1 week by foot. Travelers usually sleep on the small path in the rainforest, without any shelter. They carry dried bushmeat, fish, caterpillars, mushrooms, distilled spirits, cucurbitaceous oily seeds (*nsiyo*), coffee beans, and live chickens, goats, and pigs (Fig. 4). Most commodities used in the village of Wamba are purchased at Kisangani⁽⁶⁾.

DIACHRONIC CHANGES IN PROTEIN ACQUISITION AT WAMBA VILLAGE

When we resumed our ecological anthropological survey at Wamba village in 2005, we realized that protein consumption patterns had changed dramatically among the local people. To analyze this shift quantitatively, we conducted a systematic livelihood assessment in 2006 and 2007, and compared the results with those of the following ecological anthropological studies conducted in the



Fig. 4. Villagers travelling to Kisangani with commercial products.

1970s and 1980s:

- Takeda's dietary assessment, 1975–1978 (Takeda, 1990);
- Kano's dietary assessment, 1976–1977 (Kano, unpublished manuscript);
- Kimura's anthropological research, 1986–1989 (Kimura, 1992, 2003).

I. Takeda's Dietary Assessment (1975–1978)

Takeda conducted an ecological anthropological survey of the Bongando in the 1970s (Takeda, 1990). He stayed at the hamlet of Bowa in the village of Ilongo, which is located 10 km south of Wamba. He asked two male villagers to record all foodstuffs they ate each day in notebooks; this process continued from 1975 to 1978. Figure 5 shows monthly changes in the sources of animal proteins consumed⁽⁷⁾. Note that the vertical axis does not show weight, but “consumption frequency per 100 days” for each food category.

These data revealed that the two major protein sources were wild mammals (46.4%) and fish (36.8%); insects comprised 8.5% of protein consumption, and domestic birds only 1.4%. Monthly consumption of mammals was relatively constant, whereas fish consumption increased from January to April, when water levels were low. Insects were collected year-round, but most were collected in August when caterpillars frequently infested the forest.

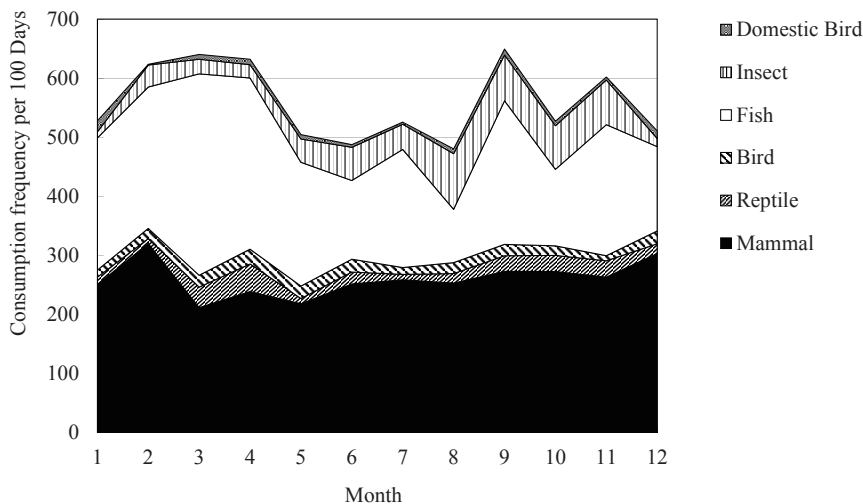


Fig. 5. Results of Takeda's dietary assessment (1975–1978).

II. Kano's Dietary Assessment (1976–1977)

At almost the same time as Takeda conducted his research, Takayoshi Kano who was studying bonobos at Wamba also studied the Bongando diet. Kano's data were not published, so we drew from his unpublished manuscript. Kano interviewed 16 Bongando men about their daily diets from 14–30 November 1976 and from 3–18 January 1977⁽⁸⁾.

Kano reported that these Bongando men consumed animal foods 665 times (54.1%) in 1,230 times' observed diet over the course of the research. Bushmeats (mammals, reptiles, amphibians, birds, and bird eggs) were most frequently consumed (406 times, 59.4% of all animal foods). Fish (including shellfish such as shrimp) were consumed second-most frequently (218 times, 31.9%), and insects were rarely consumed (59 times, 8.7%). These findings indicate that bushmeat was consumed twice as often as fish. Kano wrote: "Within the bushmeat, elephant meat was most frequently served on the dining table (138 times), followed by primate and artiodactyl meat. Even though some elephants were killed by *elongo* snare, most elephant meat was supplied from poachers who came from Kinshasa. They took only the elephant tusks, and the meat was left untouched. In the research period, at least 10 elephants were killed. Their meat was consumed as the important protein source (20.8% of animal food) in a wide area around Wamba (not only Yayenge hamlet where the bonobo research base was founded, but also Wamba and Sema villages)." In the 1970s, elephants were still abundant in the area, and were hunted in forests near the village.

Kano's data included few domestic animals. He wrote: "Domestic animals and birds appeared only 26 times in the record. This was only 3.8% of their recorded animal foods. (...) Meat of domestic animals and birds were only served in the ritual such as funeral, or in the hospitable reception of guests coming from a distance. In the daily life, these meats were quite rarely eaten."

III. Kimura's Research (1986–1989)

From 1986–1989, Kimura conducted anthropological research at the hamlet of Yalisanga, located 30 km east of Wamba village. This time-allocation study (Kimura, 1992) revealed that Bongando men and women spent an average of 32 and 0 min/day, respectively⁽⁹⁾, hunting (including trapping), and 28 and 7 min/day fishing. The villagers hunted using nets, spears, or bows and arrows, which are now rarely used. Even so, the catches were smaller compared with the 1970s. Collective net hunting of bushpigs, recorded by Takeda (1996), was no longer observed. On the other hand, fishing methods had remained almost unchanged since the 1970s, i.e., fishing with nylon nets or with fishhooks by men, and fish bailing (*mpoha nse*) by women.

In summary, in the 1980s bushmeat clearly played a more important role than fish in the Bongando diet, and appeared to be consumed more frequently than during the 2000s, although no quantitative data are available for this period.

IV. Livelihood Assessment (2006–2007)

In our recent assessment, we selected 20 families with literate heads of household from the adjacent villages of Wamba⁽¹⁰⁾ and Iyondje. We gave the head of each family a notebook and a 30-kg spring balance, and asked him to record the input and output of goods to/from the household: for example, "We harvested 10 kg of cassava tubers from the field," "We caught 5 kg of blue duiker in the primary forest by the trail," or "We got 1 kg of fish from the river, and gave half to somebody else." The leaflet used to explain the recording process to informants is included in the Appendix. We targeted informants' nuclear families, and requested that each informant record the names, sexes, and birth years of his wife/wives, children (excluding married children), and himself. Data were collected for a period of 2 years, for a total sample of 40 family-years.

We asked one reliable informant, who has supported our research for more than 20 years, to check all of the notebooks at least once a month. Some informants had obviously recorded data only periodically; notebooks had obviously been completed immediately before being collected, e.g., 2 days' data appeared on one page. After the assessment, we rigorously checked the records, and used the records from 17 informants in our analyses. As a result, we obtained data for 6,091 family-days, which included 60,434 cases; 'one case' was defined as 'a record in which one family obtained or gave one item.' These data can be analyzed in various ways, but this study focused specifically on protein acquisition⁽¹¹⁾.

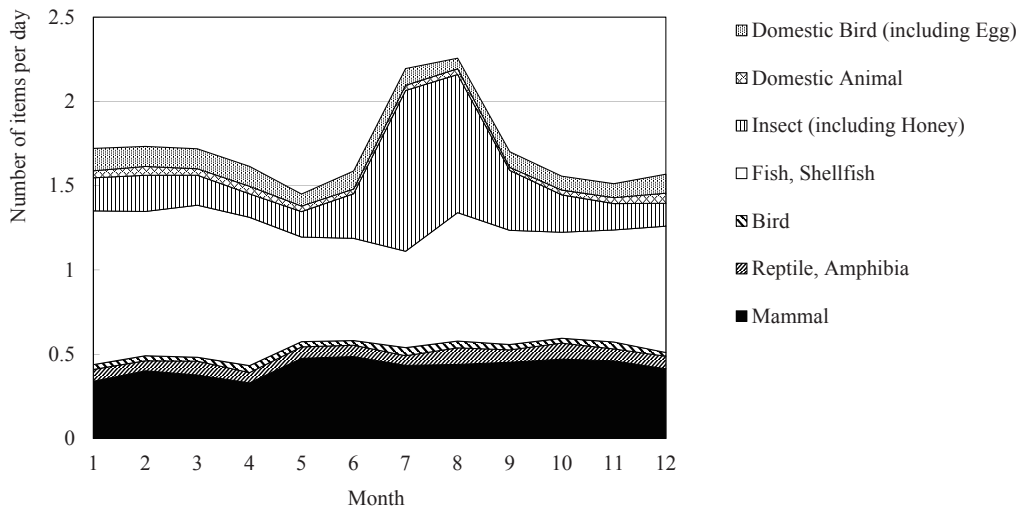


Fig. 6 Result of livelihood assessment (2006–2007).

Figure 6 shows monthly changes in the average frequency of acquiring each protein food per day⁽¹²⁾. Compared with the data of Takeda (Fig. 5) and Kano, the consumption of mammals decreased (from 46.4% of all protein as reported by Takeda and 54.1% as reported by Kano to 24.6% in this assessment), whereas consumption of fish increased (from 36.8% of all protein as reported by Takeda and 31.9% as reported by Kano to 42.9% in this assessment). Thus, fish appears to have overtaken bushmeat as an important protein source⁽¹³⁾.

We also noted that the Bongando people talked about the recent engagement of more young people in fishing.

Our assessment also revealed that more insects were being consumed (from 8.5% of all protein sources as reported by Takeda and 8.7% as reported by Kano to 18.4% in this assessment). The ratio is even higher in July and August⁽¹⁴⁾, when the forest is tremendously infested by several kinds of caterpillars. Some of the caterpillars collected are dried for sale in urban areas, such as Kisangani. The economic difficulties of the Bongando people, as mentioned above, may have accelerated the increased seasonal presence of caterpillars.

Domestic animal consumption has increased (from 1.4% of all protein as reported by Takeda and 3.8% as reported by Kano to 8.0% in this assessment), but the increase is minimal.

V. Summary of Diachronic Changes

In the 1930s, sedentarization progressed in the area as the Belgian colonial

government constructed a road network. Consequently, the Wamba village area became densely populated. Although the forests were subjected to increased hunting pressure, large mammals such as elephants lived near the village until the 1970s. Hunting provided more protein than did fishing, insects supplied about 8% of all dietary protein, and domestic animals supplied even less. In the 1980s, fewer large mammals lived near the village, and collective hunting using nets and bows and arrows had almost disappeared.

In the early 1990s, the domestic transportation network collapsed due to political and economic confusion in Zaire. The Bongando people lost the means to sell coffee beans, their only cash crop. They began to carry products such as dried meat to sell in the Kisangani area. This change meant that hunting for the sale of meat, in addition to that for domestic consumption, became common. During the war, soldiers from various countries stayed in the village and forced villagers to provide them with meat. The guns they left behind accelerated the hunting of large animals.

The war terminated in the 2000s, but transportation has not recovered well to date. Bongando people continue to travel by foot to Kisangani to sell and buy goods. Hunting to provide meat for sale is still actively practiced, and caterpillar gathering has become more common, presumably for selling.

As a result, even populations of smaller game animals have diminished over the last two decades. This may be one reason why the Bongando people now obtain more protein from fish than from bushmeat. Many studies (e.g., Yasuoka, 2006) have reported that improved traffic infrastructure due to logging operations tends to stimulate the bushmeat trade, increasing hunting pressure on wild animals to an unsustainable level. Ironically, the case of Wamba illustrates that the loss of a logistic channel, which discourages the production of agricultural export commodities (in this case, coffee), may also accelerate the hunting of wild animals, which can be sold in accessible cities.

RECENT ATTEMPTS TO ACQUIRE PROTEIN

Within the context described above, the best way to protect valuable fauna in the tropical rainforest and to ensure adequate protein consumption among the local people must be determined. Aquaculture and animal husbandry appear to be the best choices. The Bongando already breed domestic animals, but had seldom eaten them in the past. However, after we resumed our research in the 2000s, we found that they had begun to cultivate tilapia and jointly breed livestock. The following sections describe these new protein-acquisition activities.

I. Tilapia Aquaculture

Tilapia (*Oreochromis niloticus*) is the common name for a number of cichlid species. Because tilapia can be easily bred in freshwater, these species have become increasingly important for aquaculture in tropical and temperate zones worldwide.

According to the people in the Wamba region, tilapia farming was introduced around 2000 from Basankusu, a city 300 km west of Wamba⁽¹⁵⁾. Tilapia were originally cultivated at the Catholic mission in Basankusu, and tilapia farming then spread into nearby villages. Inhabitants of Wamba village took tilapia from some of these villages using buckets. Most tilapia cultivation is undertaken by teachers and missionaries at the Catholic mission, but some villagers also engage in this activity. Tilapia cultivation is especially important in villages located far from large rivers in which fishing can be practiced. Fishponds are constructed in one of two ways:

- Digging in the area around a river watershed (Fig. 7);
- Digging on the shore of a small stream (Fig. 8).

Fishponds are difficult to maintain in the riverside swamp forest (Fig. 3) because these areas are flooded during the rainy season. Therefore, locals have constructed ponds near the river watershed and beside small streams. Trees are cut down around the ponds because the fish prefer well-lighted and warm ponds. Each pond is about 10 × 10 m, and each cultivator may have one or several ponds. The fish are fed cassava leaves and tubers, oil palm fruit, or termites.

Cultivators harvest tilapia from the pond once or twice a year by bailing, and acquire one to several buckets of fish from each pond. After the cultivator's family consumes part of the catch, they donate the rest to acquaintances or sell the fish for approximately 500 FC/kg⁽¹⁶⁾. Because the ponds are not fenced, fish are frequently stolen, and some locals have stopped cultivating tilapia for this reason.

II. Joint Breeding of Small Livestock

Joint breeding of small livestock, such as pigs and goats, has been attempted in several areas around Wamba village (e.g., Djolu, Yalisele, and Iyondje; see Fig. 9). Breeding associations have been formed in these areas; most were organized in the 2000s⁽¹⁷⁾.

In 2007, we interviewed Mr. Nzoli, who was the president of *L'union des metalleurs pour les paysans qui veulent devenir eleveur*, a local nongovernmental organization (NGO) at Djolu. This association was founded in 2004, and managed about 40 pigs in 2007. At the time, the association was constructing a large breeding ground for pigs; it also planned to breed goats but had not yet begun to do so. Male pigs were castrated, with the exception of seed boars. Pigs were fed cassava leaves and tubers, maize, beans, papaya fruits and leaves, and rice. The association loaned sows to non-member villagers; if that sow gave birth, the breeder kept one piglet as payment, and other piglets and the sow were returned to the association. Pigs were priced as follows: 3-month-old piglets cost 3,000 FC, 4-month-old piglets cost 4,000 FC, and an adult male pig cost more than 10,000 FC. When pigs were butchered, the pork was sold at 500 FC/kg.



Fig. 7. Tilapia pond dug at the river watershed.



Fig. 8. Tilapia pond dug on the shore of a small stream.



Fig. 9. Pigs bred at Yalisele Catholic Mission.

III. Problems with New Protein Sources

Tilapia aquaculture and small livestock breeding have great potential to ensure a stable protein supply in the future. However, some problems arise from these practices.

The introduction of tilapia may cause environmental problems; digging at the river watershed to make fishponds may contaminate the water, and the primary forest around the pond is entirely cut down. Escaped tilapias may have an impact on the local ecosystem; some women who were bailing fish from a creek reported catching some tilapia that had escaped from a fishpond.

The efficiency of tilapia production is another issue to be considered. Few areas are suitable for fishponds, i.e., river watersheds or the shores of small streams. Large fishponds are difficult to construct near Wamba, due to the area's topography and soil. Additionally, tilapia production from one pond is only one to several buckets per year, so it is unclear whether tilapia cultivation can be a sufficiently large-scale protein-acquisition strategy.

Small livestock breeding is a promising option for the large-scale supply of protein. However, it remains unclear whether stable breeding is possible in a tropical rainforest environment (Nasi et al., 2008). Problems include the construction of fenced breeding farms and the maintenance of a sufficient feed supply. An even more serious consideration is disease among livestock; when one of the authors revisited the association in Djolu after 1 year (2008), all pigs had been killed by an epidemic. According to the association, all pigs within a radius of 100 km had died. Livestock management in this region always faces this kind of risk. Another issue is the local preference for meat; some elders said that they preferred bushmeat and did not like eating livestock, because these animals ate dirty foods in the village. Most young people, however, did not have such a prejudice.

IV. Activities of Local NGOs

Several local NGOs were founded in the Wamba region during the 1990s and 2000s. These NGOs are working to promote nature conservation and are developing new protein resources (Lingomo & Kimura, 2009). Their objectives include:

- To preserve the forest because it contains numerous materials and foods required by locals⁽¹⁸⁾;
- To protect the flora and fauna as future ecotourism resources;
- To invite donations from developed countries by implementing nature conservation⁽¹⁹⁾.

Although local NGO conservation activities vary considerably, the authors plan to collaborate with these organizations to promote a sustainable future.

CONSEQUENCES OF LONG-TERM STUDY AND FUTURE WORKS

This paper presented our analysis of diachronic changes in protein acquisition. We have also conducted anthropological and primatological studies at Wamba village, and have accumulated considerable data. We found that the problem of protein acquisition involves not only ecological aspects, but also political issues such as civil war and the ensuing economic disruption, activities of local NGOs, and cultural preferences of local people. Local NGOs are trying to develop new protein resources, but we cannot analyze their progress without at least 30 years of long-term observation in the area.

Clearly, hunting near villages is unsustainable in the Wamba region. Some international NGOs, such as the African Wildlife Foundation⁽²⁰⁾, are currently conducting animal population surveys in deep forests near Wamba. The resolution of the protein-acquisition issue will require more research. It is also important to assess the sustainability of wild fish resources, although this endeavor will be more difficult than surveying bush animals. Future research will also need to focus on accurately evaluating local hunting, eating, and selling of bushmeats, especially trading at the market in Kisangani. This future research will help to address the problem of protein consumption in the area.

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NOTE

- (1) However, due to the subsequent political disorder in Zaire since 1991 and the Congo War, which began in 1997, these studies and conservation activities were discontinued (Furuichi & Mwanza, 2003; Tashiro et al., 2007). The projects continued after the mid-2000s, when peace returned.
- (2) The Bongando have a specific term (*bokaku*) for the hunger for protein-rich foods such as meat or fish, while the general term describing the simple feeling of hunger is *njala*. This shows their strong preference for foods that are rich in animal protein.
- (3) The 150 residents of the study village kept a total of roughly 60 goats, 250 chickens, and 40 ducks.
- (4) The villagers said that they also escaped into the forest during the Congo Crisis in the 1960s to avoid 'Simba fighters.' They said they sometimes battled these fighters using poisoned arrows.
- (5) Some villagers trade goods at Isangi market, which is 100 km nearer than Kisangani.
- (6) Most goods sold in the periodic market near Wamba are purchased near Kisangani.
- (7) This figure was drawn by the authors, based on numeric data from a table in Takeda's original paper (Takeda, 1990).

- (8) Kano's research was conducted only at certain times of year, so seasonal changes cannot be analyzed.
- (9) Note that these values indicate the 'net duration' of each activity; they do not include, for example, time spent walking to the hunting/fishing location.
- (10) Administratively, it is called the "*Groupement de Wamba*."
- (11) For example, acquisition patterns of carbohydrates, varieties of edible caterpillars, or use of wild/cultivated yams. We also conducted similar assessments in Gabon, Uganda, and Tanzania; we will compare the results in future publications (see also Yasuoka et al., 2012).
- (12) In this assessment, "frequency of occasions in which each item was brought back to the house" was recorded, whereas Takeda and Kano counted the "frequency of occasions in which each item was served as the meal." Although these values cannot be compared directly, ratios of the items are roughly comparable, because foods brought back to the house were likely served as a meal once to several times.
- (13) In other areas of the African tropical rainforest, the consumption of wild meat and wild fish has been inversely correlated (Nasi et al., 2008).
- (14) Well-known bonobo researcher Suehisa Kuroda told us that the Bongando people have recently begun to collect caterpillars more intensively than in the 1970s.
- (15) Our Bongando informants also told us that they had been involved with aquaculture of domestic species, such as catfish, since at least the 1960s.
- (16) In 2011, 1 USD = ~900 FC (*Franc congolais*).
- (17) In addition to animal breeding, these associations operate cooperative farms, try to export products to urban areas, and operate micro-financing systems.
- (18) A common phrase in Lingala is "*Tobikaka na jamba* (We are saved by the forest)." Environmental education for the local people is indispensable.
- (19) Lingomo and Kimura (2009) argued that the Bongando's taboo on eating bonobo could be a 'cultural resource' because this taboo enabled Japanese researchers to study bonobo in the area, and nature conservation activities are expected in the future.
- (20) These activities are part of the Congo Basin Forest Partnership (CBFP) project.

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Appendix. Explanation of informants' livelihood assessment (original text was written in Lingara)

RESEARCH ABOUT GOODS

We want to investigate the livelihood of the Bongando people. We give you the following task. We have selected families from Wamba and Iyondje villages. If any member of your family gets some goods, or if they give some goods to others, please weigh them or record the quantity. Record these data in the notebook every day. This work will continue for 1 year.

Categories of procurement or giving

- Procurement
 - We got it by ourselves.
 - in the primary forest
 - in the secondary forest
 - in the field
 - on the river
 - We bought it.
 - We traded other goods for it.
 - We got it as a gift.
- Giving
 - We gave it as a gift.
 - We sold it.

Sample notebook entries

27 December 2005

Cassava tuber	10 kg	We harvested it in the field.
Blue duiker meat	5 kg	We caught it in the primary forest by the trail.
Tomato	1 glass	We harvested it in the garden behind the house.
Firewood	30 kg	We collected it in the burnt field.
Water	1 plastic can	We collected it at the river.
Salt	1 glass	We bought it.
Cloth for child	1	Somebody gave it as a gift.
Fish	1 kg	We got them in the river, and gave all of them to somebody else.
Coffee	2 glasses	We harvested it in the field, and we sold it to somebody else.