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Publication will be made twice a year in June and December. Deadline for manuscripts is one month before publication (i.e. the ends of May and November).

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<NOTE>

Fongoli chimpanzee (*Pan troglodytes verus*) eats banded mongoose (*Mungos mungo*)

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INTRODUCTION

We provide the first evidence of a chimpanzee (*Pan troglodytes verus*) preying upon a banded

mongoose (*Mungos mungo*). A subadult female was observed consuming a banded mongoose at the Fongoli savanna chimpanzee study site, Senegal. This recording provides new data and adds a small carnivore to the list of animal prey known for the chimpanzee diet.

Banded mongooses are found throughout sub-Saharan, central, and eastern Africa[1]. They are usually found in savanna woodland, habitually staying near water sources[1], but they are found in open savanna habitats at Fongoli, Senegal. The banded mongoose resides in groups greater than 35 individuals, which retire at night into dens, usually located in termite mounds[1]. The banded mongoose diet consists mainly of insects, worms, larvae, and small vertebrates[1].

The Fongoli study site is located in southeastern Senegal (12°39' N, 12°13' W), and the chimpanzee community has been observed since 2001. The number of chimpanzees fluctuates annually, but 33–36 individuals usually comprise the community. The chimpanzees at Fongoli are semi-habituated to human observers in that some of the adult females are still nervous in the presence of observers. The community has a home range of more than 63 square kilometers[2]. Fongoli is a mosaic environment including both open and closed canopy habitats, such as woodland and gallery forest[2]. Chimpanzees here are similar to those studied elsewhere in that their diet can be considered omnivorous, containing everything from seeds to other animals[3]. In general, the chimpanzee diet is comprised mostly of fruit (60%) with animal prey accounting for 8% (averaged from 12 sites including Fongoli)[2]. Animal prey does not constitute a high proportion of the chimpanzee diet. However, it can provide essential nutritional components that vegetation resources lack[3,4].

OBSERVATION

The banded mongoose at Fongoli are observed on average in every month of the year and range in group size from two to 24 individuals with a mean group size of 5.6 individuals (N=203 individuals, 36 sightings over 22 months from 2005–2008) and found in open savanna and closed forested habitats within the year of this study. On August 20, 2006, a group of more than five banded mongooses were seen on the plateau at Djendji water hole at 1503 hours; they then traveled into the gallery forest. Several days later, August 25, 2006, at the same locale, a chimpanzee was observed feeding on a mongoose.

At 1620 hours, Tia, a sub-adult female estimated to be about 13 years old, obtained an animal that did not resemble any of the three monkey species known at Fongoli. The capture was not witnessed so it is not known how she acquired the animal. Enough of the prey's body was intact to determine that the kill was recent and to allow identification of the animal as a banded mongoose. At one point, she did give some pieces of meat to a sub-adult male. Tia fed on the mongoose until 1636 hours, at which time she moved out of sight. When we located Tia again at 1650 hours (12°40.069N, 12°11.130W), the prey's head was gone, but the black dorsal stripes that characterize the banded mongoose were still visible. Tia ate the meat with leaves from an unidentified tree until 1750 hours when she again moved out of sight. When we attempted to follow her, Tia could not be found again within the group. The group made beds at 1820 hours; we attempted to find Tia the next morning in an effort to find the carcass of the mongoose, but we were unsuccessful.

There has never been any record of mongoose in the diet of the Fongoli chimpanzee, in feces nor in observation. Additionally, there has never been any report of the banded mongoose as a prey item at any other chimpanzee site in Africa, where banded mongooses are known to exist (Assirik, Senegal; Gombe and Mahale, Tanzania; Kibale, Uganda)[5]. Elsewhere in Tanzania, chimpanzees have been recorded to consume the white-tailed mongoose (*Ichneumia albicauda*)[6].

DISCUSSION

This instance of mongoose eating is anecdotal[7,8], but continuous study may reveal that this prey item is more common. Given that adult males are targeted for study, and certain females are relatively shy around human observers, further evidence is needed to determine whether the banded mongoose is a regular food source for the Fongoli chimpanzees or if it is an opportunistic prey species. Most likely this occurrence was the result of an opportunistic hunting event by the sub-adult female, since it has never been observed until now. This community has been observed hunting the

nocturnal lesser bushbaby (*Galago senegalensis*) with fashioned tools[9], and Tia ranks among the top five bushbaby hunters in the community. Since the capture of the mongoose was not observed it cannot be said whether a tool was used or not. However, given the behavior of the mongoose relative to a *Galago*[1], there is no reason to presume that tools were used. The capture of the mongoose may have been similar to techniques used in acquiring monkeys or even squirrels, which are chased along branches or the ground (Pruetz, unpublished data).

This is the first report of a chimpanzee feeding on a banded mongoose. Our findings may be an example of cross-cultural differences in diet among chimpanzee communities[3,10], but this hypothesis has yet to be tested with reference to the Fongoli chimpanzees. The inclusion of the banded mongoose in the diet may also be due to environmental constraints, such as the lack of mongooses at some of the other chimpanzee sites. Moreover, the faunal prey sources at Fongoli are limited to only three monkey species (*Papio hamadryas papio, Chlorocebus aethiops, Erythrocebus patas*), one nocturnal prosimian, bushbucks (*Tragelaphus scriptus*), squirrels (*Heliosciurus gambianus*), and warthogs (*Phacochoerus aethiopicus*). The Fongoli chimpanzees have been observed to pursue all but the warthog. The absence of red colobus (*Procolobus badius*), one of the main prey species at many chimpanzee sites, may explain the low occurrence of meat eating at Fongoli (5.4% of diet)[2,9]. It also may be that the low variety of prey species leads to the consumption of other small mammals, like the banded mongoose, at Fongoli.

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<NOTE>

Population density of chimpanzees in Tanzania

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INTRODUCTION

Chimpanzees (*Pan troglodytes*) are distributed around the eastern shore of Lake Tanganyika in western Tanzania. Based on an extensive survey conducted in the 1960s, Kano[1] showed that chimpanzees were distributed

in (a) Gombe, (b) Lilanshimba, (c) Ugalla, (d) Masito, (e) Mukuyu, (f) Mahale, (g) Karobwa, and (h) Wansisi (Fig. 1). In 1996, Ogawa *et al.*[2] identified another chimpanzee habitat, (i) Lwazi (Fig. 1). However, chimpanzee population density and distribution in Tanzania have not been revised since Kano's report[1]. In this paper, we showed the location in which we found beds and other traces of chimpanzees, and estimated chimpanzee population densities in (d) Masito, (e) Mukuyu, and (i) Lwazi. Besides, with the use of some additional unpublished data, we revised estimated chimpanzee population densities in (b) Lilanshimba[3], (c) Ugalla[4], (g) Karobwa[5], and (h) Wansisi[6] using the DISTANCE 5.0 computer program[7].

METHODS

In Tanzania, most chimpanzee habitats are savanna woodlands (miombo woodlands) dominated by deciduous trees of *Brachystegia* and *Julbernardia*, with a small proportion of evergreen riverine forests, grasslands, and bamboo thickets.

We visited all the areas indicated in Fig. 1 (a–i) and other areas where chimpanzees might have been distributed, using 1/50000 topographical maps, vegetation maps, satellite data, and information provided by locals. In addition to the areas reported in previous studies[2,3,4,5,6] and Table 1, Ogawa and Kanamori visited the Ufipa Escarpment (8°15'S, 32°00'E to 8°30S, 32°15'E) from Aug. 9–13 and Aug. 31–Sept. 8, 2001. Ogawa visited (a) Gombe from Sep. 3–6, 2003 and Mishamo from Aug.4–9, 2006. Sakamaki made an extensive survey in (f) Mahale from Jan. 23–30, 2006. Idani and Sakamaki stayed at the area between (g) Karobwa and (h) Wansisi from Jan. 23 to 30, 2006. Ogawa stayed at Mishamo (5°36'S, 30°28'E) from Aug. 4 to 9, 2006.

We conducted line transect bed censuses at (d) Masito: Lemera (5°15'S, 30°20'E) and Kasakati sites (5°20'S, 29°55'E), (e) Mukuyu: Lungonya site (5°40'S, 29°55'E), and (i) Lwazi: Msalamba, Mwinbi, Luanji, and Senge sites (8°10–25'S, 31°00–15'E)[2]. With the use of some additional unpublished data, we revised estimated chimpanzee population densities at (b) Lilanshimba[3], (c) Ugalla[4]: Bhukarai, Bukombe, Issa, Issa Basin, Mfubasi, Mfuwazi, Mtongesi, Nguye, Nkondwe, and Shangwasites; (g) Karobwa[5]: Ntakata and Kapalagulu[5] sites; and (h) Wansisi[6].

We measured the distance of some census lines using a tape measure; for other reconnaissance path, we used a portable GPS (Garmin 60CSx) and/or a pedometer. We walked not only on traditional paths used by locals, but also on paths used by wild animals, as well as off paths, and traveled through various types of vegetation. We measured the perpendicular distance from the census line to a chimpanzee bed using a distance meter (Nikon Laser 800S), counting the steps of local guides, or by eye after being trained to estimate distance in this way.

Densities of chimpanzee beds were estimated using the DISTANCE 5.0 computer program[7]. We used the Akaike Information Criteria (AIC) selection rule to choose a model from among three key detection functions (uniform, half-normal, hazard-rate) and three adjust detection functions (cosine, simple-polynomial, and Hermite-polynomial). We used those bed densities to estimate densities of bed-building chimpanzees,

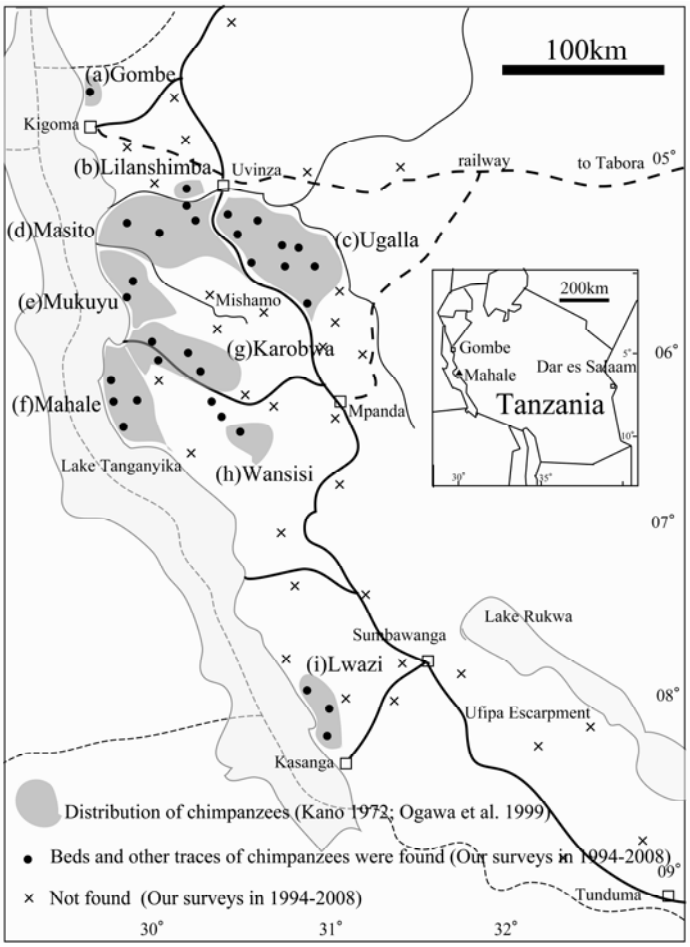

Fig. 1. Distribution of chimpanzees in Tanzania.

Table 1. Population density of chimpanzees outside of national parks in Tanzania.

Area	Density(1) (individuals/km^2)	95% Confidence interval	Number of beds	Census distance (km)	Study year	Density(2) in 1960s (individuals/km^2)	Habitat area(3) (km^2)
(b) Lilanshimba	0.02	(0. 01–0.05)	60	85.3	2006 [3]	0.29	140
(c) Ugalla	0.10	(0.07–0.18)	496	332.2	1995–2007 [4] and this study This study: Aug 10–31, 2008 Dec 23, 2007–Feb 29, 2008 Jun 27–Aug 29, 2008	0.08	2800
(d) Masito	0.12	(0.04–0.49)	54	51.3	This study: Aug 2–4, 2003 Aug 1–7, 2005	0.17	2200
(e) Mukuyu	0.05	(0.02–0.18)	55	49.1	This study: Aug 9–15, 2005	0.27	1100
(g) Karobwa	0.03	(0.02–0.08)	123	183.7	2003 [5]	0.38	900
(h) Wansisi	0.02	(0.01–0.08)	29	19.2	2001 [6]	0.12	500
(i) Lwazi	0.01	(0.00–0.03)	40	140.8	This study: Jul 20–24, 2003 Aug 17–29, 2005	-	1250
Total			857	861.6			8890

Population densities of bed building chimpanzees were estimated. Densities in the national parks, (a) Gombe and (f) Mahale, are not shown in this report.
(1) Density was estimated by DISTANCE 5.0[7].
(2) Density in 1960s[1].
(3) The habitat areas of (b), (c), (d), (e), (g), and (h) were referred to Kano[1]. The area of (i) was referred to Ogawa[2].

assuming that chimpanzees build 1.15±0.047[8] bed per day. We used 260 days[4] as the mean lifespan of a chimpanzee bed, because previous research has shown that bed trees in (c) Ugalla last for more than 260 days, and the study areas had climate, vegetation, and bed trees similar to Ugalla, with the exception of Gombe (a) and Mahale (f). We also conducted a marked bed count census at the Nguye site in Ugalla in 2008.

RESULTS

Fig. 1 shows the distribution of chimpanzees in western Tanzania. We confirmed that chimpanzees continue to inhabit all the areas they had inhabited in the 1960s. In addition to these areas, we found chimpanzee beds between (h) Wansisi and (g) Karobwa (6°17'S, 30°22'E). In contrast, we found no evidence of chimpanzees in flat areas, such as the Mishamo Basin. As reported by Kano[1], chimpanzees mainly seem to inhabit mountainous areas.

Table 1 summarizes chimpanzee population density outside national parks in Tanzania. In all areas, densities were lower in the 1990s–2000s than in the 1960s[1], with the exception of (c) Ugalla (Wilcoxon signed rank test, n = 6, z = -1.99, $p < 0.05$).

Our marked bed count census at the Nguye site in Ugalla revealed that 36 beds were made during 180 days along five 5-km transect lines, indicating a density of 0.09 individuals/km^2 (95% Confidence interval 0.05–0.24). This estimation is not contradictory to the assumption that chimpanzee beds can last as long as 260 days in this area, because the results of the standing crop bed count census in Ugalla also revealed a density of 0.10 individuals/km^2, when we used 260 days as the mean lifespan of a chimpanzee bed (Table 1).

DISCUSSION

Kano[1] hypothesized that the chimpanzee population in (h) Wansisi was isolated from chimpanzees in (g) Karobwa. However, we observed chimpanzee beds between these two areas. The hilly geographical features and type of vegetation suggest that the chimpanzee habitat of the Wansisi area may be narrowly connected with that of the Karobwa area. If so, the areas shown in (c–h) may form one continuous huge chimpanzee habitat. No researchers have observed bed-building activity in (i) Lwazi, but DNA sequences from fecal samples have indicated that the inhabitants are chimpanzees (*Pan troglodytes*) and may either be or be close to *Pan troglodytes schweinfurthii* (Tashiro, unpublished data). To date, our surveys have confirmed as many as four local chimpanzee populations in Tanzania, in: (1) Gombe, (2) Lilanshimba, (3) Ugalla-Masito-Mukuyu-Mahale-Karobwa-Wansisi, and (4) Lwazi (these populations do not include the introduced population on Rubondo Island in Lake Victoria). Our surveys indicate that no local populations have been exterminated during the past 50

years.

However, it is likely that each chimpanzee habitat area has shrunk. Calculation of the possible and actual chimpanzee habitat areas will require additional surveys and analyses using satellite and GIS data. The number of chimpanzees has clearly been reduced because population densities in each area were lower than in the 1960s[1]. Although direct comparison is difficult due to the differing methods of estimation, Table 1 indicates that the population density has been reduced since the 1960s. Density has been markedly reduced in (b) Lilanshimba, (e) Mukuyu, (g) Karobwa, and (h) Wansisi, probably due to the large human population in these areas, whereas density was unchanged in (c) Ugalla. In (b) Lilanshimba, (e) Mukuyu, (g) Karobwa, (h) Wansisi, and (i) Lwazi, increasing numbers of immigrant farmers have cultivated fields, except in steep mountainous areas. Trees have been cut down for use as lumber and firewood. Burundian refugees at the Mishamo settlement set many snares in (e) Mukuyu and (g) Karobwa, and Congolese refugees set snares in (b) Lilanshimba; this poaching resulted in deaths of chimpanzees in these areas[3,5,6]. Proper conservational planning is vital to protect chimpanzees and their habitats in Tanzania.

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<NOTE>

Arbors and cuttings: New trials for Green Corridor Project at Bossou-Nimba

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Since 1976, wild chimpanzees have been studied at Bossou, Guinea, in West Africa[1,2]. The Bossou group itself is extremely endangered. Since the beginning of our study more than 30 years ago, no female chimpanzee immigration has been recorded, whereas all of the female chimpanzees born at Bossou disappeared around sexual maturation[3]. As a result, the percentage of aged individuals is increasing in the group. To make matters worse, the number of Bossou chimpanzees suddenly decreased to 12 in 2003, due to an epidemic of respiratory disease[4]. For the group's survival, individual immigration from the nearest groups is essential.

About 10 km away from Bossou, at least one chimpanzee group lives in the Nimba Mountains[5]. In order to promote individual interchange between the Bossou and Nimba groups, we started in 1997 the "Green Corridor Project", which has involved planting trees along a 4 km long expanse of savanna area separating Bossou from Nimba[6]. Owing to this effort, we can see today small forest patches growing in this area[7].

During a decade, we have grown saplings in a tree nursery at Bossou, and transported them into the savanna. During transplantation, the environment around the saplings is drastically changed. The saplings are forced to receive strong sunshine in the savanna. For this reason, the saplings often died within a few days. To minimize damage caused by solar insolation, we started to make arbors in the savanna to protect young saplings. The arbors were constructed from natural materials, as local people do for their temporal ceremonies: we used bamboos as columns, leaf stalks of *Raffia* as beams, and palm leaves as roof. The roof allows the passage of water, whilst providing shade.

On September 2007, we constructed 3 arbors and transplanted 25 *Uapaca heudelotti* saplings under each of them (i.e., 75 saplings in total). One year later, we checked the condition of the *Uapaca* trees under the arbors. Whereas 13 trees were damaged by termites, the other 62 trees survived and thrived (82.7%). Some trees grew to 3 cm in diameter and 130 cm in height (Fig. 1). The arbor itself was small, but it proved to be a useful approach for creating patches of forest in the center of the savanna, compared to direct transplantation without protection which was often challenging. We continued to construct arbors in 2008 after the first trial, and a total of 23 arbors are now protecting young trees against strong sunshine of the savanna.

In 2007, we tested another planting method using tree cuttings. When we checked fences around villages, we noticed that some sticks were sprouting. We identified the sticks used for fences in 3 villages, including Bossou, and checked which species had shoots. Our study led us to investigate 8,998 sticks; 176 sticks were found to have new buds or leaves (Table 1). We counted 579 sticks of *Uapaca heudelotti*, but they did not have any shoots. When we transported saplings from tree nursery into the savanna, *Uapaca* was one of the most successful ones[7]. However, the Uapaca may be unbefitting in the tree cutting method. On the other hand, fifty one out of the 176 sprouting sticks were *Spondias cytherea*. We collected 1,523 cuttings of *Spondias cytherea* from forest, and directly planted the cuttings around gallery forest and small forest patches in savanna. Only 3 weeks later, 891 out of the 1,523 (58.5%) cuttings were found to have produced new shoots (Fig. 2). We still need to monitor growth development of these tree cuttings over time, but this method may be useful for enlarging the forest patches adjoining the savanna.

Fig. 1. *Uapaca heudelotti* trees under the arbor. They grew up to 130 cm in height.

Fig. 2. Cutting of *Spondias cytherea* planted around patchy forest.

These new attempts sparked great interest in the local people, because they consist of using techniques already familiar to them and applied to a conservation oriented reforestation project. Some villagers repaired the arbors voluntarily, while others started to plant cuttings including other species voluntarily. Changing savanna to forest by using the local methods is expected to increase environmental awareness of local communities and increasing their participation in conservation efforts.

Table 1. Germination rate of cuttings. We identified the sticks used for fencing in three villages, including Bossou, and checked which species had produced shoots.

Scientific name	The number of sticks used in fencing	The number of sprouting sticks	Germination rate (%)
"Kouyako" in local name	41	29	70.7
Aspilia africana	10	7	70.0
Spondias cytherea	87	51	58.6
Spathodea campanulata	16	8	50.0
Newbouldia laevis	18	8	44.4
Dracaena perrottetiii	16	7	43.8
Spondias mombin	76	29	38.2
Nauclea latifolia	105	8	7.6
Sterculia tragacantha	20	1	5.0
Mareya micrantha	57	2	3.5
Coffea arabica	58	1	1.7
Craterispermum caudatum	155	2	1.3
Craterispermum laurinum	1,351	16	1.2
Albizia lebbeck	17	0	0.0
Albizia sasa	35	0	0.0
Albizia zygia	8	0	0.0
Alchornea cordifolia	1,049	0	0.0
Allophylus africanus	21	0	0.0
Amphimas pterocarpoides	13	0	0.0
Anthonotha macrophylla	14	0	0.0
Blighia welwitschii	9	0	0.0
Bridelia ferruginea	57	0	0.0
Carapa procera	124	0	0.0
Dichrostachys glomerata	48	0	0.0
Elaeis guineensis (leaf stalks)	1173	0	0.0
Ficus exasperata	7	0	0.0
Ficus sur	30	0	0.0
Funtumia elastica	91	0	0.0
Harissonia abyssinica	66	0	0.0
Harungana madagascariensis	270	0	0.0
Lecaniodiscus cupanioides	5	0	0.0
Macaranga hurifolia	11	0	0.0
Manihot esculenta	412	0	0.0
Morinda germinata	24	0	0.0
Myrianthus libericus	35	0	0.0
Phyllantus discoideus	430	0	0.0
Phyllostachys sp.	1,873	0	0.0
Premna hispida	7	0	0.0
Pseudospondias microcarpa	18	0	0.0
Raphia gracilis (leaf stalks)	385	0	0.0
Terminalia glaucescens	42	0	0.0
Terminalia superba	8	0	0.0
Tetrorchidium didymostemon	20	0	0.0
Uapaca heudelotti	579	0	0.0
Vismia guineensis	15	0	0.0
Others (28 species)*	61	7	11.5
Unknown	31	0	0.0
Total	8,998	176	2.0

* We compiled some species here, when the number of sticks was less than 5.

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<NOTE>

Newly observed predation of wild birds by M-group chimpanzees (*Pan troglodytes schweinfurthii*) at Mahale, Tanzania

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INTRODUCTION

A number of predatory habits of wild chimpanzees (*Pan troglodytes*) have been reported across Africa[1,2,3,4]. Most of these studies have reported mainly meat-eating of mammals. There are a few descriptions of predation of birds by chimpanzees both direct and indirect evidence in some study sites[4-11].

When chimpanzees hunt and eat primates of other species, most chimpanzees present actively join in the hunt and the subsequent meat-eating[1,2,12]. In contrast, when preying on non-primate mammals, such as blue duiker, bush pig, and squirrel and so on, chimpanzees hunt in an opportunistic manner and not in groups[3,12,13]. Few studies have described predation on wild birds by chimpanzees. This study reports 3 direct observations of meat-eating of birds by chimpanzees in Mahale.

Study site and observation method

The M-group chimpanzees in Mahale have been observed for more than 40 years and all members have been identified and well habituated to human observers. The first author, *MF*, conducted the field studies between May 2005 and April 2006. The second author, *MS*, conducted his investigation between September 2001 and September 2002. We observed the chimpanzees in detail when they engaged in predatory behavior.

RESULTS

Case 1

On October 8, 2001, at 1233, *MS* observed 2 adult females TZ (age, 19 years) and NK (age, 31 years) up in a tree. TZ put her hand in the hole of the trunk and retrieved a nestling of a trumpeter hornbill (*Ceratogymna bucinator*). NK then approached TZ and took the nestling from TZ and moved to a spot approximately 3 meters away. At 1235, an adult female JN (estimated age, 27 years) inserted her hand into the same hole but did not find anything. NK held on to the carcass but did not eat it; she left the carcass on the ground at 1237. Thereafter, TZ climbed down to the ground and picked the carcass up. At 1240, she started eating the head of the carcass. An adolescent female ZL (estimated age, 15 years) approached TZ and uttered a pant-grunt. TZ stamped her foot while holding the carcass in her mouth, and ZL screamed and fled. At 1249, NK and TZ went away. *MS* did not witness whether TZ abandoned the carcass before moving or not.

Case 2

On August 2, 2005, at 1434, *MF* observed TZ (age, 23 years) climb a tree and walk slowly on one of its branches. *MF* did not clearly witness the moment when TZ procured something from a bird's nest, but observed

that at 1438, 2 parent white-necked ravens (*Corvus albicollis*) attacked TZ. TZ then descended to a lower spot on the tree, and started eating the nestling at 1508. At 1525, TZ's son TD (age, 4 years) stared at TZ's mouth and approximated his mouth to his mother's and obtained a small piece of meat. An adult female AK (estimated age, 24 years) also approached and stared at TZ for a few minutes, and then reached for the carcass in TZ's hand. AK succeeded in obtaining a piece of meat at 1548 and ate it with her daughter AC (age, 7 years). At 1551, an adult female SY (estimated age, 22 years) and her daughter SW (age 2 years) appeared. SY groomed TZ for about 3 minutes. Thereafter, SY repeatedly looked into TZ's mouth and hand, and then, TZ groomed SY for 3 minutes. TZ restarted eating the carcass, and SY extended her hand toward TZ's hand. SY acquired a small piece of meat at 1601. TZ and TD started moving and abandoned the carcass at 1609.

Case 3

On November 1, 2005, *MF* observed chimpanzees preying on a red colobus and consuming its meat for about one hour. At 1322, an adult male DW (age, 17 years) was observed holding a carcass of an adult black kite (*Milvus migrans*). At 1325, *MF*'s research assistant noted that an adolescent male PR (age, 14 years) also held a carcass of a black kite. Both DW and PR departed and were quite a distance away from the other members. When the group engaged in eating the red colobus began to disperse at 1540, a juvenile male OS (age, 7 years) arrived holding the body of an adult black kite. He carried and started eating it by himself. His mother OP (estimated age, 34 years), his sister RB (age, 19 years), and RB's daughter RC (age, 7 years) approached OS, and he allowed them to eat the kite. Afterward, two adult females got small pieces of meat from OS. The alpha male AL (age, 17 years) then arrived and stared at OS but left quickly. After this, we lost OS momentarily, and subsequently saw his niece RC with the carcass (Fig. 1). Then, OS took and carried it. At 1713, OS abandoned the carcass and started moving with the other group members. We were unable to determine whether OS had simply picked up one of the carcasses that PR or DW had abandoned or whether he captured it independently. We can report that at least 2 black kites were hunted and eaten by chimpanzees.

Fig. 1. A juvenile female with a carcass of a black kite.

DISCUSSION

Our study revealed some characteristics of bird predation by chimpanzees based on 3 direct observations and some information about the predation of wild birds by chimpanzees obtained through previous studies (Table 1).

First, capture of nestlings from their nests seems similar to that of non-primate mammals in that it is solitary and opportunistic. Our observations showed that chimpanzees do not hunt birds in groups. In the 1st and 2nd episodes, TZ took a nestling from a bird's nest. She approached each nest and took the nestling, which offered no resistance to the predator. The bird parents attacked TZ in the 2nd case, but she succeeded in capturing the nestling.

Second, we can point out individual differences among chimpanzees even within a unit group in their tendency to hunt and eat birds. Not all the chimpanzees present in the 3 episodes begged for meat actively, while the hunter and meat possessor ate the meat. In the 1st case, although the adult female NK appropriated the carcass of the trumpeter hornbill, she abandoned it without eating it. In the 3rd case, although the alpha male AL approached the meat possessor OS, AL did not show any interest in the meat. In Gombe, among 14 episodes of bird predation by chimpanzees, 7 were performed by the same individual—a juvenile female named Pom[8].

Lastly, data across study sites show that chimpanzees may not prey on birds with enough ability to fly. Most of developmental stages of bird prey were

Table 1. Species, developmental stages of birds preyed upon by wild chimpanzees and age-sex of predators in five chimpanzee study site.

Study site	*Sub sp.	Prey species	Developmental stages of prey	Hunter or meat possessor	References
Mahale	S	Crested guineafowl (*Guttera edouardi*)	Eggs	-	6
		Scaly francolin (*Francolinus squamatus*)	Young	-	6
		**Vieillot's black weaver (*Ploceus nigerrimus*)	Eggs, fledgelings	-	6
		White-browed coucal (*Centropus superciliosus*)	Injured adult	-	6
		Chicken (*Gallus gallus*) (domestic fowl)	Chickens	Adult M	6
		Tranpeter hornbill (*Ceratogymna bucinator*)	Nestling	Adult F	This study
		White-necked raven (*Corvus albicollis*)	Nestling	Adult F	This study
		Black kite (*Milvus migrans*)	Adult	Adult M, adolescent M, juvenile M & F	This study, Nishida (unpublished)
Gombe	S	**African green pigeon (*Treron australis*)	Eggs		8, 9
		Scaly francolin (*Francolinus squamatus*)	Nestlings	・7/14 episodes juvenile F (Pom)	8, 9
		Palm-nut vulture (*Gypohierax angolensis*)	Eggs, young		8, 9
		Helmet guineafowl (*Numida meleagris*)	Nestlings	・5/14 episodes adult Ms	8, 9
		African Pied Wagtail (*Motacilla aguimp*)	Injured adult		8
		**Common bulbul (*Pycnonotus barbatus*)	Unknown	・2/14 episodes adult Fs	8
		Weaverbirds (*Ploceus* spp.), at least 2 species	Nestlings, adult		8, 9
		Woodpecker ? (*Picidae* sp.)	Nestlings		8
Kibale	S	Crested guineafowl (*Guttera pucherani*)	-	-	4
Ndoki	T	Hornbill ? (*Ceratogymna* sp.)	Unknown	Adult F	10
		Francolin ? (*Francolinus* sp.)	Nestling	Adult M	10
Bossou	V	**African wood owl (*Strix woodfordii*)	-	-	11

* S: *schweinfurthii*, T: *troglodytes*, V: *verus*

** Common and species names are as reported in van Perlo, 1995, and hence, they differ from those described in each reference.

eggs, nestlings or injured adults, without either ability to fly or resistance to predators.

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<NOTE>

The Ebo forest: Four years of preliminary research and conservation of the Nigeria-Cameroon chimpanzee (*Pan troglodytes vellerosus*)

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INTRODUCTION

Cameroon harbours four great ape subspecies separated by the Sanaga River, which is an important biogeographical barrier[1]. To the south are the sympatric western lowland gorilla (*Gorilla gorilla gorilla*) and central chimpanzee (*Pan troglodytes troglodytes*) and to north the Cross River gorilla (*G. g. diehli*) and the recently distinguished Nigeria-Cameroon chimpanzee subspecies (*P. t. vellerosus*)[1,2]. The Nigeria-Cameroon chimpanzee is the least studied of the four currently recognised chimpanzee subspecies with the only current long-term study being that in the Gashaka Gumti National Park in Nigeria — a dry sub Saharan Guinea zone[3]. Very little information is available on this subspecies in the closed canopy primary forests of Cameroon.

This report aims to introduce the four years of the Ebo Forest Research Project (EFRP) which has the objectives for research and conservation of the Nigeria-Cameroon chimpanzees in the Ebo forest located in the south-western part of Cameroon.

METHODS

Research site

The Ebo forest extends over 2,000 km^2 of closed canopy primary forests in the biodiversity 'hotspot' between the Cross River in Nigeria and the Sanaga River in Cameroon (Fig. 1). The forest harbours eleven diurnal primate species including the Nigeria-Cameroon chimpanzee and a small population of gorillas of uncertain taxonomic affinity[2]. Many small villages surround the Ebo forest, which until the late 1950s and early 1960s was inhabited mostly by the people of the Banen and Bassa tribes. Bushmeat hunting and trade are the main economic activities in these villages, and this has been facilitated by a network of logging roads especially in the southern part of the forest. Following results of preliminary surveys carried out in 2002, a permanent research station was set up in the Ebo forest by the Zoological Society of San Diego in April 2005 (Fig. 2).

Procedure

Line transects and pre-existing human and elephant trails were used to determine chimpanzee and gorilla distribution and ranging patterns. Basic ecological data was collected by indirect means, from beds and faecal remains. Monthly observational censuses were conducted along each transect and trail, noting primate/mammal signs, feeding remains and human signs. Faecal samples collected within the study area were washed in 1 mm mesh metal sieves to distinguish the large seeds, other plant and animal matter ingested by the apes[4].

Our outreach program targeted all age groups in most of the villages around the Ebo forest. It consisted of sporadic hunter training workshops, primate film shows, formal and informal education programs in schools and villages.

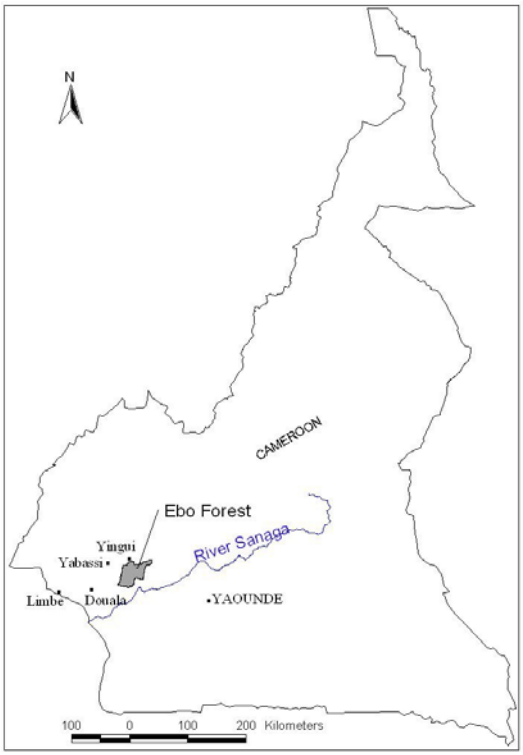

Fig. 1. Location of the Ebo forest in Cameroon.

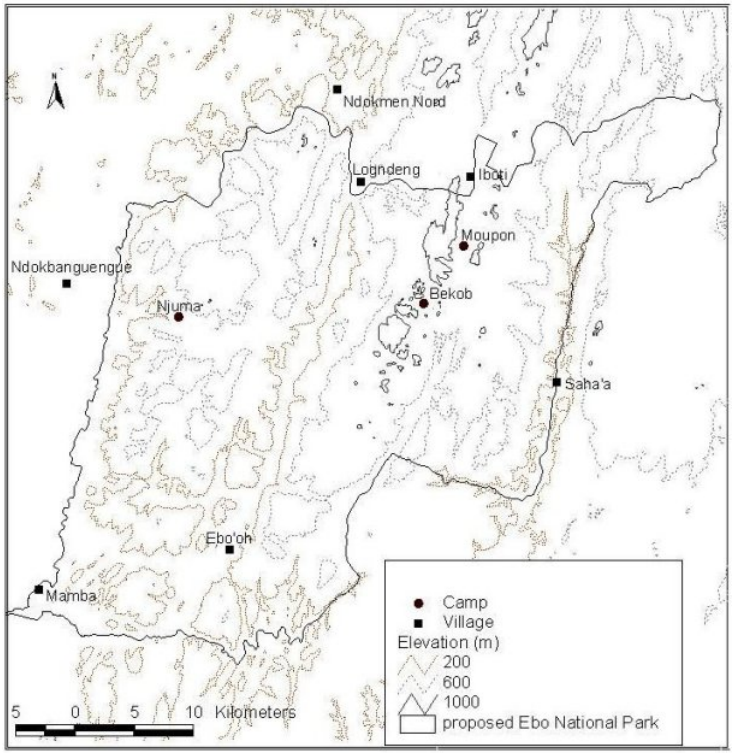

Fig. 2. The Ebo forest area, research camps and surrounding villages.

RESULTS

Bed structures

Of the 222 beds recorded along transects and trails between January 2006 and December 2007, 24 were ground beds of which 6 were night beds (Fig. 3). The Ebo chimpanzees constructed their beds mostly on steep slopes and rugged terrain probably because of night hunting by humans prevalent in the forest.

Termite fishing by chimpanzees

Discarded termite fishing tools were observed on epigeal and subterranean nests across the Ebo forest (Fig. 4). As this activity has not been observed directly in the Ebo forest, we are reluctant to speculate on how exactly it is carried out. We have, however, noted two combinations of instruments: stout long straight sticks and flexible leaf midribs, similar to those found in the Goualougo Triangle in Congo[5].

Nut cracking by chimpanzee

The Ebo chimpanzees were observed cracking *Coula edulis* nuts in 2005[6], an activity hitherto thought to be limited to communities west of the N'zo Sassandra River in Côte d'Ivoire[7]. The target species for nut cracking was *Coula* nuts. The Ebo chimpanzees have never been observed to crack open oil palm (*Elaeis guineensis*) nuts like the Bossou chimpanzees in Guinea[8]. Oil palms are common throughout the forest, and the red soft outer layer is widely consumed by the chimpanzees. So far, nut cracking sites have only been identified on the western side of the Ebo River. Four tool combinations for cracking *Coula* nuts have been observed in the Ebo forest: wooden anvil and wooden hammer, stone hammer

Fig. 3. Fresh chimpanzee night-ground bed (photograph by EEA).

Fig. 4. Termite fishing sticks on a subterranean termite bed (photograph by EEA).

Fig. 5. Stone hammer and anvil (photograph by EEA).

and wooden anvil, stone hammer and stone anvil (Fig. 5) and stone hammer without anvil.

Sympatric gorillas

Gorillas were first sighted in the Ebo forest in November 2002. This gorilla population is biogeographically interesting as it occurs less than 100 km north of the Sanaga River, the geographical barrier between the Western Lowland gorilla to the south and the Cross River gorilla to the north[2]. The gorilla population is sympatric with chimpanzees around the Moupon area. From 2005 and 2007, ten groups of 31 gorilla beds were recorded 22 of which were tree beds ranging between 0.5 m to 20 m in height. The ground beds were constructed of vegetative matter on rocks or bare ground and in a couple of occasions, the gorillas were observed to have slept on bare soil alongside ground and tree beds.

Outreach programs

The population of the 19 villages surrounding the Ebo forest generate income largely from the commercial trade in bushmeat. This coupled with local and commercial logging activities are the main threats to the forest and fauna of Ebo. Hunters spend several days in the forest and on their return to the village; they sell the bushmeat to intermediaries commonly called 'buyam sellams' who in turn supply the cities. The 'buyam sellams' come in hired taxis, motorcycles and sometimes timber trucks based on appointments with the hunters. Outreach programs were an integral part of the EFRP. Four workshops for hunters from Ebo villages were organized at the Limbe Wildlife Centre for mammal identification and comprehension of the national and international wildlife law. Three primate film shows centred on the behavioural ecology of chimpanzees and gorillas were organized in three villages. Formal and informal discussions on environmental issues were regularly held in the villages and primary schools.

DISCUSSION

The long-term goal of the Ebo Forest Research Project is to secure the population of chimpanzees, gorillas and other large endangered mammals of the Ebo forest. We are working on this through active research coupled with regular contacts with communities that use the forest resources. Today we have two permanent research stations (Bekob and Moupon) in the Ebo forest and the third (Njuma) will be operational in January 2009. We are collaborating with the Government of Cameroon and Wildlife Fund for Nature Coastal Forests Programme for the gazettement of the Ebo forest into a national park. More international networking, collaboration and commitment are required to promote the research and conservation of the endangered species in the Ebo forest, including the Nigeria-Cameroon chimpanzee.

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and Innovation. Our in-country partners include the Wildlife Conservation Society, and WWF Coastal Forests Programme Cameroon. We are grateful to the Ebo Forest Research Project staff, chiefs and villages surrounding the Ebo Forest. Special thanks to Professor Tetsuro Matsuzawa (Director of the Primate Research Institute of Kyoto University) for inviting EEA to the HOPE/SAGA symposium to introduce our research and for reading and commenting on earlier drafts of this manuscript.

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<NOTE>

Coprophagy by the semi-habituated chimpanzees of Semliki, Uganda

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INTRODUCTION

This report adds to the growing published literature on coprophagy in wild chimpanzees. We present observational and circumstantial evidence of this behavioural pattern, and test the utility of current hypotheses for explaining coprophagy in wild chimpanzees.

Eating one's own feces (autocoprophagy) and eating the feces of others (allocoprophagy) occurs in wild populations throughout the animal kingdom[1]. Yet in apes, coprophagy is commonly considered to be abnormal behaviour in captive populations. It often appears in lists of problematic behaviours[2,3], and is thought to be a response to boredom or stress[4].

Yet wild chimpanzee populations also engage in coprophagy: Autocoprophagy has now been reported from several long term study groups, including Assirik[5], Gombe[6], Mahale[7], Bossou[8], and Fongoli (Bertolani *et al.*, unpublished data). Interspecific allocoprophagy has been reported from Kibale, where chimpanzees consume elephant dung[9]. The cause of this pattern remains uncertain, but several hypotheses have been proposed.

(a) Boredom: Commonly cited as a factor inducing coprophagy in captivity[4], it has also been suggested to explain wild gorilla coprophagy during long periods of heavy rain when foraging activities are reduced[10].

(b) Insufficient roughage: Lack of "wadging" materials (such as fibrous leaves) in the diet of captive chimpanzees may increase the frequency of coprophagy[11].

(c) Provision of essential nutrients: Some captive groups of largely herbivorous gorillas may engage in coprophagy in order to gain Vitamin B12 which is present only in animal matter[12].

(d) Food scarcity: At Gombe, coprophagy occurred during a period of fruit scarcity, after an unusually dry season[6]. The pressures of foraging in a food-scarce environment may increase coprophagy.

(e) Reingesting hard seeds: Coprophagy may be adaptive when groups feed on fruits with seeds that pass through the gut whole, but then can be split open and reingested after coprophagy. Free-ranging chimpanzees in the Republic of Congo regularly engaged in coprophagy when feeding on *Dialium*

seeds, which were found both whole and fragmented in feces[13]. Chimpanzees at Assirik extract and eat baobab (*Adansonia digitata*) seeds from their feces[5]. Allocoprophagy in Kibale is positively correlated with the presence of hard seeds in the elephant dung[9]. In Mahale, an individual showed coprophagy after eating *Saba florida*[7], a species with hard seeds that are ingested whole.

(f) Culture: Nash *et al.*[3] presented evidence suggesting that coprophagy may be a socially learned behaviour in captive chimpanzee groups.

METHODS

The Toro-Semliki Reserve is in western Uganda, near the eastern edge of the Great Rift Valley (0°50' to 1°05' N, 30°20' to 30°35'E), and supports several chimpanzee communities[14]. Habituation efforts have been ongoing since 1996[15], and progress is being made.

We made observations and collected fecal samples opportunistically from May–November 2008. Feces were washed and sieved through a 1 mm mesh, and the contents recorded.

RESULTS

We saw five episodes of autocoprophagy during the study period (See details in Table 1). No allocoprophagy was observed directly, but circumstantial evidence of coprophagy comes from one case of discarded (presumably spat-out) seeds (Table 1), and from seed fragments in eight fecal samples (Table 2).

At least three individuals, including adult and juvenile males, showed coprophagy (Table 1). Individuals were observed to defecate directly into their own hand and raise the feces to their mouth. They then manipulated the feces in their mouths using their lips, spitting out seeds and indeterminate fecal matter. These cases occurred when groups ate low-quality food items, such as bark, pith and seeds (Table 1). Case 6 occurred when at least one individual was in poor health, as evidenced by vomit found on leaves, although no evidence of disease or infection was found at any other time during the study.

The presence of seed fragments in feces may be indirect evidence of coprophagy, because the apes were never seen or heard to crush the hard *Saba florida* seeds when eating the fruits whole. In every case in which coprophagy was observed, we could hear the sounds of

Table 1. Observed cases of coprophagy by Semliki chimpanzees.

Case No.	Date	Min. group size	Other food items	Individual	Duration of coprophagy (min)	Duration of observation (min)	Other notes
1	21.07.08	2	*Cynometra alexandri* bark/cambium	Juvenile male	32	75	Same individual as Case 4.
2	08.08.08	6	*Phoenix reclinata* pith, *Cynometra* leaves	Adult male	8	78	
3	14.08.08	25	*Cynometra alexandri* pods, *Cola gigantea* bark/cambium	Unknown	Unknown	186	Circumstantial evidence: two moist seeds (sp. *indet.*) smelling of feces fell to the ground below one individual*
4	21.08.08	2	*Cynometra* pods, *Acacia* bark/cambium	Juvenile male	11	22	Same individual as Case 1.
5	05.09.08	9	*Cola gigantea* bark	Adult male	1	141	
6	06.09.08	20	*Phoenix reclinata* pith, *Cola gigantea* bark/cambium	Juvenile male	30	103	Vomit found on leaves below group

* Case for coprophagy is strengthened by the fact that not only were the chimpanzees not seen to eat these seeds that morning, but also had spent the observation period (from un-nesting) in gallery forest, where this species was not commonly found.

Table 2. Chimpanzee fecal samples containing *Saba florida* seed fragments.

Fecal No.	Date	Other identified food items found
60	10.07.08	6 *Beilschmiedia ugandensis* seeds, 2 *Rhus natalenis* seeds, 33 *Saba florida* seeds, fiber "few"
75	22.07.08	3 *Saba florida* seeds, 3 *Hymenoptra* larvae, fiber "common"
87	11.08.08	Weaver ants, fiber "few", *Ficus* sp. "abundant", *Cynometra alexandri* "common"
96	23.08.08	green leaf "few"
99	25.08.08	*Cynometra alexandri* "few", *Ficus mucosa* "abundant", fiber "few", green leaf "few"
101	28.08.08	Weaver ants "few", fiber "abundant", fruit skin "few"
102	30.08.08	Fiber "abundant", fruit skin "common"
103	30.08.08	Weaver ants "few"

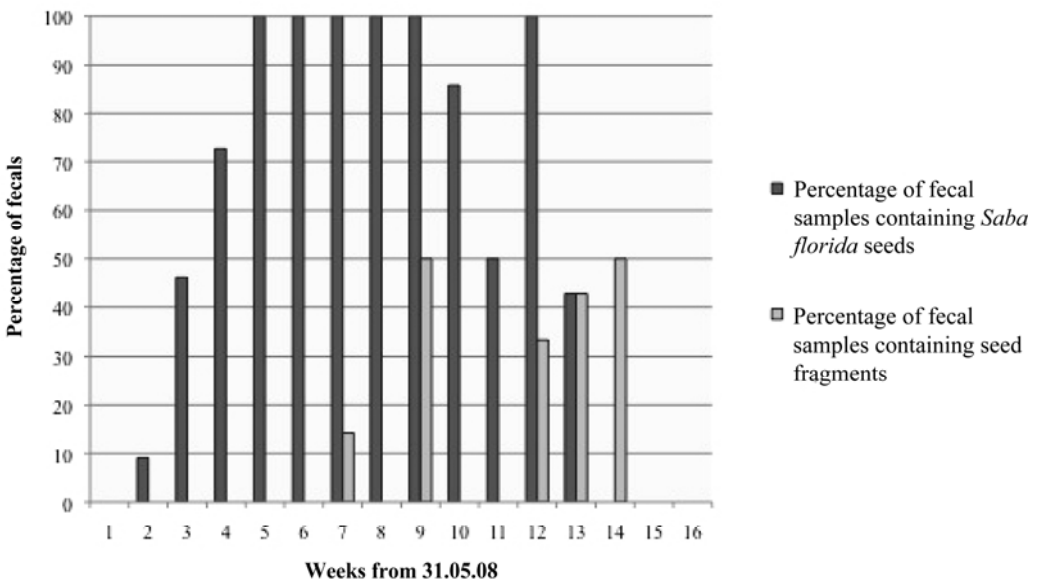

Fig. 1. Indirect evidence of coprophagy from fecal analysis: *S. florida* consumption.

seeds being crunched and cracked. We presumed these to be *Saba*, since these seeds were predominant and were found more consistently in fecal samples than any other seeds during the study period. We found crushed seeds in samples in the latter half of the *Saba* fruiting season (Fig. 1), shortly before *Saba* seeds disappeared from feces altogether.

The decline in the presence of whole seeds and increase in the presence of fragments in feces between Weeks 1–8 and Weeks 9–16 (Fig. 1) differs significantly from chance ($X^2_{(df=1)} = 10.7$, N=78, $p<0.01$).

DISCUSSION

The hypotheses (a)–(b) cannot explain coprophagy by the Semliki chimpanzees. (a): Unlike barren captive environments, the habitat at Semliki reserve is rich and stimulating; the chimpanzees engage in various kinds of extractive foraging. (b): Fibrous materials often feature in the diet of the Semliki chimpanzees[14], and were consumed during every case of observed coprophagy. (c): Insects occurred regularly in fecal samples at Semliki during the study period, so coprophagy need not supply Vitamin B12.

Instead, hypotheses (d) and (e) seem likely variables which may interact to cause the chimpanzees of Semliki to engage in coprophagy. Given the significant relationship between the presence of crushed seeds in feces and declining *Saba* availability, we propose a tentative hypothesis that coprophagy in Semliki chimpanzees is caused by the pressure to exploit added

nutrients from reingesting *Saba* seeds when availability of the fruit is in decline. There is a possibility that seed fragments in feces may not reflect coprophagy but instead the occasional crunching of the seeds during *Saba* fruit consumption that is never seen at Semliki, but observed at Mahale (Nakamura, personal communication). Further observational data are needed to clarify this.

The lack of coprophagy during times when *Saba* was consumed in abundance, and the presence of many whole, non-reingested seeds in feces in the early half of the fruiting season, suggests that coprophagy may be a fallback or seasonal strategy for Semliki chimpanzees. It may be a response to a decreasing resource, as a way of more efficiently exploiting the nutrients available from this high quality food item. It may also be specific to individuals who find it harder to acquire high quality foods (Table 1). However, further behavioural data is needed to test this, particularly since coprophagy was only observed in adult and juvenile males and these individuals are better habituated to human observation than female chimpanzees at Semliki.

Hypothesis (f) cannot be assessed from the data gathered thus far. As habituation efforts progress, it is hoped that more information on unusual behavioural patterns in this population will come to light.

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