<NOTE>

Root Eating by Wild Chimpanzees (*Pan troglodytes*) in the Kalinzu Forest, Uganda: Possible Medicinal Plant Use

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INTRODUCTION

Although wild chimpanzees mainly feed on ripe fruit and other food items found above the ground (Wrangham 1977; Nishida & Uehara 1983; Goodall 1986), some studies have reported that chimpanzees feed on roots or tubers (Nishida & Uehara 1983; Kortlandt & Holzhaus 1987; McGrew *et al.* 1988; Newton-Fisher 1999; Lanjouw 2002; Morgan & Sanz 2006; Hernandez-Aguilar *et al.* 2007; Hockings *et al.* 2010; Watts *et al.* 2012). Among the chimpanzees observed eating roots or tubers, most were observed feeding on underground storage organs (USOs), and such behavior was mainly observed in drier environments (Kortlandt & Holzhaus 1987; McGrew *et al.* 1988; Lanjouw 2002; Hernandez-Aguilar *et al.* 2007).

Only a few studies have reported feeding on roots other than USOs. M group chimpanzees of the Mahale Mountains National Park, Tanzania, bite off and chew woody roots emerging from the ground (Nishida & Uehara 1983; Itoh & Nakamura in press).Chimpanzees of the Ngogo community in the Kibale National Park, Uganda, chew wood from the roots of *Neoboutonia macrocalyx* and discard the wadge after chewing on them (Watts *et al.* 2012). In this study, we report on chimpanzees feeding on wood from the roots in the Kalinzu Forest, Uganda, and discuss some possible roles of this behavior.

METHODS

We observed the M group of chimpanzees living in the Kalinzu Forest Reserve, located in western Uganda (0°17′N, 30°07′E) (Howard 1991; Hashimoto *et al.* 2001; Hashimoto & Furuichi 2006). M group has been under observation since 1997 and is habituated to the extent that during the current study period chimpanzees could be observed at a distance of less than 10 m on the ground. Complete identification of central individuals was achieved in 2003. During the current study period, M group included 15 adult males, 9 adolescent males, 25 adult females, 16 adolescent females, and 36 immature individuals. For individuals other than those who had been observed since birth, we estimated the age class from their body size according to the standard specified by Goodall (1986).

OBSERVATIONS

Observation 1

On January 3, 2015, at 14:25, TF found an adult female *Pinka* feeding on a detached piece of root from a tree (approx. 30 cm × 3 cm). She repeatedly bit off a piece chewed it, and spat it out. After she stopped feeding on it and moved away at 14:33, we found a pile of discarded wadge on the ground (Figure 1). In a small stream approximately 10 m from the place where *Pinka* was sitting, we found many pieces of detached root, footprints of several chimpanzees, and tree roots that stuck out from the bank of the stream, and showed signs of having been bitten off (Figure 2). Because many tree roots were sticking out from the stream bank, we could not identify which tree the roots came from. TF chewed one of the pieces, but could not detect any particular taste.

Observation 2

On January 6, 2015, at 12:07, NA found *Gaia* (10-year-old female) sitting on a branch, eating something similar to a root. At 12:19, she finished eating it. We could

Figure 1. The wadge *Pinka* spat out (Photograph by Takeshi Furuichi).

Figure 2. The tree roots sticking out from the stream bank showing the bitten-off ends (Photograph by Takeshi Fruichi).

not identify what she ate because she ate all of it. We did not observe her spitting any wadge out.

Observation 3

On January 6, 2015, at 14:04, NA found *Gale* (6-year-old female) and her sister *Gaia* eating roots of a fallen tree at the edge of the stream. At 14:08, *Gaia* climbed up into a nearby tree with a part of the root. She ate it while sitting on a branch. At 14:09, *Minny* (adult female) approached and started eating roots of the fallen tree with *Mizuki* (0-year-old offspring of *Minny*) on her chest. *Minny* directly bit off a root and chewed it (Video 1: available online at mahale.main.jp/PAN/22_1/22(1)_04.html). At 14:15, *Gale* came back and started eating a piece of the root with *Minny*. At 14:29, *Minny* pulled out another root from the ground, by grasping a part of it that was found on the surface and ate it. At 14:31, *Gale* spat out a part of the root that she was chewing. At 14:37, they finished eating roots. All leaves of the tree had already fallen, but the bark was fresh. The tree was identified as *Neoboutonia macrocalyx* (Eupborbiaceae) from the color and texture of the bark and the smell of the wood. Although we only observed spitting out of wadge once, we found many pieces of wadge around the tree (Figure 3).

Observation 4

On January 8, 2015, NA observed *Iku* (9-year-old female) and her sister *Iyo* (5-year-old female) eating roots. At 13:14, *Iku* climbed down from the tree. At 13:16, *Iku* climbed up the same tree with a piece of root and at 13:17, began to eat it. At 13:18, *Iyo* approached *Iku*, and she took the root from *Iku*. At 13:19, *Iyo* started to eat it. At 13:40, *Iyo* obtained it back from *Iku* and moved away. We did not observe them spitting out wadge material during this observation (Video 2: available online at mahale.main.jp/PAN/22_1/22(1)_04.html).

DISCUSSION

Feeding on roots other than USOs is rare in chimpanzees. The lists of items ingested by chimpanzees at several study sites do not mention "root" as a plant part eaten by chimpanzees (Bossou: Sugiyama & Koman 1987 but see Hockings *et al.* 2010; Mt. Assirik: McGrew *et al.* 1988; Kibale: Chemurot *et al.* 2012), and lists from other study sites contain only few species of root items ingested (Kahuzi: 1 species, Basabose 2002; Budongo: 1 species, Fawcett 2000; Ngogo: 3 species, Watts *et al.* 2012; Mahale: 2 species, Itoh *et al.* in press). Watts *et al.* (2012) have reported that time spent feeding on roots was only 0.4% of total feeding time. Feeding on roots may be rare occurrence because roots are not easily obtainable by chimpanzees. In this study, chimpanzees obtained roots that were emerging from the bank of a stream or from a fallen tree. In Mahale, chimpanzees bit-off and chewed roots emerging from the ground (Nishida & Uehara 1983; Itoh & Nakamura in press). Although chimpanzees were observed eating roots that existed under the ground, they obtained the roots by pulling a portion of the roots that was found above the ground (Kalinzu: this study; Mahale: Itoh & Nakamura in press).

Chimpanzees and gorillas often chew woody roots or wood pulp material without swallowing it (this study; Rothman *et al.* 2006; Reynolds *et al.* 2009; Watts *et al.* 2012; Itoh and Nakamura in press). Wood is characteristically highly fibrous, relatively indigestible, and poor in nutrients (Waterman 1984). Therefore, chimpanzees may chew roots because they contain micronutrients such as sodium (Budongo: Reynolds *et al.* 2009; Bwindi: Rothman *et al.* 2006).

Furthermore, it is also possible that chimpanzees eat roots for medicinal purposes. Huffman (1997) has argued that live/dry wood feeding by chimpanzees is a possible form of medicinal plant use. Root eating observed in this study may also be classified as medicinal plant use by chimpanzees. In Kalinzu and Ngogo (Watts *et al.* 2012), chimpanzees ate woody roots of *Neoboutonia macro-*

Figure 3. There were many pieces of wadge around the roots (Photograph by Natsumi Aruga).

calyx. The stem bark of *Neoboutonia macrocalyx* has medicinal properties (Kirira *et al.* 2007; Namukobe *et al.* 2014). In fact, local people in Uganda use the stem bark of *Neoboutonia macrocalyx* to treat stomach ache and malaria (Namukobe *et al.* 2011). However, further investigation is required to determine the presence or absence of bioactive compounds in the roots in the same state as those being consumed by chimpanzees, and to evaluate the health status of consumers before and after consumption of root material before assuming further conclusions (Huffman 1997). Our observations provide new evidence suggesting the need to further evaluate this interesting behavior in chimpanzees.

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<NOTE>
Association of a Young Emigrant Female Bonobo during an Encounter with her Natal Group

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INTRODUCTION

Sex-biased dispersal is an almost ubiquitous feature of the life histories of group-living mammals (Handley & Perrin 2007). Most primates resemble other mammals in showing male-biased dispersal, which is considered to be related to the fact that female reproductive success is limited primarily by nutritional constraints in mammals where females bear the major burden of investment of their offspring, such as birth and nursing (Greenwood 1980). On the other hand, societies of chimpanzees and bonobos show clear female-biased dispersal: females usually transfer between groups upon reaching sexual maturity (Thompson 2013; Sakamaki *et al.* in press). Although inbreeding avoidance may be a plausible ultimate factor of sex-biased dispersal in mammals (Pusey 1980), it has not been well understood why females emigrate from natal groups in these species. Similarly, proximate factors for female transfer remain poorly understood due to the difficulty of successive observations of young females before and after their transfer. Therefore, more information is needed on the process of female transfer between groups.

Bonobo societies maintain relatively less antagonistic relations between groups, and affiliative interactions are observed between members of different groups during encounters (Idani 1990; Furuichi 2011). Young females often migrate between groups during inter-group encounter not only once but also repeatedly (Sakamaki *et al.* in press). Association patterns of young females during the encounters should reflect their motivation to emigrate into another group or to remain in the current group. Here, we report observations of a young emigrant female during an encounter between her current group and her natal group over four successive days. We show the association patterns and social interactions of the young female with members of both groups.

MATERIALS & METHODS

Observations for this study were made at Wamba in the northern sector of the Luo Scientific Reserve in DR Congo (Furuichi *et al.* 1998). Studies at Wamba started in 1973, but were interrupted from 1996 to 2002 due to the civil war. Research was resumed in 2003, and one study group (E1) has been followed on a daily basis since. Researchers had also observed a western adjacent group (P) until 1996, and observation of this group resumed with intensive habituation on a daily basis in September 2010. This group was renamed 'P-east' (Pe) to differentiate it from another western group, 'P-west' (Pw). All animals in Pe group were identified by August 2011. The E1 group consisted of 36 animals and the Pe group consisted of 26 animals in August 2014.

A young female (Puffy) was first identified in the Pe group in November 2010 (Figure 1). From our observa-

Figure 1. Puffy in March 2015.