



# Chimpanzees foraging on aquatic foods: algae scooping in Bossou

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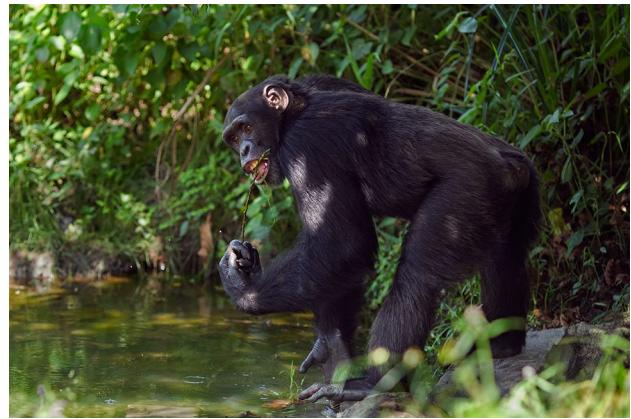
Published online: 2 July 2019

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As yet another demonstration of their technological prowess, wild chimpanzees use sticks to gather algae floating on ponds (Fig. 1). The first observation of this behavior was made in August 1995 among the chimpanzees (*Pan troglodytes verus*) of Bossou, Guinea, West Africa. This article aims to provide a detailed description of this unique behavior and contextualize it within the current knowledge of the exploitation of aquatic foods by apes in forest environments.

I would now like to take you on a journey back to the rainy season of 1995 to experience the initial observations of algae scooping. I was in Bossou with two students. One was Gen Yamakoshi, then a graduate student of Kyoto University. He had been at Bossou for months, working towards completion of the first year-round survey of this chimpanzee population. Tatyana Humle was also there and at that time was an undergraduate student of Edinburgh University. She was working as a summer intern at Bossou and was the first foreign student whom I accepted to join us in the field. I would subsequently adopt several foreign students in the following years, including Dora Biro, Claudia Sousa, Laura Martinez, Kimberly Hockings, Kathelijne Koops, Susana Carvalho, and others. Certainly, the first student's remarkable contributions as a field team member set a good example for the successive adoptions. Back to our initial trio in the forest, we can say that they enjoyed a humble, quiet, and humid life with the chimpanzees in west Africa.

It was August 28th, 1995, and Tatyana and I were following a group of chimpanzees with the local guides. The rain stopped and the sky was covered by thick clouds. In those days, it was difficult to continuously observe



**Fig. 1** Algae scooping in chimpanzees at Bossou. A young chimpanzee named Poni is holding the stick between the index and middle finger to scoop algae floating on a pond and then transfer it to his mouth. Photo was taken by Anup Shah and Fiona Rogers

the chimpanzees as they were not yet fully habituated to researchers. Nonetheless, we followed their traces as they traveled on the ground and happened to find them in a glade of tall grass.

Peering through the grass, I saw the chimpanzees stop moving and then gather together. We were located in a vantage that was slightly higher than the chimpanzees, but still could only see parts of their bodies through the dense vegetation. As I continued watching the chimpanzees, it finally became clear that they were using sticks to forage. I initially thought that they were ant dipping, as Bossou chimpanzees were known to use sticks to dip for safari ants on the ground. However, I was then astounded to realize that the chimpanzees were putting the sticks into water! It seemed ridiculous. Moments later, I could see that they were scooping algae (*Spirogyra* spp.) floating on the surface of a pond. Standing at the edge of the small pond, each chimpanzee was holding a stalk or stick in one hand and carefully putting it into the water. They slowly lifted the sticks strewn with algae to their mouths.

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s10329-019-00733-0>) contains supplementary video material.

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I regretted that we did not have a camcorder with us on that historic day to document our observations of this new type of tool-assisted foraging behavior, but time and persistence would quickly resolve this issue. The pond where the chimpanzees used sticks to gather algae was about 4 m in diameter and approximately 50 cm deep. Tatyana and I retrieved the abandoned sticks and later recounted our observations to Gen Yamakoshi. The next day, we returned to the forest carrying a video camcorder and were lucky enough to repeat our algae-scooping observations at the same pond! This second episode occurred on August 29th, 1995 and was video recorded (see Supplementary video), thus serving as a sort of digital holotype for this novel chimpanzee behavior.

I hereby describe the algae-scooping behavior that we had witnessed and video-recorded. It was seen in a group of chimpanzees including F-Family, containing the mother named Fana who was estimated to be 39 years old, the son Foaf (14 years old), and the daughter Fotaiu (4 years old). I could clearly see Foaf and Fotaiu from my position, both of whom were using the sticks to scoop algae floating on the surface of the pond.

Fotaiu stopped scooping and stepped back into the thick vegetation surrounding the pond. At this time, we would observe manufacturing of the scooping tool. First, she selected a fern (*Cyclosurus afer*, Polypodiaceae) from the various types of plants in the glade and removed a stalk from the ground. Second, she bit off the distal end using her teeth to adjust the length of the stick; achieving a modified stick length of about 50 cm. Third, she stripped off the side leaves with swift, downward motion of one hand while holding the stick in her mouth. Thus, she had manufactured a tool of a particular length that was more or less devoid of protruding leaves. Moreover, the tiny hooks that remained on the fern stalk after the stripping action might serve to increase efficiency in gathering fine algae that might otherwise slip off of a completely smooth stalk.

The tool was held between the index and the middle finger, in the same type of fine grip used for ant dipping. The distal end of the stick was then inserted into the water. Fotaiu made a swiveling action with her wrist, gently pushing the stick forward and backward to collect algae. She then lifted the stick up to her mouth and pulled the stick sideways through her lips, thus gathering algae in her mouth. This action was repeated several times as the chimpanzees foraged on algae.

In 1996, the original report of algae scooping was published in Japanese by the trio who first observed the behavior (Matsuzawa et al. 1996). We witnessed 14 episodes in the 5 months following our initial discovery. We collected a total of 42 scooping sticks, which had an average length of 54 cm and average diameter of 4 to 5 mm. We also documented material selectivity in tool manufacture as the chimpanzees showed a preference for certain plant species to make

scooping tools. Among the 42 sticks, 27 (64%, almost two-thirds) were manufactured from ferns. We hypothesized that the chimpanzees preferentially chose ferns due to the small hooks that remained along the tool after stripping away the leaves. The next most common tool material was the stalk of a sort of ginger (*Costus deistelli*, Zingiberaceae). The ginger stalk tool was longer and thicker than the fern tool, which may possibly be better for gathering algae in the early phase of foraging on this resource when there is a large amount floating on the pond; the fern could be more effective in later phases when the algae have become depleted and scarce. Interestingly, the materials used for algae scooping did not overlap with those for ant dipping. This might be at least partly due to differences in the functions of tool actions, scooping vs. dipping, as well as the availability of the plants near the pond vs. more terra firma forest. All 18 members of the Bossou community at that time visited the pond and all individuals over 2.5 years old showed algae scooping. Young infants did not exhibit this tool use. The youngest age that chimpanzees use stone tools in nut-cracking is 3.5 years. This 1-year difference might be related to the complexity of the tools. Thus, we discovered a difference in the age of the onset of tool behaviors, which may be related to the complexity of the tool types.

Our discovery of algae scooping among the chimpanzees of Bossou contributed a completely new item to the existing list of chimpanzee behavior. First, this was the first record of aquatic food exploited by wild chimpanzees. Second, the chimpanzees used tools to get the algae, thus we named this novel tool behavior “algae scooping”. Algae scooping was subsequently cited in English publications (Matsuzawa 1999; Humle and Matsuzawa 2001). In the years since its discovery, there have been three reports of algae feeding in East, Central, and West Africa: An immigrant female was observed to eat algae in Mahale, Tanzania, without using a scooping tool (Sakamaki 1998). Chimpanzees in Odzala National Park in the Republic of Congo were also observed to eat algae using scooping tools (Devos et al. 2002), and similar observations were reported from the Bakoun Classified Forest, Guinea (Boesch et al. 2017). As algae are reportedly high in protein, carbohydrates, and minerals, Boesch et al. (2017) hypothesize that chimpanzees are obtaining a nutritional benefit from this aquatic flora.

In a recent paper on the exploitation of aquatic fauna by chimpanzees, Kathelijne Koops and colleagues (Koops et al. 2019) reported the first evidence of chimpanzees habitually catching and consuming aquatic crabs. Chimpanzees in the Nimba Mountains of Guinea consumed fresh-water crabs (*Liberonautes lactidactylus* and *Liberonautes rubigimanus*) year-round, irrespective of rainfall or ripe fruit availability. Parties of females and offspring fished for crabs more than adult males. Crab fishing was negatively correlated with ant dipping, suggesting a similar nutritional role. Bossou and

Nimba are separated only by about 6 km, and intermittent efforts have been made to survey the Nimba Mountains since 1992 (Matsuzawa and Yamakoshi 1996; Humle and Matsuzawa 2001). However, only the recent effort by Koops and her team revealed the first evidence of aquatic fauna consumption. They also hypothesized that aquatic fauna provides essential nutritional resources for Nimba chimpanzees, especially for females and offspring.

Synthesizing our observations from 1995 to the present, algae scooping and crab fishing give clear evidence that chimpanzees forage on aquatic flora and fauna within forest environments. Relative nutritional value might provide an important clue for understanding the forces motivating these behaviors. However, further research efforts are warranted to know why and how regularly the chimpanzees exploit aquatic foods. Another important point to be noted is the environmental constraints on cultural behavior. Although Bossou and Nimba are so close each other, Bossou chimpanzees algae scoop, but do not crab fish; whereas Nimba chimpanzees crab fish but do not algae scoop. Why? From my field experience, I can attest that Bossou has ponds with algae but no fresh streams with crabs, while Nimba is rich in mountain streams with crabs, but ponds are scarce.

Coincidentally, the paper on crab fishing appeared in parallel with another interesting paper on tortoise hunting (Pika et al. 2019). Chimpanzees (*Pan troglodytes troglodytes*) living in the Loango National Park, Gabon, provided the first observations of chimpanzee predation on tortoises (*Kinixys erosa*). The recently habituated chimpanzees of the Rekambo community engage in this behavior sufficiently frequently for it to qualify as customary in this chimpanzee group. It occurs in most or all adult males, involves a distinct smashing technique, and frequently gives rise to food sharing with other group members.

Another intriguing new paper (Nakamura et al. 2019) reports the first observed case of wild chimpanzees (*Pan troglodytes schweinfurthii*) obtaining animal prey freshly killed by a sympatric leopard (*Panthera pardus*), scavenging it with the leopard still nearby. This observation has important implications for the emergence of confrontational scavenging. Researchers in this study observed that the chimpanzees frequently emitted waa barks during the episode, which indicated that they were aware of the leopard's presence, but they nevertheless continued to eat the scavenged meat. The authors suggest that chimpanzee-sized hominins might have confronted and deprived leopard-size carnivores of their kills.

Thus, three interesting papers have simultaneously emerged from studies of Western, Central, and Eastern Africa chimpanzees, concerning crab-fishing in *versus* chimpanzees, tortoise hunting in *troglodytes* chimpanzees, and depriving a leopard of its kill in *schweinfurthii* chimpanzees. From my own experience of discovering algae scooping, it

is both fascinating and exhilarating to be the first to witness a previously unknown behavior. I do hope that the younger generations of primatologists will continue working in the African forests, following a dream to illuminate the yet-unknown world of chimpanzees.

**Acknowledgements** We are grateful to the Direction Nationale de la Recherche Scientifique et Technique (DNRST) and to the Institute de Recherche Environnementale de Bossou (IREB), the Republic of Guinea, for granting us permission to carry out this research. We would like to thank all the local assistants who helped during this research period. I also thank Gen Yamakoshi, Tatyana Humle, Kathelijne Koops, and other members of the Bossou-Nimba international team for their collaboration on site. Financial support for preparing the manuscript came from MEXT-JSPS Grants #20040001 and #16H06283; the Japan Society for the Promotion of Science (JSPS) Core-to-Core Program CCSN, and the Leading graduate Program of Primatology and Wildlife Science (U04) to the author. I also thank Drs. James Anderson and Crickette Sanz for editing the English text.

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