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## Indirect evidence of tool-assisted hunting in the Bantan chimpanzee (*Pan troglodytes verus*) community in southeastern Senegal savanna-woodlands

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### ABSTRACT

Chimpanzees use tools extensively, but tool-assisted hunting has been reported at only two sites thus far. Systematic tool-assisted hunting has only been recorded at the Fongoli site in Senegal, where hundreds of cases have been recorded of chimpanzees using tools to hunt bushbaby (*Galago senegalensis*) prey. Here, we report a putative case of tool-assisted hunting at the Bantan study site in southeastern Senegal, based on indirect evidence of tools and tool-making traces in a context similar to that observed at neighboring Fongoli chimpanzee community. If our interpretations are correct, the simplest explanation is that Fongoli females have dispersed to this neighboring community, bringing with them the behavior of tool-assisted hunting. However, the persistence and frequency of tool-assisted hunting at other sites in Senegal is still unknown. Tool-assisted hunting in the Bantan chimpanzee community would present only the third such known site for such behavior among wild chimpanzees thus far.

**Keywords:** tool-use, chimpanzees, hunting, savanna, Senegal

### INTRODUCTION

The use of tools by non-human animals sheds light on their cognitive abilities (Seed & Byrne 2010) and propensity for material culture (Whiten *et al.* 1999; van Schaik *et al.* 2003). Chimpanzees (*Pan troglodytes*) are particularly prolific tool-users that are adept at manufacturing and using tools to obtain food. Chimpanzees commonly use tools to extract invertebrate prey from otherwise inaccessible locations (e.g., “termite fishing” and “ant dipping”: Goodall 1964; McGrew 1974). One chimpanzee community—the Fongoli community of Senegal—commonly hunts mammalian prey with the aid of tools (Pruetz & Bertolani 2007; Pruetz *et al.* 2015), though chimpanzees of Mahale, Tanzania (M-group) have also been reported to hunt a squirrel and hyrax with tools (Huffman & Kalunde 1993; Nakamura & Itoh 2008). Tool-assisted hunting in a non-human primate is particularly relevant to paleo-anthropology because tool-use and hunting have long been considered as critical developments during human evolution (Hill 1982). Additionally, this type of hunting is significant to understanding the evolution of hunting in early hominids, as bipedal apes were likely less adept at hunting prey such as monkeys, the main vertebrate prey of chimpanzees inhabiting forested environments (Pickering & Domínguez-Rodrigo 2012). Although hunting with tools is characteristic of the Fongoli group, it is unknown whether neighboring chimpanzee communities also engage in this behavior. Evidence that nearby chimpanzee groups hunt with tools could provide insight into the scope of behavioral continuity between chimpanzee

populations and may help to better understand the spread of socially-learned traditions in non-human primates. It may also be germane to parsing out the environmental pressures that gave rise to this unusual behavior observed at Fongoli.

Tool-assisted hunting bouts at Fongoli generally occur through a systematic process during which chimpanzees 1) locate a potential *Galago senegalensis* nest cavity in the hollow of a tree trunk or branch, 2) locate a branch to suitably jab into the cavity, 3) modify the branch by stripping it and/or trimming the ends, and 4) jabbing it repeatedly into the cavity to rouse its prey from the nest or injure it, whereupon it is captured by hand and eaten (Pruetz & Bertolani 2007). While this behavior remains rare outside of Fongoli, similar reports have been recorded at Mahale, in which chimpanzees were found to extract mammalian prey from tree and rock dens with sticks for consumption (Huffman & Kalunde 1993; Nakamura & Itoh 2008).

Tool-assisted hunting has been recorded more than 500 times at Fongoli (Pruetz unpublished data). Most chimpanzees at Fongoli, excluding young infants, have been observed to hunt with tools, and females do so relatively more frequently than males (Pruetz *et al.* 2015). Individuals appear to improve in their success with practice, suggesting some degree of observational learning. Most tool-assisted hunting at Fongoli occurs during the wet season from June to September, with some cases also occurring in the transitional months of May and October. The seasonality of tool-assisted hunting, in addition to the patterned tool modification and implementation process,

suggests that this is a regular foraging technique within the Fongoli community, rather than isolated, trial-and-error events.

Here, we present the first putative evidence of tool-assisted hunting of mammalian prey among unhabituated chimpanzees, the Bantan community, which neighbors the Fongoli group. We discuss the implications of this for understanding the spread of socially-learned traditions among chimpanzees and the scope of tool-use in primates more generally.

## METHODS

### Study Site and Subjects

The Bantan site lies adjacent to and northwest of the Fongoli community in southeastern Senegal, approximately 17 km north/northwest of the town of Kedougou, at 12°45.06325N, -12°15.425983W. This is a savanna mosaic habitat, including woodland, grassland, gallery forest and bamboo woodland habitat types (Pruetz *et al.* 2002).

The Bantan chimpanzee community is an unhabituated group that has been sporadically studied via indirect observational methods since 2000. There are estimated to be approximately 20 individuals in the group, based on nesting data collected in previous studies (Pruetz unpublished data; Micheletti 2018). Ndiaye and students have been conducting research on this community since 2016 (Ndiaye *et al.* 2018; Diallo 2019).

### Data Collection

The focus during the study, lasting from May through August 2017, was to survey for signs of chimpanzees in this area and to assess any anthropogenic threats to them (Micheletti 2018). Sixteen reconnaissance walks were conducted to find evidence of chimpanzee's presence. Reconnaissance walks consist of surveying by foot in a predetermined direction along a path of least resistance,

which can deviate by any degree through the survey area (Kühl *et al.* 2008). Additionally, we systematically surveyed forested habitats (e.g., gallery forest and woodland stream areas) where nests and other signs of chimpanzees were thought to be most concentrated. Any evidence of tool-use was recorded, along with the GPS location, the habitat type it was found in, and the type of tool. Tools were brought back to camp, laid flat, and measured from tip to tip.

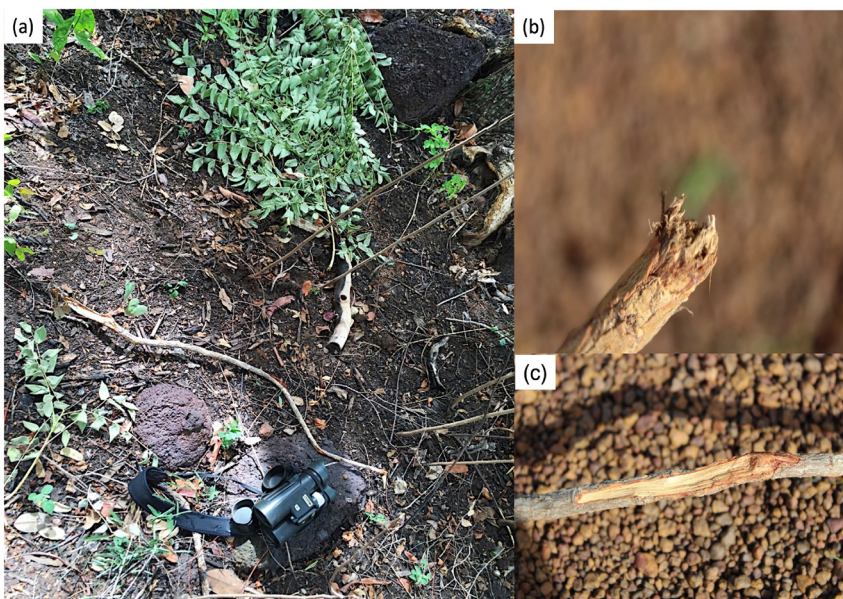
## RESULTS

Two hunting tools were identified by a resemblance to those used by Fongoli chimpanzees in terms of their deposit location, patterns of use-wear, patterns of modification in tool creation, size, and shape (Figure 1).

Hunting tools were sticks found in association with freshly removed leaves and twigs and were situated in the vicinity of possible *Galago* nesting cavities. Both hunting tools were found near each other in a woodland habitat and are from the species *Cordyla pinnata* (Figure 1; Micheletti 2018). Woodland habitats are common locations of tool-assisted hunting by Fongoli chimpanzees, where *Pterocarpus erinaceus* and *Terminalia* sp. trees are common and where *Galago* nesting cavities are frequently located (Pruetz unpublished data). The first tool was discovered under an *Anogeissus leiocarpus* tree, near the trunk, with a diameter at breast height of 33.4 cm and a visible cavity that may have been used by galagos. The second tool was found about five meters away on a termite mound, which showed no signs of recent termite-fishing behavior. The second tool was found in close proximity to the *Anogeissus* tree crown, similar to what is seen at the Fongoli site when 'spear' tools are discarded. All hunting, termite fishing, and ant dipping tools were found in the eastern side of the Bantan community's range based on 2017 nesting data (Micheletti 2018). Furthermore, the

hunting tools were found on June 22, which is considered the wet season, and when most tool-assisted hunting practices are observed at Fongoli (Pruetz *et al.* 2015).

These tools were within the range of Fongoli hunting tool size, which average 10.1 mm in width at midpoint of the tool ( $n = 223$  tools) and 64.6 cm in length ( $n = 298$  tools), being noticeably longer, thicker, and straighter than termite and ant dipping tools, which are on average less than 5 mm in width (Pruetz unpublished data). Both putative hunting tools ( $n = 2$ ; tool 1 = 83.1 cm, tool 2 = 113.9 cm,  $sd=31.8$ ) fell within the range of tool lengths recorded for the Fongoli community (40–120 cm; Pruetz & Bertolani 2007). The tools showed sites of detachment damage indicated by areas of stripped bark, consistent with side branches being pulled off, as is commonly observed in hunting tools made by Fongoli



**Figure 1.** Putative hunting tool in situ with trimmed branches (green leaves in top of photo) and binoculars for scale (a); end of tool with wear pattern (b); and scar on the edge of the tool, typical of removal of side branches and leaves (c). Scar is ~13 cm in length. Photo (a) by J.D.P and photos (b) and (c) by K.N.M.



chimpanzees (Figure 1; Pruetz & Bertolani 2007).

## DISCUSSION

We report finding modified sticks within the range of the Bantan chimpanzee community in Senegal, interpreted as putative chimpanzee hunting tools. As such, our study extends the record for the rare tool-assisted hunting behavior and contributes to the growing field of primate archaeology (Haslam *et al.* 2009; Haslam *et al.* 2017) that strives to find links between the material culture of non-human primates and their behavior. Our interpretations on the function of the purported tools are based on multiple similarities to known hunting tools of the adjacent Fongoli chimpanzee community. As at Fongoli, these modified sticks were found near potential *Galago* nesting sites, they are within the size range of Fongoli hunting tools and exhibited similar modification and use-wear patterns (Pruetz & Bertolani 2007). It is unlikely that the putative hunting tools were made by Fongoli chimpanzees given the location of the site, northwest of the Fongoli chimpanzee core range.

This form of tool-use could be carried between chimpanzee communities through dispersal and could be widespread in Senegal. Adolescent females may spread this behavior between communities upon dispersal, given that at Fongoli, females hunt with tools relatively more frequently than males (Pruetz & Bertolani 2007; Pruetz *et al.* 2015). It is probable that females from the Fongoli community brought this behavior to the neighboring Bantan community, or vice versa.

Continued research on their tool technology can help to answer questions regarding chimpanzee tool-use, socially-learned traditions, and learning processes. Such transfer of knowledge may provide insights into primate learning processes.

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