FIELD NOTES

Conspecific investigation of a deceased forest elephant (*Loxodonta cyclotis*)

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Introduction

In recent years, increasing attention has been paid to non-human animals revisiting dead conspecifics, yet only limited understanding of these behaviours currently exists. Instances of both individuals and groups visiting deceased conspecifics have been noted among a wide array of species, namely but not solely in mammals (Reggente et al. 2016; Bercovitch 2012; Iglesias et al. 2012; Douglas-Hamilton et al. 2006). Due to the highly social nature of most of these animals, hypotheses have been set forth claiming intensive emotional processing including compassionate responses akin to what humans would call mourning (Fashing and Nyguen 2011). Yet, examining the neural and emotional components of these events is challenging due to the anecdotal nature of the behaviour and the lack of biological samples (i.e. hormonal and/or neuronal) to bolster claims. Nonetheless, visitation of deceased conspecifics represents an important behavioural pattern, suggesting that social animals are processing death.

Perhaps the most well documented examples of visiting and investigating conspecific death have occurred in savannah elephants (*Loxodonta africana*) (Merte et al. 2009; McComb et al. 2006; Douglas-Hamilton et al. 2006). Specifically, McComb et al. (2006) showed that savannah elephants preferentially investigate deceased elephant bones—but not the bones of other large herbivores remains—suggesting a targeted interest in elephant bones and not simply in large mammalian bones. In one striking example, savannah elephants intensively explore-touched a deceased matriarch for days (Douglas-Hamilton et al. 2006). Both the number of long-term research projects following known individuals of savannah elephants and their open savannah habitat likely account for the numerous thanatological examples observed in this species. In contrast, forest elephants (*Loxodonta cyclotis*) are highly elusive and difficult to study, largely due to the closed-canopy forests in which they reside making long-term behavioural studies of known individuals difficult. Thus, examples of death related behaviours are difficult to observe, if they occur at all.

To date, the only evidence that does exist is anecdotal and comes from large open clearings, known as *bais*, where elephants already congregate in high densities (Wrege 2017; Turkalo et al. 2013). Here we used, camera traps to monitor the location of a known carcass and provide a rare glimpse into how forest elephants react to a deceased conspecific. Using the first known video evidence of elephant behaviour towards a deceased adult female forest elephant, we 1) describe the behaviour of forest elephants and 2) provide an estimate of the decomposition rate of forest elephant carcasses to aid in the aging of dead elephants.

Methods

While working in Ivindo National Park in Northeastern Gabon, the Duke field team was given GPS coordinates to a recently deceased, unknown female forest elephant. GPS coordinates were relayed by eco-guards stationed in the park under the direction of Agence National des Parcs Nationaux (ANPN). The elephant had not been poached, as the tusks were still intact when it was found. The multiparous deceased female was estimated to have died on the 28 March 2017 and three camera traps were set up with clear views of the carcass on 31 March 2017. We used three NatureView Bushnell camera traps: two were placed terrestrially at approximately one meter in height, one to the side, and one directly in front of the carcass; a third camera was placed in a tree looking down onto the carcass. The terrestrial camera traps took 20 second videos when triggered by motion to monitor interactions with the carcass, whereas the arboreal camera trap took one photo daily to monitor decay. The arboreal camera trap was left at the site until 14 April 2017 at which point the flesh of the elephant had completely decayed from the skeleton, while the remaining two video-recording camera traps continued to monitor the site until June 4, 2017 for a total of 65 days.

Each video was coded for behaviours defined by Douglas-Hamilton and colleagues (2006) for each individual (elephant) visible on camera (Figure 1 below). It is important to note that despite efforts made to maximize the field of view (multiple cameras set well back from the carcass), the field of view was limited by the tree density (roughly 8m^2). As such, we were only able to record behaviours when elephants were clearly in view and oriented towards each focal camera. Consequently, the interactions should be viewed as a conservative estimate of the total number of interactions. Visitation events were often nocturnal when the cameras used infrared light to record movement. The lack of colour and lower overall light levels made observations of micro-behaviour more difficult to define at night.

Results

Elephant interactions

Over the 65 days, there were a total of five visitation events (4 April 2017, 5 April 2017, 8 April 2017, 7 May 2017 and 23 May 2017) averaging 4 minutes and 43 seconds per event. The longest event was 10 minutes and 23 seconds, while the shortest was only 20 seconds because the elephant quickly fled upon discovering and after physically examining the camera. The total time during which elephants were within eight meters of the carcass was 23 minutes and 35 seconds over the study period. Given the limited field of view, it is unclear how many elephants approached the general vicinity of the deceased elephant, thus the estimated time represents intensive, localized interactions with the carcass.

In most videos adults, juveniles, and infants were present yet adult behaviour accounted for 85.8%

Figure 1. Day 8, an elephant sniffing the head of carcass (left) and an elephant conducting an inverted J-sniff.

of all recorded behaviours. In 29.0% of the encounters, elephants approached the carcass after triggering the motion sensor, compared to 19.8% of instances when they moved farther from the carcass. They spent 46.5% of the time sniffing around the carcass and 38.2% of the time directly investigating the carcass (18.4% sniffing the head and 19.7% sniffing the body). In over a quarter of the videos, following a sniff of the carcass, the elephant protracted the trunk towards their body and close to their mouth—what we are here calling an inverted J-sniff. This behaviour might represent an extended sensory experience, whereby the gustatory system is engaged along with the olfactory system.

Three of the five visitation events were group visits with one or two adult females and their related offspring, while the other two events consisted of a single adult male and a single adult of unidentified sex. At most, six elephants aggregated around the carcass at one time. In all cases, it is possible that more elephants were in the general vicinity; however, because every elephant recorded on camera directly investigated the carcass it seems unlikely that we failed to observe additional elephants.

Decomposition of the carcass

The decomposition of the carcass was rapid and completely mediated by invertebrates. The carcass first bloated and was soon infested with maggots, starting concurrently at the head and rear gradually covering the middle of the body. The body was entirely covered by invertebrates by Day 7 and was completely stripped of flesh by Day 18 (Figure 2; see colour plates: page vii). Aside from elephants, only long-snouted mongoose (*Herpestes naso*) and yellow-backed duiker (*Cephalophus silvicultor*) passed close to the carcass, on 10 and 16 occasions, respectively. Mongooses often smelled the carcass and yellow-backed duikers foraged around the carcass.

Whether duiker foraging behaviour was targeted towards the decaying flesh or the detritivores is unknown due to the lack of visibility during most of the videos.

Discussion

Based on the evidence provided here, it is clear that forest elephants, like their savannah elephant counterparts, visit dead conspecifics and spend a substantial amount of time investigating remains. While the time spent with the carcass was short, we argue that the intensive sniffing and investigation of the dead female likely represents death processing events by elephant groups. Elephants are notable among social mammals for their empathy and emotional intelligence, even at times rivalling primates (Bates et al. 2008; Plotnik et al. 2011). They are known for their ability to recognize other elephants as intentional, animate agents who direct their own behaviour (Bates et al. 2008). Yet, how elephants cope with the concept of death after a mortality event remains a mystery. The prodding of the carcass by other elephants during and immediately following the dying process may indicate an intent to understand the cessation of life-relevant behaviours (Figure 3). Whether or not elephants understand that the deceased elephant is in fact dead, and whether or not they are able to distinguish between a disappearance and an actual death is still unknown. While intraspecific questions remain, savannah elephants preferentially investigate conspecific remains compared to other large mammals like buffalo and rhinoceros (McComb et al. 2006). Given the similarities between savannah elephants and forest elephants in how they investigate deceased conspecifics, forest elephants likely show preference for their own species, yet this question currently lacks empirical validation.

We hope to further assess some of these questions by semi-routinely returning to the sites of this and other known carcasses and surveying for fresh faecal samples. By collecting samples and analysing the genetic relatedness of visiting elephants and the deceased individual, we can begin to determine whether there is a pattern to visitation compared to a control site. We can also measure the frequency of visitation and whether visitations are concentrated around the mortality period when the visual and olfactory cues are strongest, or if elephants continue to return to sites long after the carcass is decayed. This information can further speak to a death processing mechanism whereby elephants engage episodic memory, cognitive maps, and emotional intelligence.

Our understanding of the rapidity of decay rates within the forest may prove useful for in-field trackers and employees. Gaining a more precise estimate on time of death can help date carcasses and potentially the time of poaching events, which may contribute to anti-poaching efforts.

With the accumulation of case studies like this, we can begin to uncover some of the evolutionary underpinnings of thanalogy and sociality as a whole. If we can understand how animals process death, we might gain a better understanding of the strength of sociality and emotional complexity in social animals. The intensity with which social animals react to injured, dying, and dead conspecifics reveals the shock of death (Campbell et al. 2016, Fashing and Nyugen 2011) as well as the level of connectivity within a species. Much as humans react to the sight of a dead body, regardless of relatedness or membership in a social group, animals also react in behaviourally complex ways to members of their own species. The functional purpose of reactionary behaviours and visitation of a deceased conspecific remains an important next step in the future study of thanalogy. Specifically, instances of death-related behaviours in elephants provides further insight into the social and empathic complexities of this sentient mammal.

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