Domestic Dog Predation on White-tailed Small-eared Galago (*Otolemur garnettii lasiotis*) in the Taita Hills, Kenya

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INTRODUCTION

Free-ranging domestic dogs (Canis familiaris) (hereafter 'dogs') pose a threat to wildlife worldwide, including primates (Bishop et al. 1981; Anderson 1986; Butler et al. 2004). Dogs have fatally attacked and predated upon several species of primates, including baboons (Papio spp.) (Butler et al. 2004; Beamish & O'Riain 2014), macaques (Macaca spp.) (Simonds 1965; Dittus 1977; Fooden 1979; Bishop et *al.* 1981; Johnson & Southwick 1984; Riley *et al.* 2015; Waters et al. 2017), vervet monkeys (Chlorocebus pygerythrus) (Butler et al. 2004), langurs (Rahaman 1973; Bishop et al. 1981; Rajpurohit & Sommer 1991; Medhi et al. 2004; Najmuddin et al. 2019), and various species of New World monkeys (Galetti & Sazima 2006; Oliveira et al. 2008; Paschoal et al. 2012; Carretero-Pinzón 2013). In Madagascar, dogs are known predators of lemurs (Gould & Sauther 2007; Brockman et al. 2008; Moresco et al. 2012; Anania et al. 2018). In addition to predation, dogs may also negatively affect primate populations by harassment or by transmitting zoonotic diseases (Mourthé et al. 2007; Farris et al. 2014, 2019; Kshirsagar et al. 2020).

The greater galagos (*Otolemur* spp.) are relatively large-sized, nocturnal strepsirrhines which are widely distributed in the eastern and southern parts of Africa. Their taxonomy is somewhat contentious, but it is currently widely agreed that there are two species, the brown greater galago (*O. crassicaudatus*) and the northern or small-eared greater galago (*O. garnettii*). Some authors recognize the silvery great galago as a separate, third species, *O. monteiri*, whereas others consider it as a subspecies of *O. crassicaudatus*. For views on *Otolemur* taxonomy, see Olson (1979, 1981), Masters (1986, 1988), Nash *et al.* (1989), Kingdon (1997), Groves (2001), and Grubb *et al.* (2003).

Otolemur species are arboreal, but they occasionally descend to the ground (Bearder 1974; Estes 1991). During terrestrial locomotion, Otolemur move slowly and cautiously by walking on all four legs. Occasionally they stand up on their hind legs to scan their surroundings. Bipedal hopping, a mode of locomotion often used by smaller species of galagos on the ground, is also sometimes employed (Bearder 1974; H. Rosti, pers. obs.). However, the relatively large body size of Otolemur makes this form of terrestrial locomotion energetically costly (Demes & Günther 1989; Günther et al. 1991; Warren & Crompton 1998). Greater galagos are likely vulnerable to several mammalian predators, especially when on the ground (Bearder 1974). However, actual recorded cases of natural predation on any Otolemur species are few. Leopards (Panthera pardus) are known to include O. crassicaudatus

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in their diet (Grey *et al.* 2017; De Luca & Mpunga 2018; Williams *et al.* 2018). In the Mahale Mountains National Park, Tanzania, chimpanzees (*Pan troglodytes*) occasionally prey on *O. monteiri* (Nishida *et al.* 1979; Uehara 1997; Hosaka *et al.* 2020). Chimpanzee predation takes place during the day, when chimpanzees encounter galagos that are sleeping in diurnal roosts in the trees (Svensson *et al.* 2018).

Bearder (1974) cited anecdotal reports of *O. crassicaudatus* being killed, when on the ground, by dogs; however, he did not personally observe dog predation on this species. More recently, Cuozzo *et al.* (2020) reported cases of dogs killing *O. crassicaudatus* in South Africa. To the best of

our knowledge, instances of predation on *Otolemur* species by other nonhuman mammalian predators have not been previously recorded in the literature. Here, we report the killing and partial consumption of *O. garnettii* by a dog in the Taita Hills, south-eastern Kenya.

The Taita Hills (03°22' S, 38°20' E) form the northernmost part of the Eastern Arc mountain chain in East Africa (Figure 1). They rise above the surrounding plains to an altitude of 2,208 meters at their highest peak, Vuria (Pellikka *et al.* 2009). Formerly, the Taita Hills were covered with Afromontane cloud forest, but during the last centuries, forest cover has decreased by more than 90% (Pellikka *et al.* 2013). The largest remaining



Figure 1. The remnant forest fragment of Ngangao in the Taita Hills is surrounded by agroforestry landscape with mixed exotic and native tree species. a) Aerial view of Ngangao forest; digital mosaic image taken in 2004, modified from Pellikka *et al.* 2009. The location where the galago was killed by the dog is indicated by a white circle. b) The edge of Ngangao forest as viewed from the eastern side. c) Forest floor in Ngangao. Photographs by P. Pellikka.



Figure 2. White-tailed small-eared galago, Ngangao forest. This 'black-tailed' individual is a different animal than the one described in the text. Photograph by H. Rosti.

forest fragments are Mbololo (185 ha) and Ngangao (120 ha); a number of smaller forest fragments also remain (Wilder *et al.* 1998; Pellikka *et al.* 2009; Aerts *et al.* 2011). The forest fauna of the Taita Hills is highly diverse (Wagura 2014). The full extent of its diversity is still being determined. For example, the presence of a species of dwarf galago (*Paragalago* sp.) was only confirmed as recently as in the early 2000s

(Perkin *et al.* 2002). In the Taita Hills, *Paragalago* are apparently restricted to Ngangao and Mbololo forests, and their population sizes are probably very small (Rosti *et al.* 2020a, b).

By contrast, *O. garnettii* is common in the Taita Hills. The animals living in this area belong to the subspecies *O. g. lasiotis* (Rosti *et al.* 2020a), or white-tailed small-eared galago (Grubb 2006). This



Figure 3. White-tailed small-eared galago standing on a log on the ground in Ngangao forest. Photograph by H. Rosti.



Figure 4. The partially eaten remains of the dog-killed white-tailed small-eared galago. Photograph by B. M. Lombo.

subspecies is dimorphic regarding pelage colour; despite the vernacular name, some individuals have blackish tails and are overall darker-coloured (Figure 2), whereas others have whitish tails and are overall lighter-coloured (Figure 3).

Today, the Taita Hills are mostly covered with exotic tree plantations and small-scale subsistence farms (Pellikka *et al.* 2009). The largest population centre is the town of Wundanyi; there are also several smaller villages. Both Mbololo and Ngangao are officially protected by the Kenya Forest Service, but despite conservation and reforestation efforts, the area of indigenous forest keeps shrinking (Teucher *et al.* 2020). Demographic pressure has led to an increasing demand for cropland and firewood, and to an increase in poaching. Human penetration into natural habitats in the Taita Hills has also led to human–wildlife conflict in the form of crop-raiding by wild animals, such as primates (Siljander *et al.* 2020). The main crop-raiding primate species in the Taita Hills is the Sykes' monkey (*Cercopithecus mitis albogularis*) (Butynski & De Jong 2020), but *O. g. lasiotis* also often visits cultivations to feed on fruit, especially bananas.

OBSERVATION

At approximately 22:30 hr on 25 March 2019, one of the authors (BML) and his family were alerted by the sound of an animal screaming in distress outside of their house near the village of Werugha, adjacent to the southern edge of Ngangao forest. When BML went to investigate, he witnessed his dog carrying a dead *O. g. lasiotis* in its mouth. BML yelled at the dog, and tried to pull the galago's body from the dog's mouth. During the scuffle, the carcass was ripped into two pieces, and the dog ran away with the galago's head and parts of the upper body, including the left front limb. These body parts were consumed by the dog. The galago was a 'blacktailed' male (Figure 4). The remaining part of the carcass was subsequently taken to the Taita Research Station.

BML's property is separated from the nearest treecovered area by a dirt road that is approximately eight meters wide. The side of the road that is proximal to the property is covered with grass, which is kept permanently short by the grazing of sheep and goats. The galago must have crossed a distance of several meters of open ground to reach the garden. The dog may have intercepted the galago while it was making the crossing. A notable feature of the dog involved in this incident is that it is effectively three-legged, as its right hind limb was injured in an accident when it was young. This female dog is not used for hunting, and it has no previous history of killing wildlife.

While O. garnettii is trapped for dog food in Zanzibar (De Jong et al. 2019), the present report is apparently the first published record of dog predation on this species. However, as O. garnettii is often found near human habitations, it is likely that these kinds of incidents may occur, unreported, both in the Taita Hills and elsewhere within its distribution range. As the present case demonstrates, even a dog with limited mobility may be able to capture and quickly dispatch an O. g. lasiotis. Our observation therefore supports the notion that Otolemur species are highly vulnerable to terrestrial predators while moving on the ground. In many parts of the world, dog predation may be a significant additional threat to the long-term survival of endangered primate species with small remaining populations (e.g., Medhi et al. 2004; Mourthé et al. 2007; Anania et al. 2018). Otolemur garnettii is classified as Least Concern by the IUCN at the species level (De Jong et al. 2019), as are its various currently recognized subspecies, including O. g. lasiotis (Butynski & De Jong 2019). However, as forest fragmentation and human encroachment into the galagos' natural habitats continues, dog predation incidents may occur with increasing frequency.

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REFERENCES

- Aerts, R., K. W. Thijs, V. Lehouck, H. Beentje, B. Bytebier, E. Matthysen, H. Gulinck, L. Lens & B. Muys. 2011. Woody plant communities of isolated Afromontane cloud forests in Taita Hills, Kenya. *Plant Ecology* 212: 639–649.
- Anania, A., J. Salmona, E. Rasolondraibe, F. Jan, L. Chikhi, C. Fichtel, P. M. Kappeler & R. Rasoloarison. 2018. Taboo adherence and presence of Perrier's sifaka (*Propithecus perrieri*) in Andrafiamena forest. Madagascar Conservation & Development 13: 1–14.
- Anderson, J. R. 1986. Encounters between domestic dogs and free-ranging non-human primates. *Applied Animal Behaviour Science* 15: 71–86.
- Beamish, E. K. & M. J. O'Riain. 2014. The effects of permanent injury on the behavior and diet of commensal chacma baboons (*Papio ursinus*) in the Cape Peninsula, South Africa. *International Journal of Primatology* 35: 1004–1020.
- Bearder, S. K. 1974. Aspects of the Ecology and Behaviour of the Thick-tailed Bushbaby *Galago crassicaudatus*. PhD-thesis, University of the Witwatersrand.
- Bishop, N., S. B. Hrdy, J. Teas & J. Moore. 1981. Measures of human influence in habitats of South Asian monkeys. *International Journal of Primatology* 2: 153–167.
- Brockman, D. K., L. R. Godfrey, L. R. Dollar & J. Ratsirarson. 2008. Evidence of invasive Felis silvestris predation on Propithecus verreauxi at Beza Mahafaly Special Reserve, Madagascar. International Journal of Primatology 29: 135–152.
- Butler, J. R. A., J. T. du Toit & J. Bingham. 2004. Free-ranging domestic dogs (*Canis familiaris*) as predators and prey in rural Zimbabwe: threats of competition and disease to large wild carnivores. *Biological Conservation* 115: 369–378.
- Butynski, T. M. & Y. A. De Jong. 2019. Otolemur garnettii ssp. lasiotis. The IUCN Red List of

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Threatened Species 2019: e.T136900A17989378. (Accessed on 20 April 2021.)

- Butynski, T. M. & Y. A. De Jong. 2020. Taxonomy and biogeography of the gentle monkey *Cercopithecus mitis* Wolf, 1822 (Primates: Cercopithecidae) in Kenya and Tanzania, and designation of a new subspecies endemic to Tanzania. *Primate Conservation* 34: 71–127.
- Carretero-Pinzón, X. 2013. An eight-year life history of a primate community in the Colombian Llanos. In *Primates in Fragments: Complexity and Resilience*. L. K. Marsh & C. A. Chapman, eds. Springer, New York. Pp. 159–182.
- Cuozzo, F. P., A. Halajian, M. L. Sauther, B. Linden, J. Linden, J. B. Millette & D. Romanello. 2020. Human induced threats to a nonhuman primate of "Least Concern" (*Otolemur crassicaudatus*, Primates, Galagidae) in northern South Africa. 89th Annual Meeting of the American Association of Physical Anthropologists, April 15 18, 2020, Abstract Book, p. 63.
- De Jong, Y. A., T. M. Butynski, A. Perkin & M. Svensson. 2019. Otolemur garnettii. The IUCN Red List of Threatened Species 2019: e.T15644A17963837. (Accessed on 9 March 2021.)
- De Luca, D. & N. E. Mpunga. 2018. Leopard abundance, distribution, and food habits in the Mt. Rungwe–Kitulo landscape, southern Tanzania. *African Journal of Ecology* 56: 358–367.
- Demes, B. & M. M. Günther. 1989. Wie die Körpermasse den Springstil von Halbaffen und deren Proportionen bestimmt. Zeitschrift für Morphologie und Anthropologie 77: 209–225.
- Dittus, W. P. J. 1977. The social regulation of population density and age-sex distribution in the toque monkey. *Behaviour* 63:281-322.
- Estes, R. D. 1991. *The Behavior Guide to African Mammals Including Hoofed Mammals, Carnivores, Primates.* The University of California Press, Berkeley, Los Angeles, London.
- Farris, Z. J., S. Chan, R. Rafaliarison & K. Valenta. 2019. Occupancy modelling reveals interspecific variation in habitat use and negative effects of dogs on lemur populations. *International Journal* of Primatology 40: 706–720.
- Farris, Z. J., S. Karpanty, F. Ratelolahy & M. J. Kelly. 2014. Predator-primate distribution, activity, and co-occurrence in relation to habitat and human activity across fragmented and contiguous forests in northeastern Madagascar. *International Journal of Primatology* 35: 859–880.
- Fooden, J. 1979. Taxonomy and evolution of the *sinica* group of macaques: I. Species and

subspecies accounts of *Macaca sinica*. *Primates* 20: 109–140.

- Galetti, M. & I. Sazima. 2006. Impacto de cães ferais em um fragment urbano de Floresta Atlantica no sudeste do Brasil. *Natureza & Conservação* 4: 58–63.
- Gould, L. & M. L. Sauther. 2007. Anti-predator strategies in a diurnal prosimian, the ring-tailed lemur (*Lemur catta*), at the Beza Mahafaly Special Reserve, Madagascar. In *Primate Anti-Predator Strategies.* S. L. Gursky & K. A. I. Nekaris, eds. Springer, Boston, Massachusetts. Pp. 275–288.
- Grey, J. N. C., S. Bell & R. A. Hill. 2017. Leopard diets and landowner perceptions of human wildlife conflict in the Soutpansberg Mountains, South Africa. *Journal for Nature Conservation* 37: 56–65.
- Groves, C. P. 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington, D.C.
- Grubb, P. 2006. English common names for subspecies and species of African primates. *Primate Conservation* 20: 65–73.
- Grubb, P., T. M. Butynski, J. F. Oates, S. K. Bearder, T. R. Disotell, C. P. Groves & T. T. Struhsaker. 2003. Assessment of the diversity of African primates. *International Journal of Primatology* 24: 1301– 1357.
- Günther, M. M., H. Ishida, H. Kumakura & Y. Nakano. 1991. The jump as a fast mode of locomotion in arboreal and terrestrial biotopes. *Zeitschrift für Morphologie und Anthropologie* 78: 341–372.
- Hosaka, K., M. Nakamura & Y. Takahata. 2020. Longitudinal changes in the targets of chimpanzees (*Pan troglodytes*) hunts at Mahale Mountains National Park: how and why did they begin to intensively hunt red colobus (*Piliocolobus rufomitratus*) in the 1980s? *Primates* 61: 391–401.
- Johnson, R. L. & C. H. Southwick. 1984. Structural diversity and mother–infant relations among rhesus monkeys in India and Nepal. *Folia Primatologica* 43: 198–215.
- Kingdon, J. 1997. *The Kingdon Field Guide to African Mammals*. Natural World Academic Press, London.
- Kshirsagar, A. R., J. W. Applebaum, Z. Randriana, T. Rajaonarivelo, R. R. Rafaliarison, Z. J. Farris & K. Valenta. 2020. Human–dog relationships across communities surrounding Ranomafana and Andasibe-Mantadia National Parks, Madagascar. *Journal of Ethnobiology* 40: 483–498.
- Masters, J. C. 1986. Geographic distributions of karyotypes and morphotypes within the greater

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galagines. Folia Primatologica 46: 127-141.

- Masters, J. C. 1988. Speciation in the greater galagos (Prosimii: Galaginae): review and synthesis. *Biological Journal of the Linnean Society* 34: 149– 174.
- Medhi, R., D. Chetry, P. C. Bhattacharjee & B. N. Patiri. 2004. Status of *Trachypithecus geei* in a rubber plantation in western Assam, India. *International Journal of Primatology* 25: 1331– 1337.
- Moresco, A., R. S. Larsen, M. L. Sauther, F. P. Cuozzo, I. P. Youssouf Jacky & J. B. Millette. 2012. Survival of a wild ring-tailed lemur (*Lemur catta*) with abdominal trauma in an anthropogenically disturbed habitat. *Madagascar Conservation & Development* 7: 49–52.
- Mourthé, Í. M. C., D. Guedes, J. Fidelis, J. P. Boubli, S. L. Mendes & K. B. Strier. 2007. Ground use by northern muriquis (*Brachyteles hypoxanthus*). *American Journal of Primatology* 69: 706–712.
- Najmuddin, M. F., H. Haris, N. Norazlimi, B. M. Md-Zain, A. R. Mohd-Ridwan, R. Shahrool-Anuar, H. Husna & M. A. B. Abdul-Latiff. 2019. Predation of domestic dogs (*Canis lupus familiaris*) on Schlegel's banded langur (*Presbytis neglectus*) and crested hawk-eagle (*Nisaetus cirrhatus*) on dusky leaf monkey (*Trachypithecus obscurus*) in Malaysia. *Journal of Sustainability Science and Management* 14: 39–50.
- Nash, L. T., S. K. Bearder & T. R. Olson. 1989. Synopsis of *Galago* species characteristics. *International Journal of Primatology* 10: 57–79.
- Nishida, T., S. Uehara & R. Nyundo. 1979. Predatory behavior among wild chimpanzees of the Mahale Mountains. *Primates* 20: 1–20.
- Oliveira, V. B. de, A. M. Linares, G. L. C. Corrêa, & A. G. Chiarello. 2008. Predation on the black capuchin monkey *Cebus nigritus* (Primates: Cebidae) by domestic dogs *Canis lupus familiaris* (Carnivora: Canidae), in the Parque Estadual Serra do Brigadeiro, Minas Gerais, Brazil. *Revista Brasileira de Zoologia* 25: 376–378.
- Olson, T. R. 1979. Studies on Aspects of the Morphology and Systematics of the Genus *Otolemur*. PhD thesis, University of London.
- Olson, T. R. 1981. Systematics and zoogeography of the greater galagos. *American Journal of Physical Anthropology* 54: 259.
- Paschoal, A. M. O., R. L. Massara, J. L. Santos & A. G. Chiarello. 2012. Is the domestic dog becoming an abundant species in the Atlantic forest? A study case in southeastern Brazil. *Mammalia* 76: 67–76.
- Pellikka, P. K. E., B. J. F. Clark, A. G. Gosa, N. Himberg,

P. Hurskainen, E. E. Maeda, J. Mwang'ombe, L. M. A. Omoro & M. Siljander. 2013. Agricultural expansion and its consequences in the Taita Hills, Kenya. In *Kenya: A Natural Outlook.* P. Paron, D. O. Olago & C. T. Omuto, eds. Developments in Earth Surface Processes, Volume 16, Elsevier. Pp. 165–179.

- Pellikka, P. K. E., M. Lötjönen, M. Siljander & L. Lens. 2009. Airborne remote sensing of spatiotemporal change (1955–2004) in indigenous and exotic forest cover in the Taita Hills, Kenya. *International Journal of Applied Earth Observation and Geoinformation* 11: 221– 232.
- Perkin, A., S. K. Bearder, T. M. Butynski, B. Agwanda & B. Bytebier. 2002. The Taita Mountain dwarf galago *Galagoides* sp.: a new primate for Kenya. *Journal of East African Natural History* 91: 1–13.
- Rahaman, H. 1973. The langurs of the Gir Sanctuary (Gujarat)—a preliminary survey. *The Journal of the Bombay Natural History Society* 70: 295–314.
- Rajpurohit, L. S. & V. Sommer. 1991. Sex differences in mortality among langurs (*Presbytis entellus*) of Jodhpur, Rajasthan. *Folia Primatologica* 56: 17–27.
- Riley, C. M., B. L. Koenig & M. D. Gumert. 2015. Observation of a fatal dog attack on a juvenile long-tailed macaque in a human-modified environment in Singapore. *Nature in Singapore* 8: 57–63.
- Rosti, H., H. Pihlström, S. K. Bearder, P. K. E. Pellikka & J. Rikkinen. 2020a. Vocalization analyses of nocturnal arboreal mammals of the Taita Hills, Kenya. *Diversity* 12: 473. https://doi.org/10.3390/ d12120473
- Rosti, H., J. Rikkinen, P. K. E. Pellikka, S. K. Bearder & J. M. Mwamodenyi. 2020b. Taita Mountain dwarf galago is extant in the Taita Hills of Kenya. *Oryx* 54: 152–153.
- Siljander, M., T. Kuronen, T. Johansson, M. N. Munyao & P. K. E. Pellikka. 2020. Primates on the farm – spatial patterns of human-wildlife conflict in forest-agricultural landscape mosaic in Taita Hills, Kenya. *Applied Geography* 117: 102185.
- Simonds, P. E. 1965. The bonnet macaque in South India. In Primate Behavior: Field Studies of Monkeys and Apes. I. DeVore, ed. Holt, Rinehart and Winston, New York, Chicago, San Francisco, Toronto, London. Pp. 175–196.
- Svensson, M. S., K. A.-I. Nekaris, S. K. Bearder, C. M. Bettridge, T. M. Butynski, S. M. Cheyne, N. Das, Y. A. De Jong, A. M. Luhrs, L. V. Luncz, S. T. Maddock, A. Perkin, E. Pimley, S. A. Poindexter,

K. D. Reinhardt, D. Spaan, D. J. Stark, C. R. Starr & V. Nijman. 2018. Sleep patterns, daytime predation, and the evolution of diurnal sleep site selection in lorisiforms. *American Journal of Physical Anthropology* 166: 563–577.

- Teucher, M., C. B. Schmitt, A. Wiese, B. Apfelbeck, M. Maghenda, P. K. E. Pellikka, L. Lens & J. C. Habel. 2020. Behind the fog: forest degradation despite logging bans in an East African cloud forest. *Global Ecology and Conservation* 22: e01024.
- Uehara, S. 1997. Predation on mammals by the chimpanzee (*Pan troglodytes*). *Primates* 38: 193–214.
- Wagura, L. 2014. A Guide to Taita Hills Unique Natural History. Lawrence Wagura, Nairobi.
- Warren, R. D. & R. H. Crompton. 1998. Diet, body size and the energy costs of locomotion in saltatory primates. *Folia Primatologica* 69 (Supplement 1): 86–100.

- Waters, S., A. El Harrad, M. Chetuan, S. Bell & J. M. Setchell. 2017. Dogs disrupting wildlife: domestic dogs harass and kill Barbary macaques in Bouhachem Forest, northern Morocco. *African Primates* 12: 55–58.
- Wilder, C., T. Brooks & L. Lens. 1998. Vegetation structure and composition of the Taita Hills forests. *Journal of East African Natural History* 87: 181–187.
- Williams, K. S., S. T. Williams, L. E. Fitzgerald, E. C. Sheppard & R. A. Hill. 2018. Brown hyaena and leopard diets on private land in the Soutpansberg Mountains, South Africa. *African Journal of Ecology* 56: 1021–1027.

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