

Brief Communication:

Dogs Disrupting Wildlife: Domestic Dogs Harass and Kill Barbary Macaques in Bouhachem Forest, Northern Morocco

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INTRODUCTION

The domestic dog (*Canis familiaris*) is the most abundant carnivore in the world (Gompper 2014). People and dogs have a complex relationship, with dogs performing important roles in human society (Serpell 1995). Due to their presence in many regions of the world, conflicts involving dogs and wildlife have been cited as a serious problem for wildlife conservation (Young *et al.* 2011; Hughes & Macdonald 2013; Weston & Stankowich 2014; Peltola & Heikkilä 2015). The presence of domestic dogs in rural or protected areas increases the risks of disease transmission to and from wildlife and interferes with the spatial distribution of wildlife populations (Young *et al.* 2011; Hughes & Macdonald 2013; Sepulveda *et al.* 2015; Lessa *et al.* 2016). Reports of domestic dog disturbance and predation on primates are scarce, probably due to the rarity of observing such events in the field. Dogs of undetermined status (i.e., whether feral or free roaming) were reported to kill commensal macaques in India (Anderson 1986) and Japanese macaque (*Macaca fuscata*) infants in Japanese monkey parks (Knight 2011), whilst feral dogs were observed killing a juvenile long-tailed macaque (*M. fascicularis*) in Singapore (Riley *et al.* 2015).

The Barbary macaque (*M. sylvanus*) is the only macaque species found outside Asia, and is present in Morocco and Algeria, with an introduced population on Gibraltar (Fa 1981; Modolo *et al.* 2005). Researchers have observed dogs snatching infants from adult Barbary macaques on six occasions in the Middle Atlas Mountains, Morocco

(Camperio-Ciani & Mouna 2006). Shepherds and their dogs are reported to harass macaques in Talassemtane National Park in north Morocco (Mehlman 1984). Here, we report observations of domestic dogs disturbing and killing Barbary macaques in Bouhachem forest, north Morocco.

METHODS

The study site, Bouhachem forest, is an area of mixed oak forest covering ~140km² in north Morocco (Figure 1). The communities around the forest are agropastoralists. There has been no recent census at a household level so no population data are available. Cows graze in the forest unattended but goats are regularly herded into and out of the forest by shepherds. All shepherds use livestock guarding dogs to protect their goats from predators.

We identified and observed four groups of Barbary macaques (Waters *et al.* 2015) and observed each group for two days a week from February–November 2010, recording all harassment of the study groups by dogs during these observation periods. The length of observation periods depended on the macaque groups' tolerance of observers, varying from five minutes to >three hours. We supplement this with information on direct dog-macaque interactions up to and including October 2016, obtained during conservation activities, including Barbary macaque monitoring, by the Barbary Macaque Awareness & Conservation team.

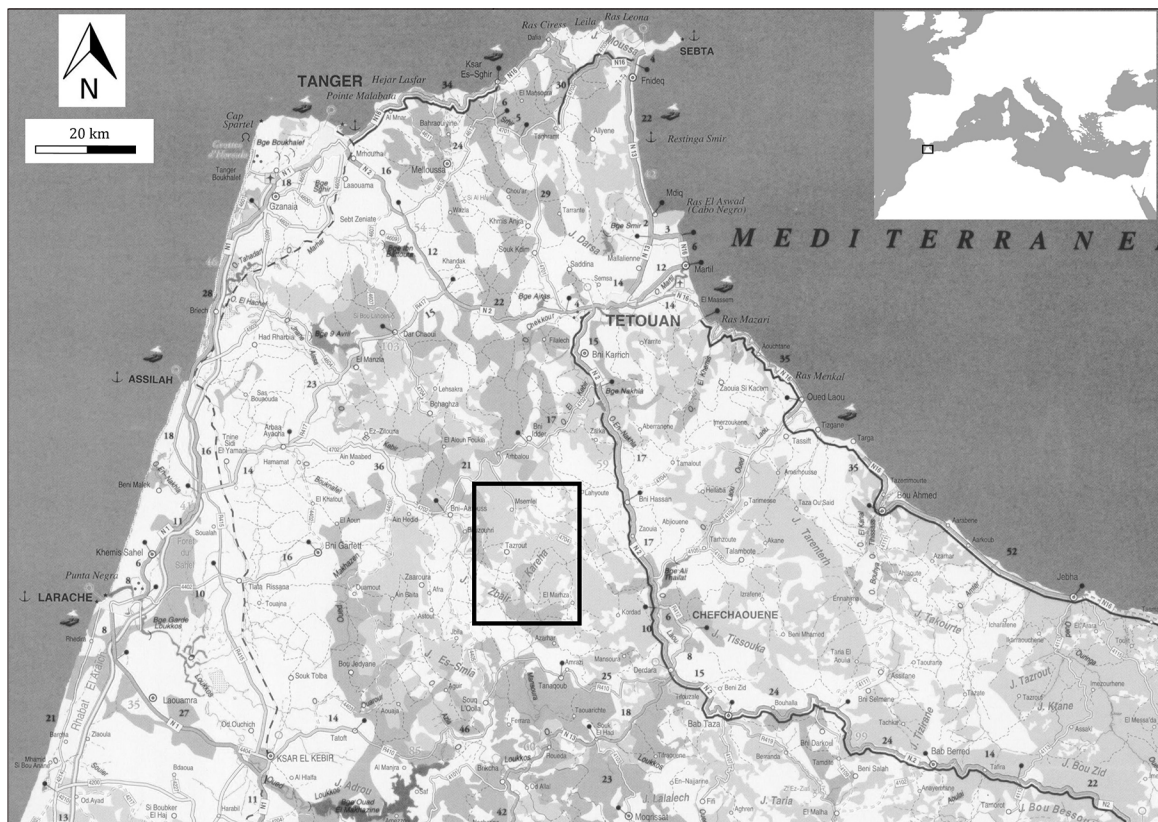


Figure 1. The location of Bouhachem forest in northern Morocco and the Mediterranean

RESULTS

Barbary macaques always emitted alarm vocalisations on sighting domestic dogs in the forest, and climbed into trees or onto high rocks to avoid them. We recorded a total of 30 events of dogs harassing macaque groups. The highest rates of occurrence ($N = 17$) happened during the months of April and May. Shepherds and dogs accompanied the goat herds on their ascent to pastures and dogs harassed any macaque groups they encountered on the way. The general pattern of an interaction involved the sudden appearance of dogs running towards the macaque group. On sighting the dogs, the macaques would alarm call and ascend into trees whilst the dogs ran around and barked beneath. Disturbances lasted from seven minutes to two hours and 15 minutes, with a mean length of 42 minutes ($N = 9$). When goat herds returned to their villages in the late afternoon, the interactions were much shorter and lasted 8 to 27 minutes with a mean of 15 minutes ($N = 21$). The mean number of dogs taking part in harassment events was four, with a range of 1 - 18. The dogs were accompanying shepherds and herds on the majority of occasions (59%), with 19% of harassment events by unaccompanied dogs and

19% by dogs accompanying mushroom collectors. It was unclear whether dogs in the remaining 3% of attacks were accompanied, but we did not detect any humans in the vicinity. The largest pack of 18 dogs was unaccompanied.

We recorded three Barbary macaque mortalities that were due (or very likely due) to dogs. In April 2010, we observed a livestock guarding dog carrying an infant macaque's head. Two weeks later, in early May, we heard the vocalisations of macaques and dogs. When we arrived at the scene, we found a dead male infant with bite wounds. In February 2014, we came across unaccompanied dogs harassing a group of macaques and a male macaque about 9 months old with bite wounds. Both bodies were still warm and dogs were still in the vicinity.

Not all dog-macaque interactions ended in the death of a macaque. In May 2011, MC disturbed a livestock guarding dog with a live infant in its mouth. On sighting MC, the dog dropped the infant and fled. MC was able to return the infant, uninjured, to its group. In March 2015, we were alerted by alarm calls and screams from one of our study groups. We intervened to stop an attack on a young female Barbary macaque by five unaccompanied dogs. The macaque survived, albeit quite badly wounded, and

managed to climb into a tree about 35 minutes after the attack (Figures 2a and 2b). At this point we left the scene, not wanting to disturb the returning group members. Finally, in October 2016, an adult male macaque attacked and bit the throat of a domestic dog attempting to guard fields when macaques were feeding on crops.

DISCUSSION

Barbary macaques are mainly terrestrial and thus susceptible to harassment from domestic dogs. The longer morning harassment events in spring may result in increased stress and energetically costly behaviour for lactating or pregnant female macaques, due to the dogs' presence impeding macaque foraging. Such effects have been observed for other species (Anderson 1986; Gumert *et al.* 2013; Riley *et al.* 2015). Barbary macaque infants begin to spend time away from carers at around four weeks old and are not vigilant toward predators, likely leaving them more susceptible than adult macaques to fatal interactions with dogs. Such a lack of vigilance in response to the ubiquitous presence of domestic dogs may have the potential to affect Barbary macaque infant survival in Bouhachem substantially. In Laem Son National Park in Thailand, the presence of domestic dogs is negatively correlated with a low proportion of infants in some

groups of Burmese long-tailed macaques (*M. fascicularis aurea*) although no actual predation events were observed (Gumert *et al.* 2013).

We also observed a Barbary macaque attack a dog. To the best of our knowledge, this is the first report of a wild Barbary macaque attacking a dog in North Africa. Human-habituated Barbary macaques living on Gibraltar sometimes attack pet dogs (L. Radford, unpublished data), and there are reports of primate males attacking dogs in other regions. For instance, adult male long-tailed macaques (*M. fascicularis*) attack dogs in Bali (Anderson 1986) and adult male baboons (*Papio ursinus*) kill dogs when baboons feed on crops in Africa (Butler *et al.* 2004). Such examples illustrate that primates are not always the victims in dog-macaque interactions.

These physical interactions also present a potential for interspecies disease transmission, particularly rabies. There are also implications for human and macaque health due to the indirect spread of pathogens from dog faeces in both village and forest. Controlling the dog population in Bouhachem and deterring the dogs' behaviour toward the macaques can only be done by understanding the relationship they have with their owners and developing a mitigation strategy inclusive of such considerations. The success of this strategy may be more likely if it incorporates the provision of salient benefits to people and their dogs.



Figure 2. a: A young female Barbary macaque, immediately after being attacked by five dogs. b: The same young female 35 minutes later. Photographs by A. El Harrad.

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