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Wolves can suppress goodwill for leopards: Patterns of human-predator coexistence in northeastern Iran

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ABSTRACT

Mammalian carnivores often cause problems for people by preying on domestic stock. Exploring the factors that affect people's attitudes to predators, in particular the circumstances when some degree of loss is tolerated, is needed for developing predator management plans. When more than one species of predator is involved, there may be unexpected interactive effects in shaping people's tolerance. We addressed this hypothesis in a west Asian multi-predator montane landscape with high density of both wild ungulates and livestock harboring two large predators, Persian leopard and grey wolf. A semi-structured questionnaire survey of herders residing around Tandoureh, Salouk and Sarigol National Parks, northeastern Iran was carried out. The perceived role of leopards in depredation was negligible compared with that of wolves which were reported to be more frequent stock raiders and responsible for an average of 5.7 times more annual losses per herd by than were leopards. Non-predatory causes of mortality, particularly diseases, were clearly the major threat to livestock. Interviewed herders showed different attitudes toward each predator. Regardless of any recent occurrence of stock raiding by wolves, they were predominantly considered negatively. Although people showed mainly positive attitudes toward leopards, respondents who reported more wolf attacks tended to have more negative attitudes toward leopards. Hence, in multiple predator ecosystems, peoples' attitudes toward each species may be affected by the perceived activity of other predators. Often neglected in conservation programs, this phenomenon is clearly important in sustaining people tolerance particularly if endangered large predators are involved.

1. Introduction

The arid montane landscapes of west and central Asia host a low density of wild ungulates, mostly confined to protected areas (Baskin and Danell, 2003). They are also densely occupied by increasing numbers of pastoral herds of small stock (Mallon and Zhigang, 2009). It is estimated that west and central Asia harbor more small-bodied livestock than North and South America combined (Thornton, 2010). As a result, competition over limited resources between wild and domestic ungulates is inevitable (Namgail et al., 2007) and conflict with large carnivores is widespread (Dar et al., 2009; Kabir et al., 2013; Suryawanshi et al., 2013).

A number of large carnivores share the montane areas of west and central Asia with humans, with the leopard *Panthera pardus* and the grey wolf *Canis lupus*, generally causing the greatest level of conflict. They are subject to different patterns of tolerance and attitudes by human communities across their very large geographic ranges (Kansky et al., 2014). The co-existence of leopards with humans is often characterised by moderate to severe levels of conflict (Dar et al., 2009; Kabir et al., 2013; Shehzad et al., 2015). The conflict is unsurprisingly often linked to the extent to which they kill domestic stock (Babrgir et al., 2017; Shehzad et al., 2015) or domesticated carnivores, particularly dogs (Farhadinia et al., 2015; Ghoddousi et al., 2016). The grey wolf is also generally considered as a nuisance due to its consumption of livestock (Kikvidze and Tevzadze, 2015; Suryawanshi et al., 2013), even in areas with abundant multiple wild prey species (Hosseini-Zavarei et al., 2013).

People's attitude toward predators are not shaped solely by perceived economic loss, however, and may be influenced by a wide range of socioeconomic factors (Babrgir et al., 2017; Dar et al., 2009; Hosseini-Zavarei et al., 2013). Age, gender, and education (Suryawanshi et al., 2014), risk to human life (Behdarvand and Kaboli, 2015) and beliefs about predator behaviour (Kikvidze and Tevzadze, 2015) can play a role.

Spatiotemporal accessibility of domestic ungulates is known to be the driving factor for large felid depredation (Jumabay-Uulu et al.,

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2014; Miller et al., 2015; Zanin et al., 2015). Thus, even in areas with high wild prey availability but with easily accessible stock resources, large felids regularly depredate on livestock (Suryawanshi et al., 2013; Ghoddousi et al., 2016). Furthermore, wild prey depletion is an additive determinant of livestock depredation by large cats in montane landscapes (Babrgir et al., 2017; Dar et al., 2009; Sharma et al., 2015; Shehzad et al., 2015). Considering these drivers of conflict, we might expect low levels of leopard depredation on livestock, and less hostility toward leopards by the local communities where there is a stable prey base, good law enforcement and where livestock are excluded.

In this paper, we explored patterns of coexistence between humans and large carnivores across a sample of well-protected semi-arid montane reserves in northeastern Iran. We investigated perceived carnivore-caused mortality using the herders' records rather than actual loss, because the perceived rather than actual level of depredation often drives powerful negative attitudes to predators (Mishra, 1997).

We investigated temporal, spatial, and socio-economic factors affecting perceived conflict with large carnivores across some key leopard reserves in northeastern Iran. We documented perceived spatiotemporal variation in livestock loss due to wild predators and other causes, by season and by locality. We expected that losses to predators would be considerably exceeded by those to other causes, and we expected that diligent husbandry would reduce depredation. Furthermore, we hypothesized that people's attitudes toward larger carnivores are mainly driven by socio-economic factors. We anticipated that our research would clarify the dynamics of human-carnivore coexistence in a poorly studied ecosystem, as well as assist to design mitigation activities to reduce conflict and inform policy for the conservation of the endangered Persian leopard *P. p. saxicolor*.

2. Materials and methods

2.1. Study area

The Kopet Dagh and Aladagh Mountains in northeastern Iran host a number of montane reserves, including Tandoureh National Park and Protected Area, Salouk National Park and Protected Area and Sarigol National Park and Protected Area, lying at the eastern extreme of the Irano-Anatolian Biodiversity Hotspot (E57°15′ to E59°15′, N36° 20′ to N37°20′; Fig. 1 & Table 1). They total almost 930 km^2 of very rugged mountainous landscapes of steep cliffs and deep valleys at altitudes of 1000 to over 3000 m a.s.l.. Mean annual precipitation and temperature are 200 to 300 mm and around 15 °C, respectively, leading to a temperate semi-arid climate (Darvishsefat, 2006).

The vegetation is generally dominated by scrub species, particularly *Astragalus* spp. and *Artemisia sieberi*, forming a bush-steppe habitat in most areas, with pockets of juniper *Juniperus* spp. and barberry *Berberis* spp. (Darvishsefat, 2006). Potential ungulate prey for leopards include urial *Ovis vignei*, Wild goat *Capra aegagrus*, and Eurasian wild pig *Sus scrofa*. These areas also support a diverse carnivore community, including leopard, grey wolf, striped *hyaena Hyaena hyaena*, Eurasian *lynx Lynx lynx*, wild cat *Felis lybica*, and Pallas' cat *Otocolobus manul* (Ziaie, 2008).

Table 1
Details of interviewed herders around multiple reserves in northeastern Iran.

	Sarigol	Salouk	Tandoureh	Total
No. villages	9	6	12	26
No. herds	18	22	60	100
No. interviewed herders	12	16	44	72
Percentage of sampling	66.7	72.7	73.3	72.0
Total livestock number of interviewed herds	5500	10,290	18,229	34,019
Mean herd size (SE)	458.3 (39.3)	643.1 (63.7)	414.3 (47.8)	472.5 (34.8)

Our three study sites encompass areas of National Park and non-National Park (hereafter NP and non-NP). NPs experience greater law enforcement, and livestock grazing is completely banned. Non-NPs designated in Iran as Wildlife Refuge or Protected Area, have lower levels of protection, and enjoy less intense anti-poaching efforts. Furthermore, nomadic pastoralists are permitted to graze their herds in non-NPs during summer (May–August). Herds are comprised largely of sheep *Ovis aries* (%84 ± 2) with goats *Capra hircus*. Livestock grazes in seasonal pastures in wilderness areas for most of the year, but they are herded closer to villages during winter, where the main food stock is often the stubble of crops.

2.2. Sampling design

From August 2013 to September 2014, we conducted a semi-structured questionnaire survey with selective open-ended questions, to obtain data on people's attitudes, perceptions and interaction with large carnivores (i.e. Persian leopard and grey wolf). Closed-format questions reportedly result in less uncertainty than open-ended ones, for both the respondent and the researcher (White et al., 2005).

We focused on villages located on the borders of the three study sites and/or their associated herds of livestock spending part of each year within the reserve's pastures (n = 29). Inside each village, several households usually merge their herds of domestic stock to create a single large herd, always accompanied by at least one shepherd and several dogs. We targeted these aggregated herds from each village and interviewed the shepherd assigned to each.

We interviewed shepherds from 91 herds (from a total of 100 herds; Table 1), representing 302 households living around three reserves, i.e. Tandoureh, Salouk and Sarigol. Each herder was interviewed between 1 and 3 times. However, we used responses only from those respondents who were interviewed more than once during the survey year. This provided data on seasonal patterns of loss. Accordingly, 72 herders' data were entered into the analysis, representing 79.1% of our initial

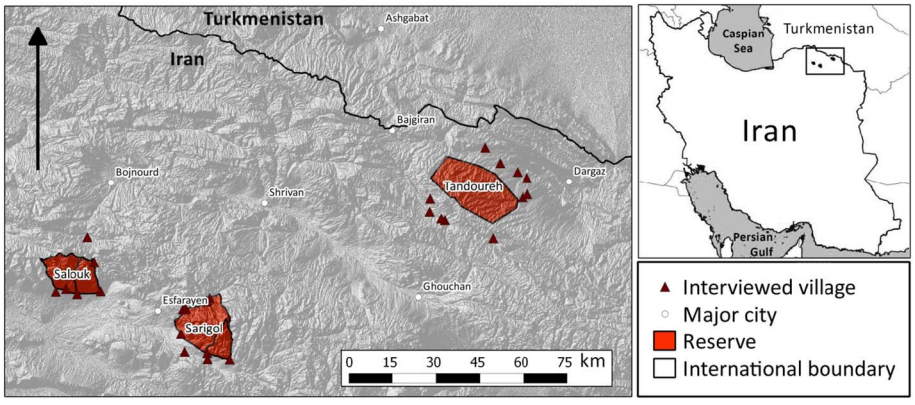

Fig. 1. Location of investigated villages (triangles) around three study sites in northeastern Iran.