

Short Communication

Status and conservation of the snow leopard *Panthera uncia* in the Gouli Region, Kunlun Mountains, China

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Abstract The elusive snow leopard *Panthera uncia* is a rare and little studied species in China. Over 1 March–15 May 2006 we conducted a survey for the snow leopard in the Gouli Region, East Burhanbuda Mountain, Kunlun Mountains, Qinghai Province, China, in an area of c. 300 km² at altitudes of 4,000–4,700 m. We surveyed 29 linear transects with a total length of c. 440 km, and located a total of 72 traces (pug marks, scrapes and urine marks) of snow leopard along four of the transects. We obtained eight photographs of snow leopard from four of six camera traps. We also recorded 1,369 blue sheep, 156 Tibetan gazelles, 47 argali, 37 red deer and one male white-lipped deer. We evaluated human attitudes towards snow leopard by interviewing the heads of 27 of the 30 Tibetan households living in the study area. These local people did not consider that snow leopard is the main predator of their livestock, and thus there is little retaliatory killing. Prospects for the conservation of snow leopard in this area therefore appear to be good. We analysed the potential threats to the species and propose the establishment of a protected area for managing snow leopard and the fragile alpine ecosystem of this region.

Keywords Camera trapping, China, human-wildlife conflict, Kunlun Mountains, *Panthera uncia*, snow leopard, trace.

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The snow leopard *Panthera uncia* is considered a typical high mountain species of the arid and semi-arid areas

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of Central Asia, occurring in 12 countries (Fox, 1992; Liao, 1992). In China the snow leopard ranges over alpine areas in Qinghai, Xinjiang, Tibet, Gansu, Sichuan and Inner Mongolia (Liao, 1985; Liao *et al.*, 1986; Schaller *et al.*, 1988; Ma *et al.*, 2002, 2005; Xu *et al.*, 2005; Jiang & Xu, 2006). Although China has the greatest proportion of the snow leopard's global range (McCarthy & Chapron, 2003) only limited information is available on the species in the country. The Gouli Region, in the south of Dulan County, Qinghai Province, is a part of East Burhanbuda Mountain in the Kunlun Mountains, which is one of the core snow leopard habitats in China (Fox, 1992). We surveyed the c. 300 km² Gouli Region because it is one of the centres of snow leopard distribution on East Burhanbuda Mountain (Yang, 1992). The climate is typical continental, characterized by dry, cold winters, frequent strong winds, strong solar radiation, and a short frost-free period. Dominant vegetation is alpine meadow and steppe. The shrub *Salix oritrepha* occurs in patches on shaded mountain slopes (Dulan County Annals, 2001).

Knowledge of the status of snow leopard in this alpine region is critical for effectively managing habitat for the species and its prey in an area with increasing encroachment of human development (Harris & Loggers, 2004). Our census indicated there were 172 people in 30 households in the region. The adults have received little if any education, although some of them can read and write simple Tibetan and Chinese. A few children, however, have had secondary school and higher college education. All of the inhabitants are Tibetan and followers of Tibetan Buddhism. They practice a pastoralist grazing regime. In total they have 6,844 livestock, with 3,880 sheep, 2,838 yaks, 68 goats and 58 horses. Summer pastures are at altitudes of c. 4,600 m, whereas winter and spring pastures are in terrains and river valleys at c. 4,000 m.

During 1 March–15 May 2006 we conducted an extensive field survey over altitudes of 4,000–4,700 m (Fig. 1). As the snow leopard is an elusive crepuscular carnivore and difficult to sight in the wild, we used transects to survey for snow leopard signs, and also interviewed villagers to obtain further information. We surveyed 29 transects with a total length of c. 440 km, and found a total of 72 snow leopard signs of five types (Table 1) along four (13.8%) of the transects. We used 10 auto-triggered cameras of which only six functioned (Fig. 1). Eight photographs of snow leopard,

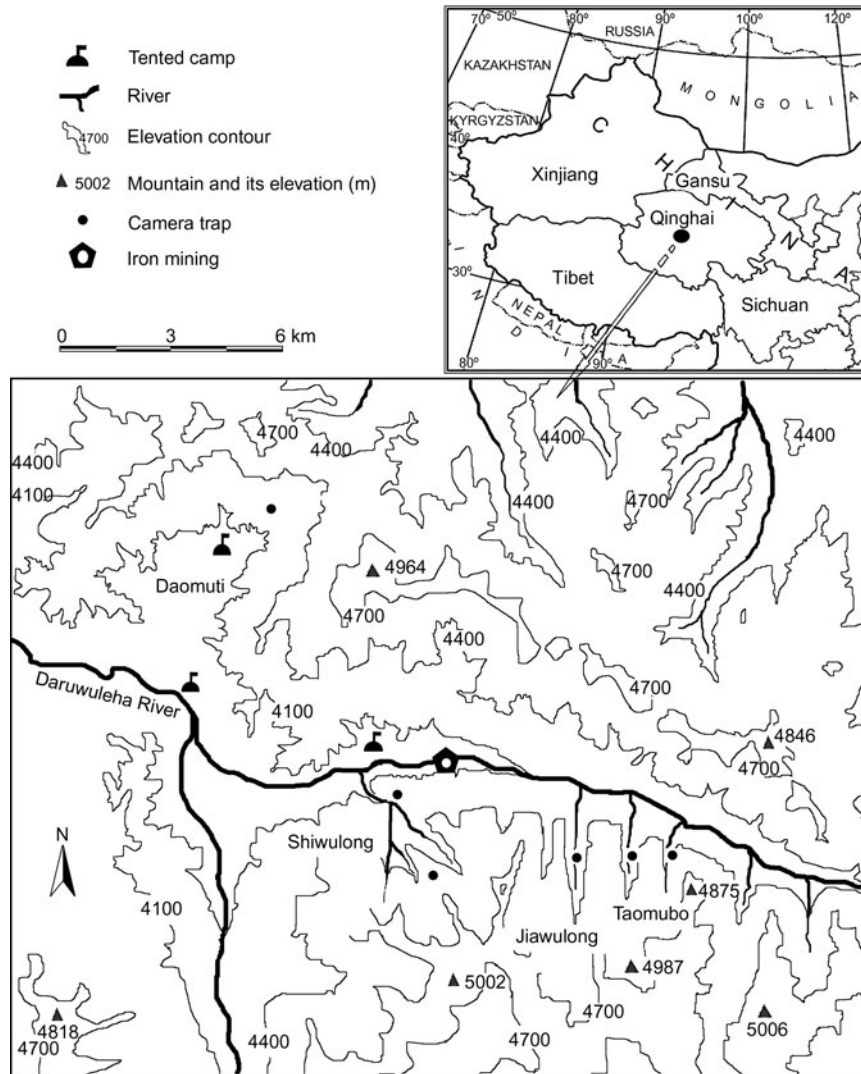


FIG. 1 Survey area in the Gouli Region in East Burhanbuda Mountain, Kunlun Mountains, China, indicating the locations of leopard signs (see Table 1) and camera traps. The inset shows the location of the main map in Qinghai Province.

two at dawn, four at dusk and two at midnight, were obtained from four of the cameras. We also recorded 1,369 blue sheep *Pseudois nayaur*, 156 Tibetan gazelles *Procapra picticaudata* (58♂), 47 argali *Ovis ammon* (10♂), 37 red deer *Cervus elaphus* (6♂), one male white-lipped deer *Cervus albirostris*, 12 Tibetan foxes *Vulpes ferrillata*, 20 woolly hares *Lepus oiostolus* and 17 wolves *Canis lupus*. We found

fresh footprints of one Tibetan brown bear *Ursus arctos pruinosus* and saw one Himalayan marmot *Marmota himalayana* on 15 April, recently awoken from hibernation.

Blue sheep and Tibetan gazelle are the most important ungulate prey for snow leopard (Chundawat & Rawat, 1992; Xu, 2007). We typically saw blue sheep in mixed-sex groups of 30–120 (mean $34.2 \pm \text{SE } 7.8$, range 2–210, $n = 40$), mainly on cliffs and breaks on ridge lines, as well as in flat river valleys or on gentle slopes. Tibetan gazelles live in same-sex groups, and we mainly saw them in flat river valleys and on gentle slopes. Male-male groups ($n = 19$) were often small with < 10 individuals (mean 3.6, range 1–9). Female-female or female-lamb groups ($n = 15$) comprised 1–14 gazelles (mean 7.3). We found many blue sheep carcasses, both fresh and old, killed by predators on mountain slopes, in valley bottoms and at the margin of shrub lands.

Information on local people and their relationship to wildlife is as important for the conservation of snow

TABLE 1 Snow leopard signs recorded in the Gouli Region, East Burhanbuda Mountain, Kunlun Mountains (Fig. 1), during an extensive survey over 1 March–15 May 2006.

Location	Pug		Prey		Total (%)
	Urine mark	Scrape Faeces	Faeces	kill	
Shiwulong (east)	1	3	30	1	35 (48.6)
Shiwulong (west)	1	2	11		14 (19.4)
Jiawulong		1	8		9 (12.6)
Taomubo		1	11	1	14 (19.4)
<i>Total</i>	2	7	60	2	72

leopard as biological information on the species (Harris, 1992). We therefore interviewed in person the heads of 27 of the 30 households (three could not be surveyed because they were visiting relatives) using questionnaires (Appendix) to investigate their attitudes towards the snow leopard. We used a translator if the interviewee could not speak Chinese. All respondents except for one local grocery merchant had seen live snow leopard or their sign; 22% of the interviewees had seen > 1 living snow leopard within the previous 3 years. Interviewees thought the population of snow leopard had decreased compared with 20 years ago because of (1) hunting and trapping in recent years (18 questionnaires, 67%), (2) fragmented habitat resulting from increasing human population and livestock (7, 26%), and (3) competition with wolves (2, 7%). If they encountered any illegal hunting or trapping of snow leopard, 20 respondents (74%) indicated they would stop the poachers immediately, and seven (26%) would report it to the Tibetan Lamasery (Living Buddha) or the local government. All those surveyed reported no cases of illegal killing or trapping of wildlife, including snow leopard, within the previous 3 years. With respect to livestock losses, 23 people (85%) believed that wolf rather than snow leopard is the main predator of livestock, and only four people (15%) thought snow leopard predated their livestock.

Generally, snow leopard are threatened by poaching, reduction in ungulate prey, retaliatory killing because of livestock depredation, and habitat degradation and loss (McCarthy & Chapron, 2003). Numerous studies have described retaliatory killing of snow leopard by herders as the biggest threat to the survival of the species in the wild (Jackson, 1979, 1988; Schaller *et al.*, 1987, 1988; Fox, 1989; Fox *et al.*, 1991; Nowell & Jackson, 1996; Malik, 1997). In the Indian Himalayas, Mishra (1997) found that local people had an extremely negative attitude towards snow leopard because of the hardship that it caused them. Similar attitudes were recorded by Schaller *et al.* (1988) in Xinjiang province, China, and by Mallon (1984) in central Ladakh. However, in the Gouli Region the local people noted that snow leopard and wolf are carnivores, and most people expressed a relatively tolerant attitude towards snow leopard. As our observations indicated that the alpine environment is relatively well preserved in this area, prospects for the conservation of snow leopard there appear to be good.

However, the perspectives of local people are changing because of the increasing human population and a desire to own more livestock. Our survey indicated there are four potential threats to snow leopard. (1) Large enclosures fenced with steel wire are being used to prevent wild ungulates, mainly blue sheep and Tibetan gazelle, foraging in contracted pastures, although the local herders are aware of the adverse impact of the enclosures on wildlife, which fragment habitat (Jiang *et al.*, 1995) and cause injuries or death. You *et al.* (2005) found Tibetan wild ass *Equus kiang*,

blue sheep and Tibetan gazelles strangled on fences c. 200 km to the north-east of our study area. (2) Increasing livestock populations and expansion of grazing areas decrease the foraging habitat available for wild ungulates, forcing them onto sparser grassland at higher altitudes and in marginal areas (Wang, 1998), and increase the likelihood that leopard and livestock will come into direct contact and thus that retaliatory killing increases. (3) Local people lack education and knowledge of wildlife protection laws. (4) Iron mining in the Gouli Region commenced in the summer of 2007 (Fig. 1). Heavy truck traffic, mining explosion noise and human activities will undoubtedly affect both wild ungulates and snow leopard.

Establishment of a protected area will be the most effective way to conserve the snow leopard and fragile alpine biodiversity of the Gouli Region. Given the large home range size of snow leopard (Fox, 1992) and the large areas required to maintain viable snow leopard populations, any such protected area will need to be extensive and will require regional, national and international cooperation in research and management.

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Appendix

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Biographical sketches

AICHUN XU, ZHIGANG JIANG, CHUNWANG LI, JIXUN GUO, SHENGLIN DA, QINGHU CUI, SHUANGYING YU and GUOSHENG WU have been carrying out research, both separately and together, since the early 1980s. Their research focuses in particular on conservation biology and the ecology and behaviour of threatened species, including bears, snow leopard, wolf, Przewalski's gazelle, giant panda, Père David's deer and Tibetan fox, and also on the sustainable use of wildlife and the restoration of grassland ecosystems.