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The wolverine *Gulo gulo* population and its distribution in the Great Khingan Mountains, northeastern China

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The geographical distribution and relative density of the wolverine *Gulo gulo* population in the Great Khingan Mountains, northeastern China, were surveyed during 1996-2000. The wolverine distribution is decreasing and the population size may be < 200 individuals. In the Great Khingan Mountains forestry areas, the wolverine was mainly separated into two small subpopulations within a total area of 80,000 km². Moreover, since the 1990s no wolverines or signs of wolverine activity have been found in the Altai Mountains, Sinkiang Province, in northwestern China, which has been another main distribution area for the wolverine in China. We suggest that habitat loss, food limitation and poaching are the main reasons for the decline of the wolverine population in China.

Key words: China, distribution, Great Khingan Mountains, *Gulo gulo*, population size, wolverine

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The wolverine *Gulo gulo* is a typical representative of boreal and tundra ecosystems, with a circumpolar distribution throughout the Northern Hemisphere (Pasitschniak-Arts & Larivière 1995, Tian et al. 2003). The wolverine is the least studied of the large carnivores (Weaver et al. 1996). Only a few studies of wolverine ecology have been con-

ducted worldwide (e.g. Wright & Rausch 1955, Fu 1966, Nowak & Paradiso 1991, Li 1984, Magoun 1985, Banci 1987, Landa et al. 1998, Persson 2003, Krebs et al. 2004).

Wolverine populations have declined in many parts of its global distribution during the last century. For instance, persecution has resulted in de-



Figure 1. The wolverine distribution in China is separated into an western subpopulation with uncertain distribution (shown by the question mark) and a eastern subpopulation with known distribution (shown by dots).

clining or disappearing wolverine populations in most states of the USA (Nowak & Paradiso 1991). Wolverine populations also declined in Scandinavia and Russia during the last century (Landa et al. 2000).

The wolverine population in China is small and it is classified as an endangered species, Category I State Protected Wildlife (Wang 1998). The distribution is separated into an eastern and a western subpopulation (Fig. 1). Apparently, the distribution of wolverines in the Great Khingan Mountains (Heilongjiang Province) and the Altai Mountains (Sinkiang Province) has become the

southern extreme of the species distribution in Asia (see Fig. 1).

Deforestation, natural fires and poaching of ungulates have resulted in habitat loss and a declining food base for the wolverine in China (Piao & Zhang 2000). The current low level of knowledge about wolverines in China complicates conservation efforts. To determine the distribution and the relative size of the wolverine population in China, we surveyed 2,569 km of sampling transect and a total area of 228 km² in the Great Khingan Mountains during five winters, i.e. during 1996-2000. This area was chosen because the wolverine distribution was

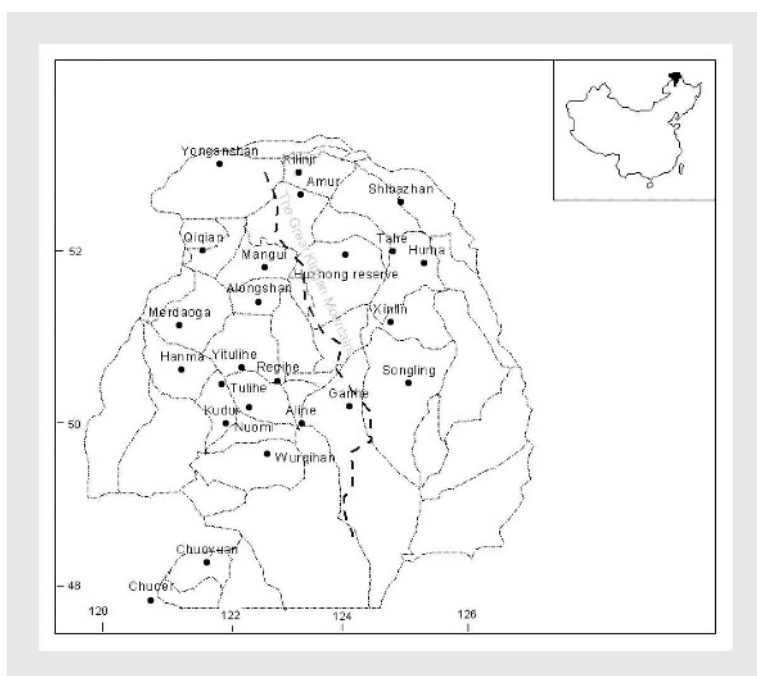


Figure 2. The distribution of line transects within the survey sites in the Great Khingan Mountains.

Table 1. Results of wolverine population investigation in the western Great Khingan Mountains.

Serial number	Surveyed farm	No of wolverine tracks (N)	Transect length (km)	Tracks/10 km
1	Wuyi	2	88	0.2273
2	Hezhong	2	62	0.3226
3	Tarqi	1	40	0.2500
4	Likeshan	1	44	0.2273
5	Yulin	1	45	0.2222
6	Wurqihan	1	42	0.2381
7	Wenkutu	2	94	0.2128
8	Bilige	1	59	0.1695
9	Hayaside	1	51	0.1961
10	Nuomin	1	66	0.1515
11	Hada	1	42	0.2222
12	Kailaqi	1	48	0.2381
13	Yinhe	1	65	0.1538
14	Hanma	2	86	0.2326
15	Tuohe	1	70	0.1429
16	Ganhe	2	82	0.2439
17	Alihe	2	90	0.2222
18	Henan	2	92	0.2173
19	Hongqi	1	53	0.1887
20	Aoluguya	2	60	0.3333
21	Mangui	1	42	0.2381
22	Qigan	1	52	0.1923
23	Yonganshan	1	64	0.1563
Total		31	1437	0.2157

relatively concentrated there and the local government has been concerned about it.

Material and methods

We investigated the Great Khingan Mountains both in the northeastern Inner Mongolia Municipality and the northwestern Heilongjiang Province, China (120°-127°E, 46°30'-53°30'N). The Great Khingan Mountains is the largest conifer forest area in the cold-temperate zone in China with a total area of 180,000 km². The study area is intersected by a number of rivers, i.e. the Heilongjiang and Huma rivers and their branches. Dominant tree species in the area are Dahurian larch *Larix gmelinii* and Scots pine *Pinus sylvestris*. The area also includes small marshlands and grasslands. It is inhabited by 56 mammalian species, 237 bird species, and 84 fish species (Ma 1989).

The altitude of the study area ranges within 500-1,530 m a.s.l.; mostly within 700-1,000 m a.s.l. The climate is defined as cold-temperate monsoon zone, with cold and dry winters. Annual average tempera-

ture is -3.5°C (range -52.3 - +43.6°C), the frost-free period lasts 80-100 days. The annual precipitation is 400-490 mm.

The distribution and relative density of the wolverine population were estimated by snow tracking along transects as follows. First, we collected available information on wolverine population size and distribution in China. Then, we set up survey transects at random within the study area in northwestern China (Fig. 2, Tables 1-2). The field surveyors were divided into eight groups with two surveyors and one local guide in each group. Transects were followed primarily by foot, but also by jeep, tractor and horse.

Results

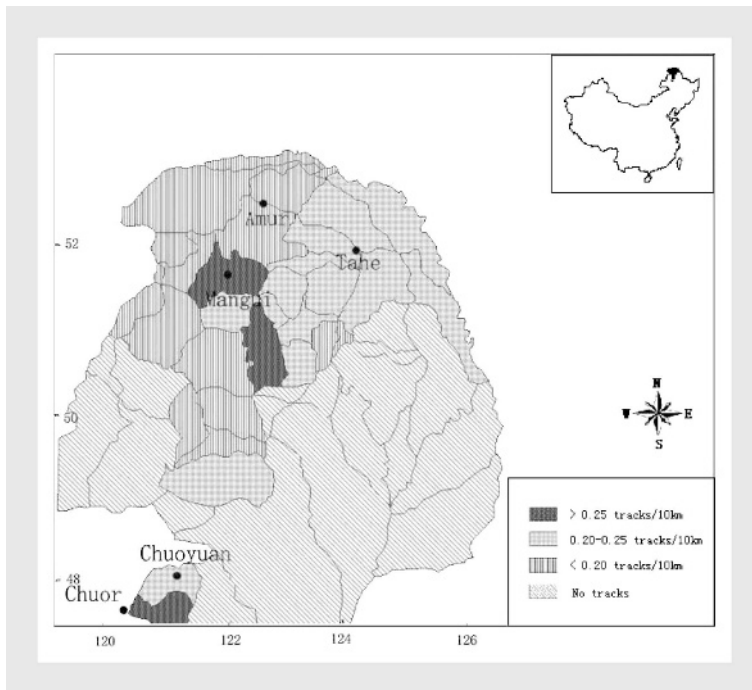
Population size and relative density

The investigation was conducted in winter when the ground was covered with snow. A total of 57 tracks were spotted along the 2,569 km of transects. The number of wolverine tracks encountered per 10 km of transect were 0.2297 in the eastern Great Khingan Mountains and 0.2157 in the western Great Khingan Mountains. The average number of tracks per 10 km was 0.2219 in the Great Khingan Mountains (Fig. 3 and see Tables 1 and 2).

Table 2. Results of wolverine population investigations in the eastern Great Khingan Mountains.

Serial number	Surveyed farm	No of wolverine tracks (N)	Transect length(km)	Tracks/10 km
24	Beijicun	1	42	0.2381
25	Jingou	1	40	0.2500
26	Qingsong	2	90	0.2222
27	Yanjiang	2	71	0.2817
28	6 Zhixian	2	75	0.2667
29	Malunxian	1	50	0.2000
30	21 Zhan	1	45	0.2222
31	25 Zhan	1	49	0.2041
32	19 Zhan	1	51	0.1961
33	Shuanghe	1	44	0.2273
34	Sanka	2	80	0.2500
35	Dongfanhong	2	74	0.2222
36	Dabaishan	1	45	0.2703
37	Cangshan	1	48	0.2083
38	Huzhong	2	78	0.2564
39	Linhai	2	102	0.1961
40	Tayuan	1	44	0.2273
41	Targan	1	50	0.2000
42	Dayangqi	1	54	0.1852
Total		26	1132	0.2297

Figure 3. Relative wolverine density in the Great Khingan Mountains.



Distribution of the population

Our investigation revealed that the distribution of the wolverine population in the Great Khingan Mountains runs along the Sino-Russia border river, i.e. the Heilongjiang or Amur riverside, from the Xilinji Forestry Area in the northern and central parts of the Great Khingan Mountains, to the Yilihuli Hill, where the wolverine distribution area was separated into a western and a southern part (see Fig. 2). Towards the east, it extends to the Sanka Forestry area, and towards the west, it extends to the Hanma Forestry Area. Towards the south, it reaches to the Chuor Forestry Area (Wang et al. 1983).

In the Altai Mountains, Northwestern China, a few wolverine pelts were purchased by furriers during the 1980s. No specimens or tracks of wolverines were found in the whole provincial survey of terrestrial wildlife during 1995-2000.

Discussion

In China, data on distribution of the wolverine population are rare and therefore difficult to review. In the 1970s, wolverine tracks could be found at Zhangdiyingzi areas (51°10'N; 126°56'E; Liang 1986). Xu (1983) reported that the wolverine population size in the Heilongjiang Province was 268. Ma (1989) estimated the wolverine population density

to be 5.5/1,000 km² in the four regions of Tahe, Xinlin, Songling and Ganhe Forestry Area. During the last 25 years, the wolverine distribution has decreased by 15% north and westwards, and it is currently reduced to an 80,000 km² area in the Heilongjiang Province (our study area).

In the Altai Mountains, the status of the wolverine population is unclear and the area needs to be further surveyed to confirm whether a breeding wolverine population still exists in the area (Wang et al. 1983).

Many factors could be responsible for the decreasing distribution and perhaps size of the wolverine population in China. Poaching by local people and capture of wolverines are possible reasons for the population decline (Piao & Zhang 1995). Human activities such as logging, road construction and establishment of residential sites may also contribute to the decline in both the size and distribution of the Chinese wolverine population.

Wolverines are generalist predators and scavengers and much of their food is obtained from ungulates killed by other carnivores. Unregulated killing by humans have made ungulates, such as moose *Alces alces*, red deer *Cervus elaphus*, roe deer *Capreolus pygargus* and other ungulates, rare (Zhang et al. 1992, Piao et al. 1995, Zhang 2001). Furthermore, other carnivores, such as wolf *Canis lupus* and lynx *Lynx lynx*, have also decreased (Piao &

Zhang 1995). Thus, the wolverines' prey base has decreased and food left by other carnivores has also declined dramatically.

The decrease of the wolverine population is indirectly related to their ecology. First, wolverines exhibit a low reproductive rate (Persson et al. 2006). Second, wolverines require broad habitats with home ranges of 48-2,000 km² (Hornocker & Hash 1981, Whitman et al. 1986, Hatler 1989, Banci & Harestad 1990) and frequently perform long distance movements (Lindstedt et al. 1986, Vangen et al. 2001). For example, in the Great Khingan Mountains area, the mean day and night movements is 14 km (range: 8.9-7.8 km; Piao & Zhang 1995). This presents a problem of scale for managers.

In conclusion, the distribution of the wolverine population in the Great Khingan Mountains is currently no more than 80,000 km², and the total population size may be < 200 individuals. Future efforts should be focused on studies of wolverine habitat selection and biological habits, as well as conservation of habitat. Finally, there is an urgent need to investigate the existence of a wolverine population in the Altai Mountains in northwestern China.

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