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GENERAL BIOLOGY

The Population Status of Snow Leopards *Uncia uncia* (Felidae, Carnivora) in the Western Sayan Mountain Ridge

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The snow leopard (*Uncia uncia* Schreber, 1776) is the most poorly studied species of the cat family in the world and, in particular, in Russia, where the northern periphery of the species area (no more than 3% of it) is located in the Altai–Hangai–Sayan range [1].

It is generally known that the existing data on the Russian part of the snow leopard population have never been a result of targeted studies; at best, they have been based on recording the traces of the snow leopard vital activity [2]. This is explained by the snow leopard's elusive behavior, inaccessibility of its habitats for humans, and its naturally small total numbers in the entire species area. All published data on the population status of the snow leopard in Russia, from the first descriptions of the species [3–6] to the latest studies [7, 8] are subjective, often speculative, and are not confirmed by quantitative estimates. It is obvious, however, that every accurate observation of this animal is of particular interest [9].

The purpose of our study was to determine the structure and size of the population group presumably inhabiting the Western Sayan mountain ridge at the northern boundary of the species area.

MATERIALS AND METHODS

The study was carried out from January to March 2008 in the Sayan ridge, the southern macroslope of the eastern branch of the Kantegir ridge, and the northern macroslope of the Khemchik ridge, on both the left and the right banks of the Sayano-Shushenskoe reserve. The study was performed during the rutting season and, hence, the period of the maximum marking activity of snow leopards. The total length of routes was more than 200 km; the total area examined was 120 km^2.

We used two methods of field studies: (1) the traditional tracking method and (2) technical photographing with the use of special autonomous cameras. First of all, we examined river valleys because of their steady snow cover and accessibility, which allowed us to survey the maximum area. When distinct tracks were found, we measured the lengths and widths of the total track, the large pads ("heels") of the fore and hind feet, and each digit. Every track or trail was assigned a number. The tracks were photographed, and their coordinates were determined using a Garmin eTrex Venture GSP receiver. We also recorded and measured all traces of the snow leopard marking behavior (scratches and other claw marks). Urine marks on vertical surfaces are the most typical of the snow leopards, as well as of other large cats [2]. These marks are of permanent interest for the animals, especially during the rutting season. This allowed us to use the other method, photographing with autonomous cameras and camera–traps, which was earlier proposed for studying tigers [10], to the full advantage. At least one camera was set at each fresh trail of a snow leopard, as well as near marked spots found earlier. The cameras were placed in stone niches on the ground surface or among stones on small elevations. The type of the digital cameras used in this study, Leaf River IR-3BU, has a matrix resolution of 4.1 Mpix and can operate in the video recording mode. It is intended for photographing animals of medium and large sizes. The camera is equipped with a passive infrared motion sensor and an infrared lamp, which makes it possible to obtain both color photographs in the daytime and monochrome photographs at night.

RESULTS

In the central Western Sayan ridge, snow leopards live at altitudes of 540–1200 m above sea level in the season studied. Snow leopard habitats are steep mountain slopes, usually southern and eastern ones, scarcely covered with snow, characterized by rocky spots, deep

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The results of identification of snow leopard tracks

Ordinal no.	Census site no.	Presumed sex of the animal/number of measurements (n)	Mean parameters of a track of the identified animal, $p = 0.05$			
			total track width, cm	total track length, cm	"heel" width, cm	"heel" length, cm
1	3	Male/n = 6	10.1 ± 0.16	10.45 ± 0.17	7.1 ± 0.15	5.3 ± 0.29
2	3, 5	Male/n = 3	11.8 ± 0.23	11.3 ± 0.2	7.6 ± 0.2	6.5 ± 0.11
3	5, 1, 4	Male/n = 11	10.8 ± 0.25	10.2 ± 0.16	7.3 ± 0.26	6.1 ± 0.12
4	5, 2	Not identified/n = 8	10.4 ± 0.26	9.9 ± 0.14	6.6 ± 0.11	5.4 ± 0.14
5	6	Female/n = 6	9.6 ± 0.3	10.1 ± 0.16	7 ± 0.09	5.4 ± 0.17
6	5, 6	Female/n = 6	9.5 ± 0.5	9.5 ± 0.47	6.3 ± 0.25	4.5 ± 0.1
7	5	Young animal/n = 3	7 ± 0	8 ± 0	5 ± 0	4 ± 0

gorges of small streams, and their estuarial areas communicating with the Yenisei River and Sayano-Shushenskoe reserve. Snow leopards also frequent the forest zone and small areas of the mountain shrub–steppe. Optimal habitats are few and small in the region studied [11].

We measured 54 traces of snow leopards. The individual specificity of the "heel" size, which is widely used in tracking felids, proved ineffective in the given case because of the absence of a stable snow cover and considerable firnification where there was snow. In about 80% of cases, snow leopards walked on snow with their hind feet stepping into the tracks of the fore feet, so that each combined track was similar in shape and size to a single track of a fore foot. The table shows the results of tracking and preliminary identification of snow leopards.

Note that, when tracking, we found a trail of an adult snow leopard (table, no. 6) periodically accompanied by relatively small tracks of another snow leopard (table, no. 7), apparently those of a past-year cub that remained under the care of its mother. This allowed us to preliminarily distinguish two age groups: adult females with a "heel" size of ≤7 cm and young animals with a "heel" size of ≤5 cm.

We also found four permanent urine spots (three on rocks and one at the root of a fallen tree). The maximum height of a urine mark was 79 cm. At the urine spot at the tree roots, snow leopard tracks were regularly accompanied by wolf tracks, the wolves not only marking the point with their urine, but also leaving feces. At the urine spots formed by numerous urinations, whitish mottles and relatively large oily drops with a specific mild odor were found against the generally dark background. The activity of snow leopards drastically decreased after February 10: the number of fresh tracks increased, paired trails appeared, and the marking behavior became more intense. All this lasted until early March. At the scratches found both along river valleys and on the tops of crests and watershed ridges, traces of urination but not defecation were found. All the excrements were found on animal trails.

During our survey, snow leopards looked self-confident and did not fear humans. When moving along our trails, snow leopards approached the objects that we lost (e.g., a glove) and marked them. Sometimes, they left claw marks at fresh campfire sites. Once a snow leopard scratched out a camera from among stones and then dropped it.

We set 14 automated camera–traps at the detected marking points. The duration of the census was 257 trap–days. The following photographs of animals were obtained: nine photographs of a total of 13 snow leopards, seven photographs of eight ibex, one photograph of a wolverine, one photograph of a fox, and one photograph of a jay. On average, we obtained 6.6 photographs of animals of images of 8.6 animals per 100 trap–days. Two photographs of snow leopards were obtained in the morning (Fig. 1) and in the evening; the remaining seven photographs, in the nighttime. Animals of all other species were photographed in the daytime.

DISCUSSION

Our data convey fundamentally new information on the population status of snow leopards, confirming that there is a population group in the surveyed region. The use of the two methods has shown that they efficiently complement each other. For example, regularly checking up a marking spot where a camera–trap was set, we found a trail of an adult snow leopard. Having looked trough the photographs made there, we found that simultaneously three snow leopards rather than one animal visited that spot in the night of February 23 (Fig. 2). Closer examination showed that the camera photographed female no. 6 with cub no. 7, which had been identified earlier on the basis of their tracks, as well as adult male no. 2 (Table 1). The combined results of tracking and automated photographing lead to the conclusion that a female with a past-year cub took part in the rut, which, in turn, indicates that females may reproduce every year under favorable conditions. Blood discharges found in the female's urine in the last third of February confirmed that it was in a state of estrus.

Fig. 1. A single snow leopard marking a permanent urine spot on a rock. The first photograph of a snow leopard in Russia obtained using a camera–trap (morning of February 23, 2008).

Fig. 2. A group of three snow leopards at a permanent urine spot on a rock. This is the first evidence ever obtained that snow leopards live in family groups.

There are no published data that snow leopards can reproduce every year; however, this has been demonstrated for female Amur leopards [12].

Analysis of selected identification zones (the shapes and patterns of spots on the skin), as well as indirect characters (an animal's general color pattern and physique) made it possible to compare the obtained photographs of snow leopards. We found that, in addition to the aforementioned group of three snow leopards, three more animals of this species were photographed in the region studied. The results of tracking indicated the presence of seven snow leopards. Evidently, only three animals were common for both groups. Therefore, we can definitely conclude that six snow leopards live in the surveyed region.

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