

Has the Snow Leopard Disappeared from Eastern Sayan and Western Hovsogol

Full Text:

Introduction

Little information has been added since the time of Pallas (1811) and Radde (1862) on the distribution of snow leopard or irbis in the Eastern Sayan and Western Hovsogol areas, although almost two-hundred years has passed (Potanin 1883, Dubrov 1884, Dorogostaiskiy, 1916, Formozov 1929, Bannikov 1954, Geptner and Sludskiy 1972, Sokolov and Orlov 1980, among others). To this day the limits of snow leopard distribution or inhabited areas is not known. For example, the general impression appears to be that the irbis has disappeared from the major part of its range in Eastern Sayan, particularly from the Tunkinskiy and Kitoiskiy Mountains and associated alpine zones above the treeline (Geptner and Sludskiy 1972; Shvetsov et al. 1984, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990), that it is very rare here (Bannikov 1954, Mallon 1984), or that it is completely absent from western Hovsogol (Sukhbat and Bazardorzh 1980, Litvinov 1983, Bazardorzh 1986, Amarsanaa 1992, Litvinov and Bazardorzh 1992). On the other hand, Hovsogol holds the most reliable core area from which the animal could spread out to the territory of Eastern Sayan and Tuva (Geptner and Sludskiy 1972, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990).

These contradictions in the published data provide evidence of the lack of a special study of irbis along the northeastern limits of its range to date. Eastern Sayan in Siberia and western Hovsogol in Mongolia remains, as in times past, the biggest "blank spot" on the distributional map of the species; published materials create many more questions than answers (Mallon 1984, Fox 1994, Schaller et al. 1994, Tserendeleg 1994).

Data for this paper was obtained during field trips conducted in 1991, 1993, and 1995 in the Eastern Sayan and western Hovsogol areas. Expeditions in 1995 were conducted with financial and equipment support from the International Snow Leopard Trust (USA), Bonnie and Dick Robbins (Robbins Company, USA), Kathleen Braden (Seattle Pacific University USA), Frith Maier (REI, USA), Al Ravenholt (USA) and Merdad Nasari (European Bank for Reconstruction and Development, UK).

Survey Regions

The following areas were surveyed during the times indicated:

- (1) Bolshoy Sayan Ridge. The entire northern slope to west of Munku-Sardyk Peak (3492 m), western and eastern slopes from Mongolia to the basin of the Sentsa River (June and July 1991). The area of territory surveyed totaled almost 1,400 km²;
- (2) Mountain junction of Munku-Sardyk. From the northern side some 125 km² was surveyed in June 1991, April 1993, and May and August 1995), while from the southern or Mongolian side approximately 165 km² was checked in July 1995;
- (3) Okinskiy and Kropotkinskiy Ridges. The Khara-Nur Lake basin, Zhombolok River (above Sharza village) and Sentsa River (including its tributaries of Dunda-Gol, Barun-Khadarus and Zun-Khadarus) were

surveyed in July 1991 and April to May, 1995). The area of surveyed territory was about 1,100 km²;

(4) Tunkinskiy Ridge: The central portion of Mogulen-Gol, Ula-Gol, Khubuty, Ikhe-Ger, and the Shumak River basins were surveyed in May - June, 1995 (area totaled about 300 km²);

Western Hovsogol

(5) Bayan-Ula Mountains: Surveys were conducted in the Tsagan-Sala-Gol, Khongor-Bosh, and Ikh-Khoro-Gol River basins in July, 1995, an area of about 400 km².

Results

The following paragraphs describe the author's observations as well as the secondary information collected during this project.

(1) The Bolshoi Sayanskiy Ridge Area

In the month of field work, not a single set of snow leopard tracks was observed, although ground visits were made through ten passes of spurs and main watersheds of the ridges, and the length of transects conducted exceeded 350 km. However, according to the secondary evidence received by the author from various sources, snow leopard tracks were observed during the 1950's and 1960's in the interbasin areas of Tissa and Dibi Rivers, and during the summer of 1989 in Zabit River area. In addition, snow leopards were reportedly sighted during the 1960's in Shutkhulai River, in September, 1979 and the winter of 1990-91 along Sarkhoi River, in the upper reaches of the Tissa River during the 1980's and in the Sagan-Gol River during the summer of 1994. Most estimates roughly placed irbis density at 0.3 to 0.4 individuals per 100 km².

Mountain goats or ibex (*Capra [ibex] sibirica*) are encountered along all of the high mountain ridges, but group size was not large as a rule, varying from three to 15 individuals. Larger herds were observed in the Sarkhoe River basin. In terms of other ungulate species, the most widespread species were red deer (*Cervus elaphus*), musk deer (*Moschus moschiferus*), moose (*Alces alces*), and reindeer (*Rangifer tarandus*).

(2) Mountain Junction of Munku-Sardyk Peak

Northern Slopes- Buryatia: Although Munku-Sardyk is located in the Bolshoi Sayan Range, it stands separately in-so-far as the surveying may have been more complete than in other regions investigated. Moreover, it is the most reliable ecological corridor which connects with the Eastern Sayan and Western Hovsogol.

In May of 1995 only one track of snow leopard was noted by the author along the upper reaches of the Beliy Irkut River. Munku Sardyk is a unique place in Eastern Sayan, where in addition to tracks, there are places where marking such as scrapes and scat were observed. Such

markings were found in spurs along the main ridges of the upper reaches of Muguvek and Belyi Irkut Rivers, and Munku Sardyk Peak, near the lake below the glacier (Figure 2). Seven scrapes and four scats were observed.

According to secondary evidence collected from a tourist group, the tracks of irbis were observed once in April 1993, three times in May in 1994, and twice in May 1995. According to local people questioned in the village of Mondy (the nearest population point to Munku-Sardyk, located 22 km. from the mouth of the Belyi Irkut River), no one had ever seen a snow leopard in the region, although hunters travel around here annually. The one exception was reported by Zabanov Bimba, a local hunter; his father told him that Zabanov's grandfather (who also was a hunter) remembered that back in the last century, more than 100 years ago, a snow leopard was seen around Munku-Sardyk.

Mountain goats are found around Munku-Sardyk regularly, but their population is irregularly distributed. Around Muguvek and the upper reaches of the Belyi Irkut River, we counted not less than 60 animals. Groups numbered from five to 24 individuals. In terms of other ungulates, the most frequently noted were red deer and musk deer. The density of snow leopard, by a very rough estimate, is placed at 0.7-0.8 individuals per 100 km².

Southern slopes on the Mongolian side: No confirmed snow leopard sign was found on the southern slopes of Munku-Sardyk and nearby areas, although I searched in great detail several side spurs and sections of the main divide along the Bolshoi Sayan Ridge up to 20 kilometers to the west of the massif (and up to elevations of 3,284 m.) A search of the eastern end and upper reaches of the Bayan-Gol River was not possible. But in my opinion, this region could provide more fruitful results: according to contacts with local shepherds, Bayan-Gol is the last remaining mountain core area for the tarbagan (*Marmota bobac mongolica*) in northern Hovsogol, and it is therefore not impossible that this region offers potential snow leopard habitat, with the predator coming to hunt from the Buryat side. Irbis tracks were noted here twice by local people. Both cases occurred exactly at the divide along the eastern side of Munku Sardyk Peak where it leads to the Bayan-Gol River.

According to local accounts, mountain goats also are found in the Bayan-Gol River area, but their groups are split up even to a greater degree than on the northern side. Areas surveyed to the west did not reveal any goats, and their tracks were only found rarely. In terms of other ungulates, the more common species are the Siberian stag (*Cervus elaphus*) and musk deer.

(3) Okinskiy and Kropotkinskiy Mountains

During the month we surveyed this area, we observed tracks of snow leopard seven times. Five or six of these cases seemed to be several animals, including one by an animal less than a year old. Three sets of tracks (one from a solitary animal and one in which two animals were traveling together) were found along the upper reaches of the Bursagai Creek, in the alpine belt above the treeline, below the pass leading from the Zhombolok River basin to the Khoito-Okki River basin. The track of the solitary animal was made done by an adult male, and it was

fresh. Along a two-kilometer length, the predator had been moving in short hops, leaning mainly on its two front and one back paws, creating a "three-pawed" track pattern. It was apparently holding up its right back paw for its imprints in the snow were very slight. Prints showed that the cat was missing two inside "fingers" on the paw section.

Tracks of two cats were old. Judging by the imprint size, they had been made by a female with a cub from the previous year. The animals arrived at Bursagai through the pass from Khoito-Oki. The whole track from the pass to the border of the forest and lower areas along Bursagai Creek was made in a straight line, with the animals moving along the river terrace. The overall length of their transect was at least 3 kilometers. In addition two sets of tracks of solitary animals were laid out along the foothills by the Zhombolok River in the forest belt, two kilometers to the west of Lake Bursagai-Nur. Apparently, these may have been made by a single individual. The fresher set of tracks climbed up three kilometers along the foothills and river course. The older set of tracks went in the opposite direction.

Fresh tracks were also found in the forest part of the Kropotkin and Peretolchin Volcano valley. We followed them for 2 km. At that distance from the river mouth, the animal crossed the valley from the right slope side and climbed down to the Zhombolok River. Further, its tracks led toward Lake Khara-Nur.

The last set of tracks, also fresh, was found at Khiorog Creek below the pass joining Zhombolok and Sentsa River basins. We were able to follow the path of this animal, located in the forest belt, only 120-150 meters - because of a broken ski and deep snow it was not possible to go any further. According to this track, we understood that the animal had come down from the pass toward the direction of Zhombolok River. According to evidence from the hunter A. Podlosinskiy (pers.comm.), who worked along the Zhombolok River from 1975 to 1991, tracks of snow leopard were found here every winter, most often around the cabin to the west of Lake Bursagai-Nur where we had also seen two sets of snow leopard tracks.

In November or December of 1993 hunter B. Budaev (pers.comm.) also hunting in Zhombolok, unexpectedly found irbis tracks higher than the Khakta Creek mouth. The irbis had come from the volcano valley (where we also had found tracks). Its track along the Zhombolok in very crumbly snow had left a large trench. The irbis moved 2.5 km in this type of snow to the point where there were ski tracks of the hunter. The cat then walked within the ski track and after 1.5 km encountered a dead musk deer who also had been following the ski marks and been caught in the hunter's snare. The deer had been torn from the tree together with the snare line and carried up the slope 500 meters from the valley after which it was eaten (this all took place within the forested zone). The only part that remained of the deer were the skin, intestines and the musk sac.

In October of 1994, on the pass from Bursagai Creek to Khoito-Oka River (where we later conducted a survey), dogs belonging to hunter B. Galsanov (pers.comm.) picked up scent and surprised a snow leopard on the slopes above. It was a large animal. The hunter, never having seen a snow leopard, took the fleeing animal to be a tiger (*Panthera tigris*). Later, in November, a reporter for the newspaper Buryatia

Pravda, K.D. Tuluyev, wrote "An Amur Tiger Appeared in Buryatia!" (pers.comm.). Galsanov, seeing our photograph of a snow leopard, then agreed that the "tiger" had indeed been an irbis. The mas its long tail.

Earlier in 1975 in Zhombolok and the surrounding areas there were also well known cases of encounters with snow leopards. (Figure 1). These dated from the 1950's and 1960's up to the 1980's (correspondence with K.D. Tuluyev in 1991, Medvedev 1990, Medvedev and Ayupov 1993). Of these, the most interesting were those cases of irbis encounters in Irkutsk Oblast, at the very edge of the species' range. They were located along the upper reaches of the Barbitai River (53ø15'N, 99ø20'E) and Zima Belaya River (53ø15'N 100ø25'E) and showed, that in Eastern Sayan, the animal is capable of inhabiting territory much more widely than was accepted earlier. Before this evidence about the Zhombolok group and knowledge of local conditions in this, the furthest point of its range, encounters with irbis were questionable, but now they do not appear arguable. The points where snow leopard sign were found in Barbitai and Zima Belaya are located 100-130 km from Zhombolok and therefore may be the first evidence of the contemporary northernmost limit of the species range.

Approximately at the same distance from Zhombolok, there is another point, Shele Ridge, where according to unverified reports, irbis have been encountered (pers.comm. with A. Timoshenko). The ridge is bordered by the Kropotkinskiy Mountains, and forms a junction together with the Shitskiy Ridge and the Belskiy alpine area.

A count of mountain goats in Okinskiy and Kropotkinskiy Mountains was not possible due to deep snow along the slopes and the high possibility of avalanches. Off to a distance, we saw only small groups of up to three individuals. According to secondary sources, herds are seen up to 30- 40 head in size. Mountain goats are widely distributed. Among other ungulates, red deer are common, along with roe deer (*Capreolus capreolus*), musk deer, reindeer and moose. The density of snow leopard in this area may be 0.7 - 0.8 per 100 km² at this first estimate.

(4) Tunkinskiy Mountains

We found three separate tracks of snow leopard in the central portion of the Tunkinskiy Mountains. One, along the upper reaches of the Ikheger River near the upper border of the tree line; the other at Shumakskiy Pass (2,760 m, Figure 3), and the third at the upper tree line along the Shumak River. The last two sets of tracks led toward each other, but were differentiated by the time they were made and their size. It is most probable that the three tracks were made by different animals.

According to secondary evidence, tracks of snow leopard were found in this region in 1981 (pers.comm. with D.G. Medvedev), and again in 1991 and 1992 (personal correspondence with B. Shakhdurov, exact date unclear). It is interesting that Medvedev, having found the tracks, doubted that they were made by irbis. But he saved a slide of a paw print in the snow, and this showed me that it was indeed made by a snow leopard.

In 1994 the hunter Shakhdurov killed a grown female and male below the Altan-Mundarga Peak (3,157 m), some 30 km. to the west of Shumakskiy Pass. There were two cubs with the adults, but after the death of the parents, they undoubtedly also perished. Their age was estimated at about 3-4 months and they were too young to survive on their own.

Yet another female with two cubs was seen in 1994 along the upper reaches of the Ikhe-Ger River, according to an account given to Medvedev by a shepherd. In the same year a solitary adult snow leopard was observed according to information given to the author of this article.

From material gathered in neighboring regions, it is known that the irbis has been encountered below Ulan-Ospin-Sardak Peak (3,215 m) on Kitoiskiy Ridge (Medvedev 1990), and not far from Ilchir Lake (secondary evidence of author), which lies between the Kitoiskiy and Tunkinskiy Mountains (Figure 1). At the present time, the central portion of the Tunkins distribution for this section of the snow leopard's range. It is located 120 kilometers from the southern edge of Baikal Lake and 150 km from the city of Irkutsk. This is the upper reaches of the Shumak River (51° 55' N, 101° 55' E), where the tracks of the animal were found in May of 1995.

Mountain goats in the Tunkinskiy alpine areas are the most numerous in the region that I surveyed. We observed them everyday of our field work, and group size was up to 20 individuals. According to secondary sources, herds are seen with a 100 or more head. In terms of other ungulates, the most common are red deer, musk deer and moose. The density of snow leopard is estimated at 0.6-0.7 individuals per 100 km².

(5) Western Hovsogol

The northwestern corner was surveyed around the Bayan-Ula Mountains. Tracks of snow leopard as well as their scrapes and scat were found exclusively along the main divide, including the slope of Lambishteg-Ula at 3,130 m (other names of this mountain are Tsumerleg-Ula and Enkishig-Ula), the highest point in western Hovsogol. In a two-kilometer section of the crest there were six spots that had been marked by the snow leopard with scrapes and scat (scrapes 9; scats 3; Figure 4). The northern section of the ridge where the last marks were found appears to be the divide between the basin of the Khongor-Bosh River (from the Hovsogol side) and the Dzharain-Gol River (from the Darkhatskaya Basin). It is about 60 km from Munku-Sardyk Peak.

Mountain goats were not sighted, only their tracks. The population is apparently strongly split up. The estimate of 750 head for this area is doubtful (Bazardorzh 1986), in-so-far as the author did not describe by what method he arrived at this number. Siberian stag and musk deer are also distributed here. The density of snow leopard is roughly estimated 0.3 - 0.5 animals per 100 km².

Discussion and Conclusion

Despite general shortcomings of available information regarding the distribution of irbis in Eastern Sayan and western Hovsogol regions, there appears to be some patterns in the distribution of irbis. First,

irbis records create notable clusters on the map, suggesting definitive territorial selection by the animal and at least two core areas seem to exist: Zhombolok and Tunkinskiy (Figure 1). The Munku-Sardyk Massif and Bayan-Ula Mountains are probably not separate, independent core distribution zones, but rather part of the Tunkinskiy area. The orography of the region and collected material also supports such a conclusion. Information from other regions indicating snow leopard encounters consist of single sightings only and require some confirmation that snow leopards are resident there (Figure 1).

The sub-population group inhabiting Okinskiy, Kropotkinskiy and Tunkinskiy Mountains have the apparent characteristics of a well-established, permanent population: the fact that animals here have been sighted over long time periods and different seasons, the presence of breeding pairs and young, and that these predators know the territory well, especially places where prey is concentrated (mountain goats) and mountain passes where they frequently travel. The discovery of an established group here in Eastern Sayan is thus a new idea, since earlier information was not available and thus scholars assumed there was no permanent population in the region (Geptner and Sludskiy 1972, Sludskiy 1973, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990, Medvedev and Ayupov 1993).

Evidence to support snow leopard distribution in Northwestern Hovsogol is also new. The fact that the species inhabits this region has not been confirmed either by previous researchers or local people whom we interviewed.

Spatial links between irbis sub-populations are not known, but encounters in the field may help establish the most likely routes of population exchange. These routes are laid out in two giant arches along the main ridges, forming a letter "X", and crossing at Topografii Peak (3,044 m, Figure 1). The eastern arch is formed by the Shele Mountains, Kropotkinskiy, Okinskiy, Bolshoi Sayan, and the Tunkinskiy Mountain, and on the west by the Udinskiy, Bolshoi Sayan, and Akademika Obrucheva Mountains. The large land area within both arches supports the disassociation of the groups more than their integration, especially in the west from the Tunkinskiy Basin side. From the east, the mountainous territory is higher, and here encounters with snow leopard are noted more often (Figure 1). The question of exchange between snow leopard populations between Eastern Sayan and Western Hovsogol is still open. I have no doubt that irbis is capable of traversing widely divided sites, but the level of density within the range along the border zone of the region is very low and does not exceed 0.3 to 0.5 individuals per 100 km², thus indicating a decline in migratory impulses, rather than activation.

The impression remains that Western Hovsogol is one of the most unfavorable habitats for irbis along the northeastern edge of its range. High levels of moisture around Lake Hovsogol and the wetlands of Darkhatskaya Basin, the meridian direction of the ridges (north-south), thus opening them to moisture-laden winds, and their isolated position, have allowed the growth of a population apparently neither in the past nor in the present, and therefore the density of irbis is among the lowest in the entire region.

Encounters with the snow leopards around Munku-Sardyk (Figure 1) supports the ability of animals to cross to the Mongolian or Russian

sides, but is hardly evidence of a large exchange route between the Eastern Sayan and Western Hovsogol populations. Inter-population exchange here, if it exists, must be very weak. Here the northern slopes of the Bolshoi Sayan Range, extending for almost 100 km provide only mild relief and very humid habitat, not apparently favorable to the snow leopard. Even we could not confirm snow leopard presence here during our 1991 and 1995 expeditions. In addition, domestic cattle are widespread in the area.

Along the southern slope of the Bolshoi Sayan, there is a high probability that snow leopards cross over between Munku-Sardyk and Lambishteg-Ula, but the possibility of them permanently populating the territory seems limited. There are very deep talus slopes on the mountains here, good pastures do not exist, and tracks of mountain goats are encountered even more rarely than in the north. Furthermore, Munku-Sardyk and Beliy Irkut River basin form the nearest "ecological corridor" to western Hovsogol, connecting it with the Tunkinskiy Range. However, the corridor is separated from western Hovsogol by a distance of almost 60 km, in which snow leopard and its tracks have yet to be sighted.

In all probability, an isolating barrier surrounds the Hovsogol population, even from the south (Khangay side) where snow leopard density is also low (Bannikov 1954, Mallon 1984). Thus, the Western Hovsogol area has all the characteristics of a disappearing core area. Therefore, it could not be possible for the northern Mongolian group to be the main source of snow leopards migrating into the territory of Tuva and Eastern Sayan, a proposition noted by some but not supported by fact (Geptner and Sludskiy 1972, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990). Judging by density indicators, the Hovsogol area can barely maintain itself, or perhaps only exists in concert with the Tunkinskiy core area.

The general picture reveals the surprising fact that the snow leopard inhabits the Zhombolok area. The landscape here gives the appearance of being unfavorable. Zhombolok is typical habitat for reindeer, but not for snow leopard. There more like the mountains of the Polyarniy Urals than Central Asian mountains, and the snow is as deep here as Khamar-Daban, one of the most snow-bound ranges in southern Siberia. Despite this, snow leopards are common in Zhombolok (Figure 3). Zhombolok presents an interesting example of an "inversion" range, in which the northernmost group fares better than the southern (Western Hovsogol). The reason for this requires further investigation, and further exploration is also needed to explain snow leopard presence in Kuznetskiy Alatau in western Siberia (Zavatskiy 1992), where the general situation (due to snow cover and other conditions) are not less unusual than in Zhombolok.

Munku-Sardyk and the western part of the Tunkinskiy Mountains are most similar to the typical Central Asian-style landscape. Indeed, not one other part of Eastern Sayan and western Hovsogol are as close in appearance to the mountains of Central Asia as these two areas. It may not be accidental that these places also have the least amount of snow and the highest numbers of mountain goats along Tunkinskiy Range. Another interesting geographic feature is the coincidence of snow leopard distribution centers with the regions of highest ancient glaciation. It is well known, for example, that during the Pleistocene period, glaciers along the Zhombolok River, in Irkut (Munku-Sardyk

region), and along the Ikhe-Ukhgun River (western half of Tunkinskiy Mountains) reached or even exceeded the size of the contemporary glaciers of Inylchek in the Tien Shan range and Fedchenko in the Pamirs (Maksimov 1965 and 1973, Olyunin 1965).

The picture of ancient glaciation in western Hovsogol (Kulakov 1981) also coincides with areas of snow leopard migration and distribution. Thus, it is possible to conclude that modern groups of snow leopard along the northern edge of its range are relict remains of a more widespread ancient population, that inhabited a much larger area than at present. On the whole, the distribution of irbis in the Eastern Sayan and western Hovsogol areas shows that even today the population is viable, and inhabits the same territory within its range as reported almost 200 years ago by Pallas (1811, cited in Geptner and Sludskiy 1972). This fact supports the idea that snow leopard have always lived here, and have not disappeared from anywhere within the region. The rarity of the predator or the opinion that it was completely absent in southern Siberia (compare Geptner and Sludskiy 1972, Zavatskiy 1988 and 1992, Medvedev 1990, Smirnov et al. 1990, and others) probably results from an absence of information. If one concludes that the snow leopard did not exist in many of these regions earlier, it is then difficult to explain its unexpected appearance in recent years (Smirnov et al. 1990). The Southern Siberia and Mongolian regions do not contain nearby source areas from which a sharp rise in numbers of the species could originate, particularly in this marginal portion of the snow leopard's range.

It is a striking characteristic of snow leopard behavior that it can maintain a population even under conditions of low density: one can look at this factor as one of the most important adaptations of the species. Despite highly broken up groups, location of various "cores" and their spatial separation, sub-populations continue to exist as "links in one chain." The largest distance separating places where snow leopard sign exists is about 150 km. This measurement is not larger than the longest known snow leopard transect within its range (Geptner and Sludskiy 1972, Matyushkin 1981, Koshkarev 1990) and provides hope that existing population centers are not completely isolated.

There is no doubt that in present day, one of the greatest problems is preserving snow leopard populations in regions of ecological marginality. However, before solving this problem, we need to know where the animal is located and in what numbers. Eastern Sayan and western Hovsogol are only a small portion of the range, but even here our painting of the snow leopard remains, as in the past, just a few strokes, barely touched by the hand of the researcher.

Has the Snow Leopard Disappeared
from Eastern Sayan and Western Hovsogol?

Dr. Eugene Koshkarev

Introduction

Little information has been added since the time of Pallas (1811) and Radde (1862) on the distribution of snow leopard or irbis in the Eastern Sayan and Western Hovsogol areas, although almost two-hundred

years has passed (Potanin 1883, Dubrov 1884, Dorogostaiskiy, 1916, Formozov 1929, Bannikov 1954, Geptner and Sludskiy 1972, Sokolov and Orlov 1980, among others). To this day the limits of snow leopard distribution or inhabited areas is not known. For example, the general impression appears to be that the irbis has disappeared from the major part of its range in Eastern Sayan, particularly from the Tunkinskiy and Kitoiskiy Mountains and associated alpine zones above the treeline (Geptner and Sludskiy 1972; Shvetsov et al. 1984, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990), that it is very rare here (Bannikov 1954, Mallon 1984), or that it is completely absent from western Hovsogol (Sukhbat and Bazardorzh 1980, Litvinov 1983, Bazardorzh 1986, Amarsanaa 1992, Litvinov and Bazardorzh 1992). On the other hand, Hovsogol holds the most reliable core area from which the animal could spread out to the territory of Eastern Sayan and Tuva (Geptner and Sludskiy 1972, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990).

These contradictions in the published data provide evidence of the lack of a special study of irbis along the northeastern limits of its range to date. Eastern Sayan in Siberia and western Hovsogol in Mongolia remains, as in times past, the biggest "blank spot" on the distributional map of the species; published materials create many more questions than answers (Mallon 1984, Fox 1994, Schaller et al. 1994, Tserendeleg 1994).

Data for this paper was obtained during field trips conducted in 1991, 1993, and 1995 in the Eastern Sayan and western Hovsogol areas. Expeditions in 1995 were conducted with financial and equipment support from the International Snow Leopard Trust (USA), Bonnie and Dick Robbins (Robbins Company, USA), Kathleen Braden (Seattle Pacific University USA), Frith Maier (REI, USA), Al Ravenholt (USA) and Merdad Nasari (European Bank for Reconstruction and Development, UK).

Survey Regions

The following areas were surveyed during the times indicated:

- (1) Bolshoy Sayan Ridge. The entire northern slope to west of Munku-Sardyk Peak (3492 m), western and eastern slopes from Mongolia to the basin of the Sentsa River (June and July 1991). The area of territory surveyed totaled almost 1,400 km²;
- (2) Mountain junction of Munku-Sardyk. From the northern side some 125 km² was surveyed in June 1991, April 1993, and May and August 1995), while from the southern or Mongolian side approximately 165 km² was checked in July 1995;
- (3) Okinskiy and Kropotkinskiy Ridges. The Khara-Nur Lake basin, Zhombolok River (above Sharza village) and Sentsa River (including its tributaries of Dunda-Gol, Barun-Khadarus and Zun-Khadarus) were surveyed in July 1991 and April to May, 1995). The area of surveyed territory was about 1,100 km²;
- (4) Tunkinskiy Ridge: The central portion of Mogulen-Gol, Ula-Gol, Khubuty, Ikhe-Ger, and the Shumak River basins were surveyed in May - June, 1995 (area totaled about 300 km²);

Western Hovsogol

(5) Bayan-Ula Mountains: Surveys were conducted in the Tsagan-Sala-Gol, Khongor-Bosh, and Ikh-Khoro-Gol River basins in July, 1995, an area of about 400 km².

Results

The following paragraphs describe the author's observations as well as the secondary information collected during this project.

(1) The Bolshoi Sayanskiy Ridge Area

In the month of field work, not a single set of snow leopard tracks was observed, although ground visits were made through ten passes of spurs and main watersheds of the ridges, and the length of transects conducted exceeded 350 km. However, according to the secondary evidence received by the author from various sources, snow leopard tracks were observed during the 1950's and 1960's in the interbasin areas of Tissa and Dibi Rivers, and during the summer of 1989 in Zabit River area. In addition, snow leopards were reportedly sighted during the 1960's in Shutkhulai River, in September, 1979 and the winter of 1990-91 along Sarkhoi River, in the upper reaches of the Tissa River during the 1980's and in the Sagan-Gol River during the summer of 1994. Most estimates roughly placed irbis density at 0.3 to 0.4 individuals per 100 km².

Mountain goats or ibex (*Capra [ibex] sibirica*) are encountered along all of the high mountain ridges, but group size was not large as a rule, varying from three to 15 individuals. Larger herds were observed in the Sarkhoe River basin. In terms of other ungulate species, the most widespread species were red deer (*Cervus elaphus*), musk deer (*Moschus moschiferus*), moose (*Alces alces*), and reindeer (*Rangifer tarandus*).

(2) Mountain Junction of Munku-Sardyk Peak

Northern Slopes- Buryatia: Although Munku-Sardyk is located in the Bolshoi Sayan Range, it stands separately in-so-far as the surveying may have been more complete than in other regions investigated. Moreover, it is the most reliable ecological corridor which connects with the Eastern Sayan and Western Hovsogol.

In May of 1995 only one track of snow leopard was noted by the author along the upper reaches of the Belyi Irkut River. Munku Sardyk is a unique place in Eastern Sayan, where in addition to tracks, there are places where marking such as scrapes and scat were observed. Such markings were found in spurs along the main ridges of the upper reaches of Muguvek and Belyi Irkut Rivers, and Munku Sardyk Peak, near the lake below the glacier (Figure 2). Seven scrapes and four scats were observed.

According to secondary evidence collected from a tourist group, the tracks of irbis were observed once in April 1993, three times in May in

1994, and twice in May 1995. According to local people questioned in the village of Mondy (the nearest population point to Munku-Sardyk, located 22 km. from the mouth of the Belyi Irkut River), no one had ever seen a snow leopard in the region, although hunters travel around here annually. The one exception was reported by Zabanov Bimba, a local hunter; his father told him that Zabanov's grandfather (who also was a hunter) remembered that back in the last century, more than 100 years ago, a snow leopard was seen around Munku-Sardyk.

Mountain goats are found around Munku-Sardyk regularly, but their population is irregularly distributed. Around Muguvek and the upper reaches of the Belyi Irkut River, we counted not less than 60 animals. Groups numbered from five to 24 individuals. In terms of other ungulates, the most frequently noted were red deer and musk deer. The density of snow leopard, by a very rough estimate, is placed at 0.7-0.8 individuals per 100 km².

Southern slopes on the Mongolian side: No confirmed snow leopard sign was found on the southern slopes of Munku-Sardyk and nearby areas, although I searched in great detail several side spurs and sections of the main divide along the Bolshoi Sayan Ridge up to 20 kilometers to the west of the massif (and up to elevations of 3,284 m.) A search of the eastern end and upper reaches of the Bayan-Gol River was not possible. But in my opinion, this region could provide more fruitful results: according to contacts with local shepherds, Bayan-Gol is the last remaining mountain core area for the tarbagan (*Marmota bobac mongolica*) in northern Hovsogol, and it is therefore not impossible that this region offers potential snow leopard habitat, with the predator coming to hunt from the Buryat side. Irbis tracks were noted here twice by local people. Both cases occurred exactly at the divide along the eastern side of Munku Sardyk Peak where it leads to the Bayan-Gol River.

According to local accounts, mountain goats also are found in the Bayan-Gol River area, but their groups are split up even to a greater degree than on the northern side. Areas surveyed to the west did not reveal any goats, and their tracks were only found rarely. In terms of other ungulates, the more common species are the Siberian stag (*Cervus elaphus*) and musk deer.

(3) Okinskiy and Kropotkinskiy Mountains

During the month we surveyed this area, we observed tracks of snow leopard seven times. Five or six of these cases seemed to be several animals, including one by an animal less than a year old. Three sets of tracks (one from a solitary animal and one in which two animals were traveling together) were found along the upper reaches of the Bursagai Creek, in the alpine belt above the treeline, below the pass leading from the Zhombolok River basin to the Khoito-Okki River basin. The track of the solitary animal was made done by an adult male, and it was fresh. Along a two-kilometer length, the predator had been moving in short hops, leaning mainly on its two front and one back paws, creating a "three-pawed" track pattern. It was apparently holding up its right back paw for its imprints in the snow were very slight. Prints showed that the cat was missing two inside "fingers" on the paw section.

Tracks of two cats were old. Judging by the imprint size, they had been made by a female with a cub from the previous year. The animals arrived at Bursagai through the pass from Khoito-Oki. The whole track from the pass to the border of the forest and lower areas along Bursagai Creek was made in a straight line, with the animals moving along the river terrace. The overall length of their transect was at least 3 kilometers. In addition two sets of tracks of solitary animals were laid out along the foothills by the Zhombolok River in the forest belt, two kilometers to the west of Lake Bursagai-Nur. Apparently, these may have been made by a single individual. The fresher set of tracks climbed up three kilometers along the foothills and river course. The older set of tracks went in the opposite direction.

Fresh tracks were also found in the forest part of the Kropotkin and Peretolchin Volcano valley. We followed them for 2 km. At that distance from the river mouth, the animal crossed the valley from the right slope side and climbed down to the Zhombolok River. Further, its tracks led toward Lake Khara-Nur.

The last set of tracks, also fresh, was found at Khiorog Creek below the pass joining Zhombolok and Sentsa River basins. We were able to follow the path of this animal, located in the forest belt, only 120-150 meters - because of a broken ski and deep snow it was not possible to go any further. According to this track, we understood that the animal had come down from the pass toward the direction of Zhombolok River. According to evidence from the hunter A. Podlosinskiy (pers.comm.), who worked along the Zhombolok River from 1975 to 1991, tracks of snow leopard were found here every winter, most often around the cabin to the west of Lake Bursagai-Nur where we had also seen two sets of snow leopard tracks.

In November or December of 1993 hunter B. Budaev (pers.comm.) also hunting in Zhombolok, unexpectedly found irbis tracks higher than the Khakta Creek mouth. The irbis had come from the volcano valley (where we also had found tracks). Its track along the Zhombolok in very crumbly snow had left a large trench. The irbis moved 2.5 km in this type of snow to the point where there were ski tracks of the hunter. The cat then walked within the ski track and after 1.5 km encountered a dead musk deer who also had been following the ski marks and been caught in the hunter's snare. The deer had been torn from the tree together with the snare line and carried up the slope 500 meters from the valley after which it was eaten (this all took place within the forested zone). The only part that remained of the deer were the skin, intestines and the musk sac.

In October of 1994, on the pass from Bursagai Creek to Khoito-Oka River (where we later conducted a survey), dogs belonging to hunter B. Galsanov (pers.comm.) picked up scent and surprised a snow leopard on the slopes above. It was a large animal. The hunter, never having seen a snow leopard, took the fleeing animal to be a tiger (*Panthera tigris*). Later, in November, a reporter for the newspaper Buryatia Pravda, K.D. Tuluyev, wrote "An Amur Tiger Appeared in Buryatia!" (pers.comm.). Galsanov, seeing our photograph of a snow leopard, then agreed that the "tiger" had indeed been an irbis. The mas its long tail.

Earlier in 1975 in Zhombolok and the surrounding areas there were also well known cases of encounters with snow leopards. (Figure 1). These dated from the 1950's and 1960's up to the 1980's (correspondence with K.D. Tuluyev in 1991, Medvedev 1990, Medvedev and Ayupov 1993). Of these, the most interesting were those cases of irbis encounters in Irkutsk Oblast, at the very edge of the species' range. They were located along the upper reaches of the Barbitai River (53°15'N, 99°20'E) and Zima Belaya River (53°15'N 100°25'E) and showed, that in Eastern Sayan, the animal is capable of inhabiting territory much more widely than was accepted earlier. Before this evidence about the Zhombolok group and knowledge of local conditions in this, the furthest point of its range, encounters with irbis were questionable, but now they do not appear arguable. The points where snow leopard sign were found in Barbitai and Zima Belaya are located 100-130 km from Zhombolok and therefore may be the first evidence of the contemporary northernmost limit of the species range.

Approximately at the same distance from Zhombolok, there is another point, Shele Ridge, where according to unverified reports, irbis have been encountered (pers.comm. with A. Timoshenko). The ridge is bordered by the Kropotkinskiy Mountains, and forms a junction together with the Shitskiy Ridge and the Belskiy alpine area.

A count of mountain goats in Okinskiy and Kropotkinskiy Mountains was not possible due to deep snow along the slopes and the high possibility of avalanches. Off to a distance, we saw only small groups of up to three individuals. According to secondary sources, herds are seen up to 30- 40 head in size. Mountain goats are widely distributed. Among other ungulates, red deer are common, along with roe deer (*Capreolus capreolus*), musk deer, reindeer and moose. The density of snow leopard in this area may be 0.7 - 0.8 per 100 km² at this first estimate.

(4) Tunkinskiy Mountains

We found three separate tracks of snow leopard in the central portion of the Tunkinskiy Mountains. One, along the upper reaches of the Ikhe-Ger River near the upper border of the tree line; the other at Shumakskiy Pass (2,760 m, Figure 3), and the third at the upper tree line along the Shumak River. The last two sets of tracks led toward each other, but were differentiated by the time they were made and their size. It is most probable that the three tracks were made by different animals.

According to secondary evidence, tracks of snow leopard were found in this region in 1981 (pers.comm. with D.G. Medvedev), and again in 1991 and 1992 (personal correspondence with B. Shakhdurov, exact date unclear). It is interesting that Medvedev, having found the tracks, doubted that they were made by irbis. But he saved a slide of a paw print in the snow, and this showed me that it was indeed made by a snow leopard.

In 1994 the hunter Shakhdurov killed a grown female and male below the Altan-Mundarga Peak (3,157 m), some 30 km. to the west of Shumakskiy Pass. There were two cubs with the adults, but after the death of the parents, they undoubtedly also perished. Their age was estimated at about 3-4 months and they were too young to survive on their own.

Yet another female with two cubs was seen in 1994 along the upper reaches of the Ikhe-Ger River, according to an account given to Medvedev by a shepherd. In the same year a solitary adult snow leopard was observed according to information given to the author of this article.

From material gathered in neighboring regions, it is known that the irbis has been encountered below Ulan-Ospin-Sardak Peak (3,215 m) on Kitoiskiy Ridge (Medvedev 1990), and not far from Ilchir Lake (secondary evidence of author), which lies between the Kitoiskiy and Tunkinskiy Mountains (Figure 1). At the present time, the central portion of the Tunkins distribution for this section of the snow leopard's range. It is located 120 kilometers from the southern edge of Baikal Lake and 150 km from the city of Irkutsk. This is the upper reaches of the Shumak River (51° 55' N, 101° 55' E), where the tracks of the animal were found in May of 1995.

Mountain goats in the Tunkinskiy alpine areas are the most numerous in the region that I surveyed. We observed them everyday of our field work, and group size was up to 20 individuals. According to secondary sources, herds are seen with a 100 or more head. In terms of other ungulates, the most common are red deer, musk deer and moose. The density of snow leopard is estimated at 0.6-0.7 individuals per 100 km².

(5) Western Hovsogol

The northwestern corner was surveyed around the Bayan-Ula Mountains. Tracks of snow leopard as well as their scrapes and scat were found exclusively along the main divide, including the slope of Lambishteg-Ula at 3,130 m (other names of this mountain are Tsumerleg-Ula and Enkhishig-Ula), the highest point in western Hovsogol. In a two-kilometer section of the crest there were six spots that had been marked by the snow leopard with scrapes and scat (scrapes 9; scats 3; Figure 4). The northern section of the ridge where the last marks were found appears to be the divide between the basin of the Khongor-Bosh River (from the Hovsogol side) and the Dzharain-Gol River (from the Darkhatskaya Basin). It is about 60 km from Munku-Sardyk Peak.

Mountain goats were not sighted, only their tracks. The population is apparently strongly split up. The estimate of 750 head for this area is doubtful (Bazardorzh 1986), in-so-far as the author did not describe by what method he arrived at this number. Siberian stag and musk deer are also distributed here. The density of snow leopard is roughly estimated 0.3 - 0.5 animals per 100 km².

Discussion and Conclusion

Despite general shortcomings of available information regarding the distribution of irbis in Eastern Sayan and western Hovsogol regions, there appears to be some patterns in the distribution of irbis. First, irbis records create notable clusters on the map, suggesting definitive territorial selection by the animal and at least two core areas seem to exist: Zhombolok and Tunkinskiy (Figure 1). The Munku-Sardyk Massif and Bayan-Ula Mountains are probably not separate, independent core distribution zones, but rather part of the Tunkinskiy area. The orography of the region and collected material also supports such a

conclusion. Information from other regions indicating snow leopard encounters consist of single sightings only and require some confirmation that snow leopards are resident there (Figure 1).

The sub-population group inhabiting Okinskiy, Kropotkinskiy and Tunkinskiy Mountains have the apparent characteristics of a well-established, permanent population: the fact that animals here have been sighted over long time periods and different seasons, the presence of breeding pairs and young, and that these predators know the territory well, especially places where prey is concentrated (mountain goats) and mountain passes where they frequently travel. The discovery of an established group here in Eastern Sayan is thus a new idea, since earlier information was not available and thus scholars assumed there was no permanent population in the region (Geptner and Sludskiy 1972, Sludskiy 1973, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990, Medvedev and Ayupov 1993).

Evidence to support snow leopard distribution in Northwestern Hovsogol is also new. The fact that the species inhabits this region has not been confirmed either by previous researchers or local people whom we interviewed.

Spatial links between irbis sub-populations are not known, but encounters in the field may help establish the most likely routes of population exchange. These routes are laid out in two giant arches along the main ridges, forming a letter "X", and crossing at Topografii Peak (3,044 m, Figure 1). The eastern arch is formed by the Shele Mountains, Kropotkinskiy, Okinskiy, Bolshoi Sayan, and the Tunkinskiy Mountain, and on the west by the Udinskiy, Bolshoi Sayan, and Akademika Obrucheva Mountains. The large land area within both arches supports the disassociation of the groups more than their integration, especially in the west from the Tunkinskiy Basin side. From the east, the mountainous territory is higher, and here encounters with snow leopard are noted more often (Figure 1). The question of exchange between snow leopard populations between Eastern Sayan and Western Hovsogol is still open. I have no doubt that irbis is capable of traversing widely divided sites, but the level of density within the range along the border zone of the region is very low and does not exceed 0.3 to 0.5 individuals per 100 km², thus indicating a decline in migratory impulses, rather than activation.

The impression remains that Western Hovsogol is one of the most unfavorable habitats for irbis along the northeastern edge of its range. High levels of moisture around Lake Hovsogol and the wetlands of Darkhatskaya Basin, the meridian direction of the ridges (north-south), thus opening them to moisture-laden winds, and their isolated position, have allowed the growth of a population apparently neither in the past nor in the present, and therefore the density of irbis is among the lowest in the entire region.

Encounters with the snow leopards around Munku-Sardyk (Figure 1) supports the ability of animals to cross to the Mongolian or Russian sides, but is hardly evidence of a large exchange route between the Eastern Sayan and Western Hovsogol populations. Inter-population exchange here, if it exists, must be very weak. Here the northern slopes of the Bolshoi Sayan Range, extending for almost 100 km provide only mild relief and very humid habitat, not apparently favorable to the snow leopard. Even we could not confirm snow leopard presence here

during our 1991 and 1995 expeditions. In addition, domestic cattle are widespread in the area.

Along the southern slope of the Bolshoi Sayan, there is a high probability that snow leopards cross over between Munku-Sardyk and Lambishteg-Ula, but the possibility of them permanently populating the territory seems limited. There are very deep talus slopes on the mountains here, good pastures do not exist, and tracks of mountain goats are encountered even more rarely than in the north. Furthermore, Munku-Sardyk and Belyi Irkut River basin form the nearest "ecological corridor" to western Hovsogol, connecting it with the Tunkinskiy Range. However, the corridor is separated from western Hovsogol by a distance of almost 60 km, in which snow leopard and its tracks have yet to be sighted.

In all probability, an isolating barrier surrounds the Hovsogol population, even from the south (Khangay side) where snow leopard density is also low (Bannikov 1954, Mallon 1984). Thus, the Western Hovsogol area has all the characteristics of a disappearing core area. Therefore, it could not be possible for the northern Mongolian group to be the main source of snow leopards migrating into the territory of Tuva and Eastern Sayan, a proposition noted by some but not supported by fact (Geptner and Sludskiy 1972, Smirnov 1988, Medvedev 1990, Smirnov et al. 1990). Judging by density indicators, the Hovsogol area can barely maintain itself, or perhaps only exists in concert with the Tunkinskiy core area.

The general picture reveals the surprising fact that the snow leopard inhabits the Zhombolok area. The landscape here gives the appearance of being unfavorable. Zhombolok is typical habitat for reindeer, but not for snow leopard. There more like the mountains of the Polyarniy Urals than Central Asian mountains, and the snow is as deep here as Khamar-Daban, one of the most snow-bound ranges in southern Siberia. Despite this, snow leopards are common in Zhombolok (Figure 3). Zhombolok presents an interesting example of an "inversion" range, in which the northernmost group fares better than the southern (Western Hovsogol). The reason for this requires further investigation, and further exploration is also needed to explain snow leopard presence in Kuznetskiy Alatau in western Siberia (Zavatskiy 1992), where the general situation (due to snow cover and other conditions) are not less unusual than in Zhombolok.

Munku-Sardyk and the western part of the Tunkinskiy Mountains are most similar to the typical Central Asian-style landscape. Indeed, not one other part of Eastern Sayan and western Hovsogol are as close in appearance to the mountains of Central Asia as these two areas. It may not be accidental that these places also have the least amount of snow and the highest numbers of mountain goats along Tunkinskiy Range. Another interesting geographic feature is the coincidence of snow leopard distribution centers with the regions of highest ancient glaciation. It is well known, for example, that during the Pleistocene period, glaciers along the Zhombolok River, in Irkut (Munku-Sardyk region), and along the Ikhe-Ukhgun River (western half of Tunkinskiy Mountains) reached or even exceeded the size of the contemporary glaciers of Inylchek in the Tien Shan range and Fedchenko in the Pamirs (Maksimov 1965 and 1973, Olyunin 1965).

The picture of ancient glaciation in western Hovsogol (Kulakov 1981) also coincides with areas of snow leopard migration and distribution. Thus, it is possible to conclude that modern groups of snow leopard along the northern edge of its range are relict remains of a more widespread ancient population, that inhabited a much larger area than at present. On the whole, the distribution of irbis in the Eastern Sayan and western Hovsogol areas shows that even today the population is viable, and inhabits the same territory within its range as reported almost 200 years ago by Pallas (1811, cited in Geptner and Sludskiy 1972). This fact supports the idea that snow leopard have always lived here, and have not disappeared from anywhere within the region. The rarity of the predator or the opinion that it was completely absent in southern Siberia (compare Geptner and Sludskiy 1972, Zavatskiy 1988 and 1992, Medvedev 1990, Smirnov et al. 1990, and others) probably results from an absence of information. If one concludes that the snow leopard did not exist in many of these regions earlier, it is then difficult to explain its unexpected appearance in recent years (Smirnov et al. 1990). The Southern Siberia and Mongolian regions do not contain nearby source areas from which a sharp rise in numbers of the species could originate, particularly in this marginal portion of the snow leopard's range.

It is a striking characteristic of snow leopard behavior that it can maintain a population even under conditions of low density: one can look at this factor as one of the most important adaptations of the species. Despite highly broken up groups, location of various "cores" and their spatial separation, sub-populations continue to exist as "links in one chain." The largest distance separating places where snow leopard sign exists is about 150 km. This measurement is not larger than the longest known snow leopard transect within its range (Geptner and Sludskiy 1972, Matyushkin 1981, Koshkarev 1990) and provides hope that existing population centers are not completely isolated.

There is no doubt that in present day, one of the greatest problems is preserving snow leopard populations in regions of ecological marginality. However, before solving this problem, we need to know where the animal is located and in what numbers. Eastern Sayan and western Hovsogol are only a small portion of the range, but even here our painting of the snow leopard remains, as in the past, just a few strokes, barely touched by the hand of the researcher.