

## Range Structure, Numbers, and Population Status of the Snow Leopard in the Tian Shan

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The question of the population status of a species is closely connected to its position in the range and internal structure of the area it occupies. Of particular importance in the snow leopard (*Panthera uncia*) range is the Tian Shan area, where the population numbers are still estimated to be higher than in other regions (Bold and Dorzhzunduy, 1976; Braden, 1982; Heptner, Sludsky, 1972; Green, 1988; Sludsky, 1973; Chichikin, 1973; Pokrovsky, 1976; Jackson, 1979; Bannikov, Flint, 1982; The Red Data Book of the USSR, 1984; Koshkarev, 1988; Liao and Tan 1988; Mallon, 1984; Schaller, 1977). Also, the Tian Shan is the most important source from which the major part of the captive population was created (Blomqvist, 1988). On the basis of the data collected in 1981-1989 and the information from literature, we will consider the causes of the higher numbers of snow leopards in the Tian Shan part of the range and the significance of this role in the survival of the population.

The study area is 25.6 thousand square kilometers, or 1/3 of the snow leopard range in the Tian Shan (table 1). The surveys covered about 7 thousand square kilometers mostly in the Northern, Inner, and Central Tian Shan. In the Western Tian Shan in the summer of 1988 separate areas of the Chatkalskiy, Santalashskiy, Ugamskiy, and Talasskiy Alatau mountain ridges were surveyed by routes. The data published before on the distribution, habitat size, and numbers of the snow leopard (Koshkarev, 1989; 1990) were confirmed and supplemented information on the Zailiyskiy Alatau, Kunghei Ala Too, Ketmen, Kokshaal-Too, and Borkoldoy-Too. Areas of higher and lower snow leopard population density were revealed and the degree of habitat decline was calculated (table I, fig. 1). Number estimates were differentiated according to the physical geographic areas by using the stratification method (Koli, 1979; table 1). The number

estimates would have been more exact in the most optimum habitats (fig. 1) where the surveys were carried out repeatedly and density fluctuations were not as considerable as in the rest of the area (Koshkarev, 1986; 1989; 1990). More than three times as many density fluctuations have been revealed for contrasting habitats: for the central part and the margins of the main ridges, and for habitats of uninterrupted and insular character (syrtly—from an Altai word meaning "ridge"-landscapes of the Inner Tian Shan). This proportion is reflected in the table; for Western Tian Shan it is rather conditional due to the scarcity of concrete information. The calculations of density were carried out according to the map on the scale of

1: 100,000. The habitat area included glaciers, except massif Khan-Tengri (7010 m) and Victory Peak (7439 m), which represent a transit zone for the snow leopard (Koshkarev, 1988b). With the adjustment for relief, the area from the map is increased by 3016.

Together with the Pamir and Pamir-Alai, the Tian Shan forms the Central Asian focus, where it occupies the north-eastern spur. Its isolation from the neighboring mountain systems is most obvious in the basin of the river Syr-Darya. Here most of the area is occupied by habitat hardly suitable for the snow leopard—spacious syrtly areas of the Inner Tian Shan and the Eastern Pamir. Groups of animals in the syrtly area are of insular character,

highly scattered, and in many areas totally absent. The natural disruption of the habitat, conditioned by the syrtly landscapes and other natural barriers, has of late been drastically increased by various forms of anthropogenic influence—primarily by the grazing of cattle, which leads to the destruction of territory for use by wild animals. The spatial gap in the habitat also exists on the side of the Dzhungarskiy Alatau, which is separated from the Tian Shan by the Iliyskaya depression. In China, though, the connection between Tian Shan and the Dzhungarskiy Alatau is preserved through the Eastern Tian Shan and the Boro-Khoro mountain ridge (fig. 1).

The most optimum areas lie within the Central Tian Shan, the south-eastern part of the Inner Tian Shan and the Northern Tian Shan. Orographically this area is the most "monolithic": habitat here is the least interrupted, creating the best conditions for the population and the integrity of the groups

inhabiting it (fig. 1). The exception is the separately located Ketmen mountain ridge. In that area, as well as in the eastern end of the Zailiyskiy Alatau and the KungheiAla-Too. snow leopard presence at this time is not confirmed (Fedosenko, 1982; author's data) and the boundary of the range is receding (table). In the optimum areas (fig. 1) the average density indicator is the highest, 2.5 specimens per 100 square kilometers (table 1). It reaches its maximum of 6.2 specimens per 100 square kilometers in the Central Tian Shan (Koshkarev, 1988a).

In the major part of the Inner Tian Shan. the situation is reversed. The ridges are insularly located; some groupings are separated by vast syrty areas and major intermontane depressions; and snow leopard population density is low, except for the south-eastern sector (fig. 1, table 1). The situation is aggravated by the overall use of the area for pastures. The habitat area in all the insular foci is decreasing, and the population is vanishing. A characteristic example is a grouping of animals of the Moldo-Too mountain ridge near the lake SonKyol.

TABLE 1: Range area, population density, and estimated numbers of snow leopards in the Tian Shan

Physical Geographic Region in Tien Shan	Habitat Area in 1000's of sq km	Study Area within Habitat	Degree of Habitat	Number of Snow Leopards
Northern	25.6	8.6	28.5%	246
Inner	25.7	7.9	24.1	235
Western	17.7	2.3	11.9	55
Central	10.3	6.8	--	228
TOTAL	79.3	25.6	19.7	764

The situation in the mountain ridges Kirghizskiy and Kokshaal-Too, which surround the InnerTian Shan from the north and south, is more favorable. Due to the integrity of the habitat. close spatial connection exists between the groupings; and the density indicator is increased (fig. 1. table 1). In the surveyed basins of the rivers Ak-Su, Sokuluk, AlaArcha. Issyk-Ata (Kirghizskiy mountain ridge), Bolshoy Uzengeguush (Kokshaal- Too mountain ridge), density did not drop below 2 specimens per

100 square kilometers. There are no data available on the most western ridge of the Inner Tian Shan, the Fergansky ridge.

The mountain system of the Western Tian Shan is comparatively compact but occupies a marginal. isolated position. Its furthest, lowest, and most isolated ridges--Boroldaytau. Syrdaryinskiy Karatau, and Mogoltau--extend into the desert. Snow leopard habitat is of the most integral character at the junction of the Chatkalskiy, Pskemskiy. and Ugamskiy mountain ridges with the Talasskiy Alatau. Snow leopard encounters there were common up to the 1950's (Shaposhnikov, 1956; Afanasyev.

1960). They were also reported in the highest part of the Syrdaryinskiy Karatau (Severtsov, 1873; Antipin. 1955). Later the animals disappeared from Karatau (Heptner, Sludskiy, 1972) and became rare in their major habitation area (Zhirnov. et al., 1978; Bannikov. Flint, 1982).

The status of snow leopard populations in the Western Tian Shan is the most unfavorable. At present the animal is considered rare even in the protected territories (The Red Data Book of the USSR, 1984; Reserves of Central Asia..., 1990). However, we managed to collect questionnaire data and in the summer of 1988 found tracks indicating snow leopard habitation along all the major mountain ridges of the Western Tian Shan. Among the most important should be considered the report by S.I. Evmenov of observing the animal's track in May, 1985, in the main watershed of the Karzhantau mountain ridge (the tracks were observed on the crest between the peaks 2525 and 2859 meters above sea level along a stretch of 3 kilometers; the written report was accompanied by photographs) and an encounter with tracks of a female with two cubs under a year old by R. F. Nasibullin in September, 1982, on the Maydantalskiy ridge (the animals climbed to the Dzhenysu Pass from the side of the

river Maydantal; written report). The presence of animals in the marginal part of the range and. primarily, an encounter with a female with young provides hope that the population is still viable. but at a vey low level. Given the few sightings in the Western Tian Shan, a powerful anthropogenic influence, and the neighboring scarce population in the InnerTian Shan (fig. 1, table I), such conditions do not leave a strong chance for the snow leopard's long-term survival in the area.



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Figure 1. Location and structure of the Tian Shan part of the snow leopard range in the Central Asian *focus*.

I. Tian Shan area (boundary is shown by solid line).  
 .solid color-areas of increased population density -  
 shaded areas-areas of lower density  
 -dotted areas-areas of receding range

II. Pamir-Alai and Pamir regions (boundary indicated by broken line)

III. Dzhungarskiy Alatau (belongs to the Eastern-Kazakhstan *focus*, including Tarbagaty and Saur)

Arrow indicates connection of the Central Tian Shan with the Dzhungarskiy Alatau through the Eastern Tian Shan and the Boro-Khoro mountain ridge.

The total number of snow leopards in the Tian Shan is estimated at 800 specimens (table 1). In general the numbers during the last 100 years are characterized as steadily declining (fig. 2). If the snow leopard numbers in Kirghizia (which is situated almost completely in the Tian Shan) are estimated correctly at 1000 - 1500 specimens for the 1960's (Chichikin, 1973) and at 600 - 700 specimens for

the 1980's (Koshkarev, 1988a), then the decline of numbers over the 20 year period would appear twofold. The annual captures of animals since the end of the previous century to the 1950's was reduced by 3 times and to the present by 30 times (fig. 2).

Thus, despite the generally more favorable situation of the snow leopard in the Tian Shan than in other foci, the population is declining even there. This occurs primarily due to the instability of scattered marginal groups separated *from* the major population nucleus by various natural barriers, aggravated by the anthropogenic factor. The receding of the boundaries of the range along the periph

ery of the Northern, Inner, and Western Tian Shan and the increased density of the snow leopard population in the most inaccessible and secluded areas give credence to the *fact* that conditions are more favorable inside the Tian Shan area than along the boundaries (excluding, perhaps, the connection to the groupings of the Eastern Tian Shan--fig. 1, table 1).

It is predicted that, isolation of the groupings will increase in the future. At first this process will affect the small foci of snow leopard habitation in the Inner and Western Tian Shan and in the Northern Tian Shan, as well as the foci in the mountain ridges Zailiyskiy and Kunghei Ala-Too. So far the numbers of snow leopard in the Tian Shan are still close to the population size necessary *for* survival-600 adult animals (Soule, 1980). But with the present rate of decline--about 30 specimens per year.--the situation may become critical in 10 to 20 years. A means of stabilizing the numbers is to establish protected areas in the key portions of the range, particularly in the most vulnerable parts of the habitat, in distribution centers, and on the migration paths.

Such reserves and corridors would be useful in the Chiliko-Keminskiy mountain junction (the intersection of the ridges Zailiyskiy and Kunghei Ala-Too), on the Dzhungalskiy ridge (the marginal area of the Northern and Inner Tian Shan near the eastern end of the Kirghizskiya ridge), and also together with China in the Khan-Tengri massif-- Victory Peak and on the Kokshaal ridge.

.Estimated according to the difference in numbers during the 1960's (Chichikin, 1973) and the 1980's (Koshkarev, 1988a).

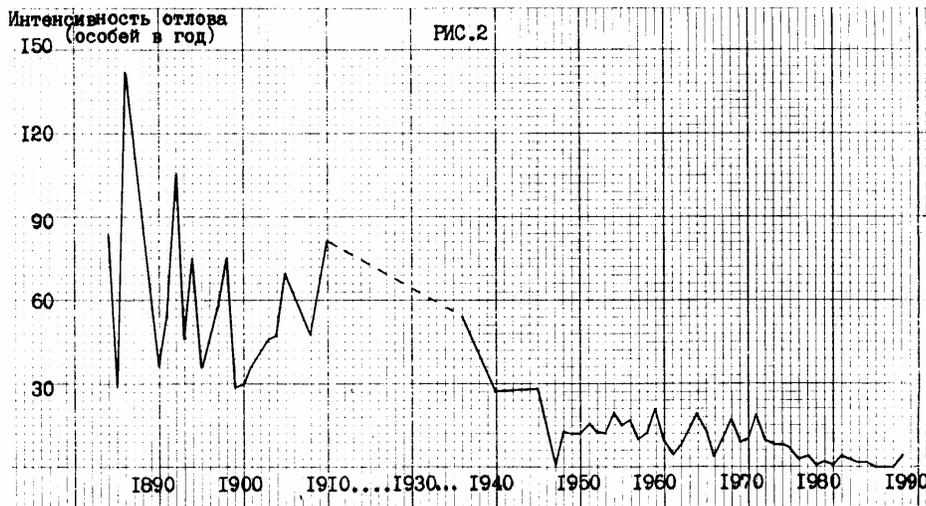


Figure 2. Dynamics of estimated snow leopard numbers in the Tian Shan (according to the prepared skins and animals captured for zoos). There are no data for the period of 1911-1935. Literature used: Ayzin, 1972; Smirnow, 1965 (according to Zverev, 1980); Shostak, 1927 (according to Fedosenko, 1982); Shurupov, 1977; data of the Frunze Zookombinat.

The necessity of creating international reserves with connecting corridors as the most effective means of ensuring the survival of the species was noted at the Sixth International Snow Leopard Symposium by Helen Freeman and Kathleen Braden.

In the future, attention should be given to the study of snow leopard groupings in the Fergansky mountain ridge and in the Eastern Tian Shan, which areas potentially may contribute to the distribution of animals from the neighboring foci and the support of the stability of the Tian Shan population.

### Summary

This paper has examined the range structure, numbers and population status of the snow leopard in the Tian Shan—one of the major foci of the preservation of the species. Areas of increased population density (over 2 specimens per 100 sq. k.) and of decreased population density (less than 1 specimen per 100 sq km) were revealed. The former area is 21.8 thousand sq km (27.5 % of the total

snow leopard range.). The number of animals here is about 450, almost 60% of the total population. The unfavorable conditions are characteristic of the Western and a large part of the Inner Tian Shan; and also of the best, the Central and south-eastern part of the Inner Tian Shan, where the most stable area of the range is located. Obviously it forms the single focus with the snow leopard groupings in the eastern (Chinese) part of the Tian Shan. The receding of the boundaries of the range is clearly noted in the periphery of the mountain country. Loss of habitat is estimated at a minimum of 20%. Captures of snow leopards since the end of the previous century have been reduced by 30 times; but the decline of numbers continues and, since the 1960's, has been twofold.

### Literature Cited

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