



Snow Leopard (*Panthera uncia*) Status in Tajikistan

CONTRIBUTORS:

Shannon M. Kachel^{1,2*}, Qobiljon Shokirov³,
Ismoil Kholmatov^{4,5}, Mirzonazar Mirzoev⁵,
Abdusattor Saidov⁶

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CORRESPONDING EDITOR: Örjan Johansson

HANDLING EDITOR: Justine Shanti Alexander

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1 School of Marine and Environmental Affairs, University of Washington, Seattle, USA

2 Woodland Park Zoological Society, Seattle, USA

3 Independent, Missoula, USA and Khujand, Tajikistan

4 Tajikistan Nature Foundation, Dushanbe, Tajikistan

5 Tajik National University, Faculty of Biology, Dushanbe, Tajikistan

6 Institute of Zoology and Parasitology, National Academy of Sciences of the Republic of Tajikistan, Dushanbe, Tajikistan

* Email: Shannon.kachel@gmail.com

1. Distribution

Snow leopards (*Panthera uncia*) are present in all major mountain ranges of Tajikistan (i.e., the Hissaro Alay and Pamir Mountains; Saidov et al. 2024), albeit at highly variable and uncertain densities and in some cases with unknown seasonality. Available evidence suggests that the species' distribution in Tajikistan is driven by a combination of terrain ruggedness and the distribution of mountain ungulate prey (Kachel et al. 2017, Kachel et al. 2022a, Kachel et al. 2022b) – ibex (*Capra sibirica*), argali (*Ovis ammon*), and markhor (*Capra falconieri*). According to Saidov et al. (2024), optimal habitats are rugged areas lying between 2000 and 4500 m in elevation. Even so, snow leopards occur at elevations as low as 1000 m along the Panj River, facilitated by the combination of rugged terrain and high markhor population density; on the high plateau of the Eastern Pamirs snow leopards have been observed upwards of 5000 m (Karimov et al. 2018).

In total, Tajikistan is estimated to hold approximately 85,700 km² of potentially suitable habitat (Figure 1), which we defined as ice-free areas between 5300 m altitude (the approximate uppermost detection of the species in the country) and above 2000 m (>1000 m in the Gorno-Badakhshan Autonomous Oblast - GBAO) where 1 km²-mean terrain ruggedness index >10. The majority of this area (53,940 km²) lies in the Pamir Mountains in GBAO. Although the flat high elevation valleys of the Eastern Pamirs do not constitute suitable habitat at the small scale, snow leopards have been regularly observed traversing these areas to access other areas of more rugged terrain (S. Kachel, unpublished data).

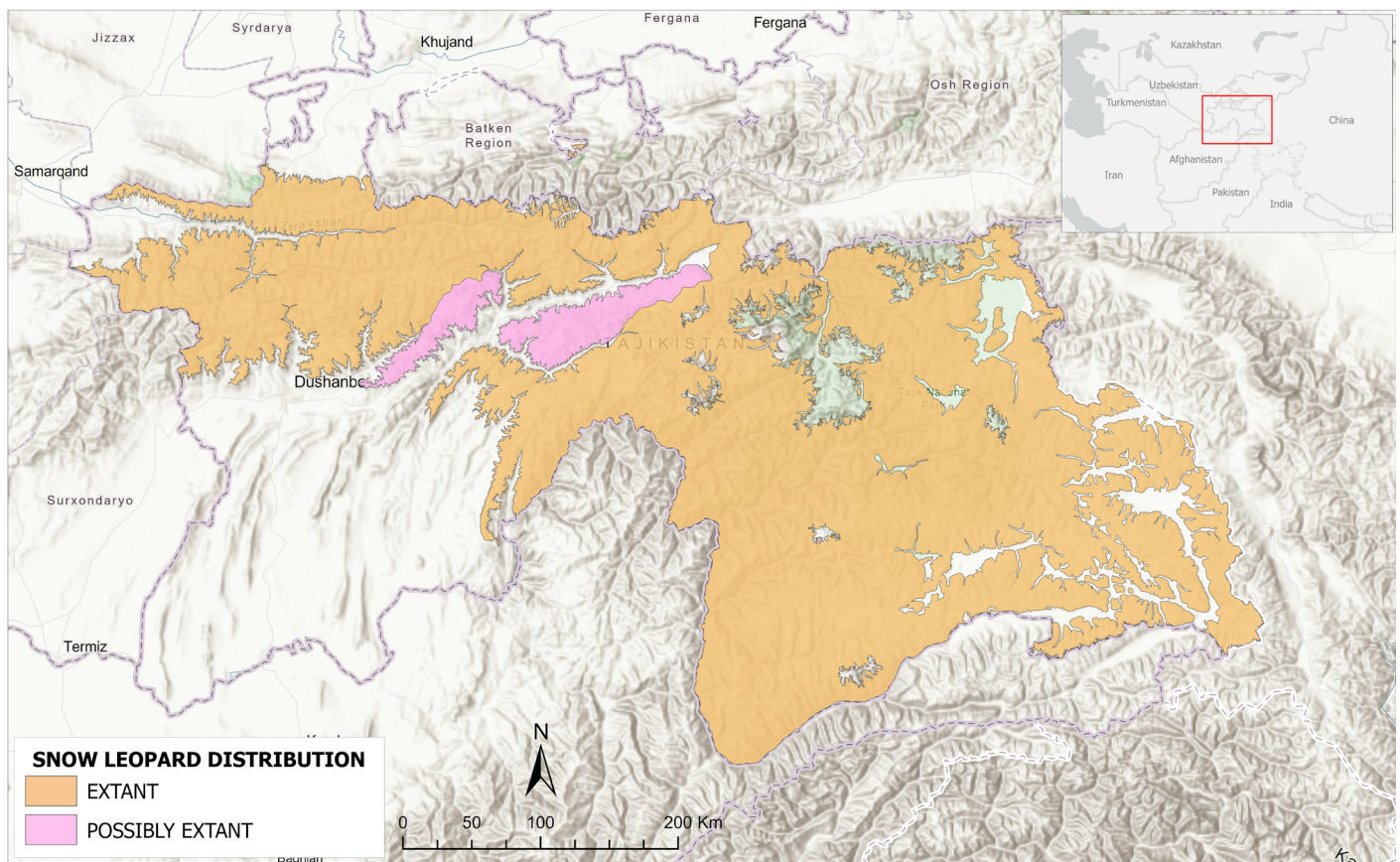


Figure 1. Distribution of the snow leopard (*Panthera uncia*) in Tajikistan. Orange areas indicate extant range, where the species is known or strongly inferred to occur. Pink areas indicate possibly extant range, where presence is uncertain but considered likely based on habitat suitability, following IUCN Red List mapping criteria.

Updated IUCN Red List Snow Leopard Distribution in Tajikistan

The updated distribution map for the IUCN Red List is based on a potential suitable habitat layer as well as published and unpublished records of snow leopard presence. To delineate potential habitat and create distribution polygons, we applied the following criteria sequentially:

- **Terrain and elevation filtering:** We used the ‘whitebox’ package (Lindsay, 2016) in R to calculate terrain ruggedness from a country wide digital elevation model at a resolution of approximately 30m (JAXA EORC, 2020). We then used a moving window filter to calculate 1 km²-mean terrain ruggedness index (TRI; at the original resolution). We removed areas >5300 m, <2000 m (or <1000 m in the Gorno-Badakshan Autonomous Oblast), and <10 TRI as calculated above.
- **Ahistorical isolated features:** We removed isolated “islands” of potential habitat <500 km² if surrounded by areas below 2000 m elevation (high elevation islands were retained) as these areas have no historical records of snow leopard presence.
- **Non-habitat features:** We removed lakes and areas covered by glacial ice as these are not suitable snow leopard habitat.

- **Cartography:** To avoid conveying false precision in the suitable habitat layer, we removed nunataks (‘islands’ surrounded by ice) <10 km², and filled remaining holes filtered due to terrain or ice cover if <50 km² (holes previously filtered due to elevation or lakes were retained).
- **Occurrence classifications:** Areas of suitable habitat were classified as “Extant” if they were both *a.* contiguous with, and *b.* <40 km Euclidean distance to recent (no older than 2015) published or unpublished occurrence records (sightings, camera trap detections, pugmarks, scrapes, scats, livestock depredations; including in neighboring countries), or geolocated reports obtained from key informant interviews in local communities indicating that snow leopards were likely present. Here, contiguous meant connected by uninterrupted potential habitat within the same mountain range (itself connected by uninterrupted high ground >2500 m) unlikely to require a traversing animal to cross glacial ice or gentle valleys (this final criterion was not applied to the high elevation valleys of the Eastern Pamirs, where snow leopards are regularly observed crossing valleys between sub-ranges). The buffer of 40 km was chosen based on observed major axes of GPS-collar relocations

of resident male snow leopards in neighboring Kyrgyzstan (i.e., the greatest distances between any two observed locations; Kachel 2021). Areas of suitable habitat that did not meet the above criteria and that also lacked records at least as recent as 2015 were classified as “Possibly Extant.” These areas encompassed portions of the Peter the Great and Qarotegin Ranges bordering the Rasht Valley.

2. Population

Despite localized research and monitoring efforts (e.g. Kachel et al. 2017, Karimov et al. 2018, Kachel et al. 2022b), no rigorous national population estimate is available (Saidov et al. 2024). The largest-scale density estimate available, estimated snow leopard densities across 20,000 km² in the Pamirs at 0.29 snow leopards per 100 km² (95%CI: 0.17–0.51; UNEP, 2024). This estimate was integrated over an area an order of magnitude larger than any other studies. Nonetheless, it is restricted to the Pamirs and is therefore likely biased relative to the national average density. Research efforts outside of the Pamirs have frequently failed to obtain sufficient spatial detections needed to estimate density (a fact likely due to a combination of insufficient sampling and low detection probabilities, but that could indicate lower densities as well).

Rather than extrapolating from GBAO to the rest of Tajikistan, we instead stratify, estimating separate population numbers in GBAO (the higher density stratum) and the rest of the country (the lower density stratum). As a proxy for a realistic range of snow leopard densities in our lower density stratum, we use estimates from Suryawanshi et al. (2021) for the Indian state of Himachal Pradesh — 0.19 snow leopards/100 km² (95%CI: 0.12–0.31) — estimates which are integrated over a comparably large area with a similar range of topography, habitats, and prey availability (e.g. Reading et al. 2020). Extrapolating with caution thus results in a national population estimate of approximately 130 – 374 snow leopards (mean, 217 animals; 92 – 275 animals in GBAO, and 38 – 99 animals elsewhere).

Saidov et al. (2024) previously estimated the total number of snow leopards between 250 – 280 individuals. Similarly, the government of Tajikistan held its official estimate at 250 animals (Red Book 2017). The latest update to the Tajikistan Red Book (2025) revised the official estimate upwards to approximately 500 individuals. The revision is based on documentation of more than 200 unique individuals identified via published and unpublished camera-trap and genetic analyses since 2012.

The data needed to estimate or infer population trends at

any scale in Tajikistan are lacking. As such, revisions to the estimated snow leopard population size (relative to the 2017 assessment) cannot yet be attributed to a genuine change in the underlying number of animals. Looking ahead, with targeted sampling and collaborative analysis/data sharing, a robust estimate of the total snow leopard population in Tajikistan should soon be achievable.

3. Threats

Livestock depredation and retaliatory killing

Livestock depredation by snow leopards and the resulting retaliatory killings and/or relocation of snow leopards, remains prevalent in the western GBAO. Many attacks on livestock occur inside barns or corrals in late fall and winter. Pamiri household barns typically have a mud roof with windows or skylights for ventilation and dropping hay down to feed the animals. Snow leopards enter through these openings, kill livestock, and often cannot jump back out to escape. These animals may be released, relocated (with unknown success), taken into captivity for rehabilitation (due to injuries associated with their capture and handling), or killed outright. TRAFFIC estimated that 45% of animals in Tajikistan captured in this manner ultimately funnel into the illegal wildlife trade (Tokubek Uulu et al. 2024). The Committee for Environmental Protection under the Government of Tajikistan has established a rehabilitation center near Murgab in the Eastern Pamir, with the objective of rehabilitating injured snow leopards for eventual release into the wild. The center features a 2-hectare fenced area with a closed structure, as well as smaller, separate fenced enclosures. The center has a staff of four permanent employees, including a veterinarian and animal caretakers.

The majority of the economic burden caused by snow leopards goes uncompensated. In the past, efforts by conservation organizations, and other institutions have assisted communities in predator-proofing corrals in summer pastures of the Pamirs. These corrals, primarily used during the summer when livestock are in high pastures, are generally perceived to be effective at deterring predators. However, the problem of household barns having open skylights remains a significant contributor to human-wildlife conflict during the winter months. To tackle this issue, conservation organizations constructed predator-proof community corrals in several villages within the GBAO of Tajikistan between 2016 and 2018. However, a survey conducted from 2019 to 2020 indicated that shared communal corrals may be ineffective there (Kachel, et al. 2022a). To avoid the difficulties of feeding their livestock, sharing common space with other livestock, and of separating out one’s own manure for fuel, many people

prefer to keep their livestock in household barns during the winter months. However, livestock owners who did not cover barn windows and skylights (with mesh or narrowly spaced metal bars) were nearly seven times more likely to report snow leopard depredations in the past 18 months (Kachel et al. 2022a), even after accounting for individual and habitat factors. Kachel et al. (2022a) recommended that in order to prevent snow leopard depredation at a meaningful level, conservation efforts should focus on retrofitting as many existing household barns as possible, at very large scales across the Pamirs.

Decline of key prey species

Hunting has been viewed as a significant contributor to the decline of key prey species in Tajikistan since the middle of the twentieth century, including ibex, argali, urial (*Ovis vignei*), and markhor (Michel et al. 2015; Michel and Rosen 2015; Michel and Rosen 2016; Michel and Karimov 2017). A civil war from 1992 to 1997 likely exacerbated the pressure on ungulate populations, by creating near-famine conditions for people in the mountainous regions of Tajikistan; with access to guns and limited availability of goods, people in local communities were often forced to hunt for survival (Shokirov and Backhaus 2020).

Over the last decade, many mountainous areas of Tajikistan have seen a significant apparent recovery of key prey species, thanks to the efforts of various institutions, community-based conservancies, private hunting concessions, government bodies, and international organizations. For instance, the population of markhor, previously estimated at fewer than 500 individuals in the early 2000s, has increased to approximately as many as 5,000 individuals (Akramov et al. 2022). Similarly, the argali sheep population, previously estimated at 26,500 in January 2018 was estimated at over 29,000 argali sheep just 3 years later (Institute of Zoology and Parasitology, National Academy of Sciences of Tajikistan, *unpublished report*). Recent work by Oshurmamadov (2021) estimates at least 24,000 ibex are present in the country, compared to 40,000 previously estimated to inhabit the country. Most urial habitat is found in Southwest Tajikistan, on the margin of the snow leopard's potential habitat. There, the urial population is threatened by illegal hunting and grazing related to its proximity to nearby villages and towns. Recent estimates suggest that the urial population stands at fewer than 500 individuals (Michel and Ghoddousi 2020).

In addition to illegal hunting, wild ungulates may be susceptible to disease transmission from livestock. Markhor in particular have previously experienced dramatic declines in response to zoonotic diseases also found in livestock (Ostrowski et al. 2011), although the dynamics involved are not well understood.

Climate Change

Tajikistan's mountains are predicted to serve as a vital refuge for the survival of snow leopards over the next 40 years amidst climate change (Li et al. 2016). Climate change is already impacting humans and wildlife throughout Tajikistan's mountain ranges. For example, it is currently affecting the ibex and argali sheep, which are key prey species for snow leopards. Studies (Zhuo et al. 2022) predict that in the coming decades, climate change may drive the ibex and argali sheep to higher elevations to escape heat and due to limited precipitation.

Illegal Wildlife Trade

It is thought that many of the snow leopards and snow leopard parts that end up in the illegal wildlife trade originating from Tajikistan are killed in retaliation following livestock depredation in household barns as described above. TRAFFIC estimates 45% of incidents of retaliatory capture and/or killing or non-target poaching of snow leopards in Tajikistan led to people attempting to sell the animals in illegal markets (Tokubek Uulu et al. 2024). By reducing livestock depredations, Tajikistan could likely diminish the likelihood of illegal hunting and further prevent snow leopards from entering the illegal wildlife trade.

According to the Committee for Environmental Protection under the Government of Tajikistan, approximately 4-5 snow leopards are killed each year. Sometimes, people still use traps to catch wolves in Tajikistan, especially in winter when wolves are near villages. It is easy for snow leopards to become caught in traps designed for wolves. Each year, members of conservation organizations and government institutions, such as protected area rangers, collect these traps to prevent the injury and killing of snow leopards (Saidov et al. 2024).

4. Conservation

Legal frameworks

The Government of Tajikistan protects snow leopards through various laws and legal frameworks. For instance, it regularly updates the species' status by publishing Tajikistan's Red Book. Since 1988, snow leopards have progressed from a classification of "rare species with a declining trend" (Narzikulov 1988) to Endangered status in 2015 and again in 2025 (Saidov et al. 2016). The Government of Tajikistan ratified the Convention on the Conservation of Migratory Species of Wild Animals (CMS) in 2000, joined the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) in 2015 (Saidov et al. 2016, 2024), and joined the IUCN in 2025. In February 2024, the government of Tajikistan adopted a National

Program for the Conservation of Snow Leopard for 2024–2028. The Committee for Environmental Protection and the National Academy of Sciences, with the involvement of NGOs, are responsible for implementing this program. It prioritizes mitigating threats such as livestock depredation and prey decline, raising public awareness, and calls for establishing a national monitoring program for the snow leopard population. The program primarily seeks funding for its activities through grants.

Protected areas

Through the extensive network of reserves and national parks, the Government of Tajikistan establishes a foundation for protecting snow leopards and their prey. For example, three nature reserves, one biosphere reserve, one national park, four nature parks, and thirteen additional reserves with regulated resource use (“zakazniki”), help protect snow leopard habitats in Tajikistan. Snow leopards have been observed in Tajik National Park, Zorkul State Reserve, Romit State Reserve, Dashtijum State Reserve, and three nature parks (Shirkent, Sarikhosor, and Yagnob). Rangers from state institutions, national parks, and various protected areas implement patrolling and anti-poaching programs year-round to safeguard wildlife species, often collaborating with the private sector. (Saidov et al. 2024).

Community-based conservation and private hunting concessions

Various community-based conservancies and family-managed concessions lease land from the government of Tajikistan and manage ungulate trophy hunting programs across the Pamir Mountains, including the Hazratisho range in the Shurabad district (Saidov et al. 2024). These trophy hunting programs include key snow leopard prey species such as ibex, argali sheep, urial, and markhor. These trophy hunting programs provide financial incentives for managing communities and families to protect wildlife, limit poaching, and reduce livestock overgrazing (Michel et al. 2015). Many of these programs have confirmed the presence of snow leopards in their territories through direct observations, camera trap surveys or genetic sampling. For instance, several public protected areas have reported the presence of snow leopards, such as Darashaydara in Ishkashim District, Alichur in Murgab District, and Ravmeddara in Bartang Valley (Saidov et al. 2024). Snow leopards have been similarly documented in family-managed concessions in Murghab (Kachel et al. 2017) and Darvaz (S. Kachel and Q. Shokirov, *unpublished data*). As of today, based on surveys, roughly 70 snow leopards are present in territories managed by community-based conservancies (CITES 2019).

Institutions and civil society organizations

Studies and research on snow leopards are generally overseen by the National Academy of Sciences of Tajikistan, which recently updated the Red Book of Tajikistan (2025), featuring updates on current trends in the snow leopard population. Several NGOs are conducting camera trap studies in previously unstudied areas. Through these efforts, these institutions are engaging local communities on the ground by raising awareness about snow leopards and implementing people-centered approaches and development management plans to be carried out in national parks, reserves, and community-based conservancies.

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6. Conflicts of Interest

The authors declare no known conflicts of interest.

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