



Some monitoring studies of wild animals of the Turkestan Range

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Abstract. The conservation of mountain ecosystem biodiversity in Kyrgyzstan remains one of the priority tasks of modern ecology and nature conservation practice amid increasing anthropogenic pressure, including year-round livestock grazing, poaching and habitat fragmentation. The aim of the study was to analyse the results of monitoring the snow leopard (*Panthera uncia*) population and associated fauna in the Turkestan Range. The work employed remote monitoring methods using 87 Reconyx HC500 camera traps installed in a targeted manner in Sarkent State Nature Park, Surmatash State Nature Reserve and the Leylek Forestry in 2020-2021. Camera traps were placed along animal trails and passes at 2-3 km intervals. Individual identification was carried out by the unique spot pattern by two independent experts. Spatial analysis of the data was performed in ArcGIS and QGIS using a digital elevation model. As a result, 21 snow leopards were identified, including 4 cubs, confirming successful reproduction of the local population. The species demonstrated high ecological plasticity, occupying an altitudinal range from 1,973 to 3,993 m above sea level. A strong positive spatial correlation was revealed between the snow leopard's distribution and the concentration of ungulates (ibex – 120 independent events, 38% of all records). A total of 320 independent events were recorded for 15 mammal and bird species, with ibex, Himalayan snowcock and Tolai hare dominating. Detailed maps of animal distribution and seasonal dynamics of altitudinal

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records were compiled, showing predominance in mid- and high-mountain belts. The analysis confirmed a balanced trophic structure of the ecosystem and the presence of rare protected species (lynx, bearded vulture). The obtained materials are of practical value for the development of snow leopard conservation measures and optimisation of management of specially protected natural areas in the Turkestan Range

Keywords: snow leopard; camera traps; population assessment; altitudinal distribution; trophic relationships; spatial analysis; GIS technologies

Introduction

Biodiversity conservation is one of the key objectives of modern ecology. To assess the status and conservation prospects of species, systematic monitoring is required to track changes in population size and structure, as well as to identify risk factors. Regular monitoring forms the basis for science-based management of conservation activities (Rode *et al.*, 2021). A distinctive feature of the Turkestan Range is the increasing anthropogenic impact associated with year-round grazing of farm animals, poaching and habitat fragmentation. As noted by J. Li *et al.* (2023), these factors lead to a reduction in the snow leopard's food supply and changes in its spatial behaviour, necessitating systematic monitoring studies in this region. Indicator species, which reflect the state of ecosystems, are of particular importance in such studies. Among them, the snow leopard (*Panthera uncia*) occupies a special place, inhabiting high-altitude areas and sitting at the top of the food pyramid. It regulates the populations of other animals and maintains the balance of biodiversity. According to H. Ma *et al.* (2024), its presence serves as a marker of the resilience of mountain ecosystems.

In Kyrgyzstan, the snow leopard has been recognised as the country's national symbol by a decree of President Sadyr Zhaparov (Presidential Decree No. 369, 2023). However, as noted by N.A. Bizhanova *et al.* (2017), the snow leopard is among the least studied large carnivores: its secretive lifestyle, the inaccessibility of its habitats and low population density significantly complicate research into the species. According to E.P. Kashkarov (2017), as recently as 50 years ago there were around 1,500 snow leopards in Kyrgyzstan; however, their numbers have now declined by approximately tenfold. During the Soviet era, the republic was the world's main supplier of snow leopards to zoos. Following independence, the situation regarding the conservation of the species deteriorated repeatedly: in the Sarychat-Ertash Nature Reserve, considered one of the best habitats for the snow leopard in Central Asia, the species was almost completely wiped out three years after the reserve was established, and was subsequently gradually reintroduced. Currently, in the author's view, threats to the snow leopard and other rare species in Kyrgyzstan are once again on the rise.

Monitoring results depend largely on external conditions. According to C. Yang *et al.* (2021), the presence of farm animals makes it difficult to detect signs of

snow leopard's activity and reduces the likelihood of sightings, even in areas with favourable terrain and ecology. Livestock grazing not only complicates observations but also reduces available habitats and decreases the animals' daytime activity. Further research in Kyrgyzstan confirms that livestock grazing, poaching and the reduction of the food supply pose serious threats to the conservation of the species and significantly hinder monitoring (NABU, 2025). Against a backdrop of a shortage of natural prey, the intrusion of domestic livestock into hunting grounds may provoke attacks by predators on domestic animals. This risks a retaliatory response from herders and poses an additional threat to the survival of local snow leopard populations. In recent decades, snow leopard research has evolved significantly: from simple descriptive observations, it has moved towards comprehensive interdisciplinary approaches based on modern monitoring and analysis methods (Kuzhlekov *et al.*, 2022). Among the technologies used, camera traps occupy a special place. Their use has proven highly effective in studying the ecology and behaviour of animals inhabiting inaccessible and extreme environments (Dyldaev *et al.*, 2021). Camera traps are recognised as the primary methodological approach for determining the spatial distribution of the snow leopard, its population size, and for tracking migration routes.

NABU Kyrgyzstan (2022) makes a significant contribution to the study of the snow leopard by conducting wildlife monitoring studies across the country. The organisation conducts population surveys of the snow leopard in key areas, including the Turkestan Range. Research into the snow leopard and its prey base in the Turkestan Range began in 2020. According to orographic classification, the Turkestan Range forms part of the Southern Tien Shan; it stretches for 300 km, with a width of 10-15 km in the west and up to 30 km in the east. The highest point is Pyramidal Peak (5,509 m above sea level). The region is characterised by unique natural landscapes and rich species diversity. In recent years, the area has been actively used as year-round pastureland, which in some cases disrupts the food supply. Illegal hunting of wild animals remains an additional threat to the region's biodiversity. The aim of this study was to analyse the results of monitoring surveys of wild animals, including the snow leopard, in the Turkestan Range.

Materials and Methods

The research was conducted within the Sarkent State Nature Park, the Surmatash State Nature Reserve, the Leylek Forestry Enterprise and the adjacent areas of the Turkestan Range. The Sarkent State Nature Park, covering an area of 40,000 hectares, is located in the Leylek district of the Batken region; the Surmatash State Nature Reserve, covering an area of 66,194 hectares, is located in the Kadamzhay district of the same region. The Leylek Forestry covers mountainous forest-meadow, semi-desert and high-altitude nival-glacial zones in the south-western part of Kyrgyzstan, at altitudes ranging from 1,500 to 4,000 metres above sea level. Fieldwork was carried out by staff from specially protected natural areas in collaboration with specialists from the monitoring department of the Nature and Biodiversity Conservation Union (NABU) in 2020-2021, in accordance with generally accepted wildlife monitoring methodologies (Asykulov, 2021). The expedition in the Turkestan Range took place from 4 to 27 July 2021.

The main tool used for remote monitoring was the Reconyx HC500 camera trap (USA) – 87 units in total. Between 12 and 26 September 2020, 43 camera traps were installed within the Sarkent National Park and the Leylek Forestry; between 2 and 14 October 2020, a further 44 devices were placed in the Surmatash State Nature Reserve. The cameras operated in photo and video mode with a highly sensitive motion sensor and a 1-minute interval between triggers; the design of the devices allowed them to be used in conditions of low temperatures and precipitation. The average installation altitude was 2,627 metres above sea level, and the average operational period for a single camera trap was approximately 260 days; the total number of trap-days exceeded 22,000. The camera traps were positioned according to a targeted principle – primarily along animal tracks, on mountain passes, at marking points, and in areas showing signs of activity by snow leopards and ungulates. The deployment pattern was non-uniform (not grid-based), due to the complex terrain and the need to cover key habitats. The average distance between stations was 2-3 km; one camera was installed at each station. The total area of the study site was 475,000 ha.

An independent event was defined as the detection of the same species with a time interval of at least 30 minutes between consecutive triggers. Snow leopards were identified by the unique pattern of spots on the animal's body (paws, tail, flanks): an individual "photo-ID" was created for each animal. Identification was carried out independently by two experts; in the event of a discrepancy in assessments, a consensus approach was used; no specialised software was employed. Records of ungulates and other species were compiled using photographic data; the relative density of groups was estimated based on encounter frequency – the number of independent events per 100 trap-days – as well as the activity index (the proportion of species records in the total number of events).

Once the fieldwork was completed, the data underwent initial processing: sorting of photographic material, creation of a database and organisation of the records. For each observation, the date, time, GPS coordinates and absolute elevation above sea level were recorded. Spatial analysis was carried out using ArcGIS and QGIS in the WGS 84 coordinate system (EPSG:4326): observation points were overlaid onto a digital elevation model (DEM) and thematic layers (hydrology, protected area boundaries, landscape structure). Methods of visual analysis and comparison of recording density were used to interpret the spatial distribution; maps were compiled at scales of 1:150,000 and 1:400,000, also using Google Earth Pro. The GPS positioning accuracy of the recording points averaged $\pm 5-10$ m. To analyse the seasonal dynamics of the altitudinal distribution of snow leopards, observations were organised by site and plotted on a timeline: the X-axis represented observation dates, the Y-axis represented recording altitude; a separate coloured line was used for each site. All data used as the basis for the spatial analysis were obtained from an internal report by NABU Kyrgyzstan (2021), which is not publicly available but is in the authors' possession. All fieldwork was conducted using exclusively non-invasive observation methods – camera traps and visual counts, – without trapping, tagging or any other physical contact with the animals, in accordance with the principles of humane treatment of wildlife enshrined in the International Union for Conservation of Nature's guidelines on the responsible use of wild animals for research purposes (IUCN, 2012).

Results

Between April 2020 and February 2021, a total of 320 separate sightings of 15 species of mammals and birds were recorded across the three study sites in the Turkestan Range. The spatial distribution of identified snow leopard individuals and the locations of the monitoring stations are shown in Figure 1.

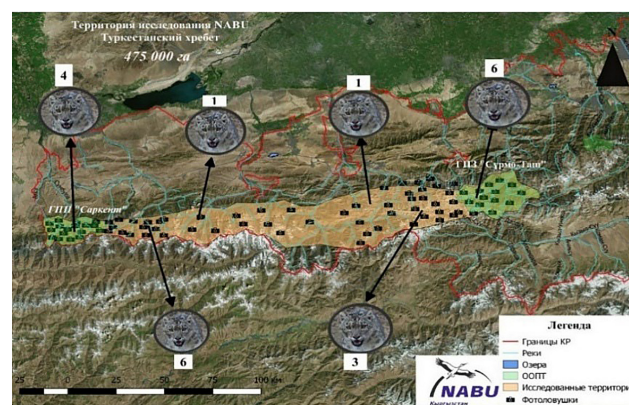


Figure 1. Map showing the locations of camera traps and identified snow leopards

Source: NABU Kyrgyzstan (2021)

The locations of the camera traps are marked on the map with black squares. The circular symbols depicting a snow leopard's head and numbers (1, 2, 3, 4, 6) indicate the uneven distribution of the animals and the varying frequency of their detection within the study area. On the map, the Sarkent State Nature Park is shown on the left, and the Surmatash State Nature Reserve on the right. In the map legend, the borders of the Kyrgyz Republic are marked with a red line, rivers and lakes with blue symbols, specially protected natural areas are highlighted in light green, and the study area is shown in orange.

A total of 17 adults and 4 cubs were identified – making a total of 21 snow leopards. Cubs were recorded in two areas, indicating active reproduction within the local population. Detailed data for each individual, including an individual identification code, the date and time of the first recording, the area and GPS coordinates, are given in Table 1. Four adult individuals have been recorded within the Sarkent State Nature Park, in

the Kok-Zoo and Kak-Zhayloo areas. Nine individuals were identified in the Surmatash State Nature Reserve: two adults in the Oiterek section, three adults in Kara-Shoro, two adults and two juveniles in Ak-Zhylga; individuals [SL-876T/H] and [SL-874/H] were recorded simultaneously – 19 January 2021 at 16:56. In the Leylek Forestry, 8 individuals were recorded: 1 adult in the Baul section, 3 adults and 2 cubs at Özgörüş, as well as 2 adults with ID tags [SL-1148T/H] and [SL-170T/H], recorded simultaneously at the Toguz-Bulak site. Identification was carried out using the unique pattern of spots on the hind paws – one of the most convenient body parts for recognition, as the paws are most often captured in the frame when the animal crosses a trail. The asymmetry of the pattern (the left and right paws differ) allows for reliable differentiation between individuals. An example of the identification of two individuals – [SL-249T/H] and [SL-651T/H] – in the Kök-Zoo section of the Sarkent State Nature Park is shown in Figure 2.

Table 1. Results of snow leopard surveys in the Sarkent State Nature Park, the Surmatash State Nature Reserve and the Leylek Forestry

Snow leopard facts					
No.	Personal identification number	Date/time	Location, area	Coordinates GPS	Altitude, m above sea level
Sarkent State Nature Park					
1	[SL-651T/H]	11.02.2021 09:34	Turkestan Range, the Kok Zoo section	N = 39.57791 E = 069.40112	3,993
2	[SL-249T/H]	08.12.2020 12:13	Turkestan Range, the Kok Zoo section	N = 39.66581 E = 69.36504	1,973
3	[SL-1808T/H]	14.12.2020 10:12	Turkestan Range, the Kok Zoo section	N = 39.59085 E = 069.43331	3,138
4	[SL-574T/H]	24.01.2021 13:15	Sarkent State Nature Park (Kak Zhayloo)	N = 39.63851 E = 069.50115	3,464
Surmatash State Nature Reserve					
5	[SL-271T/H]	27.01.2021 13:19	Turkestan Range, Oiterek section (Zhindi Suu)	N = 39.81013 E = 071.96488	2,569
6	[SL-105T/H]	04.02.2021 13:37	Turkestan Range, Oiterek section (Suuk Jailoo)	N = 39.81510 E = 072.08064	2,702
7	[SL-50T/H]	20.10.2020 03:08	Turkestan Range, the Kara-Shoro section (Gozhir)	N = 39.87276 E = 071.68302	2,775
8	[SL-45T/H]	21.11.2020 07:35	Turkestan Range, the Kara-Shoro section (Kara Kazyk)	N = 39.85122 E = 071.55346	2,877
9	[SL-2248T/H]	20.04.2020 09:09	Turkestan Range, the Kara-Shoro section (Marcha)	N = 39.83332 E = 071.58482	2,728
10	[SL-4186T/H]	08.04.2021 08:29	Turkestan Range, the Ak Zhylga section (Chon-Bevet)	N = 39.77898 E = 072.20576	2,543
11	[SL-832T/H]	10.01.2021 10:07	Turkestan Range, the Ak Zhylga section (Ming Zhylky)	N = 39.78860 E = 072.08426	2,420
12	[SL-876T/H]	19.01.2021 16:56	Turkestan Range, the Ak Zhylga section (Chon-Bevet)	N = 39.77898 E = 072.20576	2,543
13	[SL-874/H]	19.01.2021 16:56	Turkestan Range, the Ak Zhylga section (Chon-Bevet)	N = 39.77898 E = 072.20576	2,543
Leylek Forestry					
14	[SL-247T/H]	21.09.2020 16:45	Turkestan Range, Baul (Kashka-Suu)	N = 39.69738 E = 069.83067	3,327
15	[SL-73T/H]	25.09.2020 13:11	Turkestan Range, Özgörüş (Ashat)	N = 39.64954 E = 069.89582	2,836

Table 1. Continued

Snow leopard facts					
No.	Personal identification number	Date/time	Location, area	Coordinates GPS	Altitude, m above sea level
Leylek Forestry					
16	[SL-232T/H]	25.09.2020 12:00	Turkestan Range, Özgörüş (Ak-Zhar)	N = 39.67288 E = 069.89695	2,456
17	[SL-360T/H]	24.09.2020 11:50	Turkestan Range, Özgörüş (Laili)	N = 39.64434 E = 069.85869	2,513
18	[SL-1148T/H]	24.09.2020 12:43	Turkestan Range, Özgörüş (Kyrk-Bulak)	N = 39.64927 E = 069.86926	2,546
19	[SL-170T/H]	24.09.2020 12:43	Turkestan Range, Özgörüş (Kyrk-Bulak)	N = 39.64927 E = 069.86926	2,546
20	[SL-150T/H]	19.09.2020 16:45	Turkestan Range, Toguz-Bulak (Altyn-Beshik)	N = 39.67160 E = 069.64877	3,464
21	[SL-151T/H]	19.09.2020 16:45	Turkestan Range, Toguz-Bulak (Altyn-Beshik)	N = 39.67160 E = 069.64877	3,464

Source: NABU Kyrgyzstan (2021)



Figure 2. Identification of snow leopards by their hind paws (Kök-Zoo area, Sarkent State Nature Park)

Source: NABU Kyrgyzstan (2021)

The highest number of sightings occurred in September 2020 and January 2021. Within the daily cycle, the morning and afternoon hours (09:00-13:00) were predominant, indicating that the animals are primarily active during daylight hours. The snow leopard exhibits a wide ecological range, occupying an altitude range from 1,973 to 3,993 m above sea level. The seasonal dynamics of altitude records for each of the three sites are shown in Figure 3. The Sarkent State Nature Park exhibits the greatest variation in altitude – ranging from 1,973 metres above sea level (December 2020) to 3,993 metres above sea level (February 2021) – reflecting the

use of both mid-mountain and high-mountain zones. The Surmatash State Nature Reserve is characterised by a more stable range – 2,420-2,877 m above sea level. Within the Leylek Forestry district, observations are concentrated mainly in the autumn of 2020 and cover altitudes from 2,456 to 3,464 m a.s.l., with several observations coinciding at the highest elevation. Overall, in autumn (September-October) average altitudes (2,400-2,800 m above sea level) predominate, whereas in winter and early spring (January-February) the range expands in both directions. In spring (April), records are again concentrated in the mid-mountain range.

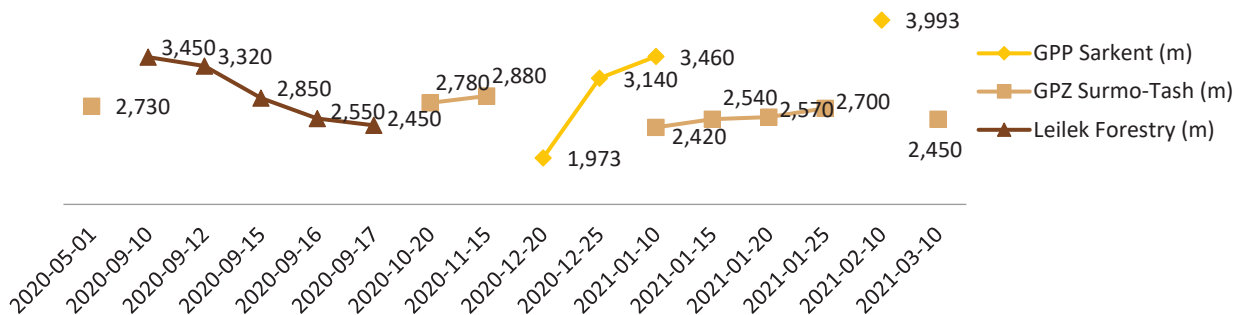


Figure 3. Seasonal dynamics of snow leopard recording altitudes in the Turkestan Range

Source: compiled by the authors

An analysis of spatial distribution revealed a strong positive correlation between the areas where snow leopards and Siberian ibex are concentrated (qualitative estimate: $r \approx 0.7-0.8$): areas with a high frequency of ungulate sightings are also characterised by increased snow leopards' activity. A map of wildlife sighting points

within the Sarkent State Nature Park, compiled at a scale of 1:150,000 based on GIS analysis, clearly demonstrates this pattern (Fig. 4). Most records occur in the mid-mountain (1,961-2,942 m a.s.l.) and high-mountain (2,942-4,500 m a.s.l.) altitude ranges, which correspond to the main areas of ungulate concentration.

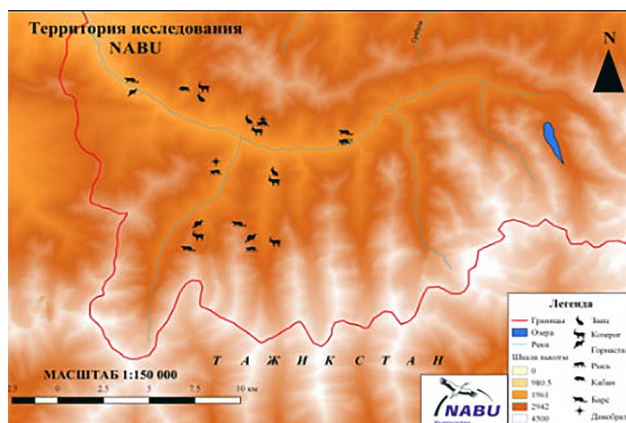


Figure 4. Wildlife observation points within the territory of the Sarkent State Nature Park

Source: NABU Kyrgyzstan (2021)

In addition to the snow leopard, camera traps have recorded the ibex, lynx, wolf, red fox, red marmot, badger, weasel, ermine, Himalayan marmot, rock partridge,

sand hare, red pika, wild boar, porcupine, bearded vulture and stone marten. Summary data on encounter frequency are presented in Table 2.

Table 2. Frequency of occurrences and number of independent events by type

Type	Number of independent events	Frequency, %
Siberian ibex	120	38
Himalayan snowcock	75	24
Sand hare	40	13
Snow leopard	20	6
Wolf	15	5
Lynx	8	3
Other types	42	11
Total	320	100

Source: compiled by the authors

The dominant presence of the mountain goat (38% of all records) confirms that there is a sufficient food supply for the snow leopard. High numbers were also recorded for the Himalayan marmot and the sand hare, which form an important part of the ecosystem's trophic structure. Predatory species – the snow leopard, wolf and lynx – were recorded significantly less frequently, which is consistent with their low population density and secretive lifestyle. The presence of rare protected species – the lynx, bearded vulture and stone marten – confirms the ecological stability of the studied area and the functional completeness of its food web.

The research conducted has provided a comprehensive description of the spatial distribution of the snow leopard and associated fauna within the Turkestan Range. It has been established that the population is characterised by low density and uneven distribution, broad

ecological flexibility, and close trophic links with ungulates. The data obtained confirm the high conservation potential of the Turkestan Range, but at the same time highlight the need to strengthen conservation measures in the face of increasing anthropogenic pressure.

Discussion

The data obtained on 21 identified snow leopards across the three study sites in the Turkestan Range are generally consistent with the results of similar monitoring studies in other regions (Spitsyn, 2023). However, direct comparison of numerical indicators requires caution: unlike most modern studies, this study did not calculate population density in standardised units (individuals/100 km²), as the camera trap deployment scheme was uneven and targeted. According to K. Suryawanshi *et al.* (2021), snow leopard density

estimates obtained using the spatial capture-recapture (SECR) method vary significantly across regions: from 0.19 individuals/100 km² in Himachal Pradesh (India) to over 3 individuals/100 km² in several regions of China. The lack of a standardised camera trap deployment scheme in this study prevents the calculation of comparable indices; however, the detailed individual identification and the distribution maps compiled provide a valuable basis for future SECR estimates.

The reproductive success identified in this study – 4 cubs out of 21 recorded individuals – indicates active reproduction within the local population. These findings are consistent with the results of long-term monitoring in the Naryn Nature Reserve (Kyrgyzstan): during four field seasons in the Naryn Nature Reserve, at least five adult snow leopards were identified, and throughout the study period, reproduction was recorded in two females – a total of five cubs and yearlings from three litters were recorded (Rode *et al.*, 2021). Data on reproduction are particularly important for assessing the long-term sustainability of the population: according to O. Johansson *et al.* (2020), snow leopard cubs remain with their mother for up to 20-22 months, which means that the minimum interval between successful litters is at least two years.

The wide recorded altitudinal range of the species – from 1,973 to 3,993 metres above sea level – indicates its high ecological plasticity. A similar pattern is observed in other mountain ranges of Central Asia. The snow leopard's seasonal movements across altitudinal zones are well documented in the literature: GPS tagging in the Mongolian Altai has shown that females' monthly home ranges shrink in summer, whilst males maintain a stable home range size throughout the year; with both sexes preferring steep south-western slopes at high altitudes during the winter (Rosenbaum *et al.*, 2023). The seasonal dynamics observed in this study, in which the majority of autumn records occur at medium altitudes (2,400-2,800 m), whilst both low and maximum elevations are recorded in winter and early spring, are consistent with this pattern: the snow leopard follows the food supply and available habitats depending on the season.

The significant positive spatial correlation identified between the distribution of the snow leopard and the concentration of the ibex (120 independent events, 38% of records) confirms the key role of trophic factors in shaping the spatial structure of the population. This conclusion is supported by a wide range of studies. In a study assessing snow leopard abundance in Himachal Pradesh, K. Suryawanshi *et al.* (2021) demonstrated a significant positive linear relationship between snow leopard density and wild ungulate density ($R^2 = 0.51$, $p = 0.01$); areas with high ungulate density also exhibited higher snow leopard density. A similar pattern was described by S.M. Kachel *et al.* (2022) for the ecosystems of the Mongolian Altai: in Tajikistan – in

the Zorkul Nature Reserve – both snow leopards and wolves relied heavily on long-tailed marmots during the summer, although as the population of this species declines in winter, trophic competition between predators may intensify. The spatial interaction of the snow leopard with other predators – the lynx and the wolf – warrants separate consideration. The simultaneous detection of these species by camera traps on the Turkestan Range indicates shared use of the territory. According to S. Kachel *et al.* (2023), snow leopards and wolves exhibit different patterns of spatial use – snow leopards tend to favour steeper slopes and rugged terrain compared to wolves, and it is precisely this topographical separation of space that constitutes the main mechanism of their coexistence. This makes the mapping of habitats and terrain – implemented in this study by overlaying GPS data onto a digital elevation model – a particularly valuable tool for analysing interspecific interactions.

The presence of the bearded vulture (*Gypaetus barbatus*), a rare protected species, underscores the ecological value of the study area. The presence of high-level scavengers alongside an apex predator indicates the functional completeness of the food web. Research by J.S. Alexander *et al.* (2016) in the Qilian Mountains Nature Reserve (China) showed that other large predators – the wolf, lynx, red fox – are regularly encountered, which allows the snow leopard to be regarded as an umbrella species, the presence of which indirectly ensures the protection of the entire predator community. The high frequency of Himalayan snowcock (*Tetraogallus himalayensis*) sightings – 75 independent records, 24% of all records – is significant from the perspective of the snow leopard's trophic ecology. This bird is a common component of its diet in the high-altitude ecosystems of Central Asia. According to data from G.C. Christensen (2020), in the Central Asian part of its range, the Himalayan snowcock may descend to 2,500 m in spring to feed on young vegetation, and then return to higher altitudes, which chronologically correlates with the data obtained in this study on spring sightings of the snow leopard in the mid-mountain zone.

The data obtained confirm the status of the studied areas of the Turkestan Range as a stable snow leopard habitat with high reproduction rates and a functionally complete food web. The predator's identified association with mountain goat populations, seasonal shifts in altitude zones, and coexistence with other large carnivores are fully consistent with the species' pan-areal ecological strategy as an "umbrella" taxon. Despite methodological limitations in calculating population density due to the specific placement of camera traps, the detailed identification of 21 individuals and the mapping of their home ranges form the necessary basis for transitioning to standardised monitoring using the SECR method. This will enable the results of research on the Turkestan Range to be integrated into

global assessments of the status of snow leopard populations in Central Asia.

Conclusions

The study confirmed the key role of systematic monitoring in the conservation of biodiversity in Kyrgyzstan's mountain ecosystems. Using the Turkestan Range as a case study, it demonstrated the high effectiveness of remote monitoring methods – particularly camera traps – in studying the snow leopard and associated fauna. Compared to traditional approaches (recording based on signs of activity), this method provides more reliable results, requires less labour and has no negative impact on the animals, although the specific features of the terrain and natural conditions must be taken into account when applying it. In 2020-2021, 87 camera traps were installed in the territories of the Sarkent State Nature Park, the Surmatash State Nature Reserve and the Leylek Forestry, and field research and mapping were carried out. As a result, 21 snow leopards (17 adults and 4 cubs) were identified, indicating reproduction and the relative stability of the population. The use of a unique pattern recognition method enabled the creation of “photo-IDs” for the animals, providing a basis for their further monitoring.

An analysis of altitude distribution (1,973-3,993 m above sea level) revealed the species' ecological plasticity and its adaptation to seasonal changes and the availability of prey. Spatial analysis confirmed the link between the snow leopard's range and the distribution of its prey, as well as overlaps with the ranges of the lynx and the wolf. During the studies, 16 animal species were recorded, including two listed in the Red Data Book, which underscores the importance of conserving this ecosystem. The photo databases and distribution

maps created provide a reliable basis for long-term monitoring. However, the study has limitations related to uneven coverage of the territory during the winter period and the inability to accurately calculate population density, which requires the use of more detailed spatial analysis methods in the future. The results obtained confirm the need to continue research into the snow leopard population and the state of its food supply in order to develop effective conservation measures. Livestock grazing and poaching remain key threats, which must be taken into account when formulating conservation policy.

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References

- [1] Alexander, J.S., Zhang, C., Shi, K., & Riordan, P. (2016). A granular view of a snow leopard population using camera traps in Central China. *Biological Conservation*, 197, 27-31. doi: 10.1016/j.biocon.2016.02.023.
- [2] Asykulov, T. (2021). *Study and protection of the snow leopard habitat*. *Science, New Technologies and Innovations of Kyrgyzstan*, 4, 112-116.
- [3] Bizhanova, N.A., Grachev, Yu.A., Saparov, K.A., & Grachev, A.A. (2017). *Distribution, abundance and some features of the ecology of large carnivores in Kazakhstan: Analytical review*. *Eurasian Journal of Ecology*, 52(3), 97-107.
- [4] Christensen, G.C. (2020). Himalayan snowcock (*Tetraogallus himalayensis*), version 1.0. In S.M. Billerman (Ed.), *Birds of the world*. Ithaca: Cornell Lab. doi: 10.2173/bow.himsno.01.
- [5] Decree of the President of the Kyrgyz Republic No. 369 “On Recognition of the Snow Leopard as the National Symbol of the Kyrgyz Republic”. (2023, December). Retrieved from <https://cbd.minjust.gov.kg/230001468/edition/2820/ru>.
- [6] Dylidaev, M., Chymyrov, A., Mukabaev, A., & Omurzak uulu, O. (2021). Investigation of the population area of snow leopard in the Central Tian-Shan Mountains. *E3S Web of Conferences*, 227, article number 02002. doi: 10.1051/e3sconf/202122702002.
- [7] International Union for Conservation of Nature (IUCN). (2012). *Guidelines for application of IUCN Red List criteria at regional and national levels*. Retrieved from <https://portals.iucn.org/library/sites/library/files/documents/RL-2012-002.pdf>.
- [8] Johansson, O., Ausilio, G., Low, M., Lkhagvajav, P., Weckworth, B., & Sharma, K. (2021). The timing of breeding and independence for snow leopard females and their cubs. *Mammalian Biology*, 101, 173-180. doi: 10.1007/s42991-020-00073-3.

- [9] Kachel, S., Bayraccismith, R., Kubanychbekov, Z., Kulenbekov, R., McCarthy, T., Weckworth, B., & Wirsing, A. (2023). Ungulate spatiotemporal responses to contrasting predation risk from wolves and snow leopards. *Journal of Animal Ecology*, 92, 142-157. doi: [10.1111/1365-2656.13850](https://doi.org/10.1111/1365-2656.13850).
- [10] Kachel, S.M., Karimov, K., & Wirsing, A.J. (2022). Predator niche overlap and partitioning and potential interactions in the mountains of Central Asia. *Journal of Mammalogy*, 103(5), 1019-1029. doi: [10.1093/jmammal/gyac026](https://doi.org/10.1093/jmammal/gyac026).
- [11] Kashkarov, E.P. (2017). *The snow leopard of Kyrgyzstan: National shame or national pride*. *Russian Regions: A Look into the Future*, 4(2), 239-263.
- [12] Kuzhlekov, A.O., Skopintseva, E.V., & Gulyaev, D.I. (2022). *Research and monitoring of the snow leopard in the Altai Republic*. In G.Yu. Gulyaev (Ed.), *Scientific research – 2022: IV international scientific and practical conference* (pp. 22-26). Penza: MCNS "Science and Education".
- [13] Li, J., Shi, X., He, X., Li, D., Hu, Q., Zhang, Y., & Ran, J. (2023). Free-ranging livestock affected the spatiotemporal behavior of the endangered snow leopard (*Panthera uncia*). *Ecology and Evolution*, 13, article number e9992. doi: [10.1002/ece3.9992](https://doi.org/10.1002/ece3.9992).
- [14] Ma, H., Qiuying, B., Rong, Z., Zhang, J., Liang, G., Ma, S., Gao, Y., & Chen, S. (2024). Snow leopard (*Panthera uncia*) activity patterns using camera traps in the Qilian Mountain National Park (Qinghai Area), China. *Animals*, 14(18), article number 2680. doi: [10.3390/ani14182680](https://doi.org/10.3390/ani14182680).
- [15] NABU Kyrgyzstan. (2021). *Report on the identification of snow leopards from camera trap images*. Bishkek: Monitoring Department of NABU Kyrgyz Republic Branch.
- [16] NABU Kyrgyzstan. (2022). *Activity report 2010-2020: Ten years of wildlife protection activities*. Retrieved from <https://en.nabu.de/imperia/md/nabu/images/international/asien/kirgistan/220804-nabu-activity-report-kyrgyzstan-en-web.pdf>.
- [17] Nature and Biodiversity Conservation Union (NABU). (2025). *Upward trend for snow leopards in Kyrgyzstan*. Retrieved from <https://en.nabu.de/news/2025/35792.html>.
- [18] Rode, J., Lambert, C., Marescot, L., Chaix, B., Beesau, J., Bastian, S., Kyrbashev, J., & Cabanat, A.-L. (2021). Population monitoring of snow leopards using camera trapping in Naryn State Nature Reserve, Kyrgyzstan, between 2016 and 2019. *Global Ecology and Conservation*, 31, article number e01850. doi: [10.1016/j.gecco.2021.e01850](https://doi.org/10.1016/j.gecco.2021.e01850).
- [19] Rosenbaum, B., et al. (2023). Seasonal space use and habitat selection of GPS collared snow leopards (*Panthera uncia*) in the Mongolian Altai Range. *PLoS ONE*, 18(1), article number e0280011. doi: [10.1371/journal.pone.0280011](https://doi.org/10.1371/journal.pone.0280011).
- [20] Spitsyn, S.V. (2023). Results of monitoring the transboundary grouping of snow leopard on the Altai side of the Chikhachev Ridge by the method of camera trap in 2021-2022. *Field Research in the Altai Biosphere Reserve*, 5, 33-57. doi: [10.52245/26867109_2023_5_33](https://doi.org/10.52245/26867109_2023_5_33).
- [21] Suryawanshi, K., et al. (2021). Estimating snow leopard and prey populations at large spatial scales. *Ecological Solutions and Evidence*, 2, article number e12115. doi: [10.1002/2688-8319.12115](https://doi.org/10.1002/2688-8319.12115).
- [22] Yang, C., Zhang, P., Wu, Y., Dai, Q., Luo, G., Zhou, H., Zhao, D., & Ran, J. (2021). Livestock limits snow leopard's space use by suppressing its prey, blue sheep, at Gongga Mountain, China. *Global Ecology and Conservation*, 2, article number e01728. doi: [10.1016/j.gecco.2021.e01728](https://doi.org/10.1016/j.gecco.2021.e01728).

Түркстан кырка тоосундагы жапайы жаныбарларга болгон айрым мониторингдик изилдөөлөр

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Аннотация. Кыргызстандагы тоолуу экосистемалардын биоар түрдүүлүгүн сактоо азыркы экология илиминин жана жаратылышты коргоо практикасынын приоритеттүү милдеттеринин бири бойдон калууда. Бул аймакта малды жыл бою жайыттоо, браконьерлик жана жашоо чөйрөлөрүнүн фрагментациясы сыяктуу антропогендик факторлор күч алууда. Изилдөөнүн максаты Түркстан кырка тоосунда ак илбирстин (*Panthera uncia*) популяциясынын жана аны коштогон фаунанын мониторингинин жыйынтыктарын талдоо болгон. Жумушта 2020-2021-жылдары “Саркент” мамлекеттик жаратылыш паркында, “Сүрмө-Таш” мамлекеттик коругунда жана Лейлек токой чарбасында 87 Reconyx HC500 фототузак орнотулган аралыктан мониторинг ыкмалары колдонулган. Фототузактар жаныбарлардын издери боюнча 2-3 км аралыкта максаттуу жайгаштырылган. Жеке идентификация тактардын уникалдуу үлгүсү боюнча эки көз карандысыз эксперт тарабынан жүргүзүлгөн. Маалыматтарды мейкиндик талдоо ArcGIS жана QGIS программаларында рельефтин санариптик моделин колдонуу менен аткарылган. Изилдөө учурунда 21 ак илбирс аныкталган, анын ичинде 4 баласы – бул жергиликтүү популяциянын көбөйүшүн тастыктайт. Түр жогорку экологиялык пластикалуулукту көрсөткөн: деңиз деңгээлинен 1973 метрден 3993 метрге чейинки бийиктик диапазонунда жашайт. Жырткычтын мейкиндик жайгашуусу менен тоо текелеринин (120 окуя, 38 %) топторунун тыгыздыгынын ортосунда күчтүү оң корреляция аныкталган. 15 түр сүт эмүүчү жана канаттуулар боюнча 320 көз карандысыз окуя катталган; басымдуулук тоо текеси, гималай улары жана кумдук коендо. Жаныбарлардын бөлүштүрүлүшү жана бийиктик фиксацияларынын сезондук динамикасынын деталдуу карталары түзүлгөн. Талдоо экосистеманын туруктуу трофикалык түзүмүн жана Кызыл китепке кирген сейрек түрлөрдү (сүлөөсүн, бүркүт-бородач) ырастаган. Алынган материалдар ак илбирсти сактоо чараларын иштеп чыгуу жана Түркстан кырка тоосунун өзгөчө корголуучу жаратылыш аймактарын башкарууну оптималдаштыруу үчүн практикалык мааниге ээ

Негизги сөздөр: ак илбирс; фототузактар; популяцияны баалоо; бийиктик боюнча бөлүштүрүлүш; трофикалык байланыштар; мейкиндик талдоо; ГИС-технологиялар

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Аннотация. Сохранение биоразнообразия горных экосистем Кыргызстана остается одной из приоритетных задач современной экологии и природоохранной практики в условиях усиливающегося антропогенного давления, связанного с круглогодичным выпасом скота, браконьерством и фрагментацией местообитаний. Целью исследования был анализ результатов мониторинга популяции снежного барса (*Panthera uncia*) и сопутствующей фауны на территории Туркестанского хребта. В работе применены методы дистанционного мониторинга с использованием 87 фотоловушек модели Reconyx HC500, установленных целевым образом в Государственном природном парке «Саркент», Государственном природном заповеднике «Сурмө-Таш» и Лейлекском лесном хозяйстве в 2020-2021 годах. Фотоловушки размещались по следам животных на тропах и перевалах с интервалом 2-3 км. Идентификация особей проводилась по уникальному рисунку пятен двумя независимыми экспертами. Пространственный анализ данных выполнялся в программах ArcGIS и QGIS с наложением на цифровую модель рельефа. В результате было идентифицировано 21 особь снежного барса, включая 4 детеныша, что подтвердило успешное воспроизводство локальной популяции. Вид продемонстрировал высокую экологическую пластичность, занимая высотный диапазон от 1973 до 3993 м над уровнем моря. Выявлена выраженная положительная пространственная корреляция между распределением хищника и концентрацией копытных (горный козел – 120 независимых событий, 38 % всех регистраций). Зафиксировано 320 независимых событий по 15 видам млекопитающих и птиц; доминировали горный козел, гималайский улар и заяц-песчаник. Составлены детальные карты распределения животных и сезонной динамики высотных фиксаций, показавшие преобладание регистраций в средне- и высокогорных поясах. Анализ подтвердил устойчивую трофическую структуру экосистемы и присутствие редких охраняемых видов (рысь, бородач). Полученные материалы представляют практическую ценность для разработки мер охраны снежного барса и оптимизации управления особо охраняемыми природными территориями Туркестанского хребта

Ключевые слова: снежный барс; фотоловушки; популяционная оценка; высотное распределение; трофические связи; пространственный анализ; ГИС-технологии