École de Biologie
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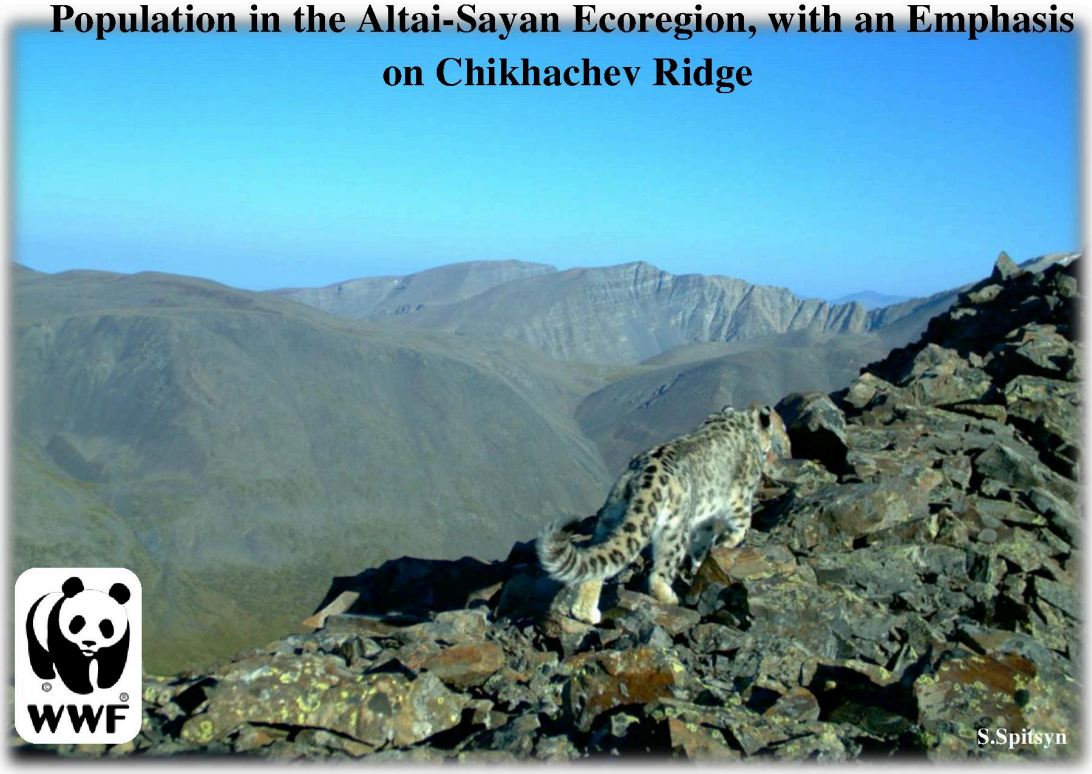
Altaisky State Nature Biosphere Reserve
Altai Republic, Russia

Assessing Distribution and Number of the Snow Leopard (*Panthera uncia*) Population in the Altai-Sayan Ecoregion, with an Emphasis on Chikhachev Ridge



Internship report submitted in partial fulfilment
of the requirements for M. Sc. Degree in Biology of Organisms and Ecology

Academic year 2015-2016

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On the trails of the snow leopard: Russian volunteers, Sergei Spitsyn, snow leopard expert, and Audrey Jost (the author) for the Altaisky zapovednik and WWF Russia (A. Smolentsev)

Contents

I. Hosting structure

The Altaisky State Nature Biosphere Reserve (Алтайский Государственный Природный Заповедник (АГПЗ)) is a Russian "zapovednik"[1] located in the north eastern part of the Altai Republic, South Siberia, Russia. It was established on April 16th 1932 and is, since December 5th 1998, part of the UNESCO World Heritage Site "Золотые горы Алтая" (Golden Mountains of Altai). The reserve is divided into three zones (Appendix 1 includes further details):

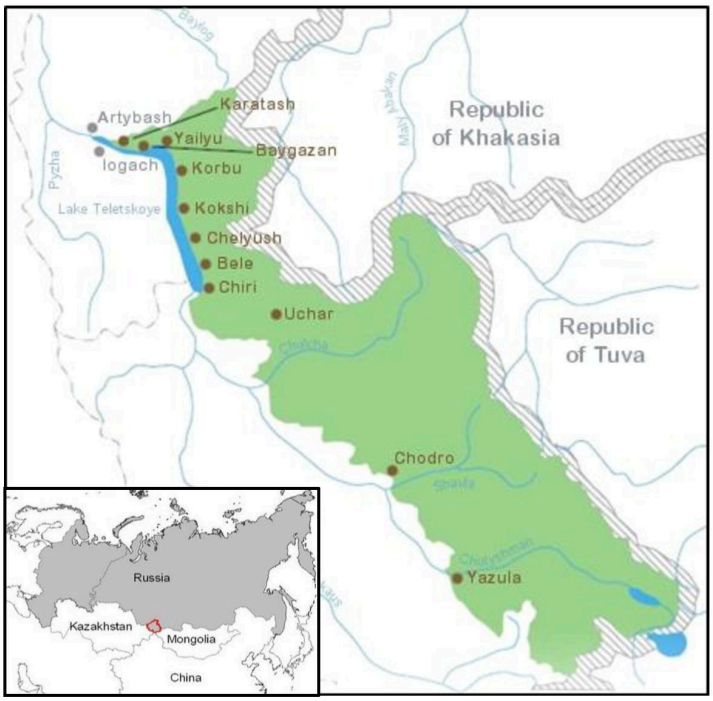

Figure 1. Localization of the Altai Republic and map of the core area of the reserve (АГПЗ)

- The core area territory is the zone of the reserve where conservation activity is developed. It includes 871 206 ha (25%) of different ecosystems such as taiga, tundra, and alpine highlands for example. It also contains 52% of the Teletskoye Lake's water surface (11 757 ha) (Figure 1);

- The buffer zone (962 800 ha, 27%) serves to neutralize potential negative processes and activities on the core area;

- The transition zone contains lands for agricultural production and provides help for improving socio-economic development. 48% (1 688 198 ha) are included in the transition area (RGO booklet).

Since May 26th 2009, the Altai Reserve is part of the UNESCO program "Man and Biosphere" (MAB). It also currently has joint research projects with the Parc des Bauges (France), the Karst Research Institute (Slovenia) and the State University of Helsinki (Finland).

The head office of the reserve is located in the capital of the Altai Republic, Gorno-Altaisk, situated approximately 200 km from Yailyu, a settlement located in the core area where the Reserve's central administrative building can be found. As of January 1st 2016, 88 people are employees of the reserve and 33 of them work directly in Yailyu.

As the Altaisky Reserve is a zapovednik, building construction, economic activities and unrestricted entry are prohibited. However, parts of the territory are open to public, although an entry permit is necessary – it can be obtained by contacting the head office. Tourism in the reserve can take different forms, ranging from scientific tourism, ecotourism and green tourism to sport tourism.

The flora and fauna of the reserve are quite diverse, with more than 3101 plants species and 420 animal species found there; 70 species being mammals (UNESCO, 2009). Some of these are registered in the IUCN[2] Red List of Threatened Species, such as the snow leopard (*Panthera uncia* syn *Uncia uncia*), which is listed as Endangered. My internship is mainly based on the conservation and population monitoring of this elusive animal, as part of a collaboration work between several people from different organizations such as World Wide Fund for Nature (WWF), and Altaisky and Katunsky Reserves for example.

[1] A zapovednik (Russian: заповедник) is the name given to a protected area maintained in its natural condition, where public access is restricted

[2] International Union for Conservation of Nature

II. Introduction to the snow leopard project

The snow leopard (*Panthera uncia* syn *Uncia uncia*) is a large felid endemic to the mountains of Central Asia. (McCarthy & Chapron, 2003). Occurring mainly in rugged highlands, clearly defined crests of mountain ridges and deep gorges within 12 countries, the snow leopard is registered in the Red Data Book of Russia, which is interrelated with the IUCN list. Solitary and secretive, with an inhospitable native terrain, limited specific funding and a lack of localized biology experts, the actual status, biology and ecology of the snow leopard unfortunately remains poorly understood (Jackson *et al.*, 2005).

Even though Russia contains one of the largest potential snow leopard habitat areas (second after China), only 1-2% of the big cat's total population (thought to be around 4080-6590 animals) can be found in the country (McCarthy & Chapron, 2003). Latest data (2000-2011) estimated that the number of snow leopards in Russia to consist of 70-90 individual animals (Paltsyn *et al.*, 2015). The optimal habitat areas for the few stable populations of animals are located in the Altai-Sayan ecoregion (Figure 2) which includes among others, the Altai Republic.

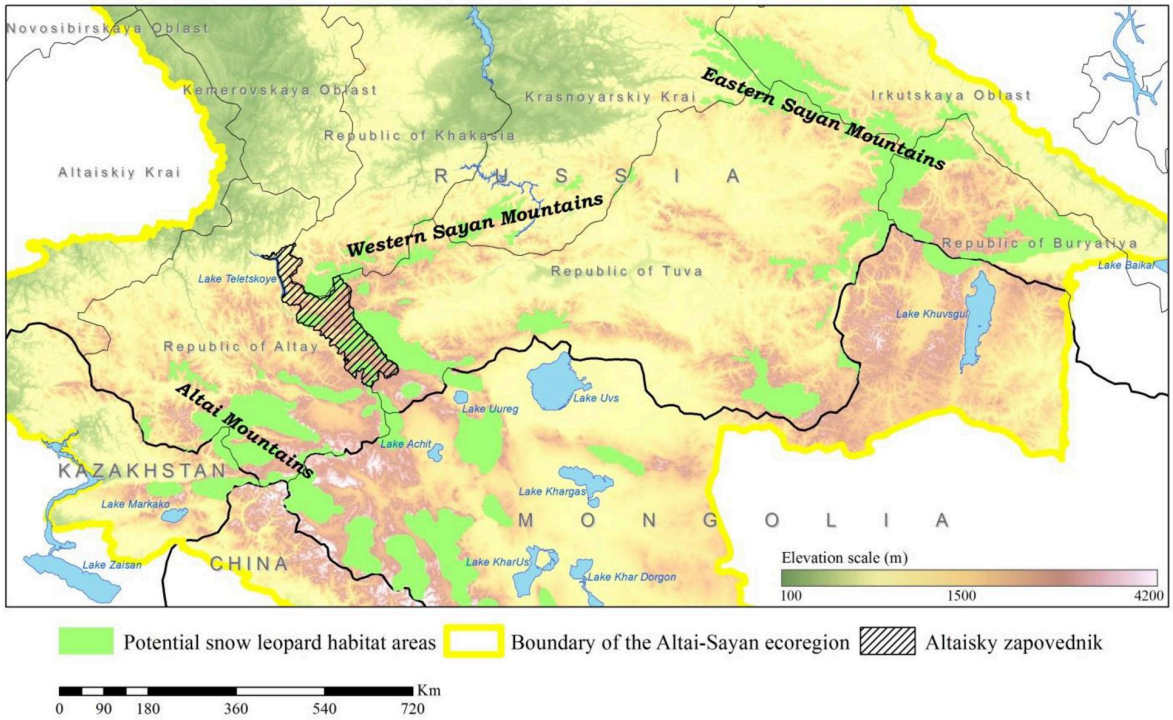

Figure 2. Distribution of the snow leopard habitats in Russia and adjoining Mongolia, Kazakhstan and China (modified from Paltsyn *et al.*, 2015)

The diet of the snow leopard in the Altai-Sayan ecoregion mainly consists of Siberian ibex (*Capra ibex sibirica*), an ungulate whose range on the Russian side almost completely overlaps with the cat's range. However, it can also kill argali mountain sheep (*Ovis ammon*), yaks (*Bos grunniens*), Altai snowcocks (*Tetraogallus altaicus*) and marmots (*Marmota* spp.). Attacks on livestock have also been reported, causing tensions with local people who have subsequently become one of the main threats to the carnivore, along with poaching and loss of prey base and/or habitat (Paltsyn *et al.*, 2012).

As the snow leopard is an umbrella species, its conservation is closely linked to the protection of not only other animal species but also the protection of the entire mountain-steppe and mountain-tundra biomes (Batnager *et al.*, 2002 ; Paltsyn *et al.*, 2012, 2015). My internship therefore takes place in the context of this conservation strategy currently running in Russia. Its main goal is to monitor the snow leopards present on the Russian side of the Altai-Sayan ecoregion and more particularly in the Altai Republic.

The source of financial income for this snow leopard conservation program of the Altai Reserve is predominantly from funding via federal budget, provided to perform search research on the "Monitoring of the population of the snow leopard in the key areas of the Altai-Sayan Ecoregion" topic. Further monetary input derives from WWF, Global Environment Facility (GEF), United Nations Development Programme, as well as Siberian Health, LLC for example.

During the time of my internship, I was mainly under the supervision of Sergei Spitsyn. He is senior researcher working in the department of Science of the Altaisky zapovednik and he specialized in scientific research of rare animal species, particularly the snow leopard and the mountain sheep. I was in touch with him on a regular basis, either through meetings at the zapovednik office (in Gorno-Altaisk or in Yailyu) or through email/phone. I also later met, during a WWF Russia seminar held in Barnaul (Altaisky Krai), other experts working on snow leopard conservation, in Russia but also in Mongolia.

III. Methods used for monitoring

To survey the status and distribution of snow leopards, a standardized technique has been developed; the Snow Leopard Information Management System (SLIMS). It involves simple field techniques to establish the presence of the species within a particular area (First Order Surveys) and to monitor relative abundance (Second Order Surveys) based on signs left by snow leopards (Jackson & Hunter, 1996). Indeed, as the snow leopard is a very elusive animal, it is rare to see them and count them directly. However, they do leave specific signs of activity indicating their presence, such as scrapes, scats or feces, pugmarks and scent-sprayed rocks. The SLIMS methodology also includes survey of prey species.

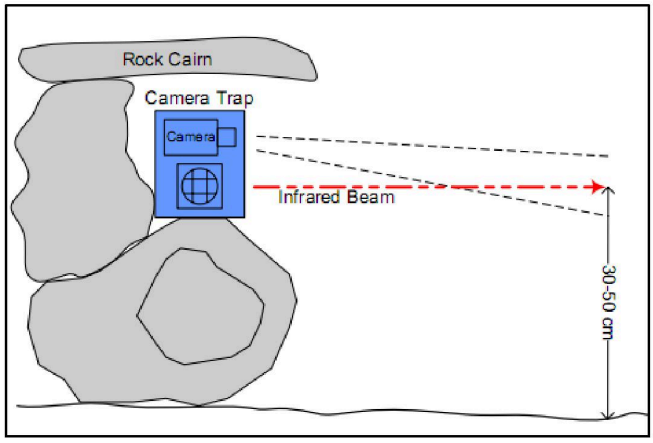

Figure 3. Theoretical example of a rock cairn used to stabilize a camera-trap (from Jackson *et al.*, 2005)

In addition, camera-trap surveys are also conducted. Automatic cameras are installed on the sites known to be frequently visited by snow leopards. The pictures and videos taken allow identification through the unique spotting pattern on the cat. Automatic camera-traps are usually attached to trees, but as these are lacking in most of snow leopards sites, cairns are built in order to hide the camera and its sensors, but also to protect them from bad weather and overheating during sun exposure (Jackson *et al.*, 2005). The optimal height for the infrared beam to be set is around 30-50 cm above ground; this height being the average chest height of a snow leopard (Figure 3, Figure 4).

The camera-traps are high-speed digital cameras equipped with passive infrared motion detectors and infrared night vision LEDs. During the day, images are in color, up to a 12 Megapixel high-quality resolution (Boskon Guard). They are monochrome at night. Videos with sound can also be recorded, up to 1080P high definition resolution.

The interval between snapshots is 1 second, with up to 7 shots in sequence (Reconyx). The usual length of a video is 60 seconds. Cameras work with a SD card and run on 8 or 12 batteries. Photos taken are stamped with the date, time, moon phase and temperature, which can provide useful information on the snow leopard's activity pattern. Some of them, such as Boskon traps, have an MMS function: with a working SIM card inserted, MMS can be sent to registered numbers as soon as a picture is taken. This allows us to know when a snow leopard triggers the trap without needing to go check the camera. We used different models of Boskon, Bushnell, Reconyx and Bestok traps (Figure 4). I learnt how to use them and how to program the MMS function, either on the trap itself or with the help of a computer.

Map 1. Orography scheme of the Altai Mountains

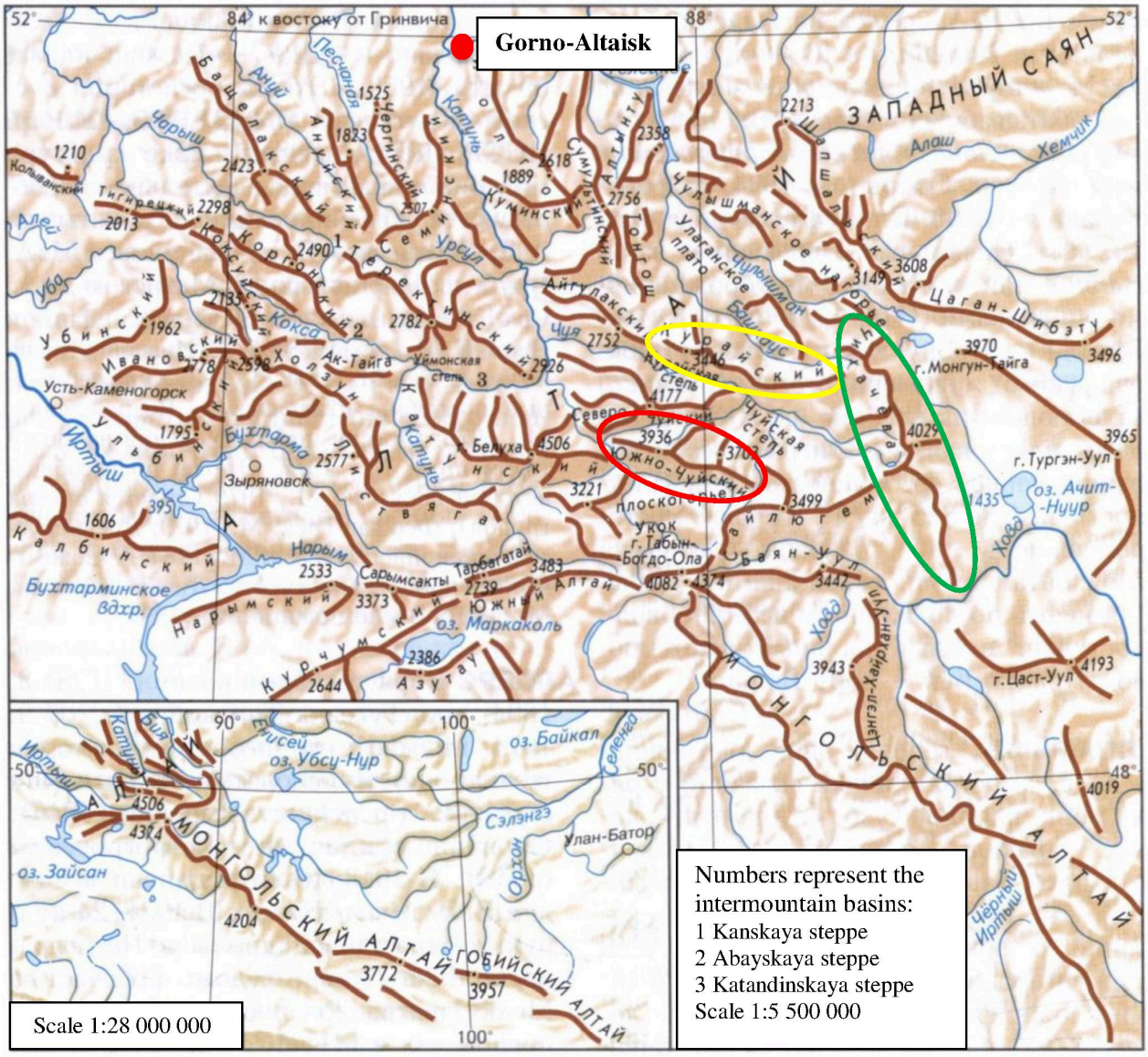

Figure 4. Different models of camera-traps have been used: Boskon Guard with MMS function (with antenna) hidden in a rock cairn (left) ; Bushnell and Bestok camera-traps (middle) ; installation of a Bushnell trap by Audrey Jost (the author) (right)

IV. Presentation of the study area

Snow leopards have been spotted in many locations in the Altai Republic (Appendix 2). However, their presence is sometimes only sporadic. Two locations are currently well-known to be home to sustainable snow leopard populations, both parts of the Golden Mountains of Altai: Argut River basin and Chikhachev Ridge. Argut River basin includes Katunsky and North and South Chuisky Ridges System. It is only in 2012 that evidence of the continuous presence of snow leopards was discovered in that area, notably in the Kulagash, Iedygem and Karagem river valleys. However, their occupancy on Kuraisky Ridge has also been proven since the beginning of 2015, notably the presence of kittens, and more research is therefore conducted in this area (Kuzhlekov *et al.*, 2016). Evidence of this presence takes the form of photographs and videos of individuals captured on camera-traps, as well as specific signs of activity described earlier. These surveys are also part of an ecotourism program where selected participants follow the tracks of snow leopards in their native habitat.

I took part in such an expedition on the Southern part of Chikhachev Ridge where we climbed to 3500m. This ridge is located in South-Eastern Altai. It is a transboundary corridor between Russia (Altai and Tuva Republic) and Mongolia where 245 km² are suitable habitat for the predator (Kuzhlekov *et al.*, 2016). On the Altai Republic side, the ridge is located in the districts of Ulagan and Kosh-Agach. Part of it is located in the Altaisky reserve. It expands on 100km, with a maximum elevation of 4029m (Turgen-Ula peak). The ridge itself is comprised of rocky and glacial terrain. Rocky landscapes, grasslands, as well as shrubs are specific to a tundra-steppe climate, implying minimal vegetation; indeed mostly only Gramineae are present (Figure 5). As is usual with the tundra landscape, the climate is characterized by increased wind levels at higher elevations.

Fauna is quite diverse. Steep slopes are home to Argali mountain sheep and Siberian ibex, main prey of the big cat. Alongside the snow leopard live other carnivores such as the corsac fox (*Vulpes corsac*) and the Pallas's cat (manul) (*Otocolobus manul*). Grasslands are home to rodents like the Altai marmot (*Marmota baibacina*) and the long tailed ground squirrel (*Spermophilus undulates*) with prey birds such as the black kite (*Milvus migrans*) also being common.

I was also able to participate to a second expedition that took place on the Eastern side of Kuraisky Ridge and on South Chuisky Ridge. As much as the landscape of the latter looked like the landscape found on Chikhachev Ridge, the area of Kuraisky Ridge where the expedition was held is rather different as taiga forests consisting of pines, spruces and larches are dominant, along with an alpine tundra climate (Figure 5).

Locations of the ridges are presented on the adjacent map (Map 1).

Figure 5. Biomes encountered: top: tundra-steppe of Chikhachev Ridge and glacial terrain ; bottom: taiga and alpine tundra of Kuraisky Ridge

V. Identification of snow leopard individuals from photographs

Each snow leopard carries on its pelage a specific pattern of individual spots and rosettes that differ in shape, size, orientation and coloration. These patterns are not symmetrical, and can vary all over the body of the animal. In 1980, Blomqvist and Nyström identified captive snow leopards thanks to a distinctive spotting pattern on the forehead (Appendix 3). However, with camera-traps in the field, it is more difficult to get clear shots of the snow leopard's head. Moreover, even if a picture of the face is taken, it is not necessarily sharp enough to see details. This is why Jackson *et al.* determined other body parts that could be used as diagnostic identification areas. Following their protocol adapted from the bobcat identification using pelage patterns of Heilbrun *et al.*, (2003) (Appendix 4), I was able to sort pictures from camera-traps placed in Argut River basin and Chikhachev Ridge during the 2011-2015 period. I successfully identified more than 12 different individuals thanks to these photographs (Figure 6, Figure 7). I also completed a table illustrating, when it was possible, each side of the identified snow leopard. These tasks took place prior any field work.

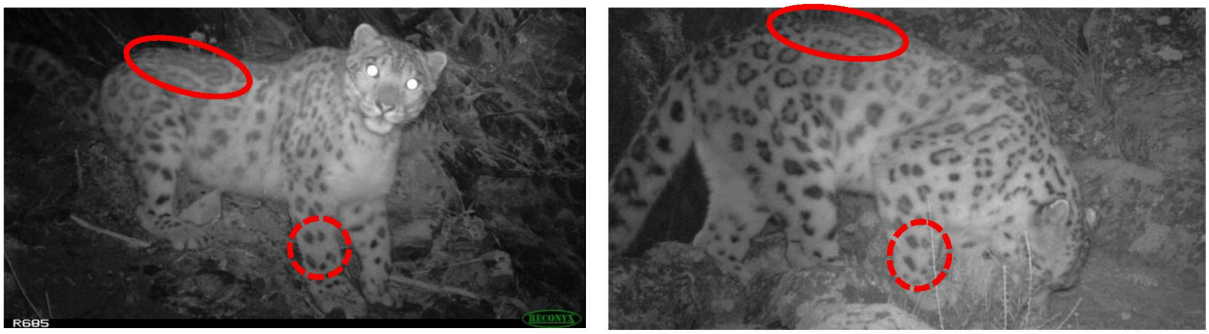

Figure 6. Identification of one snow leopard, Kryuk, based on pelage pattern. Solid line indicates the primary feature, dashed line indicates the secondary feature (S. Spitsyn)

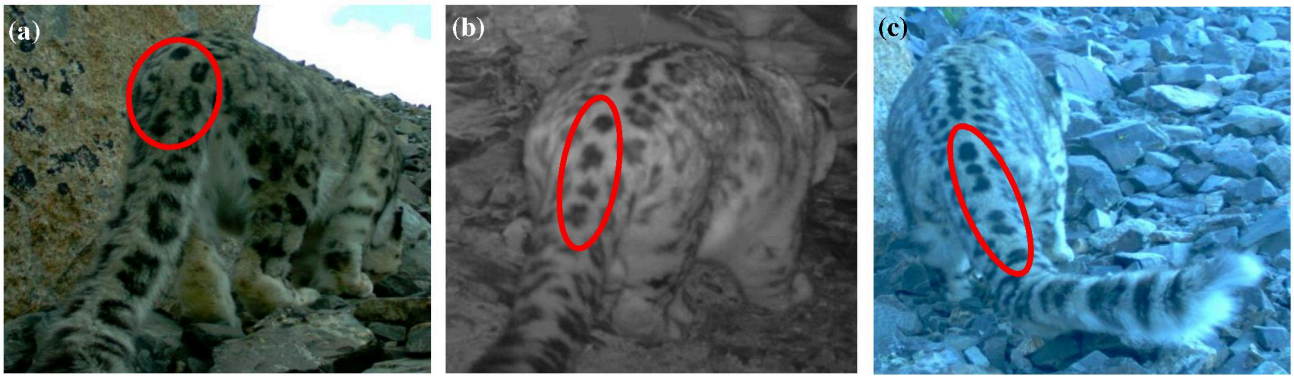

Figure 7. Pelage pattern differences on the dorsal surface of the tail (a) Bogusha (b) Kryuk (c) Khorgai (S. Spitsyn)

Some snow leopards had already been named, others remain unknown. However, there was great variance in the number of photographs of each individual: while one individual could be seen in approximately 20 pictures, another one could be spotted in more than 300 pictures. I was able to isolate 5 individuals with more than 100 pictures each. As all of them had been previously recorded on video footage, I also did high quality screenshots and added them to the corresponding folder. The pictures of these five snow leopards (named Kryuk, Vita, Bogusha, Khorgai and Guta) have been sent for use as a basis for a software program that automatically identifies if the picture of interest corresponds to one of the already known individuals. This program is running under the URL *irbis.bigsiter.ru* and was presented for the first time in May 2016. For each individual, a profile is manually completed, with their names, sex, date of birth, habitat place, genetic markers etc. Pictures of their specific pelage pattern are then uploaded. It then compares a picture to all the individuals registered and gives a probability of match for each individual. This site was also presented to journalists in May, however due to internet problems, to give an in-depth demonstration and explanation was difficult. Therefore, more training and time will be needed to learn how the site works and although it is in its infancy, this new site provides a tool that will be pivotal to this work in the future. Importantly, as Chikhachev Ridge is located in Russia and in Mongolia, the tool also includes the snow leopards on the Mongolian side.

VI. Expedition in the Altai mountains

The first expedition started on Chikhachev Ridge with 8 volunteers from the cities of Novosibirsk, Ekaterinburg and Tomsk. I later went alone to a different location with my supervisor Sergei Spitsyn. I finally went to Kuraisky and South Chuisky Ridges with Aleksei Kuzhlekov and Adar Anchin, two other snow leopard experts, and one volunteer from the Baikal region. Locations of the tracks, camps and camera-trap locations are presented on the adjacent maps (Map 1 and Map 2). As I focus mainly on the individuals inhabiting Chikhachev Ridge, only its results are presented here. It is however possible to spot them on Kuraisky Ridge, but it was not the case for this expedition.

1. Presence/absence of snow leopards:

For these expeditions, the strict SLIMS technique has not been used. These surveys are done at a specific time and separately from the camera-trapping expeditions, as are prey surveys. They also require other equipment. Nonetheless, we systematically searched each site for snow leopard signs. At the highest spots however, the deep snow cover and avalanches hid quite a lot of potential sign zones.

The most frequent snow leopard sign found was scrapes, present at the top of ridges where there was more or less flat terrain composed of gravel (Figure 8). They can occur in clumps of up to 24 but most of the ones found were solitarily (Jackson & Hunter, 1996). We however found one clump of 5 on Chikhachev Ridge. Camera-traps are often installed where these signs are found, as scrapes are one of the best reliable predictors of snow leopard presence and visitation, along with scent marks (Ahlborn & Jackson, 1988).

Figure 8. Solitarily scrape made in gravel (Chikhachev Ridge)

Feces were only found once, on a slope. They were of grey-white color, with a hard surface and dry interior, indicating old age (several weeks to several months (Figure 9). No other snow leopard scat was found.

Claw-rakes were found on living trees such as larches on Kuraisky Ridge (Figure 9). Old and more recent marks were visible on several trees. Their height on the trunk can be an indicator of the size of the animal, and therefore of its age.

Figure 9. Old feces found on Chikhachev Ridge (left) and claw-rakes on a tree found on Kuraisky Ridge (right)

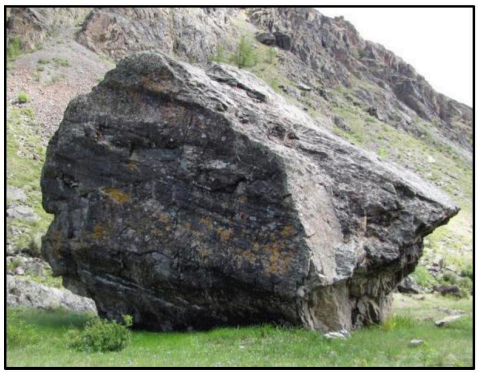

Figure 10. Typical boulder where scent marks can be found (Kuraisky Ridge)

Scent sprays typically occur on prominent overhanging boulders and at the base of cliffs (Figure 10). When they are fresh, they are easily detected by their strong odor. Scent is also spread by cheek-rubbing, which can leave some hair. Even though we checked several potential scent-sprayed rocks, no recent mark was identified.

No pugmarks or remains from kills were discovered either.

Furthermore, during the Kuraisky expedition, a snow leopard itself was spotted on the side of a slope (Figure 11).

In addition, several prey signs have been found such as resting depressions ("beds"), feces and horns. The animals themselves were spotted twice (3 female argali on Chikhachev Ridge and a herd of 40 ibex on South Chuisky Ridge).

Figure 11. Snow leopard "Han" sighting on Kuraisky Ridge (A. Anchin)

2. Photo-trapping:

We set new camera-traps and checked old ones for a total of 14 traps on Chikhachev Ridge and 8 on Kuraisky Ridge. Batteries and SD cards have been changed when needed. However, not all traps have been picked up. Indeed, we left the cameras that had not taken many pictures, as they will be picked up during the next expedition, in 3 months. Overall (Chikhachev and Kuraisky Ridges), snow leopard pictures have been caught on most cameras, but as presented in Table 1, their proportion is still low compared to false-triggered pictures (over 60% of pictures taken).

Parameter	Location 1	Location 2	Location 3
Percentage of snow leopard pictures	0%	0,6%	35,9%
Percentage of false pictures	73,8%	98,9%	61,1%
Percentage of non-target species pictures	26,2%	0,5%	3,1%

Table 1. Summary of pictures taken on the Chikhachev Ridge picked-up traps

Parameter / Location	Location 1 (2649m)	Location 2 (2805m)	Location 3 (3400m)
Sampling Period	09/3/2016 – 03/6/2016 87 days	04/3/2016 – 29/5/2016 87 days	18/12/2015 – 29/5/2016* 164 days
Number of cameras	1	1	3
Type of camera	Bushnell	Reconyx	Reconyx (2), Boskon (GSM)
Total number of photos	1269	2948	262
Number of snow leopards identified	0	1	2
Total number of snow leopards photos	0	17	94
Number of photos with false/no images	936 (73,8%)	2917 (98,9%)	160 (61,1%)
Number of photos of non-target species	333 (26,2%)	14 (0,5%)	8 (3,1%)
Siberian ibex (primary prey species)	0	3 (0,1%)	0
Argali (primary prey species)	45 (3,5%)	0	0
Rodents (marmot, ground squirrel)	234 (18,4%)	11 (0,4%)	0
Beech marten	45 (3,5%)	0	3 (1,1%)
Fox	9 (0,7%)	0	0
Bird (raven)	7 (With marmot) (0,6%)	0	5 (1,9%)

*Boskon trap only from 18/12/2015 to 27/1/2016

Table 2. Summary of camera-trap efforts at 3 locations on Chikhachev Ridge

As the populations in Russia and especially in the Altai Republic are not composed of a lot of individuals, photo capture-recapture density estimation is hard to achieve as the assumptions needed for statistical analyses cannot be reached. Moreover, a rigorous population estimate requires 20-40 camera-traps (Jackson *et al.*, 2005 ; McCarthy *et*

al., 2008), a number that is not reached yet in the study area. However, more camera-traps will be installed in the future. That being said, even if estimates are difficult to obtain, it is possible to provide a minimum number of snow leopards living in the area (McCarthy *et al.*, 2008). Applying the simplified approach of direct counting of individuals, it appeared that two snow leopards are still frequently encountered on the ridge, male Khorgai and female Guta (Table 2). Pictures of Khorgai received as MMS in mid-July also prove his presence at each spot. No other individual has been caught on camera during the time of my internship, but the picture of Guta on April 23rd 2016 seems to indicate kittens were probably born this past spring. Thanks to pictures received from the Mongolian side, we can also affirm that Guta and Khorgai regularly move from the Russian side of the ridge to the Mongolian side and vice-versa. It is then logical to think that others could do the same, as at least 7 more snow leopards have been spotted in Mongolia (expedition of June 2016). However, these constant movements across borders make it difficult to estimate the total number of individuals and a collaborative work between Mongolian and Russian sides has been set up. Gathering latest data from the field, I was able to determine that the population on Chikhachev Ridge is composed of about 9-13 individuals (12-16 individuals in 2015 as estimated by Paltsyn *et al.*)

Furthermore, camera-trapping can be a difficult method: in a region such as the Altai Republic where we know that the number of snow leopards is low, their pictures caught on camera traps must not be taken for granted. For example, 98,9% of all images caught at Location 2 are false images, triggered mainly because of the snowy weather, snow covering the infrared sensors (Table 1, Table 2). At Location 1, besides the fact that no snow leopard was caught on camera, the latter has been moved by a marmot and took many pictures while on the wrong side. The quality of snow leopard pictures might also be variable (even though it is possible to identify the individual thanks to a cross-comparison), as well as the number of pictures taken: it all depends of the model used. Besides, camera-trapping is a method that takes time and as my internship only lasted 4 months, I was not able to collect data from several expeditions, which would have been beneficial to obtain more precise estimates. However, traps also provide information on other animal species inhabiting the area, adding important photographic data to prey surveys (Table 2).

VII. Conclusion and perspectives

Even if it is true that weather conditions and the remoteness of areas do not always allow field work or collection of data, conservation and monitoring efforts must continue. It has recently been brought to our attention that Vita, the female snow leopard living in the Argut basin, was killed by poachers, as well as her kittens[3]. While populations in Russia seem to slowly grow, as we have proof that individuals on the territory are breeding, poaching constitutes one of the major threats to the predators, especially with such a low number of confirmed individuals.

Snow leopard presence on the ridges had already been proven earlier, but the sign evidence shows they still currently inhabit the area. Monitoring with camera-traps is quite recent in the republic, as it only started in 2010 with extensive research beginning only in 2015. Snow leopard displacements are still rather vague but search for sign in different areas provides more detailed information. Besides, even though wildlife radio telemetry method is still pretty new in Russia and radio-collaring of snow leopards is a project of great complexity, using radio signals to get the exact location of a transmitter attached to the animals could actually bring some useful information on their displacements.

Finally, collaboration work is essential to gather the most information possible on the elusive cat, so that more and more data can be collected and new tools such as DNA analyses based on scat and hair can be developed and used to provide greater help in the future.

[3] "Snow leopard female and her cubs died in a poacher's wire loop" WWF Russia article, May 30th 2016 https://www.wwf.ru/resources/news/article/eng/14308

VIII. Personal evaluation

My internship started in a pretty unusual way; the initial plan was to work for WWF Russia but I had troubles getting the invitation needed for the visa to enter Russian Federation and time was passing by. Luckily, everything was sorted out and I was able to maintain the same subject and still eventually work with WWF Russia, regardless of the fact that my start date was also delayed by about a month. As things began to go well, another surprise came to me in mid-June and I was forced to leave Russian territory because of a visa problem that arose due to some confusion and a misunderstanding from Russian administration. Being back to France with one month left in my internship, I decided to obtain a new visa and go back to Russia. It went quicker and smoother than expected and I was back only 5 days later.

The zapovednik team have been of great help and support to me during my journey. They warmly welcomed me at the airport, aided me in finding housing and were always there to answer my questions. During the first weeks, I could follow them in daily meetings and presentations in the reserve office itself, but also in front of journalists and at the university. It was interesting to see how they are promoting the reserve not only with meetings but also online, as they write articles, share pictures and facts on social media. This part was interesting as it showed me another side of the work that was not directly linked to the snow leopard project but to a conservation project as a whole.

Furthermore I had the chance to spend some time in the settlement of Yailyu. Besides entering a zapovednik for the first time and admiring the beautiful landscapes of the Altai Mountains, I could practice the use and manipulation of the same camera-traps that are deployed in the snow leopard habitats.

The field expedition itself was an incredible experience. I was initially disappointed that it happened later than expected, but in hindsight, this actually meant that I was able to study more about the snow leopard conservation in Russia itself and also about the individuals encountered in Russia. To recognize a snow leopard is not as easy as one would think, and I am glad I had time to practice and get used to it through my initial sorting and classifying of existing images that provided great help for the identification program. Eventually, I actually took part in two expeditions located on different ridges, which allowed me to compare the different snow leopard environments. I had never really hiked before but I am in good physical condition and although it was hard on the first trails, effort became easier throughout the days. However, mindset is equally as important. When others went back to the camp because of bad weather conditions/tiredness/etc, I decided to go on, believing I was there for a purpose. We ended up at 3 people but the result was worth it. It proved that even when one is rather comparatively small in stature, it is possible to achieve high objectives. Moreover, this made me gain my advisor's confidence, as he didn't know what I was capable of before. Trust placed in me became stronger and later on, I was even allowed to go install a camera-trap alone. However, for the results to be more accurate, it would have been nice to stay longer and participate to more expeditions.

Finally I would like to say a word about the integration in the country itself. I think it is worth to speak about it because one has to adapt not only to new work environment, but as a foreigner, you also need to adjust to a culture, a language and traditions that are not your own. Indeed, not many people speak English and most of my internship was in Russian only - communication with my supervisor included, as he does not speak English. I did study Russian for 3 years, but it was the first time I could actually use my skills in everyday life. It was difficult at first, but after some frustration and effort I now understand and speak much better. It also has quickly become clear to me that it was not possible to sum up Russia to Moscow, the only city I had already visited. Adaptation is a word that became completely meaningful to me in a very short time.

To conclude, this internship was a real roller-coaster and presented me with several challenges. Luckily, I always had people behind me that helped me facing situations. However, it reinforced the fact that I like working abroad and that I want to work in the field, preferably on feline conservation, in the future.

Piece of advice

I also would like to give some advice to other students that would want to get such an internship in Russia. Firstly, it is a great necessity to have at least basics in Russian language. English is a language that is still too rarely spoken and one could waste a lot of time focusing on becoming more proficient in the language instead of actually working on the internship topic. However, if possible, I would recommend taking more than just university classes, as I don't think university programs are entirely appropriate in preparation for full immersion in the country.

Secondly, it may be beneficial to practice or train in physical activity for some time prior to the internship, preferably endurance sport. Good physical condition is essential as slopes to climb to reach the places where camera traps are installed are rather steep. One should be able to walk and climb for several hours and kilometers. However, as mentioned earlier, a strong mindset is equally as important and recommended. Sleeping in a tent, having limited communication with the world (network is rare but not inexistent), one has to adapt to living in nature and giving up material comfort for a while. One also has to be careful because scratches, bruises, burns, cuts, mosquito bites and tick bites can be more common than thought.

Finally, one also has to be sure to be prepared to live far away from family, I know it can be hard for some people. On the administrative side, the visa for an internship is rather easy to get once one knows how to do, and it can be obtained in one day.

However, with motivation, one can always reach one's goals. The life experience such an internship brings is worth everything and the results are worth it. I could only recommend such an amazing adventure!

On the trails of the snow leopard: Artyom Smolentsev (volunteer) and Audrey Jost (the author) on Chikhachev Ridge (May 2016) (S. Spitsyn)

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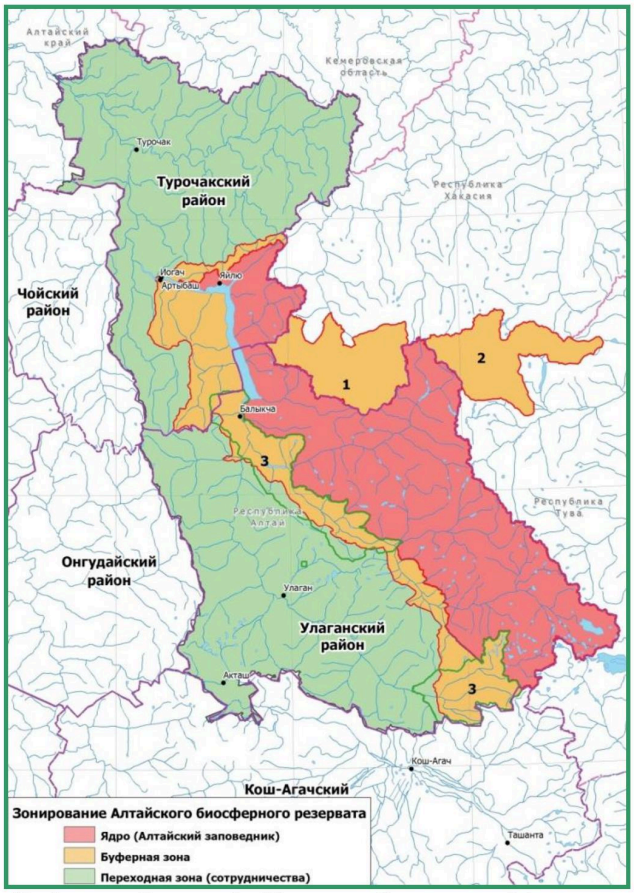
Appendices

Appendix 1

Map of the 3 zones of the Altaisky State Reserve

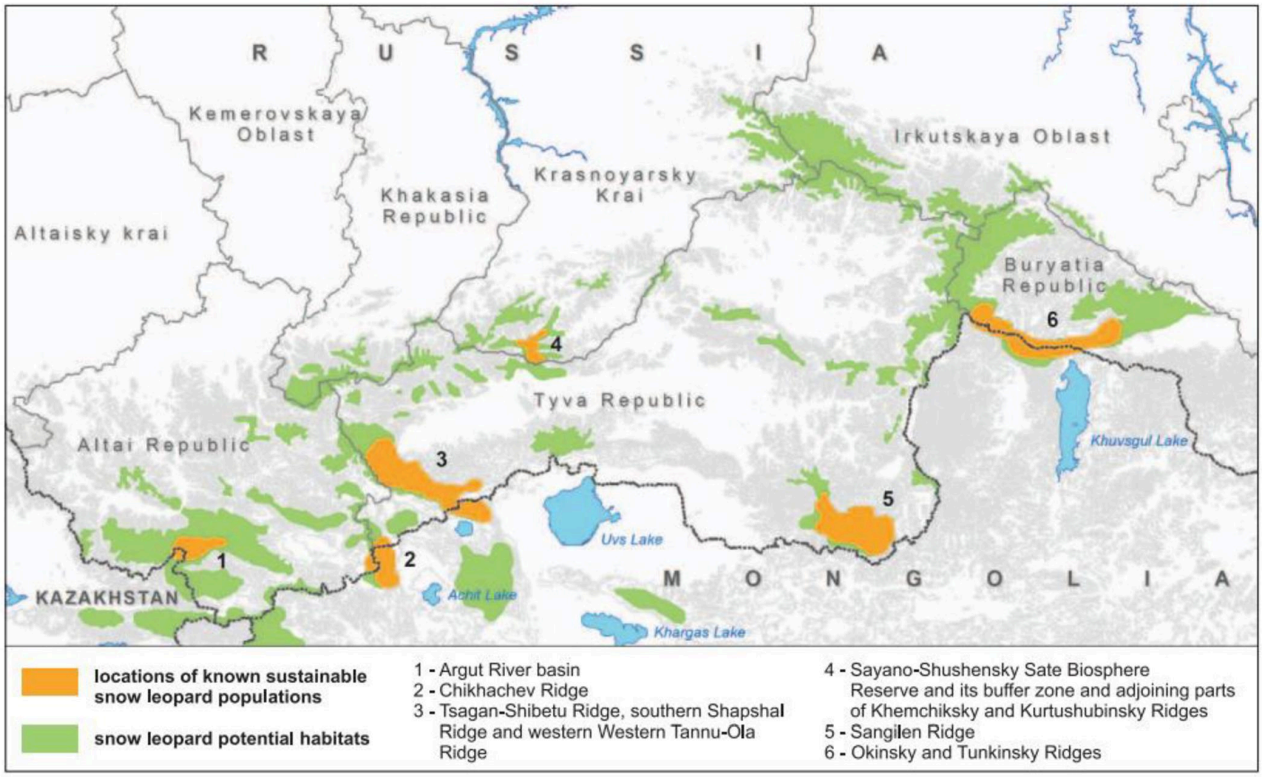


Red: core, Orange: buffer zone, Green: transition area

1. Cluster Lykov's Zaimka, Khakassky Reserve, Khakassia
2. Cluster Kara-Khol, Ubsunurskaya Kotlovina (Tyva Republic)
3. Buffer zone

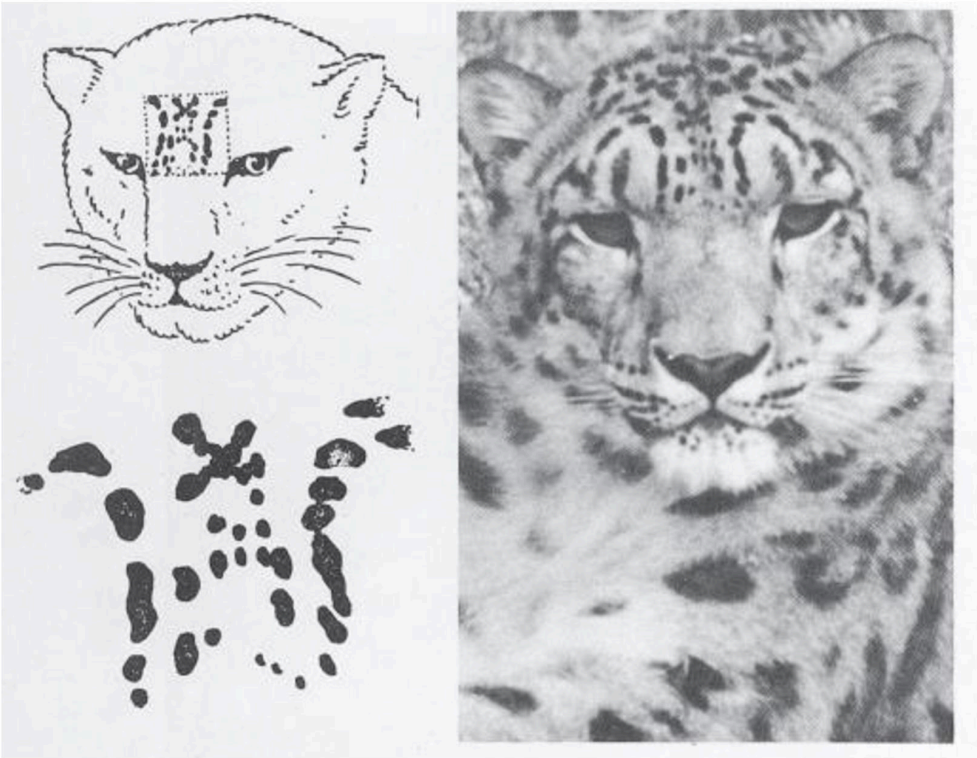
Appendix 2

Map of sustainable populations of snow leopards (Paltsyn *et al.*, 2015)



Appendix 3

Facial features used to distinguish snow leopards in captivity (Blomqvist & Nyström, 1980)



Appendix 4

Protocol used for identification of snow leopards using pelage patterns (from Jackson *et al.*, 2005, adapted from Heilbrun *et al.*, 2003)

1. A photograph was considered an "initial capture" only if it could not be positively matched with a previously photographed individual;

2. A "recapture" need not have been a photograph of the entire animal, but one that could be positively matched to a previously identified individual;

3. A poor photograph or one that could not be classified as an initial capture or recapture was classified as a "non-capture;"

4. Areas used for identification included uniquely shaped or arranged rosettes, spots or groupings thereof, located on the lower limbs, forequarters, flanks and dorsal surface of the tail;

5. Distinct areas used for identification were classified as either primary or secondary features. A single primary feature was designated for each photograph and was defined as the most distinct, clearly visible and easily recognizable marking or group of markings that readily identified an individual. All other distinct markings were classified as secondary features;

6. A positive identification was made by comparing the primary feature and at least one secondary feature to determine if the animal was an initial capture, recapture or non-capture;

7. Identification of one different feature was considered sufficient to determine that two photographs depicted different animals.