Searching for the ghost of the mountains (phase 3)

Report of a camera trapping study of the snow leopard and other mammals in KHORK SERKH STRICTLY PROTECTED AREA, Altai Mountains, NW Mongolia

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Introduction

Obtaining reliable estimates of a rare species' population is not a straightforward task. The gaps in our knowledge about rare and elusive species constrain our ability to design reliable conservation strategies. Surveys to gather the data of interest for rare and elusive carnivores such as the snow leopard (*Panthera uncia*) are often costly and challenged by environmental and ecological factors, which can cause imperfect detection and biased estimates, because they occur at very low densities, they often live in very remote and less accessible areas, and can cover long distances in short time. Indeed, research on snow leopard (SL) conducted during the last decades at global level produced reliable population estimates only covering less than 2% of the species' vast distribution range.

In Mongolia, the SL's countrywide population is estimated at 1000 adult individuals (Snow Leopard Strategy, 2014), mainly based on extrapolations from density known at a few localities. The snow leopard distribution in the country is reported to range over 103,000 km^2. Mongolia represents a critical area in the species' global distribution because it connects populations in western Mongolia and northwestern China to a remnant SL population in Russia. Nevertheless, as mentioned, no robust SL population size estimates were produced for the Mongolian Altai region. Hence surveys including robust density estimates by means of camera trapping is recommended in the western Mongolian Altai.

As a part of a wider multi-year project implemented by Green Initiative NGO (Mongolia), Italy's MUSE- Museo delle Scienze and the University of Lausanne (Switzerland), and in collaboration with the Institute of General and Experimental Biology of the National University of Mongolia, the Altai Institute for Research and Conservation, with the support of the local environmental office,

we conducted a systematic camera trapping survey in Korkh Serkhiin Special Protected Area (KS), to assess the density and the occupancy of the snow leopard (SL) and the sympatric mammals. The survey is part of a broader program aimed at assessing the status and conservation of SL and sympatric mammals in the western Mongolia (and particularly the Bayan-Olgii province) and followed earlier surveys that Green Initiative and MUSE conducted in 2015 in 'Siilkhem B' National Park (Rovero at al., 2018), and in 2017 in Tavan Bogd National Park (with UNIL, which joined as partner in the project).

This report summarizes the qualitative results from the camera-trapping survey, while more detailed and focal analyses concerning the density and the occupancy of SL are on-going by the principal investigators of the research program.

Study Area and Methods

The study was conducted in the 'Khork Serkhe' Strictly Protected Area (47°93'N; 90°99'E) area, 659 km² (http://www.infomongolia.com; http://whc.unesco.org/en/tentativelists/5955/), and its surrounding zones, covering a total area of 1,150 km^2, an area laying across Bayan Olgii and Hovd provinces. The protected area is located in NW Mongolia, approximately 45 km E to the closest point bordering China. The highest peak in KS raises to 4,019 m a.s.l. The park covers a portion of steep, rocky and dry habitat within the Altai Mountain range, and is mainly covered in grassland with valley bottom sparsely covered by shrubs (Fig. 1).

From 16th of March to 5th of April 2018, researchers from the mentioned institutions deployed camera traps at 77 sites using pairs of camera traps at each site, each set at one side of the target area. The camera trap models were Reconyx, Bushnell, Browning and UO Vision IR Plus.

Fig.1- A view of the northern valley where a snow leopard was captured by our camera traps.

Camera models were arranged to have at least one Reconyx per site, given these cameras are best performing among the ones used. We deployed paired cameras to photograph both flanks of the animals and later identify SL individuals through their spot patterns. Three sites out of 77 were sampled using a single camera (and one of these cameras was stolen), due to logistic constraints. Spacing and location of camera trap stations was based on a predetermined design informed by known home range sizes of SL, and available information on snow leopard presence in the area (supplied by the Altai Institute of Research and Conservation). We therefore designed a grid of camera traps spaced at a distance of 2-4 km with a view of covering the largest possible area with available camera traps and resources, without leaving major gaps of un-sampled suitable habitat. Camera traps were placed by four teams working simultaneously, targeting narrow SL passing trails and marking sites.

Fig. 2- A Reconyx set within stones.

Thirthy-two camera trap stations were placed in Hovd province of which 18 inside the protected area, while 45 sites were arrayed in the Bayan Olgii side, all within the protected area. Sampling sites covered an altitudinal range from 1,800 to 3,100 m a.s.l. from valleys bottom to highest ridges. Cameras were left in the field from 55 to 67 days. A team including researchers from Green Initiatives, the University of Lausanne, collected the cameras from 24th of May to 1st of June 2018 (only two cameras in the same site were collected in October due to the terrain inaccessibility in May-June).

Upon retrieving the images, we conducted a preliminary screening whereby species identification was made by using the ”Guide of Mammals of Mongolia” (Batsaikhan et al. 2014), with a focus to assess SL images. The images of SL were all codified and renamed, noting in the file name a

unique individual ID, the camera trap site, the date and the time of the detection, the SD card number, and the individual flank (Left, Right, Front, Hind).

We analyzed the images from the cameras entering species identification and metadata using a dedicated open-access software (i.e., Wild.ID; Bolger et al. 2011). The images were filtered for independent detection events, i.e., images of the same species taken within a span of 15 minutes were scored as a single event to avoid multiple scoring of the same individuals that represents a single detection event (Bolger et al. 2011).

Using the statistical program R (R Development Core Team, 2018), we analyzed the camera traps data calculating for each species the relative abundance index (RAI; O'Brien 2011, Sollmann et al. 2013) which represents the number of photographic events at which a species is trapped during the sampling and naïve occupancy (MacKenzie et al. 2002, MacKenzie and Nichols 2004). The naïve occupancy is considered as the number of sites positive to species presence to the total number of sites, which is a complementary index of abundance to the event rate (MacKenzie et al. 2002). Naïve occupancy value ranges from 0 to 1, when the value is closer to 1 a larger proportion of sites were occupied by the species (MacKenzie et al. 2002, Rovero and Zimmermann 2016). We determined the rRelative abundance index for every mammalian species was determined using the following equation:

RAI_{spa} = events*100 camera trap nights / sampling effort

Where RAI_{spa} = relative abundance index for species 'a'; events = number of independent records per species; 100 camera trap nights = unit of standardization to compare data with other studies; sampling effort = total amount of nights that the camera trap stations were working.

Results

We cumulate a sampling effort of 4762 nights-trap. Overall, 16 wild mammal species were captured by camera traps (Table 1).

Tab.1- List of wild mammal species detected by camera traps in Khork Serkhe. The table reports the "independent detections events", the "naïve occupancy" and the "relative abundance index (RAI)", for each species recorded. The list is ordered by the RAI value.

Vernacular Name	Species	Independent Detections	Naïve occupancy	RAI
Siberian marmot	*Marmota sibirica*	651	8.45	13.67
Red fox	*Vulpes vulpes*	239	3.10	5.02
Pika	*Ochotona spp.*	178	2.31	3.74
Siberian ibex	*Capra sibirica*	84	1.09	1.76
Pallas cat	*Otocolobus manul*	83	1.08	1.74
Tolai's hare	*Lepus tolai*	53	0.69	1.11
Snow leopard	*Panthera uncia*	35	0.23	0.73
Argali sheep	*Ovis ammon*	28	0.36	0.59
Grey wolf	*Canis lupus*	22	0.29	0.46
Steppe polecat	*Mustela eversnanii*	18	0.23	0.38
Pallid ground squirrel	*Spermophilus pallidicauda*	16	0.21	0.34
Beech marten	*Martes foina*	8	0.10	0.17
Stoat	*Mustela erminea*	4	0.05	0.08
Wolverine	*Gulo gulo*	4	0.05	0.08
Long-tailed ground squirrel	*Spermophilus undulatus*	2	0.03	0.04
Eurasian lynx	*Lynx lynx*	1	0.01	0.02

The most represented taxonomic group was the mustelids with 4 species, followed by the felids and rodents with 3 species, while the canids, the artiodactyls and the lagomorphs were represented by 2 species per group. Remarkably, 9 of the 16 detected mammal species were carnivores. The diversity of the medium-to-large mammals captured by camera traps largely overlapped the one we detected from the previous surveys, in Siilkhem B and Tavan Bogd National Parks. Interestingly, during this survey we detected the Eurasian lynx for the first time in our surveys. It was detected with a single event in the North-Western most area we sampled. The globally endangered Siberian marmot has been the most detected species (651), showing

the highest value of RAI (13.67). it is also relevant the independent detection events of Pallas cat (83), which presents among the highest RAI (1.74). The independent detection events of Siberian ibex, is similar to that of Pallas cat (84) as well as the RAI (1.76).

Fig. 4- A selection of the species captured by our cameras in KS. From up to down: a, Pallas's cat; b, Eurasian lynx; c, wolverine; d, stoat; e, grey wolf; f, red fox; g, Siberian ibex; h, argali.

For the snow leopard, we obtained 433 images representing 11 individuals that could be identified from the coat pattern (Tab. 2) through 34 'independent' events (i.e. separated by a 15-min interval); we also obtained 2 SL images that could not be identified. One additional individual was detected after the end of sampling period (after 1st of June) by the 2 cameras which were retrieved in October (with the last SL photo recorded on 8th of June).

The spatial arrangement of camera traps is shown in the map in Fig. 3, which also indicates sites where the SL was photographed. We recrded the species in approximately the 23% of the sites sampledand its RAI was 0.73. A single detection was recorded in the 50% of the sampled area laying on the northern side, while 34 independent captures have been done in the remaining 50%. Despite in the northern side we set 30 camera traps, which are considerably less than the number of cameras we allocated to the southern part of the sampled area (47 cameras), it cannot explain a such large difference among the SL detections in the northern and southern area. Likely the southern area host a better habitat suitability tha the northern one.

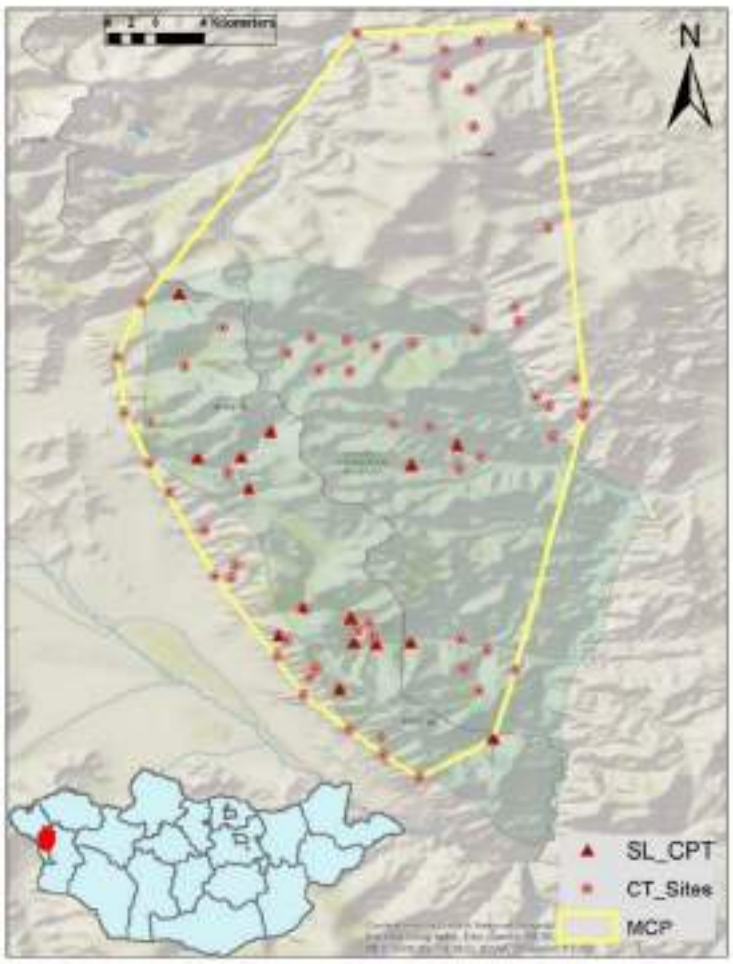

Fig. 3 - Map of the area sampled, with camera traps sites (circles) and snow leopard captures sites (triangles).

Fig. 5- A selection of the snow leopard individuals captured by our cameras in Khork Serkh

Horses, yaks, goats and sheep have been detected throughout the surveyed area, However, apparently a very low number how livestock has been detected on the SL detection sites (it will be developed by a quantitative analysis).

Discussion

This report presents qualitatively the results of our 2018 survey, while quantitative data analyses towards scientific publications are on-going. Results show the presence in the study area of a diverse community of medium-to-large mammals with several species of conservation relevance, in addition to the snow leopard. In particular, the area holds a relatively high presence of Pallas's cat if compared with our previous surveys conducted in Siilkhem B and Tavan Bogd National Parks, where we detected the species 11 times in each area. Likely the rugged mountains characterizing the Altai habitats, offers a high density of natural dens to the species, in contrast with the steppe areas where the species generally occupy other dens burrowed by other species as the Siberian marmot which is quickly decreasing in the steppe. The spread presence of Siberian marmot in our study area, confirms the results we obtained from the previous mentioned study and it confer to the western Altai a particular importance on the species conservation. The abundance of Siberian ibex is considerably higher if compared with the results of our previous survey. It combined to a high ruggedness level in the southern part of the sampled area, may explain also the relatively high density of the snow leopard.

The number of identified individuals and snow leopard detection is considerably higher than what we recorded in Siilkhem B (Rovero et al., 2018; 3 individuals 15 captures) and Tavan Bogd (2015; 1 or 2 individuals 2 captures). This is partially the result of a greater sampling effort and over a larger area that we deployed relative to the earlier surveys. However, the target area might inherently hold a higher density of SL than elsewhere, which may be due to two reasons: (1) the

wide extension of continuous suitable habitat which potentially connect the population of KS to those in Mönkhkhairkhan Mountain (4031 m a.s.l.) to the south, and the Tsanbagaraav National Park to the north; (2) the effectiveness of protection of the area appears to be extremely good.

In relation to this, the presence of livestock inside the protected area was limited to few and sparse free ranging horses and yaks. This may contribute to maintain good densities of SL population inside the protected area (Rovero et al. 2018). Unfortunately, not all the area we planned to sample was accessible including areas with the highest peaks holding apparently suitable SL habitat. However, we recorded all the captures in approximately 350 km^2 (MCP), falling inside the protected area (which may confirm the importance of an effective protection).

We will use a Spatial Capture Recapture analysis to estimates the snow leopard density in the study area. Furthermore, we will conduct a species occupancy analysis, evaluating how the topographic and the biotic factors affect the occupancy probability of the snow leopard in a certain site. In conclusion, we have conducted the first systematic camera trapping study of the larger mammal community in Khork Serkhe (including the Hovd side), which will give a considerable contribution to the ongoing long-term study of these species. In particular, we revealed important information on the presence of SL in the area. We recommend future efforts consider sampling additional populations in the same region to achieve a more robust data set to estimate the abundance and assess the conservation status of this threatened and charismatic large felid.

Fig. 6 – The survey team. A) From left to right and from down to up: Claudio (Green Initiative and University of Lausanne), Sandigul (SPA Director), Barry (Altai Conservation), Johnatan (Consultant), Khuandaq (translator), Ibra and Dario (master students, Italy), Yelik (SPA Officer), Aska (SPA Officer). B) The researchers with local people who collaborated to the survey.