A Comprehensive Long-term Study of Snow Leopards in South Gobi, Mongolia

Progress Report

December 2009

Introduction

The snow leopard (*Panthera uncia*) is a magnificent predator and flagship species that inhabits one of the last, great wilderness regions on earth – the spectacular mountain ranges of Asia, including the Himalayas, Karakorams, Hindu Kush, Pamirs, Tien Shan, and Altai. Here on "the roof of the world" the snow leopard reigns supreme, a top predator perfectly adapted to life in the harsh conditions that characterize its mountain home. Yet snow leopards face threats such as poaching, loss of natural prey due to human hunting and competition with domestic livestock, and retaliatory killing by humans in response to predation on livestock, that are bringing the species closer to extinction. Categorized as Endangered by the World Conservation Union (IUCN) since 1972, and listed on Appendix I of the Convention on International Trade in Endangered Species (CITES), as few as 3,500 cats may remain in the wild and the population is thought to be dwindling across most of its range. Although there is a crucial and immediate need to enhance conservation efforts to ensure survival of the species, a thorough understanding of the species' ecology, behavior and habitat requirements needed to design and implement effective programs is lacking.

In 2008, the Snow Leopard Trust (SLT), in partnership with the Snow Leopard Conservation Fund (Mongolia) and Panthera Foundation, in collaboration with the Ministry of Nature, Environment and Tourism, the Mongolian Academy of Sciences, and the Mongolian State University of Agriculture, and with support from Felidae Conservation Fund, Kolmarden Zoo, the David Shepherd Wildlife Foundation, the Association of Zoos and Aquariums, Cat Life and Research Foundation, and the Columbus Zoo, launched the first long-term study of snow leopards at the J. Tserendeleg Snow Leopard Research Center in the South Gobi province of Mongolia (Fig. 1). This report summarizes progress during the summer and fall of 2009.

Figure 1. Location of SLT's Snow Leopard Research Center in the South Gobi Province of Mongolia.

Progress-to-Date

Camera Trapping

In June we deployed 41 Reconyx™ cameras throughout a 1300 km^2 survey area in the vicinity of our research center (Fig. 2). After a thorough survey of the area, cameras were placed at recentlyused scrapes in saddles located along ridgelines and at scrapes near steep walls in canyons. We deployed cameras singly, rather than in pairs, to maximize the number of sites surveyed. The cameras remained in the field for 30 days, at which time they were retrieved and the photos were downloaded.

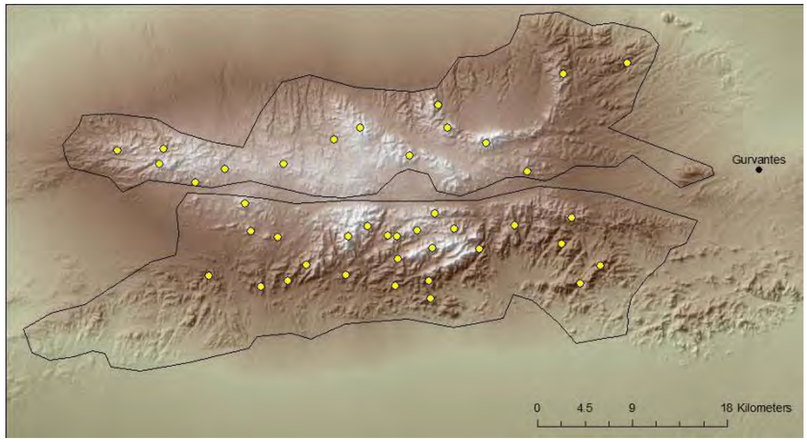

Figure 2. Locations at which 41 cameras were deployed during summer 2009.

Thirty-seven of the 41 cameras functioned for all or part of the survey period for a total of 1,112 trap nights. We recorded 18,253 photos including 4,345 photos of non-target wildlife, 3,932 photos of livestock, 1,528 photos of humans, and 645 photos of snow leopards. A total of 15 snow leopards were identified in 34 encounters. We photographed 9 adults and 6 cubs, including three previously unidentified adults (Fig. 3).

We analyzed the data for the 9 adult snow leopards using mark-recapture analysis to estimate the size of the snow leopard population. The 6 cubs photographed were excluded from the analysis because their encounters were not independent from those of their mothers. Based on our analysis, 10 adult snow leopards are estimated to inhabit the area in the vicinity of our research camp, with a 95% confidence interval of between 9 and 16 adults. This represents a relatively large number of cats given the aridity of the habitat in the South Gobi.

Occupancy Surveys

Occupancy surveys were conducted during the summers of 2008 and 2009. The goals of the two surveys differed and this was reflected in the study design. In 2008 the primary objective was to estimate site occupancy (i.e., the proportion of sites occupied by the species of interest) while collecting data on factors that might influence the probability of occupancy to develop a predictive model. In contrast, in 2009 we tested a survey protocol that was designed to optimize the power of our presence-absence surveys to detect a decline in occupancy over time by sampling high-quality habitats.

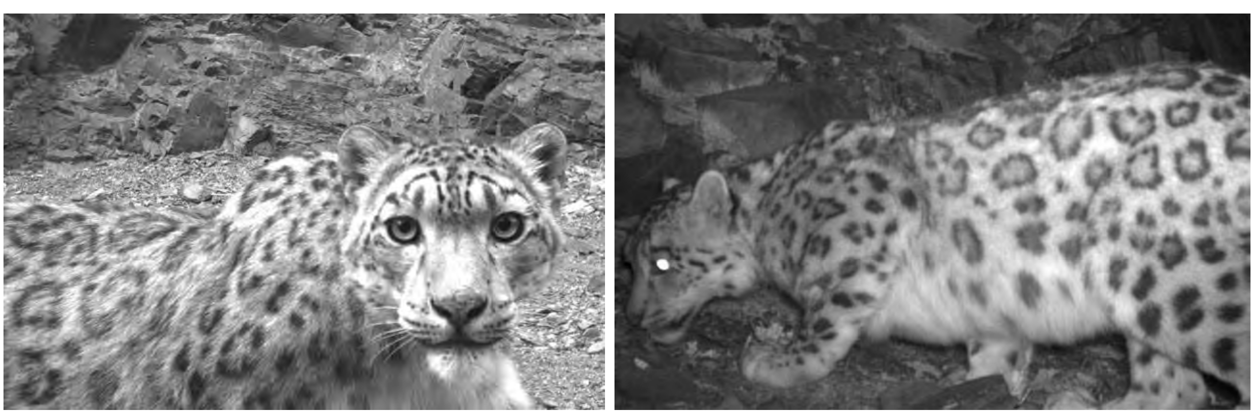

Figure 3. Photos of two previously unidentified snow leopards photographed during summer 2009.

We surveyed 465 km at 45 sites in 2008 and 125 km at 42 sites in 2009. Sites were selected randomly in 2008, although habitat that exhibited no topographic relief was excluded because the lack of preferred marking terrain makes it difficult to detect snow leopard sign. In 2009 we used information on snow leopard habitat preferences obtained from the results of our 2008 occupancy surveys to construct a model of terrain ruggedness and slope to identify sites with the highest probability of snow leopard use within in each survey area (Fig. 4). At each survey point, a 2-6 km transect was walked along micro-habitats most likely to be marked by snow leopards. Transects were broken into segments reflecting changes in topography such as slopes, canyons, ridgelines, and wide valleys, which may influence the probability of detecting snow leopard sign. At each change in topography, the GPS coordinates and distance traveled were recorded to determine the segment length. Information on terrain brokenness and the presence of fecal pellets of livestock and native prey was recorded within each segment. In addition, we recorded the distance from each transect to the nearest human settlement. Terrain ruggedness and slope were determined using GIS.

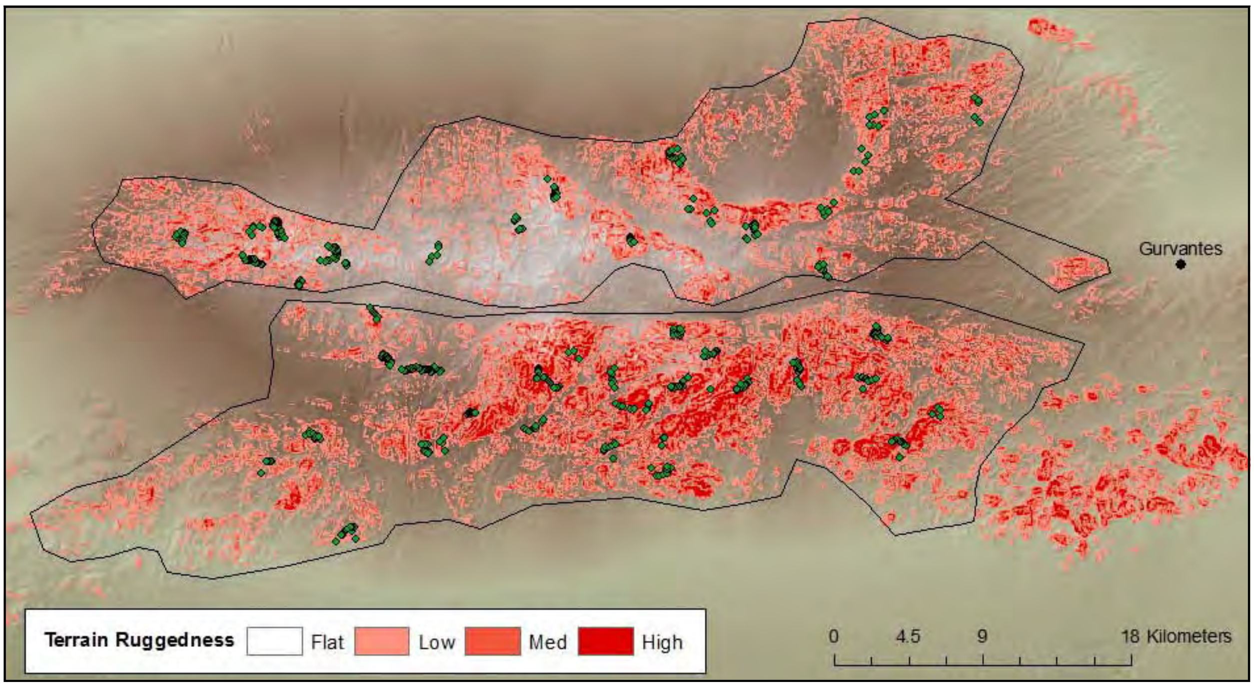

Figure 4. In 2009 we used a model of terrain ruggedness to identify sites with the highest probability of occupancy. Green dots represent the locations at which data were recorded during the occupancy surveys.

In both years we recorded the presence of snow leopards scrapes along transects. In 2008 scrapes were classified as fresh (0-15 days old), old (15-30 days old), and very old (>30 days old). In 2009 we simplified the classification to fresh (0-30 days old) or old (>30 days old) to reduce classification errors. For purposes of estimating occupancy and detection probability, only segments with fresh sign were classified as occupied.

The data were analyzed to estimate detection probability (i.e., the probability of detecting a snow leopard when it is present) and the probability of occupancy using PRESENCE. In 2008 our analysis indicated that detection probability was influenced by segment length, terrain brokenness, and topography. The probability of detecting a snow leopard was higher for canyons and ridgelines compared to wide valleys and slopes, and increased with terrain ruggedness and segment length. The probability of occupancy increased with increasing terrain ruggedness and slope, and decreased as the distance to the nearest ger increased. This may indicate that snow leopards are selecting for habitat in close proximity to gers because of the presence of livestock, or it may serve as a surrogate for proximity to water, since the locations of gers, livestock, and natural prey are constrained by the availability of water.

Our analysis of data collected during the summer of 2009 indicated that detection probability was influenced by segment length, terrain ruggedness, and topography. The probability of detecting a snow leopard was again higher for canyons and ridgelines compared to wide valleys and slopes, and increased with terrain ruggedness and segment length. However, in contrast with 2008, in 2009 site occupancy was independent of the variables we tested. This seemingly contradictory result is not surprising, however, as the use of the habitat model to identify sites with the highest probability of occupancy meant that we were controlling, up front, for habitat variation.

In 2008, the mean probability of occupancy for *all* habitat in the study area was 0.49 ± 0.29 (mean ± S.E.). In comparison, in 2009 the mean probability of occupancy for the *best* habitat in the study area was 0.92 ± 0.06 for all sites.

Genetics

Scat transects were conducted in conjunction with occupancy surveys during summer 2009. We collected all large carnivore scats that we encountered along trails, and all carnivore scats, independent of size, that were associated with snow leopard scrapes. For each of the 200 scats collected in the field, we recorded the GPS coordinates, a description of the site, topography, color, length, diameter, appearance, and a subjective assessment of the likelihood that the scat was deposited by a snow leopard (high, medium, or low). Each of the samples was broken into 3 sub-samples for analysis. Two of the three subsamples were submitted to the Center for Conservation Genetics at the American Museum of Natural History for species identification and to the Laboratoire d'Ecologie Alpine for dietary analysis. The third sub-sample was sent to Working Dogs for Conservation for species identification by a scat detection dog. The results of the analyses will be used to generate comparative population estimates via mark-recapture analysis and develop an improved protocol for identification of snow leopard scats in the field.

Radio-Collaring

We have radio-collared seven snow leopards (six males and one female) since initiating capture efforts in August 2008 (Table 1). Aztai, the first snow leopard captured in the fall of 2008, was recaptured in late June to replace his radio-collar as the battery was nearly depleted (Fig. 5). In early July we radio-collared a young adult male snow leopard (nicknamed Itgel) that had been caught in a wolf trap set by a herder. The cat suffered a serious injury to his right rear leg as a result of the trap, and we collared him to monitor his recovery from, or loss to, his injuries. For nearly two months Itgel seemed to defy the odds and we watched him move across his mountain home through the periodic locations we received from his radio collar. At the end of September, Itgel's collar stopped moving, so we sent a team in to investigate. The crew found the collar and noticed that the nuts fastening it

Table 1. Capture date, gender, home range size, and status of seven snow leopards radio-collared as part of the long-term ecological study of snow leopards in Mongolia.

Name	Capture Date	Gender	100% MCP Home Range Size (km^2)	Status
Aztai (Lucky)	8/19/2008 Recaptured 6/28/2009	Male	257 710 (with walkabout)	Collar scheduled to drop 6/27/2010
Bayartai (Go with joy)	9/14/2008	Male	274	Killed by a herder 1/1/2009
Tsagaan (White)	2/23/2009 Recaptured 3/20/2009	Male	261	Collar scheduled to drop 2/22/2010
Shonkhor (Falcon)	4/21/2009	Male	487	Collar scheduled to drop 4/20/2010
Saikhan (Beautiful)	5/6/2009	Male	1,628	Collar scheduled to drop 5/5/2010
Suhder (Shadow)	5/11/2009	Female	No data	Slipped out of collar
Itgel (Hope)	7/7/2009	Male	185	Unknown - collar removed or slipped 9/19/2009

closed were missing. However, Itgel was nowhere to be seen at the time the collar was found. We had difficulty getting the collar to fit well because Itgel was underweight when we removed him from the trap, so it was not clear whether the nuts on the collar had come loose, allowing the collar to slip off, or whether Itgel died or was killed and his collar was removed. In late October a member of our field crew reported seeing a snow leopard with an injured right rear leg chasing a herd of ibex in the area where Itgel had been living. Since the sighting was so brief, we cannot confirm whether the cat he saw was indeed Itgel or another snow leopard with a similar leg injury. But at this point we are guardedly optimistic that Itgel may still be alive. We hope to photograph Itgel to confirm his survival when we resume camera trapping next summer.

Overall the satellite collars are performing well, although we have experienced a marked deterioration in the uplink success rate over time (Fig. 6). To date we have had an overall success rate of 37% on satellite uplinks, recording 1,408 locations in 3,824 attempts. This

Figure 5. In June our field crew recaptured Aztai (top) to change out his radio collar. In July we collared Itgel (right), a young adult male snow leopard that was captured in a wolf trap set by an unidentified herder.

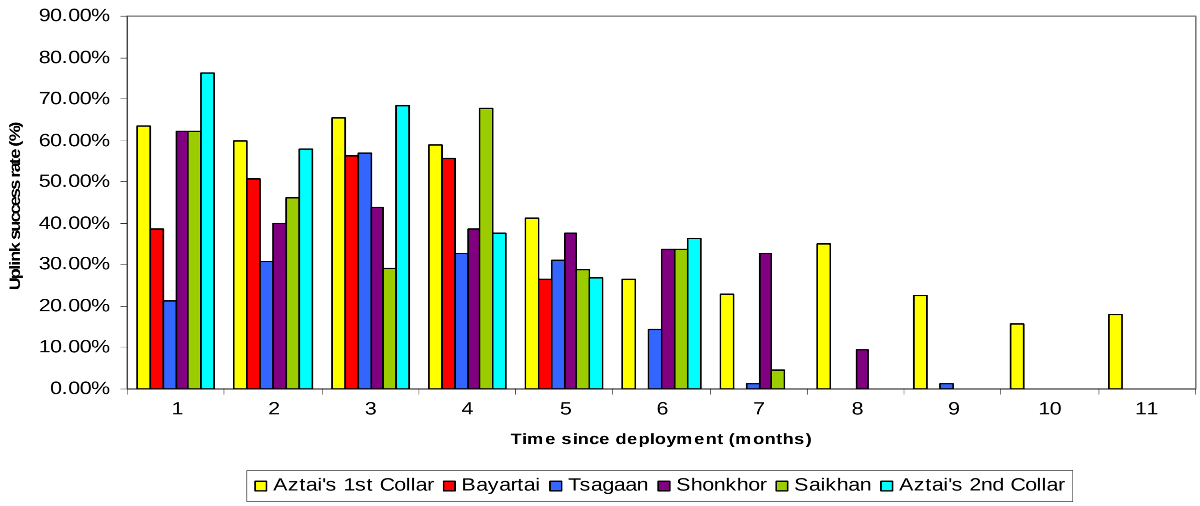

Figure 6. The uplink success rate of the North Star satellite GPS collars shows a marked deterioration as the time since deployment increases.

winter we will be deploying a test collar manufactured by Vectronic to evaluate whether it is an improvement over the North Star collars we are currently using.

Based on 100% minimum convex polygons, home range sizes for the radio-collared snow leopards have ranged from a low of 185 km^2 for Itgel (whose movements may have been compromised by his injured paw) to 1,628 km^2 for Saikhan (Table 1 and Fig. 7). While Aztai's core home range (the area where he spends the majority of his time) is just 257 km^2, that figure balloons nearly three-fold to 771 km^2 if his single trip to the eastern edge of the Tost mountains is included (Fig. 7). The information on home range sizes is helping the Trust determine how we define communities when we establish conservation agreements to ensure the cats are protected year-round.

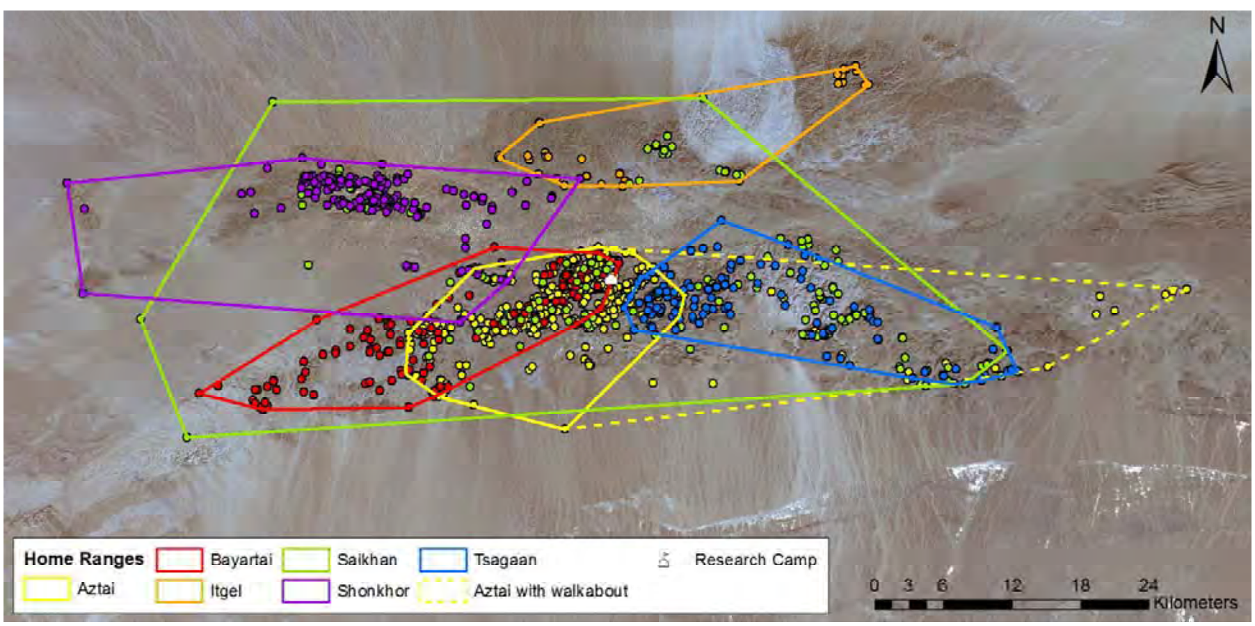

Figure 7. Home range sizes for the radio-collared snow leopards have ranged from 185 km^2 for Itgel (orange line) to 1,628 km^2 for Saikhan (green line).

What We're Learning

The results of the occupancy and camera trapping surveys are a promising step forward in the process of developing rigorous, cost-effective survey methods needed to identify priority areas, guide the development of conservation strategies, and evaluate the effectiveness of these programs in mitigating threats. In contrast with previous efforts, the availability of high-capacity digital cameras with long battery life, and cost-effective presence-absence surveys, enables the application of these methods at spatial scales that are biologically relevant to snow leopard conservation.

Additional testing of the occupancy survey methodology is needed to further refine the protocol and to clarify the relationship between changes in population size and changes in occupancy. Still, the results of the initial surveys are encouraging, as the precision of the occupancy estimates (CV = 7%) compared favorably with that of the camera trapping surveys (CV = 14%). In addition, the dramatic cost-savings of occupancy surveys over camera trapping methods (~48 times less expensive if the cost of the equipment is included) shows promise for application in range countries where human labor is readily available, but resources for purchasing expensive equipment are often scarce.

Further analyses of the occupancy and camera trapping data are planned in the coming months. The camera trapping data will be re-analyzed using a presence-absence framework to provide comparative estimates of occupancy with those generated by the sign surveys. Although cameras are a much more expensive alternative to sign surveys for documenting snow leopard presence, they have the advantage of providing unambiguous confirmation of species presence during the survey period and the potential for individual identification; thus, cameras may be a justifiable alternative in situations where more intensive monitoring warrants the added expense. The occupancy data collected during the summer of 2008 will also be re-analyzed with all scrapes less than 1 month old classified as fresh. This will allow us to determine the extent to which the difference in the observed results between the two years was the result of variation in the classification of sign versus variation in the site selection methodology. Finally, the results of the occupancy surveys will be used to run a series of simulations to evaluate the survey effort and associated expense needed to increase the precision of the occupancy estimates. This information will allow us to assess the trade-off between allocating additional resources to monitoring versus conservation programs, an essential consideration in the development of an improved monitoring protocol for range-wide application.

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