Snow Leopard Conservation Grants, Snow Leopard Network

FINAL REPORTS FOR 2012 PROJECTS

DUE: 15 FEBRUARY 2013

Please submit your final report by the due date above. We would appreciate it if you could follow the suggested format below. Additionally, please send us copies of any detailed technical report(s), papers, and other output arising from this work. Please refer to your original proposal for items such as objectives, methods, etc. unless those were substantially altered during the course of the work. If so, please explain why.

1. Executive Summary: No more than 750 words. Please describe the original goals and the final results of your project. This may be used in press releases and other publicity material about the Grants Program, so please write it for the general public who may not have scientific background.

Snow leopards throughout their distribution range across Central Asia occur in multiple use landscapes, sharing their mountainous habitat with humans practicing pastoralism and agro-pastoralism. The mountains support traditional pastoral economies and lifestyles despite being inherently low in primary productivity(Mishra and Prins 2001). It is presumed that historically, pastoralism dated back at least 3 millennia and involved low intensity grazing(Blench and Sommer 1999). Though the Trans-Himalayas are amongst the least productive of the graminoid-dominated ecosystems on earth(Mishra and Prins 2001), the rangelands support a diverse assemblage of wild mountain ungulates.

Though livestock is considered to be an important contributor to snow leopard diet, livestock depredation results in human-snow leopard conflict and hinders conservation efforts. This essentially results in situation wherein the survival of snow leopards hinges upon an uneasy co-existence between competing needs of snow leopards and subsistence pastoralists and farmers.

Project Snow Leopard(Anonymous 2008), a national level project proposed for the conservation of snow leopards in India identified the occurrence of wildlife populations outside the protected areas as a unique feature of trans-himalayas. The stated goal of Project Snow Leopard is *to safeguard and conserve high altitude wildlife populations and their habitats by promoting conservation through participatory policies and actions*.

Recognizing the multiple uses of trans-Himalayan rangelands a landscape level management approach that can reconcile the human livelihoods with wildlife conservation has been recently proposed (Mishra et al. 2010).

Given this background, it is important to understand how snow leopards respond to a range of landscape, environmental and anthropogenic variables not only for a better ecological understanding but also for formulating better conservation actions that can strike a balance between the competing needs of snow leopards and people. Designing effective snow leopard conservation strategies would depend upon our understanding of their ecology and critical needs. For instance, if wild prey populations in a given area are depleted and snow leopards have a high dependence on livestock for food, making livestock unavailable by improving anti-predatory livestock management may prove detrimental for this endangered carnivore. It is important to understand how snow leopards respond to a gradient of relative abundance of livestock, human disturbance and wild prey. Does snow leopard density and use of an area vary in response to the relative abundance of livestock and wild prey across a disturbance gradient? Is there any change in the

activity patterns of snow leopards to fit the needs of operating in a human dominated area? Is livestock crucial for the survival of snow leopards? What proportions of livestock to wild prey support higher snow leopard densities? The present study attempts to address these important conservation questions using best scientific practices.

Using camera traps, I have been able to sample large (*ca.* 1500 sq. km) areas to estimate snow leopard population-density. Preliminary analysis has suggested 101 captures of 18 snow leopards over 38 occasions.

The study has generated good data to provide baseline estimates of snow leopard population, understand the snow leopard response to prey, habitat and anthropogenic factors at multiple spatial scales and to understand snow leopard response to varying livestock pressures as well. This is a long term project with the field working ending in 2013.The data analysis is under progress and more detailed results will be available thereafter.

2. Objectives: What was the purpose of the project? How was it expected to contribute to the knowledge or conservation of snow leopards, their prey, or habitat?

The goal of the project is to understand the opportunities and threats to a continued existence of people and snow leopards in a multiple use landscape. The following objectives indicate how I planned to achieve this goal.

1. Estimate snow leopard population in ~2000 km^2 area to establish baseline for long term monitoring.
2. Determine how snow leopards respond to a range of anthropogenic, landscape and environmental factors in a multiple use landscape (~2000 km^2 area)
3. Determine whether snow leopard activity patterns vary to fit the needs of operating in a human dominated area?
4. Determine whether snow leopard density and use of an area vary in response to the relative abundance of livestock and wild prey across a disturbance gradient?
5. To optimize study designs for obtaining reliable estimates of snow leopard population density.

The study is expected to improve our understanding about how snow leopards respond to various prey, habitat and anthropogenic factor in a multiple use landscape. The study is expected to contribute to the current knowledge of large carnivore ecology, especially in understanding the extent of plasticity and resilience of carnivore populations to gradients of habitat quality and anthropogenic impacts. A strict protected area approach has always resulted in resentment among local communities whose legitimate livelihood needs have often been overlooked in the past. My study will provide a better scientific basis for identifying the opportunities and limits to potential co-existence between snow leopards and humans in multiple-use landscapes. The results are thus expected to contribute to better conservation management of this endangered carnivore across Central Asia.

3. Methods: Describe the methods you used in detail, so that someone else could repeat the work, or, avoid the problems that you encountered.

Camera trapping: We placed camera traps in a 7 × 7 km grid cell in a *ca.* 1500 sq. km's landscape. The grid size was used to ensure a systematic coverage of the study area. The camera traps were placed in the best possible locations within each grid cell using snow leopard spoor as cue. Cameras were operational for c. 60 days and the data will be used to estimate snow leopard population size and spatio-temporal use of the habitat.

Double observer surveys: were conducted to estimate the population of the primary prey of snow leopard i.e. Blue Sheep *Pseudois nayaur* and Ibex *Capra sibirica.* For details on methodology please see (Suryawanshi, Bhatnagar, and Mishra 2012)

Resource mapping: was done for *c.* 32 villages to estimate the extent of influence of anthropogenic activities, mapping of key resources for villagers and using the information from villagers to mark key areas used by wild species. We used Google-Earth imagery and open source Q-GIS software to map the extent of pastures and other key resources.

Livestock census: was conducted using door to door census approach to estimate the stocking densities of livestock.

Extracting terrain variables: Topographic features will be determined for all appropriate spatial scales of analysis using Geographical Information System. Slope, altitude and ruggedness will be derived from a Digital Elevation Model, using the package spatial tools in ArcGIS (ESRI, Redlands, CA).

Problems/Constraints: Some of the camera traps placed on high ridgelines has become inaccessible due to heavy snow-fall and the associated risk of avalanches.

4. Results: Please describe in detail the results of your project. Please illustrate clearly how your stated goals and objectives could be met. You may wish to include tables or graphs in this section if appropriate. This section will be very important to explain the value of these grants to funders of the Snow Leopard Conservation Grant Program. Please be clear, concise, and thorough.

One of the key goals of this project was to estimate snow leopard population size over a landscape scale. This was a challenge as basic data such as snow leopard home range size or land tenure systems are not known in this landscape. We used data from a preliminary camera trap study conducted in 2009 and 2010 to inform the design of the landscape scale study. Using spatially explicit capture recapture models (SECR) (Borchers and M. Efford 2008; M. G. Efford and Fewster 2012; Gopalaswamy and Royle 2012) we computed the likely home range size of a snow leopard in the USL. The home range size was computed as 113 sq. km's and then using the accepted criteria of placing 2 traps per average home range (Karanth et al. 1998) we estimated a grid size of 7 × 7 km for camera trap placement. This design would help us to avoid serial autocorrelation between camera traps and cover a larger area.

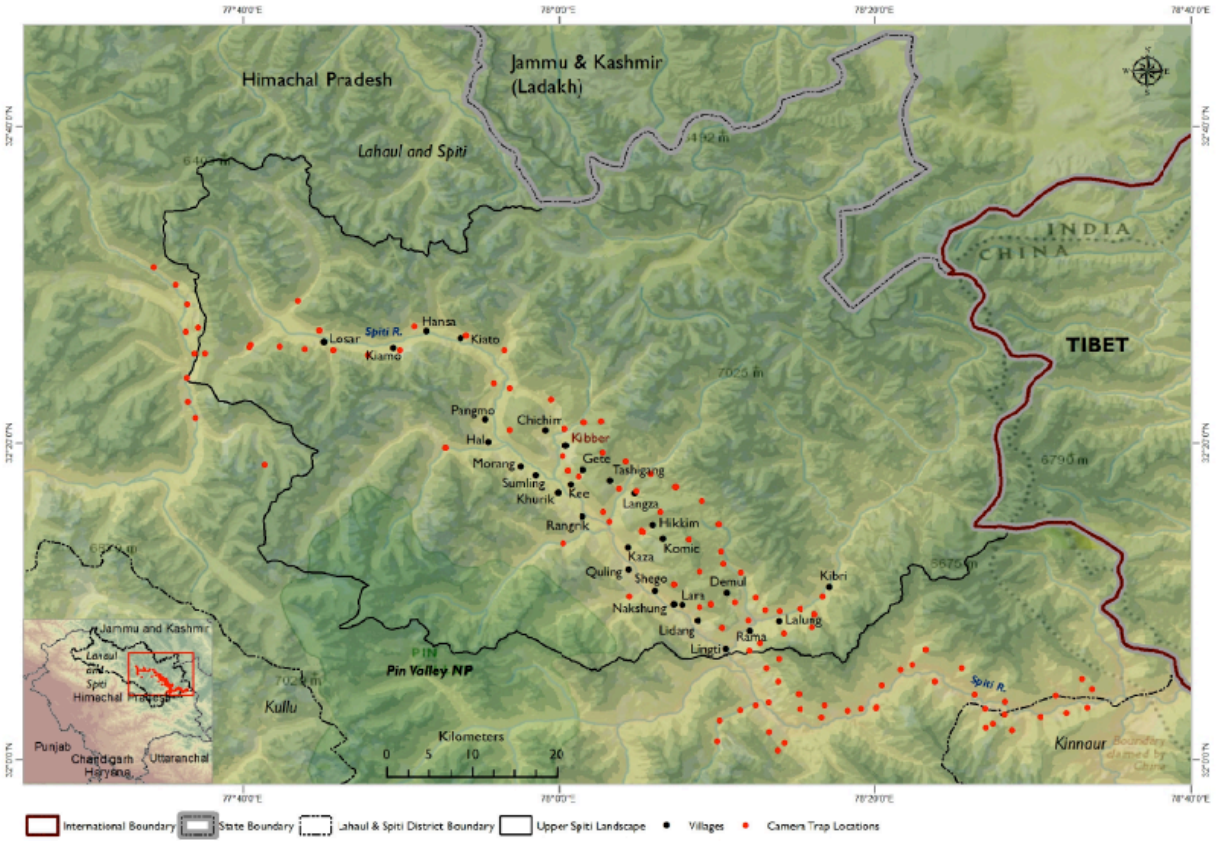

Figure: Camera trap locations that have been covered in the Upper Spiti Landscape and adjacent areas.

Over a period of 38 sampling occasions, I obtained 101 captures of 18 snow leopards. Population estimate using the null model M_o = 18± 0.4, 95% CI = 18-19.2, P-hat=0.11; using heterogeneity model M_h = 24.7 ± 5.3, 95% CI= 19.7-44.1, P-hat= 0.08
Density estimates using the traditional ½ MMDM model = 1.89 ± .58/100 sq. km, ESA= 951 sq. km while full MMDM resulted in= .92 ± .34/100 sq. km, ESA= 1953 sq. km. The recently developed spatially explicit model MLSECR resulted in= .72 ± .20 / 100 sq. km

Prey estimation: The estimates of snow leopard wild prey using a double observer sampling approach are given below.

Area	Estimated population	Variance in mean group size	Variance in estimated number of Groups	Variance in estimated population
Ibex (Upper Spiti Landscape)	62	4.36	0	157.07
Blue sheep (Kibber Panchayat)	383	9.02	0	3975.98
Blue sheep (Langza-Demul Panchayat)	418	5.98	4.02	5077.4
Blue sheep (Sichling to Hurling)	555	1.65	1.18	2736.73

I have just returned from field and have started collating data and detailed data analysis will begin subsequently. This is a long term study and field work will continue till 2013. As the project stands now, I have data to address the objectives 1, 3 and 5. I will have sufficient data to address the objectives 2 and 4 once the field sampling is completed in 2013. Intensive nature of the work has resulted in most of the

project time being spent in fieldwork. I intend to send a separate update to the SLN once good progress is made on data analysis.

5. Discussion: Please evaluate your own work. What did you learn that could help others wishing to do similar projects? How do you see the results being applied to conservation? What additional work is now needed based on your findings?

- A few key things that others wishing to do similar projects should keep in mind are 1) make sure you have adequate logistics and manpower in place as camera trapping over large landscapes is very resource intensive 2) even NiMh batteries show reduced performance in winters and one should either intensify monitoring or use Lithium batteries 3) build trust with local communities to ensure safety of equipment and potential misunderstandings.
- A complete analysis of the results would allow me to better assess the conservation significance of my work. At this stage, it is clear that the study has generated good data to 1) provide baseline estimates of snow leopard population for future monitoring for the entire Upper Spiti Landscape 2) determine whether snow leopard activity patterns vary to fit the needs of operating in a human dominated area and 3) to optimize study designs for obtaining reliable estimates of snow leopard population density.
- Another sound of sampling which is scheduled after May 2013 will result in sufficient data for addressing 1) Determine how snow leopards respond to a range of anthropogenic, landscape and environmental factors in a multiple use landscape (~2000 km^2 area) 2) Determine whether snow leopard density and use of an area vary in response to the relative abundance of livestock and wild prey across a disturbance gradient?
- The results of this study will feed directly into the management plan for the Upper Spiti Landscape. Once I disseminate the findings of this study through peer reviewed manuscripts in scientific journals, I expect the findings to influence conservation-management of snow leopards in multiple use landscapes across central Asia.

6. Photographs: If you have good photographic (preferably digital) images of your project that we could use to advertise the Grants Program, please submit them at this time. Please be sure to include a brief description of the photo and provide the credits for the photographer.
Photographs attached separately.
If you have any questions on the format or other aspects of your final report, please contact us at grants@snowleopardnetwork.org.

Final reports and digital images should be emailed to grants@snowleopardnetwork.org.

Bibliography:

Anonymous. 2008. *The project snow leopard*. New Delhi.

Blench, Roger, and Florian Sommer. 1999. "UNDERSTANDING RANGELAND BIODIVERSITY." (September):1–51.

Borchers, DL, and MG Efford. 2008. "Spatially explicit maximum likelihood methods for capture–recapture studies." *Biometrics* 64(June):377–385. Retrieved January 28, 2013 (http://onlinelibrary.wiley.com/doi/10.1111/j.1541-0420.2007.00927.x/full).

Efford, Murray G., and Rachel M. Fewster. 2012. "Estimating population size by spatially explicit capture-recapture." *Oikos* (August):no–no. Retrieved October 26, 2012 (http://doi.wiley.com/10.1111/j.1600-0706.2012.20440.x).

Gopalaswamy, AM, and JA Royle. 2012. "Program SPACECAP: software for estimating animal density using spatially explicit capture–recapture models." *Methods in Ecology and Evolution* 3(6):1067–1072. Retrieved January 28, 2013 (http://onlinelibrary.wiley.com/doi/10.1111/j.2041-210X.2012.00241.x/full).

Karanth, KU et al. 1998. "Estimation of tiger densities in India using photographic captures and recaptures." *Ecology* 79(8):2852–2862. Retrieved October 21, 2012 (http://www.esajournals.org/doi/pdf/10.1890/0012-9658(1998)079[2852:EOTDII]2.0.CO;2).

Mishra, Charudutt, Sumanta Bagchi, Tsewang Namgail, and Yash Veer Bhatnagar. 2010. "Multiple Use of Trans-Himalayan Rangelands : Reconciling Human Livelihoods with Wildlife Conservation." Pp. 291–311 in *Wild Rangelands: conserving wildlife while maintaining livestock in semi-arid ecosystems*, edited by Johan T. Du Toit, R Kock, and J.C. Deutsch. Blackwell Publishing Retrieved January 29, 2013 (http://www.ncf-india.org/publication/Mishra et al 2010 Wild Rangelands Conserving Wildlife Book Chapter.pdf).

Mishra, Charudutt, and HHT Prins. 2001. "Overstocking in the Trans-Himalayan rangelands of India." *Environmental* 28(3):279–283. Retrieved December 26, 2011 (http://journals.cambridge.org/production/action/cjoGetFulltext?fulltextid=88168).

Suryawanshi, Kulbhushansingh R, Yash Veer Bhatnagar, and Charudutt Mishra. 2012. "Standardizing the double-observer survey method for estimating mountain ungulate prey of the endangered snow leopard." *Oecologia* 169(3):581–90. Retrieved August 1, 2012 (http://www.ncbi.nlm.nih.gov/pubmed/22231373).