Snow Leopard Conservation Grants, Snow Leopard Network

FINAL REPORTS FOR 2011 PROJECTS

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1. Executive Summary:

Conservation of large-bodied carnivores has traditionally followed the protected area approach. But, more recently, the need to focus on large carnivore conservation outside protected areas has gained emphasis. One such initiative is the '***Project Snow Leopard***' launched by the Government of India in 2009. The Project recognizes that the high mountain regions of the Himalaya and the Trans-Himalaya are one contiguous landscape. Thus, two of the ten objectives of this nation-wide program aim for conservation of species such as the snow leopard *Panthera uncia* at landscape level (>1000 km^2) and outside protected areas.

The snow leopard, although widely distributed in 12 countries throughout the high mountain ranges of Central and South Asia, shares its range with agropastoral communities. A substantial proportion of these communities (>40%) live below national poverty line. The impact of livestock depredation by snow leopard and other sympatric carnivores such as wolf (*Canis lupus*) on the local herding communities is very high. About 3 to 12% of livestock holding is reportedly lost to snow leopards annually. As a consequence, the species is persecuted by local communities throughout its distribution range. The Snow Leopard Survival Strategy identified killing of snow leopards in retribution against livestock depredation loss as one of the most important threats for the survival of the species.

We investigated the interactions between snow leopard, domestic livestock and the principal wild prey, the blue sheep (*Pseudois nayaur*) and ibex (*Capra sibirica*) to understand the livestock depredation behavior of the snow leopard. The primary objective of the project were to identify factors affecting snow leopard foraging decisions with special emphasis on livestock depredation and to quantify snow leopard densities and examine its determinants with special emphasis on abundance of primary (wild-prey) and alternate (livestock) prey.

We estimated wild prey abundance at seven sites using the double observer survey method. We estimated the livestock population through door to door surveys. Snow leopard diet was assess through the hair mounting technique of scat analysis. Snow leopard population was estimated using non-invasive molecular genetics.

Wild prey abundance varied from 735 bharal at site kibber to 30 ibex at site lossar. The contribution of wild prey to snow leopard diet ranged from 98% at site lingti to 40% at site lossar. Contribution of livestock also varied from 2% to 60%. Due to delay in standardizing molecular methods of estimating snow leopard abundance, we have so far estimated abundance at two sites with estimates of 7 (±3) and 6 (±1). Data on the abundance of snow leopards at the remaining five sites will be available by April 2012.

We have fulfilled all the proposed objectives of the proposal. A scientific papers has already been published from our work (Suryawanshi et al. 2012). Detail analysis and synthesis will be carried out after the data on snow leopard abundance are available.

2. Objectives:

To identify factors affecting snow leopard foraging decisions with special emphasis on livestock depredation

A well known result of optimal foraging theory is that when the density of the profitable prey drops below a threshold, an adaptive forager will include the less profitable prey in its diet. In multiple prey situations, the decision to include progressively poorer prey in the diet depends on the density (encounter rate) of the most profitable prey. Theoretically, progressively poorer prey should be added to the diet as the density of the most profitable prey drops below different thresholds that are determined by the relative profitability of the poorer prey, creating a step function of diet choice dependent on the density of most profitable prey. I intended to explore and identify thresholds in snow leopards' decision making where livestock killing becomes a part of snow leopard foraging strategy and not merely a consequence of opportunity. Understanding the mechanism behind the livestock killing behavior is the key to reduce/mitigate this problem.

To quantify snow leopard densities and examine its determinants/correlates, with special emphasis on abundance of primary (wild-prey) and alternate (livestock) prey.

Across the gradient of wild and domestic ungulate abundance, I intended to understand the relationship between snow leopard density and the relative abundance of wild-prey and domestic livestock along with other potential determinants (habitat, sympatric carnivores etc.). My objectives included density estimation of snow leopards across the study sites. Robust baseline estimates of snow leopard population are necessary to assess the impact of any conservation intervention.

3. Methods:

Study Design:

- seven study sites with a gradient of wild prey to livestock ratio were chosen.
- Snow leopard diet and abundance was assessed along this gradient

Assessing snow leopard diet:

- Livestock availability was estimated by conducting a door to door census at all the villages within the seven sites.
- Double-observer (to incorporate observer bias) field surveys were conducted to estimate wild prey abundance at every site (See Suryawanshi et al 2012 for details).
- About fifty scat samples were collected from each study site.
- DNA was extracted from the scat samples using commercially available Qiagen Stool DNA kit following the protocol by the manufacturer with slight modification
- We developed a snow leopard specific primer that amplified 111 base pairs form the mitochodrial DNA of the snow leopard. We used this species specific primer to confirm the identity of snow leopard scats (to eliminate misidentification of scats of other carnivores such as red fox; wolf; feral dogs).
- We used the hair mounting method to assess snow leopard diet from the prey hair remains in the scat.

Assessing snow leopard abundance:

- For the individual identification of snow leopards we started with the seven microsatellite loci described in Janecka et al (2008). Due to low amplification rate we added five FCA primers. and seven mini STR's from Mondol et al (unpublished). These nineteen primers were standardized individually using DNA from a known snow leopard tissue.
- Off these nineteen primers, seven primers with the highest amplification rate were identified for individual analysis.

4. Results:

Double-observer surveys to estimate wild prey availability: We modified the double observer survey technique to estimate the populations of bharal (Pseudois nayaur) and ibex (Capra sibirica) at seven different sites. Conducting the two double-observer surveys simultaneously led to underestimation of the population by 15%. We therefore separated the surveys in space or time. The overall detection probability for the two observers was 0.74 and 0.79. Our surveys estimated mountain ungulate populations (± 95% confidence interval) of 735 (± 44), 580 (± 46), 509 (± 53), 310 (±50), 206 (±89), 184 (± 40) and 30 (± 14) individuals at the seven sites, respectively. A detection probability of 0.75 was found to be sufficient to detect a change of 20% in populations of >420 individuals (See Suryawanshi et al. 2012 for details)

Molecular analysis to identify snow leopard scat samples:

Out of the 273 scat samples collected during the first bout of sampling 176 turned out to be snow leopards. The error rate in the identification of scats in the field varied from 3.77% in Lingti to 58 % in Lossar. The average misidentification rate for the first bout of samples was 25.57%. The canid PCRs for some of the samples, however, are yet to be done.

Table 1: Amplification success of scat samples using snow leopard and canid specific primers.

Site	# Samples	Snow leopards	Unid Canids	Unresolved
Kibber (additional)	35	21	-	-
Lingti	53	41	2	10
Lossar	50	13	29	8
Kibber	44	30	5	9
Pin Valley	24	16	7	1
Tabo	23	20	-	-
Gobi	44	35	-	-
Total	273	176	43	28

Snow leopard diet: Snow leopard diet was assessed only for the samples that were positively identified with snow leopard specific primer. Diet was assess through hair mounting from the hair remains of prey in the scat. Contribution of livestock varied from 2% to 60%. Contribution of blue sheep to snow leopard diet varied from 40% to 98%. Ibex was recorded in snow leopard diet at only 3 sites. Argali was recorded from two sites. Small mammal contribution to snow leopard diet was negligible (<1%). Snow leopard sem to prefer blue sheep over all other potential prey species.

Snow leopard abundance: So far we have finished analyzing samples from only two sites for individual identification. The delay was caused due to the unexpectedly long time need for standardization of the protocol. We used to program CapWire to estimate snow leopard abundance in a mark recapture framework. The estimates for the two sites are 7 (±3) and 6 (±1) from Lingti and Kibber respectively. The sample from the other sites are currently being processed at Dr Uma Ramakrishnan's lab at the National Centre for Biological Sciences, Bangalore, India.

5. Discussion:

Some of the key outputs of our project are: I. Robust estimation of the mountain ungulate prey of the endangered snow leopard. We have already shared our method of estimating the mountain ungulate prey of the snow leopard through the journal ***Oecologia***. II. Baseline data on livestock damage by the snow leopard and other sympatric carnivores in over 50 villages along seven different sites. We have achieved all the objectives proposed in the original proposal. Estimating snow leopard abundance through non-invasive genetic sampling took us longer than expected as we had to re-standardize the protocol. Overall, our project throws light on our understanding of the important aspects of human-snow leopard conflicts. It has also helped us develop and sustain robust methods of prey monitoring. The long-term work of the Nature Conservation Foundation has developed a robust understanding of the socio-economic trends in the Trans-Himalayan region. But, our understanding of the basic ecology of the snow leopard ecology is still relatively weak. I think the important next steps would be to develop a robust understanding of the ecology of the snow leopard, its relationship with other native and non-native sympatric carnivores, and its interaction with the prey.

References: Suryawanshi KR, Bhatnagar YV, Mishra C (2012) Standardizing the double observer survey technique to estmate mountain ungulate prey of the endangered snow leopard. Oecologia. DOI 10.1007/s00442-011-2237-0

6. Photographs:

Photo 1: Snow leopard sighted near Kibber village in Spiti Valley during the field work. **Photographer: Kulbhushansingh Suryawanshi**

Photo 2: Two snow leopards sighted near the Kibber village in Spiti valley during field work. **Photographer: Kulbhushansingh Suryawanshi**

Photo 3: Blue sheep seen in the Lingti Valley. Lingti Valley has one of the highest density of blue sheep amongst all the seven sites. **Photographer: Kulbhushansingh Suryawanshi**

Photo 4: Ibex sighted in the Pin Valley National Park. Pin Valley has the largest population of Ibex amongst all the study sites. **Photographer: Kulbhushansingh Suryawanshi**