

Snow Leopard Population Estimation and Conflict Assessment in Eastern Ladakh, India

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Executive Summary

Ladakh in the state of Jammu and Kashmir, India is one of the key habitats for snow leopards. Until recently, much work has been undertaken in the Hemis National Park though strong presence of snow leopards has been observed outside the protected areas. This study was undertaken to determine the presence status of snow leopards and understand the human-wildlife conflict issues in the Rong Valley of Eastern Ladakh. The study determines the region might has a good population of snow leopards in Ladakh with 18 individuals animals and an density which is similar to previous studies in Hemis National Park and other key snow leopard range countries. The study also highlights the strong presence of snow leopards near human habitations, further vindicating the human-wildlife conflict in the region. Livestock losses due to predators was reported in the villages surveyed, and continues to be a key issue in the region. The local communities do not have protective or guarding measures, which would be one of the key reason for higher livestock losses. Despite which, the local communities have a positive attitude towards the snow leopards and wildlife. This is can be highly advantageous and can support conservation actions in the region. Though, this is a preliminary study it has been able to determined that Rong could be one of the key areas for snow leopards outside the national park. The overlapping and co-existences of human –settlements and snow leopard habitat is one of the key attributes and continues to shape the landscape and the species in the Indian trans-Himalayas.

Objectives

There were main objectives of the study were:

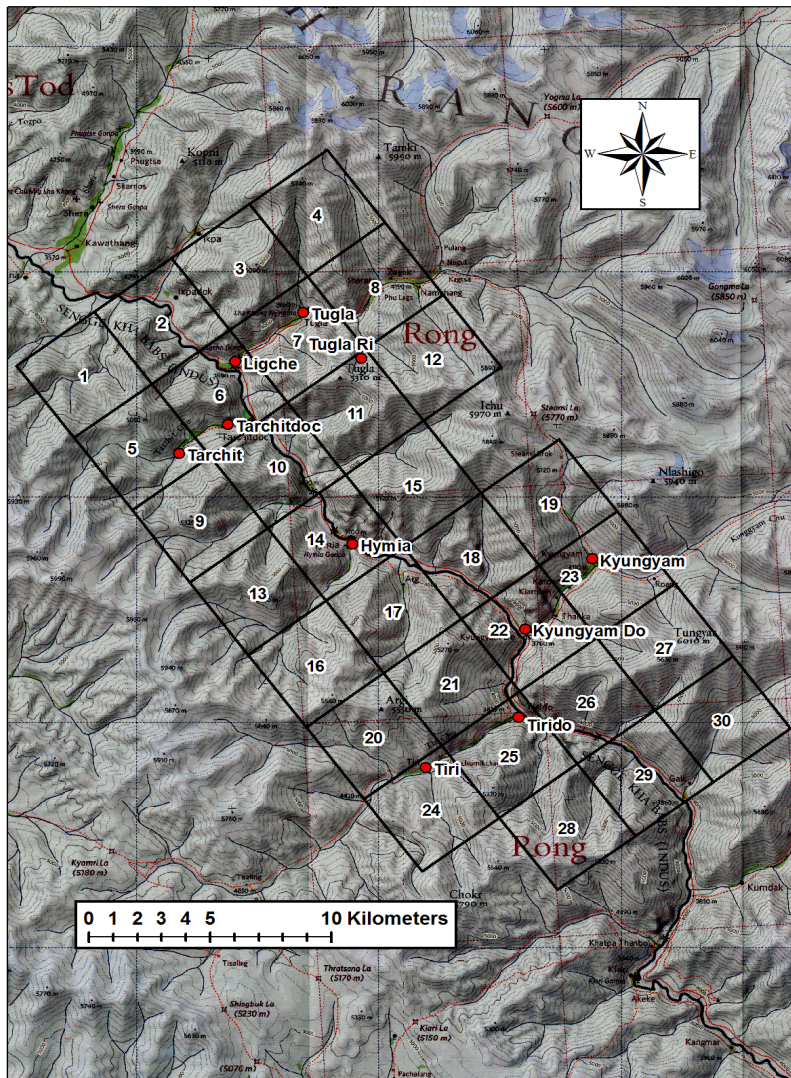
- To determine the status and population size of snow leopards in the Rong valley of Ladakh. This number will give a greater understanding of the status and distribution of snow leopards in Ladakh, which will help in having a more accurate global estimate of the cat
- To determine the importance of the Rong Valley in supporting snow leopards in Ladakh
- To understand the spatio-temporal pattern of livestock depredation by snow leopard, and movement pattern of snow leopard in relation to human habitations in the Rong Valley

Methods

Camera Placement

We used 36 camera trap in 30 4km x 4km grid-cells. The number and size of the survey grid needed to be altered slightly from the original stated methodology 5x5km grid, this was done because of the survey area's topography. In many places the terrain becomes very high (over 5,500m) close to the main Indus valley. Placing 5x5km grids-cells resulted in too many grids on the outer edges of the survey area dominated by unsuitable habitat. While, the final survey area was smaller than originally intended it is still large enough to cover main focus in the main Rong valley. The camera traps were placed in randomly selected grid-cells spread across an altitudinal gradient ranging from 3529 – 4908 m asl, with an average altitude of 4182m. Within the selected grid-cells cameras were placed along snow leopard travel routes: ridgelines, scrapes, rock scent, scats etc.

Figure 1: Map of Survey Area



Three models of camera traps were used during the study, with all models being dispersed across the survey grid-cells.

- i. Reconyx Hyperfire HC500 (n=10) placed singly in 10 grid-cells
- ii. Bushnell X-8: Trail Cam (n=1) and Trophy Cam (n=55) placed singly in 6 grid-cells
- iii. Panthera V4 (n=20) placed in pairs in 8 grid-cells and singly in 4 grid-cells

Camera Maintenance

Maintenance visits to change camera batteries were made to 16 trap stations at an interval of 20 days (14 Panthera trap stations, 1 Reconyx trap station and 1 Bushnell trap station). The latter two were visited to assess if visits were needed for the rest of these camera models. However, the battery performance in these models was good, and it was decided not to change battery for these models. The high density of camera traps in the survey area ($n = 36$) reduced the chances of missing a snow leopard, but it increased the chances of multiple captures of individuals at different locations. It also allowed us to place some of the Panthera cameras in pairs rather than singly. This was potentially an opportunity to obtain more data at each capture incident- e.g. multiple angles of a cat- at these stations, allowing stronger identifications of individuals.

Cat Identification

We identified unique individuals of snow leopards with the help of patterns of spots and rosettes across its body. We focused especially on the markings on the forelimbs, flanks, face, and dorsal surface of the tail.

Socio-Economic Survey

For the human-wildlife conflict surveys, we conducted a random questionnaire survey in the targeted villages. We also used involved community members to develop seasonal calendars for the village, which was broadly same for the entire Rong Valley. We also used their knowledge to understand and verify the depredation hotspots near the villages.

Results

Camera Trapping Study

Status and estimation of snow leopard population

We captured 1099 snow leopard photographs during the 2-month study period. The activity noted was that snow leopards were recorded facing the cameras, passing, marking sites. We captured flanks, face, and full body of snow leopards.

The estimated snow leopard population among all the studied grid-cells is roughly 18 i.e 14 adults and 4 juveniles. About 10 cats were identified from both left and right side, while 5 cats were identified from only one side. Four individuals remained unidentified. The unidentified cats remained so because there was only one picture of these cats. Thus, it is difficult to make a clear distinction from the rest of the cats. There is a possibility that these pictures are of the cats that are already identified. In the cameras, we also captured foxes, blue sheep, Tibetan woolly hare, marmots, pika, Tibetan snowcocks, Chukar partridge, domestic livestock and herders.

<i>Individuals</i>	<i>Identified both sides</i>	<i>Identified one side</i>	<i>Unidentified Cats</i>
Adults	9	5	4
Cubs	2	2	-

We also captured fox, blue sheep, woolly hare, marmots, pika, snow cocks, chukar, livestock, and herders during the study.

Density and Movement

The 18 individuals of snow leopards in the area translate to a density of 0.0375 snow leopards per sq km. We did not record any snow leopard crossing the Indus River. Most of the snow leopard restricted their movement to the adjacent grid-cells. There are only

two cats, which moved more extensively i.e., cat 2 visited 4 grid-cells and cat 9's movement spanned over 5 grid-cells. We captured snow leopards in cameras in 18 grid-cells whereas cameras in the rest of the 12 grid-cells did not capture any snow leopard image. We however cannot conclude that these grid-cells do not have snow leopard, as we have recorded snow leopard signs such as scats, pugmarks, and spray sites. Interestingly, all the cameras that captured snow leopards were placed in the grid-cells in the proximity to human settlements, and most of the villages in the vicinity of the camera trap stations reported livestock loss.

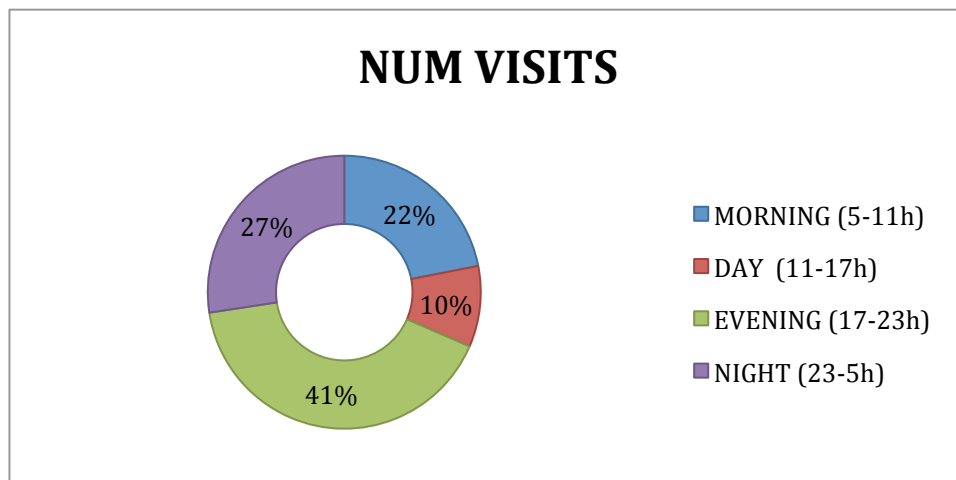
Activity Pattern

The preliminary analysis informs us the daily activity pattern of snow leopards. To determine the activity pattern we divided a day in four time periods (6 hours each) during the 24h in four 6hours-periods:

The first analysis informs us what daily hours the SL have more activity in front of the cameras. Four categories were created dividing the 24h in four 6hours-periods:

- **Morning** (5:00 to 11:00) fresh hours after sunrise
- **Day** (11:00 to 17:00) hot full-light hours
- **Evening** (17:00 to 23:00) fresh hours before sunset and first hours of darkness
- **Night** (23:00 to 5:00) full-dark hours

Figure 2: Daily activity pattern of snow leopards



This shows that the snow leopards were most active during the evening (17-23 hours) 41% which comprised of 30 visits, followed by night (23-5 hours) 27% comprised of 20 visits, morning (11-17 hours) 22% i.e visits and day (11-17 hours) which was 10% i.e 7 visits. The snow leopards apparently rest during the hotter parts of the day.

Human-wildlife conflict

Livestock holdings and Depredation Survey

A total of 104 households were interviewed in 9 villages in the study area (Table 1). While it is difficult to determine the number of livestock killed by snow leopards, majority of respondents implicated snow leopard as the most important predator followed by wolves and wild dogs. About 11 respondents also reported livestock loss to feral dogs. About 30 livestock succumbed to cold weather, diseases and accidents. The type of livestock includes cows, horses, donkeys, yaks, dzos (hybrid between yak and cow), goat and sheep. Cows, goats and yaks were however the main victims of predation.

Table 1. Livestock holding and total livestock loss in 9 villages of the Rong Valley

Village Name	Livestock Holding	Total Livestock Loss
Ik	47	10
Tuglu	128	30
Liktsey	87	17
Tarchit	168	92
Khaptu	112	15
Himya	109	22
Tiri	49	22
Kyungyam	350	54
Gaik	31	10
TOTAL	1081	271

Table 2. Causes of livestock mortality in 9 villages in the Rong valley

Type of Livestock	Total Holdings	Depredation	Other Causes (Cold, Accident, Diseases)	Unknown	Total Loss
Cow	320	64	19	5	88
Ox	93	1	3	0	4
Yak/Demo	122	21	2	0	23
Dzo/Dzomo	31	-	-	-	0
Goat	438	108	30	2	140
Sheep	57	12	-	-	12
Horse	15	1	1	2	4
Donkey	5	-	-	-	0
TOTAL	1081	207	55	9	271

Wildlife sightings

When asked about wildlife sightings, the participants mostly reported snow leopards, wolves, wild dogs, blue sheep, red fox, pika, hare and marmots. Respondents also sighted feral dogs in the area, which is a growing menace in the valley. Out of the 104 participants, all had sighted snow leopards.

Guarding practices for livestock

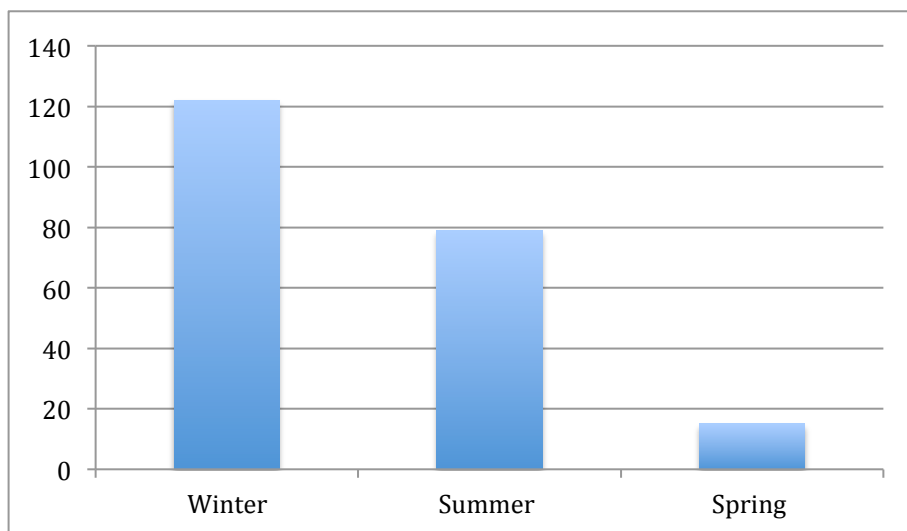
Out of fifty-eight households that owned small-bodied livestock, only seventeen had adopted protective measures like herders/ shepherd for guarding their small-bodied livestock during the day, and were corralled at night. While the rest were unable to give definite answers, there were usually kept in open corrals. Of the eighty-four large-bodied livestock owning households, seventy-one responded that they tended these large-bodied.

Eight households responded that they did not tend these livestock types, while five did not respond. Some villagers also said that they take turn to tend the livestock.

Seasonal pattern of livestock loss

Eighty-four households (80.8%) responded to this question on seasonal depredation. Sometimes it was difficult for the respondents to remember the month, so most mentioned the season. Therefore, the year was divided into three seasons: Winter (October to March), Spring (April-May) and Summer (July to September). To verify the seasons, there was given indicators of festivals and agricultural season. Therefore, it was broadly categorized in three seasons: Winter (October to March), Spring (April-May) and Summer (July to September). Livestock loss occurred throughout the year. There is no particular month or season when the predation was exclusively in the winter months; rather it was spread throughout the year. Many respondents mentioned in the summer months – the main causes were diseases as well as depredation by snow leopards and wolves.

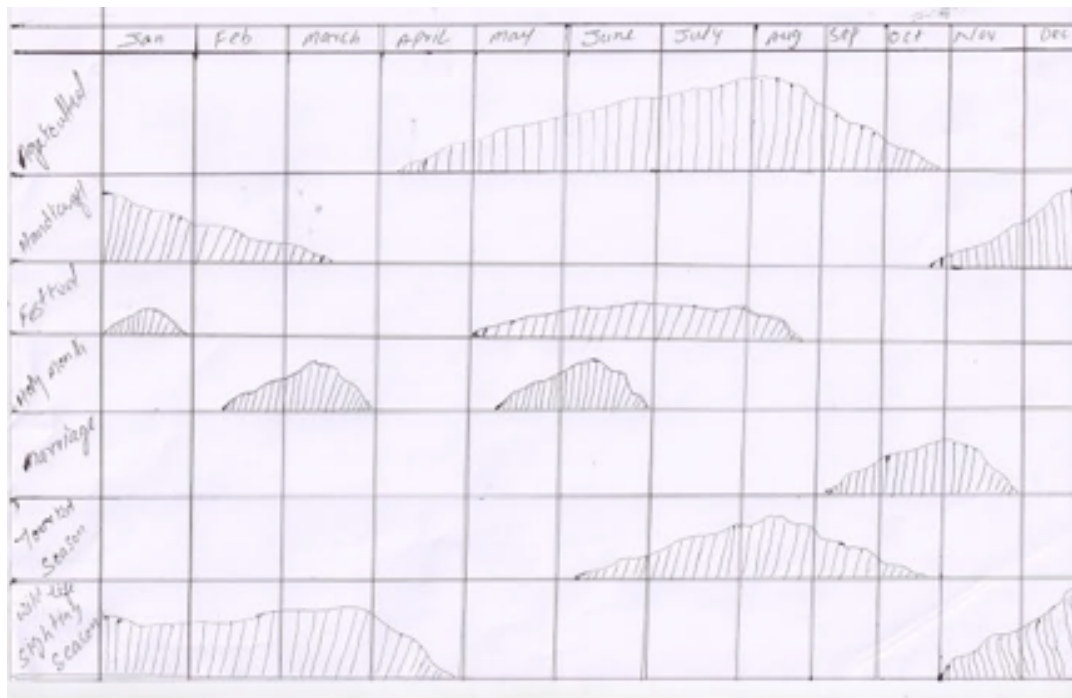
Figure 3: Seasonal Pattern of livestock loss



The seasonal calendar that was developed with the local communities showed that wildlife was seen throughout the winter months. Some of the other activities were also highlighted to understand the busy seasons of the local communities. Though most of

respondents indicated that wildlife sighting was limited in summer months, depredation was still occurring. People were busy with agriculture in the summer (May to Sept). They were busy hand crafting things during winter (Nov to Feb).

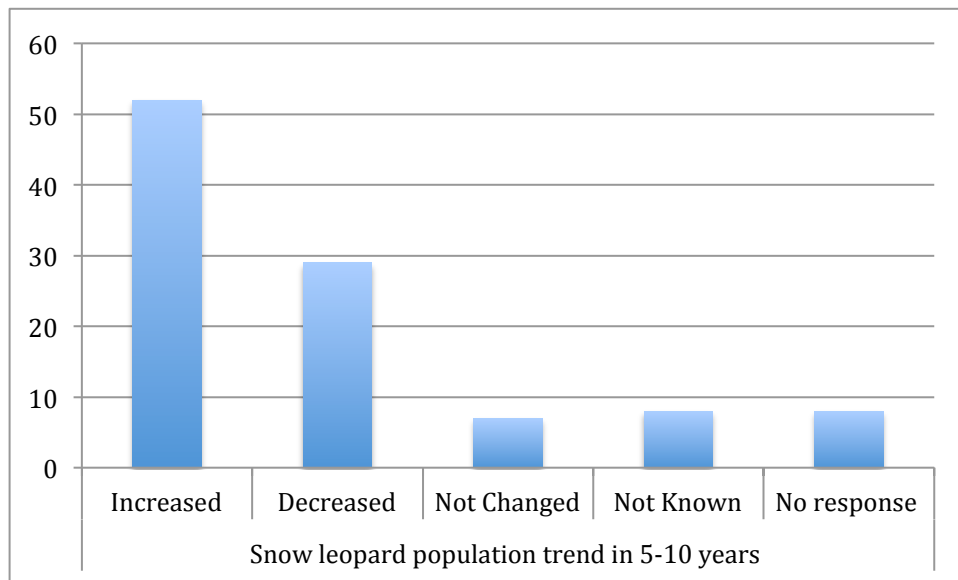
Figure 4: Seasonal Calendar



Community perspectives on snow leopard population and depredation

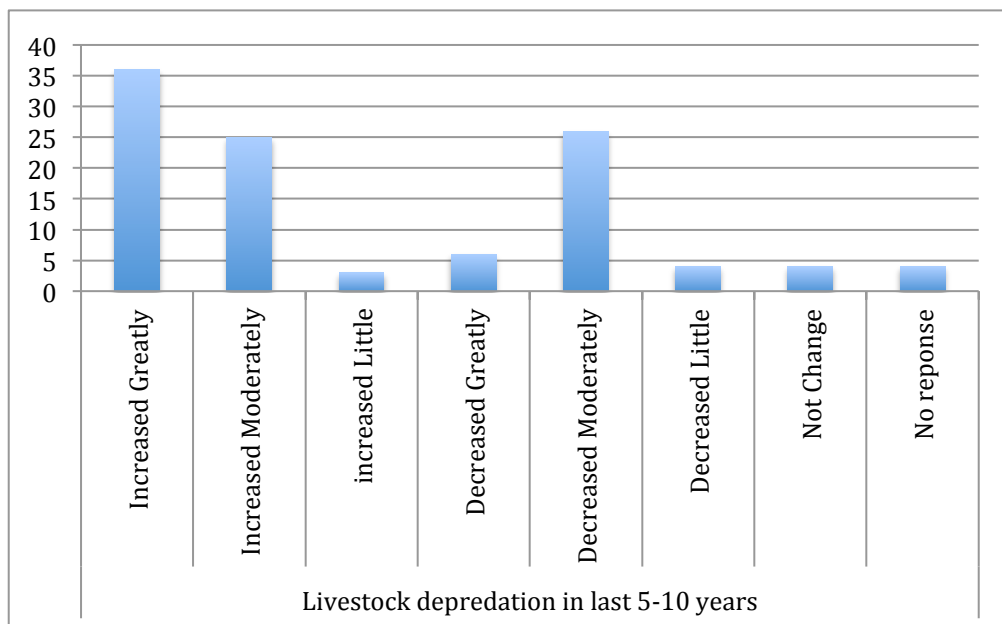
Although, there is no baseline information on snow leopard population in the region, we asked the local community to give some insights into the snow leopard population trend, i.e, if the population increased in the last 5-10 years. Figure 5, shows while fifty-four households (51.9%) participants responded an increase in snow leopard population in the recent years, about twenty-nine households (27.8%), seven (6.7%) reported there was no change in snow leopard population.

Figure 5: Community perspective on snow leopard population trend in last 5-10 years



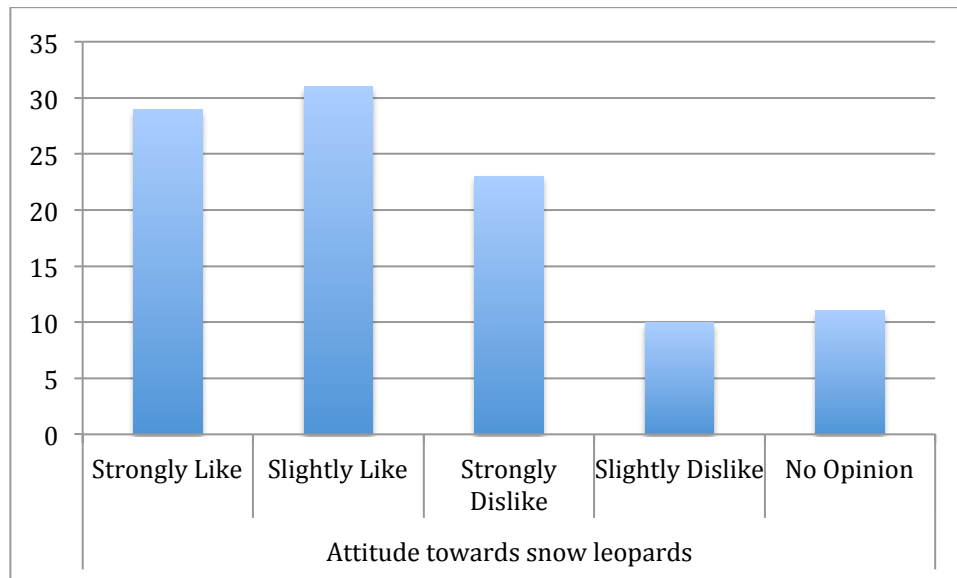
Similarly, figure 6 shows, thirty-six households (34.6%) responded that livestock loss to wild predators has increased greatly in the last 5-10 years. Twenty-five households (24.3%) responded – increase of moderate rate, three (2.8%) responding – little increase. Twenty-six (25%) responding that it had decreased moderately, and two responding that it had not changed. Depredation continues to be an issue with the local communities.

Figure 6: Community perspective on livestock depredation due to predators



Community attitude towards snow leopards

Figure 7: Community attitude towards snow leopards

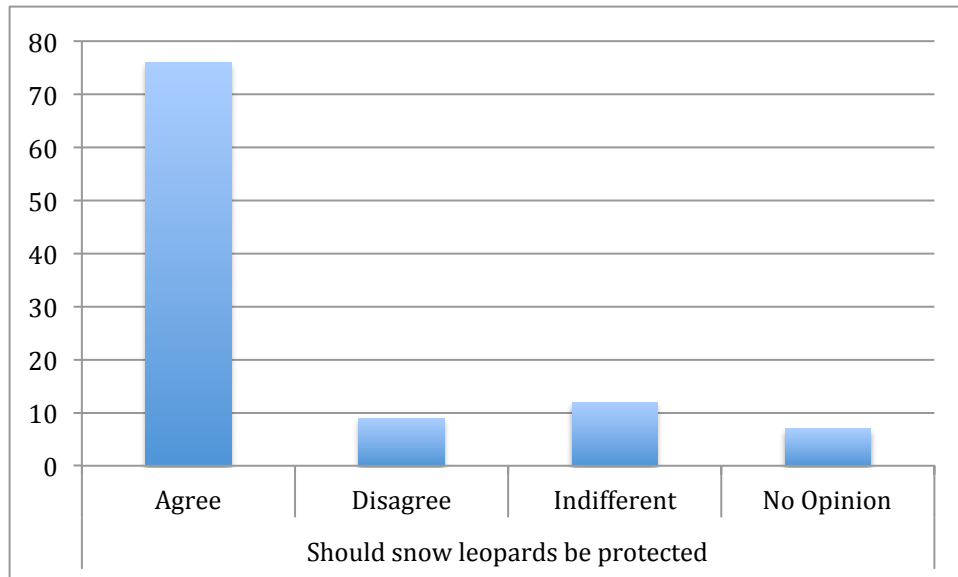


Despite the livestock losses to snow leopard, many respondents (figure 7) had a positive attitude towards the cat with twenty-nine households (27.8%) expressing a strong liking. Thirty-two households (30.7%) expressed slight liking whereas twenty-three households (22.1%) expressed strong dislike. Eleven households (10.5%) did not have any opinion about it.

Protection of snow leopards

The positive attitude of the people towards snow leopard was also reflected in their support for the cat's protection (see figure 8). Seventy-six households (73%) endorsed the protection and conservation efforts of snow leopards, while 9 (8.5%) disapproved conservation efforts and about thirteen (12.5%) were indifferent.

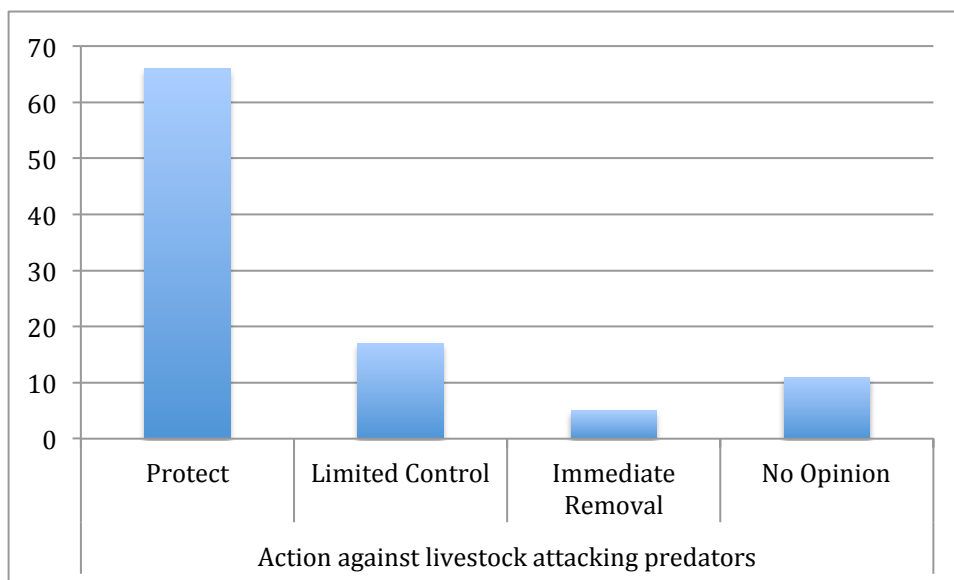
Figure 8: Community attitude towards snow leopards



Action against predators attacking livestock

Despite losing livestock to predator attacks, sixty-five (62.5%) of the households agreed for their protection, whilst about seventeen households (16.4%) mentioned measures for limited control referencing to the traditional traps. And five (4.8%) strongly concluded immediate removal of the predators.

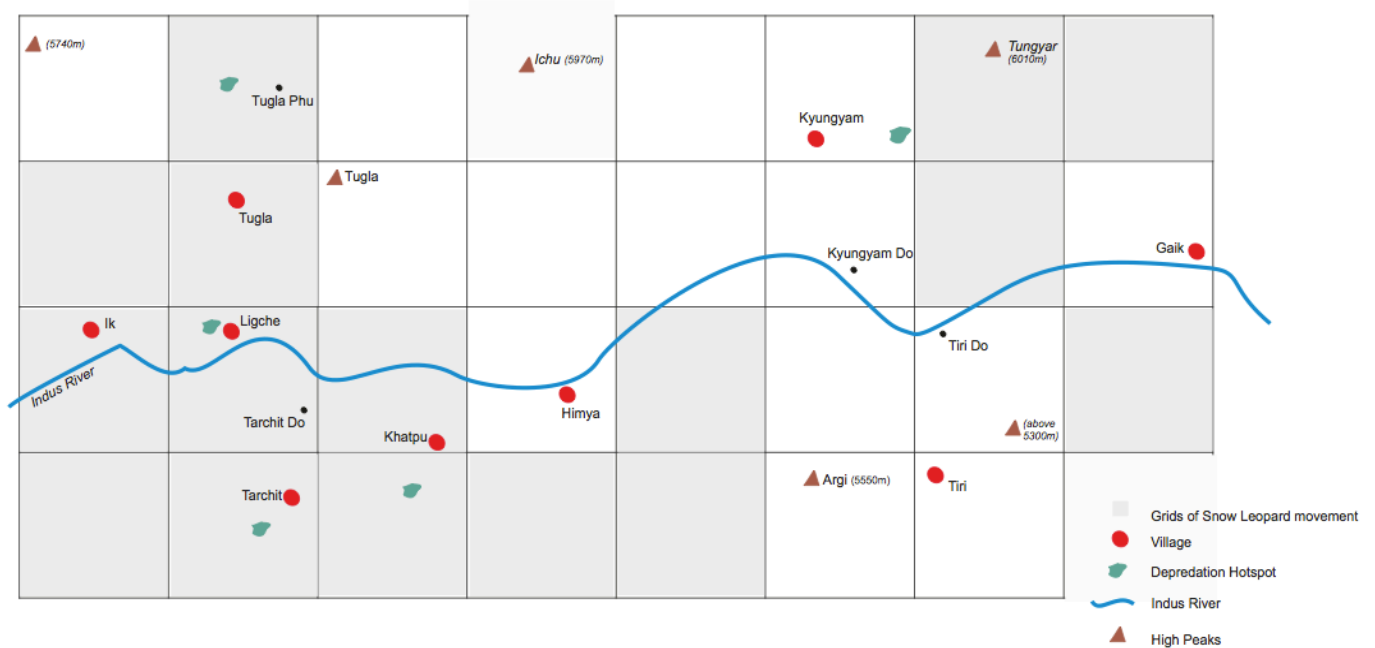
Figure 9: Action against predators attacking livestock



Depredation Hotspots and overlaps

We determined depredation hotspots in the Rong Valley. Though, many respondents mentioned that depredation took place within the village pastures as well as in the corrals. These areas are near villages, where livestock is usually left unattended without any human presence, which increases the vulnerability of the livestock to predators.

Figure 10: Depredation hotspot and snow leopard and human-settlement overlaps



The map also shows greater movement of snow leopards in the grey grid-cells, which also have a greater concentration of human habitations. Thus, it indicates that snow leopards are more active in vicinity of the villages. There is also a clear overlap in the depredation hotspot and snow leopard activity, as most of the livestock were killed in the grey grid-cells, where snow leopards were more active. Cameras in the white grid-cells did not capture any snow leopard.

Discussion

As a preliminary study, we recorded 18 snow leopards in an area of 480 sq.km which translates to a density of 0.0375-individual/ sq.km or 3.7/100 sq.km. The density of snow leopards is similar to the density reported in Mongolia 3.6/100 sq.km and in Nepal 3.5-5.3 individuals/100 sq. km (Jackson & Ahlborn 1989). The previous study in Rumbak, Hemis National Park suggested a density of approximately 6 snow leopards per 100 sq.km in areas of good habitat and no more than 4/100 sq.km in marginal habitat (Jackson et. al 2006). The capture of 4 cubs is also a strong indicator that the species is actively breeding in the region. With those preliminary results we can conclude, Rong Valley could be one of the key habitats for snow leopards other than the Hemis National Park.

Snow leopard movement was restricted to adjacent grids. The movement reflects during the study period is seem limited but there could be movement of cats during the other seasons. This study could be reflective of their movement during the winter or spring season. Even the local communities in the seasonal calendar have cited active snow leopard movement during the winter and spring seasons.

Livestock depredation has been one of the major challenges in the snow leopard range countries. While, majority of the livestock losses in Rong occurred during the winter months, the two primary causes can be determined as predatory attack and the harsh winter that had gripped the region in 2012-13. Also, predator attacks on livestock are not limited to winter but have occurred throughout the year. All villages reported loss of livestock to predators. The small-bodied livestock are the most vulnerable and easy target for predators. The snow leopard has been previously recorded for breaking into livestock pens and killing large numbers of sheep and goats at one time in an area not far from our study area (Namgail et.al 2007). Despite the losses, the optimistic and resilient attitude of the people is remarkable. The attitude towards wildlife and predators in general is positive. People continue to co-exist with snow leopards and predators despite the economic challenges and losses it is causing. Recent records about snow leopards having

a sacred place in Tibetan Buddhist scriptures and revered as a protector of the sacred mountains (Li et al 2013) could vindicate the positive attitude of the local Buddhist communities. Officially, there has been no reported killing of snow leopards or wolves. Though, local communities are extremely skeptical of revealing such information since it can have legal implications. It is difficult to determine if there have been any retaliatory killings of snow leopards or other predators. The respondents also believe snow leopard population has increase in recent times. Though there is no baseline information available for validate the same.

The study clearly shows the movement of snow leopards around the villages. All the depredation hotspots determined within the study are in grey-grid-cells, where there were more snow leopard photo captures, apart from one in Kyungyam, where it is adjacent to the grey grid-cell. The region has reported livestock losses in the past and continues to do so. There is probable dependency on livestock by snow leopards for survival. Therefore, some level of livestock depredation may be inevitable to maintain the snow leopard population in Rong. There is a clear indication of overlaps between prime snow leopard habitats and human habitations.

The study strengthens the fact that snow leopards are found in healthy numbers outside the protected areas of Ladakh. The focus for addressing snow leopard conservation and mitigation measures must shift from Hemis National park to Rong and other key areas in Ladakh. These areas also need attention when it comes to conserving snow leopards in this Trans-Himalayan region. Lastly, working with local communities could help develop and strengthen long term monitoring programs in the region. Considering the evident overlaps, before setting traps we consulted villagers if they had seen any movements or presence of the cats. Their inputs were important to incorporate to the overall study. Working with local communities will continue to be a key element for future conservation and mitigation work in Ladakh.

The Road Ahead for Rong Valley

Since this is only the first effort in the area, there is a high possibility of undertaken further research to draw a bigger and clearer picture of snow leopards in the area. The

present study can be supported to develop a bigger monitoring program. There is scope that there could be more snow leopards in the region. The study can be extended to other parts of Rong Valley to determine actual population. This can be used as a baseline to determine and monitor snow leopard populations in the future. The area of Rong has no definite boundaries to it, but the suitable habitat makes it an important area for snow leopards outside the Hemis National Park. More research can be undertaken to provide more in-depth studies in the area on the species ecology, prey, and population.

In terms of human-wildlife interactions, there is a need for better compensation for communities for the losses the local communities are incurring. The community has a positive attitude towards snow leopards and wildlife in general, which is an added advantage to work with them. More intervention is required to help the communities in terms of building snow leopard-proof corrals or develop other mitigation measures. The recent efforts by Nature Conservation Foundation and Snow Leopard Conservancy India Trust may support in this process. There is also a possibility to designating the identified hotspots as community managed reserved areas, where livestock is limited or restricted to reduce the livestock-predator confrontations. The point of conflict is the livestock losses, but the positive attitude of the people can help play a crucial role in ensuring the co-existence continues. Our observations have also shown change in livestock holdings of the local communities in the recent past. Local communities have been selling their livestock in upper Rong areas. The reasons cited were that the youth are not inclined to the traditional agro-pastoralists lifestyles. Many are moving to urban areas to study and work during the tourist season. Though, this was outside the scope of this study, future studies should see if social changes, especially urban-rural migration issue in the region drive livestock holding patterns. And, indicating the dependence of snow leopards on livestock, it could also affect the species negatively. To conclude, Rong is clearly an important habitat for snow leopards in Ladakh, and more studies need to be undertaken to provide more in-depth knowledge from the area.

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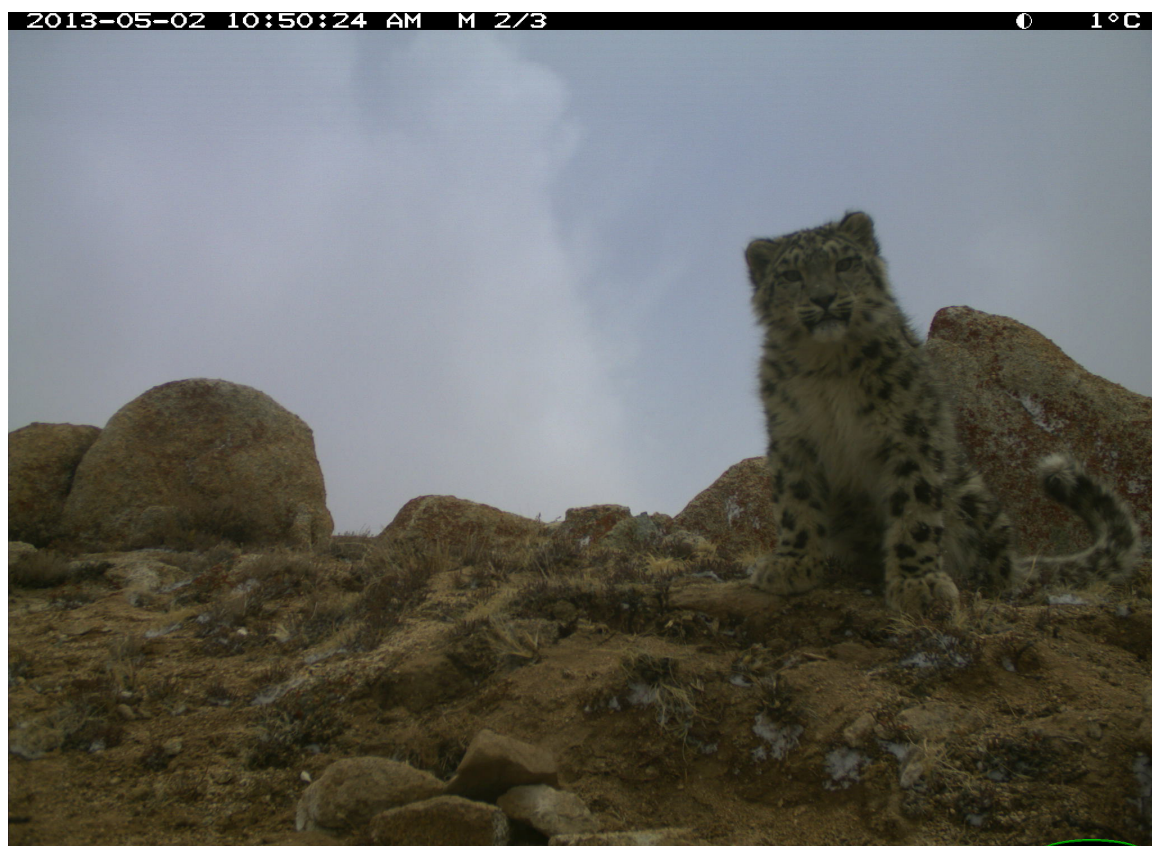
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Photographs



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RECONYA

Funds Utilization

S.No	Particulars	Unit	Qty	Sub-Total (USD)	Notes
1	Local transportation				
	Car Transportation		10	583	Hire organisation car and fuel costs
	Local transportation			19	
	Car hire		1	385	
2	Field logistics (food and accommodation)				
	Food and accommodation	months	2	1365	Including homestays on some days during camera trapping field work and conflict survey. Also including 3-4 local guides and volunteers
	Camping equipment hire/materials	days	45	144	Sleeping bags, tents, mattress
3	Communication				
	Communications			69	
	Postages			19	
4	Printing and equipment				
	Printing			135	
	Equipment Camera traps (Batteries, cods)			394	
	TOTAL			3,113	

SLN Grant	3500	
Received	3492	8 USD Bank Charge
Utilized	3113	