The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.
Josh Cole, Grants Director

Grant Recipient Details	
Your name	Bikram Shrestha
Project title	Interaction between sympatric species (snow leopard and co-predators) and their conservation in Annapurna Conservation Area, Nepal
RSG reference	16363-1
Reporting period	January 2016 - December 2016
Amount of grant	£5000
Your email address	bikramone@gmail.com
Date of this report	December 2nd 2016

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Assess the status, distribution and habitat use of sympatric carnivores (snow leopard and co-predator) and their main prey				It was done using SLIMS survey technique, camera traps and genotyped scat samples' GPS data. Still more study is needed to know seasonal habitat use of *Canis lupus*.
Estimate density, dispersal pattern, activity patter, diet overlap of the sympatric carnivores in selected areas.				In case of common leopard, microsatellite genotype analysis' protocol or necessary primer is yet to develop to know individual number. Therefore, we could able to identify up to its species and sex only. We did not have scat sample of lynx, only one captured image. Regarding dispersal pattern and activity pattern of sympatric carnivores, the huge data obtained from camera trap are yet to be analysed.
Assess human-snow leopard and co-predators conflict and effectiveness of adopted conflict mitigation measures				Data collection was done in four settlements of Manang and Mustang.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

During field work in summer season in Annapurna Conservation Area, some the trails to camera traps were obstructed because of a landslide and heavy flood in the river. I had to use alternative route to reach up to camera trap which required more time and effort.

3. Briefly describe the three most important outcomes of your project.

A. Status and density of snow leopard and its prey species:

Among two areas, sign abundance (scrape/km) was higher in Manang (4.7-5.0; SE= 0.44 to 1.5) than that of Lower Mustang (2.7-4.6; SE=0.67-2.1). Similarly, camera trap captured success rate (capture event/100 night traps) was higher in Manang (mean=3.37; SE= 0.69) than Lower Mustang (mean=3.0; SE=1.2). Six snow leopard individuals were identified in Lower Mustang and eight in Upper Manang for 2014 and 2016. Other wildlife such as wolf, lynx, golden jackal, red fox, jungle cat, golden jackal, weasel spp., stone marten, pika, and Pallas' cat (new species to Nepal, see detail in Shrestha et al. 2014 in Cat News) were also captured in camera traps.

During field survey, in total 198 faeces samples (Phase I and II) were collected for genetic tests. Regarding non-invasive genetic population estimation, out of 198 samples, 87 samples were positive for snow leopard (*Panthera uncia*), 58 were for common leopard *(Panthera pardus*), six for wolf (*Canis lupus*), five for golden jackal (*Canis aureus*) and 23 for red fox (*Vulpes vulpes*). For snow leopard individuals, final allele call analysis obtained from microsat genotyping analysis generated by 12 loci is ongoing (Table 1).

The population of blue sheep in Lower Mustang ranged from 135 - 241 (SE= 56.5) and a density of 1.7/km^2 from 2010 to 2016. In Manang, it was a mean of 723 (SE= 21) and a density of 6.7/km^2 from 2014 to 2016.

Table 1: Overall Summary of non-invasive genetic population estimation

Samples screened(n=198)	SL Positives (n=87)	SL Negatives (n=111)	
198 Scat samples Phase I= 158 Phase II= 40	Female=41 Male=29 Unconfirmed sex=17	Common leopard Positives = 58 Female=32 Male=18 Unconfirmed sex=8	Common leopard Negatives= 53 Carnivore ID Positives =43 Negatives =10

Microsatellite genotyping (n=70) Combination 1 and 2 (6 loci)	
Microsatellite genotyping (n=34) Combination 3 (additional 6 loci)	

Canis lupus=	6
Canis aureus=	5
Vulpes vulpes=	23

B. Habitat utilization and diet of sympatric species:

Based on genotyped scat's GPS location and camera trap data, I analysed percentage habitat utilisation of five sympatric carnivores (snow leopard, common leopard, red fox, wolf and golden jackal) recorded in the study areas.

In case of topographic habitats, cliff was the main factor for separating carnivore's microhabitats. Cliff was most preferred by snow leopard, and then it was followed by golden jackal, red fox and common leopard. Wolves did not prefer cliffs. Other features such as hill slope and ridge overlapped for all carnivores (Figure 2).

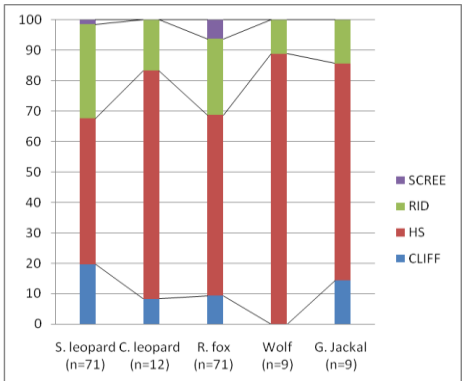

Figure 2: % Topographic features

Very broken micro-habitat was the most important factor in case of habitat ruggedness. Common leopard and golden jackal did not prefer very broken habitat, however rolling and broken habitat overlapped for all carnivores (Figure 3).

Snow leopard, wolf and golden jackal did not prefer forest (canopy cover more that 50%). Wolf and golden jackal also did not prefer open forest (canopy cover less than 50%). Common leopard did not prefer alpine grass habitat. Shrub land was the overlapped habitat for all carnivores. Open forest was also overlapped habitat for snow leopard and common leopard (Figure 4).

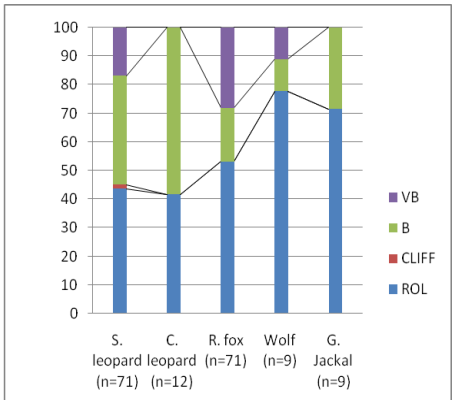

Figure 3: % Habitat ruggedness

In case of elevation, common leopard and golden jackal did not prefer elevation ranging between 4501 m and 5000 m while red fox, wolf and golden Jackal did not prefer elevations below 3001 m. Elevation ranging between 3501 and 4000 was overlapped for all five carnivores (Figure 5).

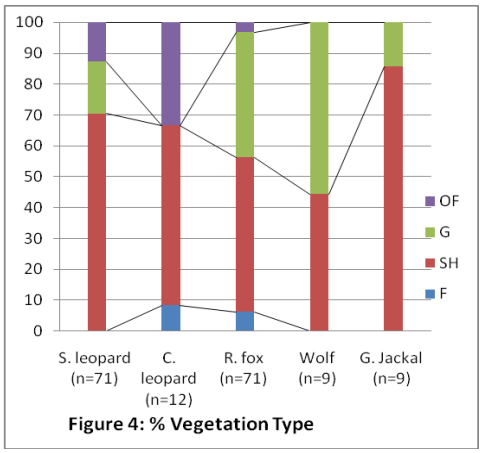

Figure 4: % Vegetation Type

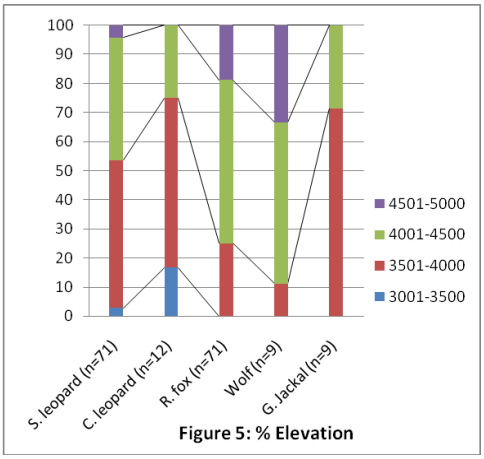

Figure 5: % Elevation

Based on microscopic hair characteristics (scale pattern, medulla type and cross section of the hair), I explored diet of the five sympatric carnivores from genotyped scat samples. In Lower Mustang and Manang, eight wild species and six domestic livestock species including dog were recorded from diet of the carnivores.

In the case of Manang, blue sheep was staple diet for all carnivores except common leopard during winter and the percentage volumetric contribution ranged between 33 and 73. In case of common leopard, it killed the highest frequency on domestic livestock which contributed 73 % and it was followed by blue sheep (18%) and small prey species (9%). In case of all four carnivores except common leopard, wild prey species contributed the highest volume in their diet which ranged between 47% and 92% and domestic livestock ranged between 8% and 44% in percentage. In overall, wild prey species contributed 64 % and domestic livestock contributed 33 % in all five carnivore's diet in Manang. In case of Lower Mustang, the case is different from Manang. Small prey species and domestic livestock contributed the highest percentage frequency in the diet of carnivores. Domestic livestock, small prey species and blue sheep ranged between 33% and 56%, 35% and 67%, and 0% and 27% in diet of carnivores respectively. In overall, wild prey species contributed 56% and domestic livestock contributed 44 % in all five carnivore's diet in Lower Mustang.

C. Human-snow leopard conflict and effectiveness of mitigation measures

We interviewed local residents of 92 households in four selected settlements in Lower Mustang (Lupra and Jhong) and Upper Manang (Khangsar and Proper Manang) to assess pattern of livestock depredation by predators, peoples' perception on snow leopard and effectiveness of adopted mitigation measures. This study revealed that losses to snow leopard ranged from 2.3% to 6.3% and 10.3 % to 14.3 % of total stock per annum in Lower Mustang and Upper Manang respectively. The loss to other predator (e.g., wolf, red fox or golden jackal) was 5% of total stock per annum in Upper Manang. In average, the monetary lost to predator was NRs. 34880 (USD 349) per family in Upper Manang which is about equal to the average income per capita in Nepal averaged 387.02 USD. Yet, villagers in settlements like Proper Manang, Khangsar and Lubra suffering large livestock mortality to snow leopard are still willing to tolerate the presence of snow leopards, albeit uneasily. Local inhabitants showed mixed feelings toward snow leopard for good reasons: livestock-rearing, although declining, still represents a significant socio-economic activity in Mustang and Manang, and snow leopards often prey upon domestic animals. Although averaged 39% of all livestock losses were attributed to snow leopard depredation, many more animals (61% of total) died from other causes (starvation, accident and disease).

A number of mitigation measures locally adopted and their effectiveness were assessed by discussion with two field unit conservation officials of ACA, key informant interview, household survey and focal group discussion. Out of 50 respondents in Upper Manang, 90% were aware about the Livestock Insurance Scheme (LIS) in the village provided by Manang's unit conservation office of ACAP whereas only 10% had no response. Compensation through the livestock insurance scheme perceived the highest perception with 56% agreed to control predation by snow leopard. Whatever the scheme is, most people do not apply for the compensation because of the lengthy process and they are not able to confirm the kill is by snow leopard. It was found that the compensation was provided to the villager if it proved loss only by snow leopard. Most of the attacks occur in grazing/pasture place and herders cannot collect the evidence of a livestock kill by snow leopard. Thus, within the total respondents, 23 had applied for the compensation but only 17 benefited by the LIS up to 2014. In 2015 no distribution of compensation has been found recorded from the CMC office whereas most of the villagers did not apply for the compensation. Similarly, most of herders were not interested in the partial compensation scheme provided by Mustang's unit conservation unit office of ACA. They complain the procedure in getting the compensation is lengthy and compensated amount is very nominal in comparison to the loss of livestock. In 2015, only nine local herders were compensated partially for 23 livestock killed by predators in Lower Mustang. Only 9% of the respondents were disagreed to control predation by snow leopard by others or incentive programmes (saving and credit conservation group, handicrafts, home-stay programme or entrepreneur conservation business) and only 8% of the respondents strongly agreed with the control of predation by livestock measures (avoiding grazing in areas which have high predation risk, reducing the number of livestock), 42% of respondents strongly agreed with the wildlife-related measures (prey conservation, complete examination of snow leopard). Improved animal husbandry practices (close guarding of herds, corralling animals in predator-proof enclosure at night, use of dogs, electric fencing) contributes 24% agreed. Based on local recommendation and conservation point of view, education programme and community-based livestock insurance scheme with integrating other mitigation measures should implement effectively.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Two local people were fully involved in camera trap and one ranger of ACAP along with conservation officer partially engaged in camera trap and household interview survey. One BSc student from Kathmandu Forestry College was selected as a research assistant for the purpose of survey on snow leopard-human conflict and effectiveness of mitigation measures in Upper Manang and his partial fulfilment. We aim to publish the finding in referred journal and published paper will share with the

Rufford Foundation. This project supported a student financially and technically. I also trained a student on microscopic hair slide preparation for the purpose of diet analysis. Some local herders were also engaged to safeguard for my installed remote camera and in making an informal record on wildlife presence nearby their corral (Goth) or pasture land. Therefore involved local people were capable to share snow leopard and co-predator's ecological role in the nature among the villagers.

5. Are there any plans to continue this work?

Wildlife monitoring and mitigating human-wildlife conflicts are equally important for the betterment of both wildlife and livelihood of local people who share wildlife habitat. Gradually increasing common leopard and wolf establishing again in Mustang and Manang of ACA are causing more challenges in a context of human-wildlife conflict. Therefore, I want to continue community-based wildlife conservation programme for a better understanding of the ecology of sympatric carnivores and enhancement of livelihoods of local communities. Next step would also be to do the same kind of research on the adjacent areas.

6. How do you plan to share the results of your work with others?

I have presented the results of the research in 8th post graduate student conference held in Charles University, Czech Republic. For the part of the project's work, a research assistant, a BSc student, was selected for his partial fulfilment and he presented part of work in thesis evaluation presentation in Kathmandu Forestry College, Nepal. As I worked the project work in coordination with Department of National Parks and Wildlife Conservation and National Trust of Nature Conservation/Annapurna Conservation Area Project, my progress report is being simultaneously shared with them. In the meantime, I am also writing two manuscripts to publish in peer reviewed journal and disseminate in relevant conferences. Once, it is published I will disseminate via Rufford Foundation website.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

It has successfully completed the project in actual time i.e. January 2016- December 2016.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Local assistant (local herder) for field guide and research assistant (student and ranger) for field survey and lab work	2100	2100	00	
Porter	165	50	115	I used few porters.
Local travel	192	307	-115	I had to use horses to go summer high camp and local horse fee was higher than expected.
Vehicle rental	149	149	00	
Genetic analysis	1850	1850	00	
Maps and stationary	149	149	00	
Communication, printing, writing	372	372	00	
Total	4977	4977	00	

9. Looking ahead, what do you feel are the important next steps?

Conservation cannot be imposed from the scientific research but it must ultimately be based on local interests who share snow leopard habitat. Conservation should be linked with the livelihoods of local people. Community-based wildlife (snow leopard and compititors) monitoring and conservation programme is important to save endangered mountain wildlife and to improve local income simultaneously.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Yes I acknowledged and put Rufford Foundation logo in my powerpoint presentation during 8th PGS conference in Charles University, Czech Republic. I will also mention the RSGF and use its logo in my future publication.

11. Any other comments?

This support from Rufford Foundation small grant has helped me to get involved in wildlife research and conservation. I will do my best in the field of research and conservation in days to come also.

Left: Snow leopard captured by remote camera trap, Lower Mustang, Annapurna. Photo by Bikram Shrestha. Right: Reintroduced wolf after 3 or 4 decade in upper Manang and Lower Mustang Annapurna. Photo by Bikram Shrestha.

Left: Researcher, Bikram Shrestha, monitoring installed camera trap. Photo by Bikram Shrestha. Right: Summer high temporary herder camp, Manang, Annapurna. Photo by Bikram Shrestha.

Blue sheep, main prey species of snow leopard in Annapurna. Photo by Bikram Shrestha.