The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants 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	Som B. Ale
Project title	Assessing snow leopards and their corridor habitats in Nepal
RSG reference	10662-B
Reporting period	Autumn 2011 to autumn 2012
Amount of grant	£11,767
Your email address	Sale1@uic.edu
Date of this report	26 November 2012

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
- Generating spatial data for Annapurna and selected areas between Annapurna and Sagarmatha/Rolwaling			Fully achieved	This was simply collating existing, scattered spatial data for mapping
- Generating data and models for snow leopard distribution and relative abundance in selected areas			Fully achieved	Data collection is complete and one level of modelling, using Discriminant Functions Analysis was done.
- Developing seasonal snow leopard maps for Annapurna and merge them with Everest to model corridors at landscape level, for management interventions		Partially achieved		All field data were collected. The modelling, which may be intensive, is under progress.

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

Field data collection, which is crucial in field biology, is always challenging. The terrains where snow leopards occur are remote. Parts of Manaslu Himalayan range, e.g., Tsum valleys, are very remote (five full days of continuous walk). Although we made up to these remote alpine dwellings of snow leopards, torrential monsoonal rains hampered to some extent the data collection. But this was anticipated to some extent. The field trip to Everest was equally difficult in 2012. In the absence of flights, I had to descend down to Kathmandu from Everest walking for five full days. Annapurna field work was alright.

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

- *Preliminary data collection for agent-based modelling:* We collected data from Everest and Annapurna (with source snow leopards' populations) to identify corridors for snow leopard movements. My responsibility under Booster grant was to collect required data (find the snow leopard locales, collect data on snow leopard signs and prey presence, obtain seasonal data on livestock grazing and human presence, and in the field extensively map these areas on top-maps). In addition, the following activities were accomplished: habitat mapping in relation to livestock grazing and upper/lower snowlines for each season, and assessment of livestock depredation trend. All this was done for parts of Annapurna and Manaslu (Manaslu field work may require additional data collection with additional support).

  The corridor modelling, a group exercise, is currently undergoing and van be an intensive undertaking largely because the technique, the agent-based modelling (agent being the snow leopard), itself is emerging in ecological modelling.

- *Simple corridor modelling:* One level of corridor modelling was complete. We used snow leopard sign --faeces (scats), footprints (pugmarks), scrapes, and scent (spray) marks and boulders and rocks where the animals had rubbed against (often at or near spray/scent spray site) to determine sites where snow leopards were active. We searched signs along sign transects (few hundred metres to up to 1 km long). We also recorded signs whenever encountered opportunistically. To detect snow leopard sign, we trekked the region extensively, visiting all locations where we judged snow leopards and their prey to occur, employing the techniques of the Snow Leopard Information Management System. Sampling was conducted during the period of 2011 but the data from the earlier surveys from Everest, Gaurishankar, and Annapurna (upper Mustang) were also included in the analyses and modelling.

  To determine the characteristics of the habitat available for use by snow leopards, random sites were selected from areas that had been surveyed for snow leopards but at which no snow leopard sign was found. We selected one random ''available'' site associated with each of sites at which snow leopard "activity" was detected. Hawth's Tools for ArcGIS 9.x (www.spatialecology.com) was used for random selection of sites. Available site (randomly selected) and use site (where snow leopard sign was detected) were characterised with respect to a number of habitat variables. Nine habitat variables measured were elevation, slope, aspect, annual precipitation, vegetation cover, and nearest distance to significant water body, human settlement, trail, and prey feeding or resting site. We used Arc GIS software (version 9.3, ESRI Inc., Redlands, California, USA) for all our analysis. Altogether 469 snow leopard use points and equal number of random points were used in the analyses.

  We used principle component analysis to ordinate nine habitat variables estimated from GIS layers from sites with signs and sites which were chosen randomly into three components. We fed these components into Discrimant Functions Analysis to cut the scores in the middle to create two habitats – preferred sites (that is, sites with signs or snow leopard activity) and marginal sites (that is, random sites). We assumed that individual leopards use their preferred habitat rather than marginal habitats when low in numbers but use both when high in number in line with the principles of habitat selection theory. We built habitat selection from presence–only data using Discriminant Functions Analysis (DFA). The DFA approach allowed us to categorise habitats into two, in our case, those preferred (all sign sites) and those which are marginal (random sites). We used the new DF classification, as our dependent variable, to find out the most significant variables (out of nine original independent habitat variables) that characterise leopards' habitat preference. For this, we sued stepwise DFA. The analysis indicated that five variables were significant, namely slope, aspect, elevation, nearest distance to trail, and nearest distance to prey. The next step is to use these variables to come up with areas that snow leopards are most likely to use as their corridors to move from one area to another (see Table 1).

Table 1: Variables in the analysis

Step		Tolerance	F to Remove	Wilks' Lambda
1	Slope	1	432.587	
2	Slope	0.903	577.075	0.8
	Aspect	0.903	355.851	0.683
3	Slope	0.845	678.162	0.698
	Aspect	0.894	339.711	0.551

	Elevation	0.935	208.477	0.494
4	Slope	0.842	640.213	0.623
	Aspect	0.875	365.511	0.514
	Elevation	0.908	240.279	0.464
	Distance to trail	0.955	87.309	0.403
5	Slope	0.84	641.884	0.621
	Aspect	0.875	359.64	0.509
	Elevation	0.907	237.472	0.461
	Distance to trail	0.942	90.848	0.403
	Distance to prey	0.982	4.668	0.369

- *Snow leopard status surveys*: As part of the bigger corridor project, snow leopard intensive status survey was carried in two places, parts of Annapurna and Manaslu. The Annapurna report is described here. In 2010 (one survey) and 2011 (two surveys), in lower Mustang [upper reaches of Thini, Jomsom (the district headquarters), Lubra, and Muktinath] and in upper Mustang (parts of the rugged terrains covering Chhuksang, Chaile, and Sommar), we randomly laid out 51 transects of various lengths, and walked along them looking for snow leopard signs. We covered a total 37.6 km of linear distance, following standard Snow Leopard Information Management System procedures. We detected several scrapes, scats, pugmarks, and scent spray, and calculated the sign abundance: 3.8 all signs per km (1.9 scrapes per km, Table 1a). In the autumn of 2010, we covered only lower Mustang but in 2011 (spring and summer) we researched both lower and parts of upper Mustang.

  The likelihood of encountering signs was greatest in autumn (8.2 signs/km) and least in summer (1.6 signs/km). The sign density was not that different in lower and upper Mustang (although more scrapes in upper Mustang might have been the reflection of suitable terrain in upper Mustang where scrapes carved would last much longer but for the experienced snow leopard biologists upper Mustang would look much better habitat for snow leopard than lower Mustang). Snow leopard sign density in overall Mustang was not different than that on Mt. Everest (Ale 2007) and Rolwaling (Ale et al. 2010), both below 4 sign items per km. Mt. Everest revealed two resident cats (Loavri et al. 2009) while in Gaurishankar/Rolwaling snow leopards were transient (Ale et al. 2010). To take an extreme case, Langu in west Nepal, with a snow leopard density of 8-10 cats/100 square km, revealed 36 signs per km (Jackson 1996).

Table 1a: Snow leopard sign abundance in Mustang, Annapurna

			Sign types								
	Transect	Length (km)	Feces	Pug mark	Scrape	Spray	Total	Total sign/ km	Sign Sites	Sign sites/ km	Scrape /km
Season											
Autumn	9	7.2	18	10	27	4	59	8.2	46	6.4	3.8
Spring	15	11	12	5	34	0	51	4.6	38	3.5	3.1
Summer	27	19.4	18	3	10	0	31	1.6	23	1.2	0.5
Total	51	37.6	48	18	71	4	141	3.8	107	2.8	1.9

Study area											
Lower	33	24.4	40	14	43	4	101	4.1	77	3.2	1.8
Upper	18	13.2	8	4	28	0	40	3.0	30	2.3	2.1
Total	51	37.6	48	18	71	4	141	3.8	107	2.8	1.9

We also surveyed blue sheep, opportunistically, to understand its population structure and composition. The overall average group size 12.6 (SE=1.6, range = 1 – 43) [Table 2a] was comparable to that Oli (1996) found out in adjoining district, Manang, two decades ago (blue sheep group size, in Manang, 15.6, SE = 1.3). That we obviously missed many herds, in particular male herds, is evident from the male to female ratio (which is much lower than 1). Also group size was comparatively larger in lower Mustang than in upper Mustang - a reflection of terrain ruggedness. That upper Mustang had lower young to old male ratio may be perhaps the region is less productive than lower Mustang (Table 2b). Schaller (1977) opined much earlier, in his classic book – the Mountain Monarchs, that productive grasslands would have higher proportion of young males and the opposite would be the case with the ungulate population in degraded lands (in our case, upper Mustang is more degraded and less productive than lower Mustang).

The kid to female ratio of blue sheep in Mustang was within a normal range (that is, 0.6, Table 2b). The proportion of females seen with a calf at the end of birth season is used as a proxy of birth rate in ungulates (e.g. elk *Cervus elaphus* L.: Eberhardt et al. 1996; White-eared kob *Kobus kob leucotis A. Smith*: Fryxell 1987; moose *Alces alces* L.: Laurian et al. 2000; Himalayan tahr *Hemitragus jemlahicus*: Scahller 1973, 1977; Lovari 1992; Lovari et al. 2009; Ale 2007). This is a quick, easy-to-use method to assess status of ungulates in open habitats. A normal range for kid to female ratio for ungulate is c. 0.6 for stable populations and c. 0.7 for a growing population.

Table 2a: Blue sheep structure and composition in Mustang, Annapurna

	Total	Male	Female	Yearling	Kid	Unidentified	Young male	Old male	Sample	Group size (SE)
A. Season										
Autumn 2010	149	32	63	16	35	3	16	16	11	13.54 (SE=2.4)
Spring 2011	292	95	78	32	43	44	43	41	25	11.68 (SE=2)
Summer 2011	87	0	22	10	12	43	NA	0	6	14.5 (SE=6.31)
Overall	528	127	163	58	90	90	0	0	42	12.57 (se=1.57)
B. Study area										
Lower Mustang	419	102	120	44	68	85	48	43	30	13.97 (SE=1.95)

Upper Mustang	109	25	43	14	22	5	11	14	12	9 (SE=2.13)
Overall	528	127	163	58	90	90	59	57	42	12.57 (se=1.57)

Table 2b: Blue sheep structure and composition in Mustang, Annapurna

	Ratio of --			
	Kid-female	Yearling-female	Male-female	Young-old male
A. Season				
Autumn 2010	0.56	0.25	0.51	1
Spring 2011	0.55	0.41	1.22	1.05
Summer 2011	0.55	0.45	0.00	NA
Overall	0.55	0.36	0.78	NA
B. Study area				
Lower Mustang	0.57	0.37	0.85	1.12
Upper Mustang	0.51	0.33	0.58	0.79
Overall	0.55	0.36	0.78	1.04

Despite barren landscape with patchy vegetation, Mustang supports a healthy population of blue sheep and a good number of snow leopards (reported elsewhere and will be included in peer-reviewed article, see below). Perhaps a combination of local people's religious attitude toward wildlife and over two decades of conservation activities initiated by the National Trust for Nature Conservation's Annapurna Conservation Area Project may be credited for this success. Snow Leopard Conservancy, a Californian-based non-profit, has been supporting snow leopard conservation and monitoring in the region since 2002. In addition to these, part of the reason why snow leopard population has been thriving and will continue to thrive in this part of the world is that these cold, rugged valleys may be some of the worlds' most inaccessible places for any form of human activities and assaults. These are truly snow leopard dwellings. Further up from Chhuksang and Ghami, in and around remote Lo-Manthang, for instance, there are isolated valleys where as recent as in 2007, the 15th-century Buddhist and pre-Buddhist religious texts and wall paintings were found in series of man-made caves carved into sheer cliffs. Few have been able to explore the mysterious caves, since the place was long closed to outsiders. A team of researchers and mountaineers scaled the crumbling cliffs on a mission to explore the caves where they even discovered ancient Tibetan Buddhist shrines decorated with exquisitely painted murals, including several 600-year-old human The National Geographic team and locals even christened one of the caves "the snow leopard cave" as the elusive animal's footprints were found inside! [see -- skeletonshttp://thehimalayanuniverse.blogspot.com/2007/05/mustang-caves-excite-archaeologists.html.]

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Lovari, S., Boesi, R., Minder, I., Mucci, M., Randi, E., Dematteis, A. & Ale, S. B. 2009. Restoring a keystone predator may endanger a prey species in a human-altered ecosystem: the return of the snow leopard to Sagarmatha National Park. Animal Conservation 12, 559-570.

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

The bigger snow leopard corridor project is an initiation of the Snow Leopard Conservancy in collaboration with the National Trust for Nature Conservation – the country's largest non-governmental environmental organisation. Its three components, that is, conservation, education, and research, in the Himalayas of Nepal, have been ongoing since 2009. I, during this Booster Grant support period, partly trained school children and local herders, under the education component through "snow leopard scouts" programme. The main aim being teaching school students who will work with local herders in learning nature, biodiversity, and monitoring snow leopard in their localities while spreading conservation message to the world. So far three areas in Annapurna have been chosen for snow leopard scouts' activities – Jomsom (lower Mustang), Lo-Manthang (upper Mustang), and Manang. The work in Lomanthang and Manang has started this year (2012) but the work in Jomsom has been ongoing since 2011. This is part of our long-term snow leopard corridor project in which we wish to model and monitor snow leopard corridor habitat along the Himalayas of Nepal. These students have been monitoring region's snow leopards deploying nine remotely triggered cameras (Bushnell and ScoutGuard passive infrared detector) in 2011. Three individual snow leopards were camera trapped by students and herder team (a detail report on this is being prepared).

I trained at least 15 students, three herders, one teacher, one graduate students and a dozen of rangers during this snow leopard corridor project (2011 and 2012).

5. Are there any plans to continue this work?

Yes, the corridor models need field validation. I need supports for this and in addition to this I will be focusing on training school children, herders, and local rangers on snow leopard and biodiversity, beyond the year 2013.

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

Two peer-reviewed articles are under preparation. The snow leopards scouts video (http://www.youtube.com/watch?v=7DyqnyeNwK4) is already online.

7. **Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?**

The RSG support was used to support organising part of the snow leopard corridor surveys and snow leopard scouts' projects. The research component of the snow leopard corridor project was mostly funded by RSG. In other words, the RSG was used partly to accomplish the bigger (conservation, education and research) goals of the snow leopard corridor project which will continue for foreseeable future largely because educating public on nature conservation may take many years.

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
1. Field work A. Travel and per diem expense, Som B. Ale	2677.9	1551.5	1126.4	The left over used for item c
B. Field Assistants, local helpers and guides	5599.8	5176.6	423.2	The left over used for item c
C. Research supplies, porter etc.	3489.2	4587.2	-1098.0	Unanticipated local level (expensive) porter/horses' cost
2. Admin, lab (genetics) and conservation work	NA (covered other sources)			
Total	11766.9	11315.2	451.7	The left over will be used to cover some related admin expense

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

Two steps ahead, while validating models, are –

- Expanding snow leopard scouts programme to other corridor areas, the isolated and remote areas between Annapurna and Mt. Everest.
- Implement direct conservation measures such as the initiation that essentially merges ecology with economy (snow leopard savings and credit program can be a suitable candidate project).

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

Yes, on calendars and also on online video.

11. Any other comments?

The RSG support for my snow leopard work in the Himalayas of Nepal has been very crucial. I serve the Snow Leopard Conservancy as the regional conservation director and I am a lecturer at the University of Illinois and Wright Community College (Chicago). My field project on the snow leopard, for which I obtained the RSGs three times, has been very instrumental to build my own capacity in nature conservation. In turn, I can better train local scientists and public alike in nature research, education, and conservation.