

Final Project Evaluation Report

Your Details	
Full Name	Vishal Santra
Project Title	Surveys of venomous snakes and other reptiles in the Himalayan biodiversity hot-spot.
Application ID	25313-1
Grant Amount	£ 4708
Email Address	vishal.herp9@gmail.com
Date of this Report	27 th May, 2019.

1. 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
To understand the herpetofaunal diversity				<p>We have been successful in finding a considerable number of herpetofauna species from our study area which have never been documented in Himachal Pradesh. This includes the possibility of cryptic species (e.g. <i>Gloydius himalayanus</i>). Preliminary DNA analysis results also suggest that several colubrids sampled are incorrectly placed at the generic level. We have also rediscovered a species from the state after a lapse of 148 years. At the same time, we have gained a better understanding of the distribution within the state, enabling deeper insight into snakebite patterns. However, the terrain is extremely challenging and additional long-term study is required for a proper understanding of the species diversity in the state.</p>
To generate Awareness and Education				<p>We have carried out multiple awareness and education sessions at many of the primary schools situated within our study sites. We demonstrated how to avoid snakebite and why snakes should be conserved, through popular talks in the local language and with the help of educational materials in the form of posters and stickers. Most of the state is mountainous and many villages are quite difficult to access within a short period of time. Further efforts to raise awareness should be designed within the framework of a long term plan. We intend to continue this in the following few years, and plan to carry out surveys</p>

			to quantify the success of our awareness efforts.
Training of the Forest Department Staff			We have carried out training of two forest divisions at two districts (Chamba Forest Division and Mandi Forest Division) Divisions of the Forest Department of Himachal Pradesh. The department has agreed that such training is crucial for the capacity building of the staff and adequately addressing snake-human conflict. This resulted in one of our lead researchers, Dr. Anita Malhotra, obtaining another small grant from the Bangor University in order to carry out a more comprehensive training programme for the Forest Department of Himachal Pradesh.
Venomics and antivenomics of medically significant venomous snakes.			Analysis of <i>Naja oxiana</i> venom has shown that 40% of the molecules in the venom were not neutralised by the present Indian anti-venom. Reverse-phase HPLC analysis of <i>Naja</i> venom from Himachal Pradesh also shows that the major peaks present are different from those in the venom from the Irula co-operative, the source of the majority of venom used for the manufacture of anti-venom in India, and that in-vitro neutralisation with currently available anti-venom leaves some of these only partially recognised. It is essential that these results are now followed up by identification of the toxins in the unbound fractions using mass spectrometry and in-vivo (mouse model) tests to determine whether the unbound fraction contains clinically relevant compounds. <i>Cryptelytrops septentrionalis</i> has also been shown, through biochemical activity tests, to show higher activity, especially hameolytic and pro-coagulant activity, which corroborates clinical reports of long-lasting coagulopathy (non-clotting blood) following bites

			of this species, which is common in some districts and causes over 70% of bites in Solan district.
Highlighting the special nature of the reptiles of this region.			We have been able to carry out extensive field work amidst difficult weather conditions in the monsoon season. Our field work for has yielded the rediscovery of a non-venomous snake from the region after 148 years, confirmation of the distribution of <i>Naja oxiana</i> (Central Asian cobra) from the region with the collection of DNA material in India for the first time ever. This work has also suggested the possibility of cryptic species <i>Gloydius himalayanus</i> (western Himalayan pit viper). Never previously sampled for DNA, we have found a large divergence in mtDNA between eastern and western samples in Himachal Pradesh, which preliminary morphological data has suggested is congruent with differences in at least some meristic characters. We also sampled many other colubrid species which could be either represent new species or be attributed to new genera. We have recorded <i>Daboia russelii</i> at the highest elevation ever recorded (above the winter snow line), which is highly novel information on the natural history of the species. We observed <i>Eublepherus</i> species in unique wet green habitats unlike the common understanding of arid habitats where most <i>Eublepherus</i> species of the world are found, raising interesting questions about captive husbandry and conservation breeding.

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

Our field work, being carried out in the months of monsoon (as this is the period of maximum reptile movement), resulted in logistical challenges due to landslides and increased rates of food and accommodation. To reach our pre-determined survey

sites, we had to take multiple long distance alternate routes as the shortest roads were blocked due to landslides. At some sites, we had to stay put as there were no alternate routes. The increased expenditure was challenging, but the volunteers participation fees and financial contribution from senior team members aided us and meant that we could continue with our work.

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

- a) We have been successful in convincing the Forest Department of Himachal Pradesh that thorough research on the herpetofauna of the region is needed, especially with increasingly important issues such as climate change, which is predicted to affect the Himalayan region particularly hard due to shrinking glaciers. The administration and the Forest Department now understand that sensitisation, awareness and education are the key to conservation of the lesser known fauna. In this regard, they have shown interest in collaboration in carrying out awareness and education in schools across the state. They have also requested us to prepare a manual for the Forest Department staff for identification of snakes and carry out awareness and education programmes. We have also been asked to carry out training for the field staffs on tackling a snake conflict situation, and conservation planning.
- b) We have been able to get a grasp on the snakebite problem and challenges in the region. Our analysis have been able to show that a significant fraction of compounds in the venoms of the snakes of Himachal Pradesh are not being neutralised by the present polyvalent anti-venom. This is likely to highlight issues with anti-venom efficiency all over India, but particularly in the regions where the "big four" species are less prevalent and are replaced/supplemented by additional venomous species.
- c) Our molecular work is quite ground breaking as this was the first time that reptiles from this region have been studied on a molecular level. Primary analysis shows that there are likely distinct species hidden *Gloydius himalayanus*. We were also successful in producing the first ever DNA sequence for *Naja oxiana* from India, confirming the presence of this species in India.

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

The local communities have been attracted to the fact that we are looking for snakes to carry out research. This brought them close and we had their undivided attention. At all our survey sites, we contacted the communities to interview them regarding snakes they come across and any snakebite cases reported from their community, bringing about a sense of being involved. They expressed happiness that someone was thinking about their plight as they have been living in remote locations, far from the nearest medical help. We engaged a few local trackers to guide us through different habitats while we looked for snakes. Every survey site was thoroughly understood and we engaged with most primary schools during the day with snakebite awareness education classes and workshops. Stickers with snake pictures, and brief description of them in the local language, were distributed to the school and village children, and also to the community elders and teachers. We also

distributed very easily understood but effective illustrated posters on how to avoid snakes and snakebites. These posters were also prepared in the local language. Our surveys attracted a lot of attention and we were often stopped to explain our work and answer questions regarding snakes and snakebite. We took all these opportunities to carry out a planned talk on awareness and orientation around snakes in the region. We also held small community awareness sessions at our field stations. We invited the community and shared education and awareness materials written in the local language. The communities we have visited now know which number to call if there is snakebite, and what to do if there is a snake in the house. They would also call our team when they encountered a snake, often telling us where it had gone and describing its behavior. Given that killing it would have been the likely outcome prior to our awareness work, we feel that our programme has been effective.

5. Are there any plans to continue this work?

Yes, we wish to continue this work as the herpetofauna of the Himalayan biodiversity hotspot region has been very poorly studied in comparison to mammals, plants or avians. It is even more crucial now to expedite these studies, as many of these species are likely to suffer with ongoing climate change, as do most high altitude species across the globe. As the whole region is very mountainous, the awareness and education work will take time and it has to be done periodically in the right season. At the same time it is very important to build the capacity of the people responsible for conservation work in the region, i.e., the Forest Department. We will be conducting training of the field staff and senior officers in mitigating snake-human conflict and prepare conservation plan for the different regions in their state.

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

We have submitted a detailed report of our work to the Principal Chief Conservator of Forests and Chief Wildlife Warden of Himachal Pradesh and also to the Principal Secretary, Ministry of Environment forests, Government of Himachal Pradesh. We have published one open-access article on snakebite prevention (*Dyfyniad o'r fersiwn a gyhoeddwyd / Citation for published version (APA): Trogridou, A., Graham, S., Santra, V., Owens, J. B., Bharti, O., & Malhotra, A. (Accepted/In press). Prevention is better than cure: snakebite education in India. Episthmes Agogis.*) We are in the process of submitting a number of other scientific papers for publication these will also be open-access. We have been sharing our work and findings at different conferences across the country. We also continue to share our findings and articles through social media which will have a wider reach.

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

The grant was used in one monsoon season, for preparing material used for training and awareness (posters, stickers), and for subsidising fieldwork. However, the actual period of fieldwork was extended by contributions from participants to offset substantial costs such as travel to Himachal Pradesh and subsistence and transport costs.

8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Translation and printing of awareness and training material	200	194	-6	The printers gave us a small concession
Snake collecting equipment	215	216	+1	There was a slight hike in the price of product.
Food	588	1155	+567	Frequent landslides meant that supplies could not reach those locations and thus the prices soared. We also had to spend more on buying packaged drinking water as the pipelines got dismantled at various locations due to landslides.
Accommodation	1350	1635	+285	Same as above. Due to landslide blockades the expenses for accommodation also went up as supplies were scarce and there was tremendous occupant pressure due to congregation of stuck travelers at these various locations.
Car Hire	1775	3371	+1596	The large difference between the budgeted cost and actual cost is due to three reasons: first, we had to travel extra miles to reach our survey sites bypassing landslides, which increased the total costing per day as the cars have limited mile travel agreement for the whole day. Second, as sampling snakes from the whole region was the priority to successfully answer our research questions, we had to travel the extra mile to collect snakes from a few rescuers who reported a few snakes being caught from their area. Also, we had to attend snake removal calls

				reported by the forest department. Those were very likely opportunities to find snakes for sampling for our study. This also involved a lot of travelling. Third, as we have been travelling over rough terrain in the middle of monsoon, we had to change tyres and other maintenance and repair work had to be done in both the cars.
Internal flights	580	250	-330	This difference is because I did not fly to a few locations to cut down costs and travelled by bus and train. The difference amount was used for covering some of the car hire costs.
Tracker fees		100	+100	This was not budgeted and we had to hire local trackers for a few locations as the terrain was difficult and there was the chance of getting lost.
TOTAL	4708	6921	+2213	

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

The important next steps would be:

- a) To continue the exploration of the Himalayan region to document the herpetofaunal diversity, as many of the species that occur in this region seem to be part of species complexes.
- b) This exploration is crucial in the light of climate change, as we might be looking at massive local extinction of high elevation species.
- c) To continue awareness and education drive. This region needs large-scale rigorous awareness and education in the communities living in remote areas with unavailability of basic facilities. There is a need for generating conservation awareness and sensitisation in the diverse communities of the region.
- d) Continue survey to sample more specimens. We need more DNA samples from multiple species to arrive to conclusions on the molecular identity of the species. We also need more venom samples to continue with our venom characterisation and antivenomics work to come up with the gaps in anti-venom design and help the concerned department take necessary steps to bridge it.

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

Yes, The Rufford Foundation logo was used in all education and awareness material, advertisement and training banners. The logo was also in all presentations on this research work at various conferences and workshops during and after the study. The Rufford Foundation has received a lot of publicity during the course of my work and continues to do so. Many individuals have communicated with me from within India and abroad inquiring about The Rufford Foundation and to help them apply for the small grant. I still continue to receive emails and messages in social media inquiring about the grants and guidance to write proposals.





11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Mr. Vishal Santra

Herpetologist & Reptile Consultant, Simultala Conservationists (Foundation for Wildlife), Nalikul, Hooghly, West Bengal; Partner, field expeditions, training, reviewer, online Peer Reviewed Journal, Captive and Field Herpetology, UK. Research grant recipient from the Rufford Foundation and project lead. Roles include epidemiological research, field/research, field work, coordination, training in scientific and humane snake handling, taxonomy, sample collection, photographic documentation, and data analysis.

Dr. Anita Malhotra

Herpetologist, Taxonomist (pitvipers), Lead researcher, International Collaborator (School of Natural Sciences, Bangor University, Wales, UK) and Overseas Citizen of India. Roles include fund raising, project management, sample collection, data analysis, training in taxonomic methods (morphological and molecular), and preparation of publications.

Dr. Omesh Kumar Bharti

Medical Officer, Epidemiologist, Directorate of Health Services, Government of Himachal Pradesh. Pioneer in medical research, up-gradation of public health problem mitigation & management and cost reduction in treatment of Rabies. Roles include coordination, liaison with the Forest Department of Himachal Pradesh, Data analysis, site selection, supervision and preparation of publication.

Mr. John Benjamin Owens

Herpetologist. Director, founder and chief editor of Captive & Field Herpetology. Co-organizer of C&FH India expeditions. Founder and director of North West Reptile Encounters. Roles include organizing field work, volunteer recruitment, fund-raising, epidemiological research, snakebite field research, environmental field data and reptile behaviour research, training in handling and snakebite prevention, sample collection, taxonomy, photo documentation and field data collection.

Dr. Wolfgang Wüster

Herpetologist, Taxonomist (cobras), Lead researcher, International Collaborator (School of Biological Sciences, Bangor University, Wales, UK). Roles will include sample collection, data analysis, and preparation of publications.

Dr. Stuart Graham

Herpetologist, Conservationist, Researcher (Honorary Researcher, School of Natural Sciences, Bangor University, Wales, UK) & Principal Ecological Consultant (UK). Roles include sample collection and preparation of publications.

Dr. Anatoli Togridou

Social Scientist, Herpetologist, Independent Researcher & Senior Ecological Consultant (UK). Roles include sample collection and preparation of publications. Also to assisting with education and awareness sessions.

Mr. Sourish Kuttalam

Third year undergraduate student (BSc. Zoology with Herpetology, Bangor University, UK). Roles include field work, sample collection, taxonomic (morphological and molecular) analysis of *Gloydus* species.

Mr. Nilanjan Mukherjee

Wildlife cinematographer and researcher based in Kolkata, West Bengal. Primarily interested in fish and reptiles, he has also worked in various capacities on human and environmental projects with organizations like the National Geographic Society and Channel 5 UK. Roles included photographic documentation, filming, field work, survey, assisting sampling, taxonomy, literature survey, assisting publication manuscript preparations.

There were several other volunteers who joined us at different phases of the survey. Their roles mostly included survey, assisting sampling, assisting community engagements and awareness and support our daily activities.

12. Any other comments?

I presented our preliminary findings at the Rufford India Conference, Fostering Grass-roots Conservation in India – A Rufford Initiative 2019 which was held at Corbett Tiger Reserve, Uttarakhand, India. The potential for research, discovery, conservation and community development is immense in the state of Himachal Pradesh and we have the support of the State Epidemiologist (Dr Omesh Bharti, who has been awarded the Padma Shri, India's fourth highest civilian award for his work on rabies) and the Forest Department. As a mountainous state, it is quite challenging to carry out surveys and community outreach, but with more time, proper funding and concerted effort, this state could serve as a role model for conservation through research, education, awareness and community engagement.