

## The Rufford Foundation Final Report

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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](mailto:jane@rufford.org).

Thank you for your help.

**Josh Cole, Grants Director**

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Grant Recipient Details	
<b>Your name</b>	Ugyen Kelzang
<b>Project title</b>	Freshwater biodiversity conservation; Distribution and diversity of aquatic macro-invertebrates in the headwater streams of Woochhu watershed, Bhutan
<b>RSG reference</b>	20849-1
<b>Reporting period</b>	December 2016 to December 2017
<b>Amount of grant</b>	£5000
<b>Your email address</b>	lhuentsebhutan@gmail.com
<b>Date of this report</b>	20 <sup>th</sup> December, 2017

**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
Evaluate macroinvertebrates distribution, diversity and density in the streams.				<p>Largely, streams are dominated by Trichoptera (40.63%) and Diptera (35.47%) followed by Ephemeroptera (19.12%). However, during post-monsoon season macroinvertebrates were mainly dominated by Diptera (37.24%), whereas Trichoptera dominated during pre-monsoon and monsoon season.</p> <p>Kruskal-Wallis test indicated that there is no significant difference of diversity among the streams [<math>H(4) = 12.37, p = .121</math>]. Nevertheless, there were significant difference of macroinvertebrates density among streams [<math>H(4) = 8.15, p = .013</math>].</p>
Study habitat condition of streams and changes against the different time scale.				<p>Physico-chemical environmental variables like water temperature, depth, width, water pH, turbidity, dissolved oxygen, and conductivity were measured. The lowest pH (7.02) was recorded during monsoon and the highest (8.04) was recorded in post monsoon season.</p> <p>The highest conductivity (130.89 <math>\mu\text{S}/\text{cm}</math>) was recorded during monsoon and the lowest (88.80 <math>\mu\text{S}/\text{cm}</math>) during post-monsoon season. The temperature was recorded relatively low during the post-monsoon (7.41°C) than the pre-monsoon (8.75°C) and monsoon (11.12°C).</p> <p>The study found that species diversity</p>

			decreases with increasing depth ( $\tau = -.21, p = .01$ ). In the same way, pH and species diversity were negatively correlated ( $\tau = -.35, p = .00$ ). With increase in pH, diversity decreases.
Documentation of freshwater macroinvertebrates and preservation of voucher samples in UWICER laboratory.			<p>Among the 7253 individuals, 2466 were recorded during post-monsoon, 2756 during pre-monsoon and 2031 during monsoon from four sampling sites. In total 28 species of macroinvertebrates were identified at family level which belong to seven different orders. However, two species were identified only up to order level which makes 30 taxa altogether.</p> <p>The voucher specimens collected from every sampling point are preserved and stored in the Ugyen Wangchuk Institute for Conservation of Environment and Research (UWICER) laboratory. These voucher specimens will be foundation of information and knowledge for the students and researchers for future study and reference.</p>
Compare the diversity of macroinvertebrates between different seasons.			<p>The diversity during the post-monsoon had 25 species identified till family level belonging to seven orders. Diversity during the pre-monsoon had 28 families belonging to seven orders. Similarly, the diversity during the monsoon had 18 families belonging to seven orders. The taxa orders reported from the site was all common in all season.</p>
Assessment and recording of conservation threats.			<p>Threats to conservation of freshwater like grazing, road debris, waste disposal and habitat disturbance by logging, road widening, house</p>

			<p>construction, agriculture activities, town expansion, land use change and water abstraction for irrigation were noted and shared with different groups of people.</p>
<p>Inculcate school children the knowledge and appreciation of natural freshwater resources and associated biodiversity.</p>			<p>Conservation education and seminar presentation was conducted in two colleges, one high school and middle school where the participants received practical training on freshwater invertebrates sampling techniques, equipment handling, macroinvertebrates identification, and specimen collection and preservation methods.</p>
<p>Conservation education, awareness, presentation and workshops to disseminate information and findings of the study.</p>			<p>Public gatherings are conducted in the study area in collaboration with village head and district environment officer. The results of the study were presented and shared to the students, public and other stakeholders during the conservation education and awareness programme, seminar and workshop.</p> <p>The copy of results will also be presented to Ugyen Wangchuk Institute for Conservation of Environment and Research (UWICER), National Environment Commission and Royal Society for Protection of Nature. Moreover, findings of the study will be presented to the scientists, PhD and MSc students of Forests Research Institute (Deemed) University, Dehradun, India.</p> <p>Currently, we are working on the paper to be published in the freely accessible journals and it would enhance the skills and knowledge to</p>

			<p>carry out similar work in future which will help in exploring the aquatic diversity of the country.</p> <p>The posters and brochures are shared with the different stakeholders including schools and colleges to be distributed amongst the students.</p>
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**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).**

Some of the difficulties that we encountered during the project are described below:

The team faced difficulty in gaining public trust and cooperation in the beginning. Almost all farmers residing nearby the streams were not aware of what is there in the streams and rivers. They just know the existence of fishes as only living things in the river. The continual public awareness campaign, meeting and participatory discussion involving communities with the help of district environment officer, village head, and officials from the Department of Forests and Park Services facilitated in disentangling the challenges. In the course of the campaign and meetings with the public we have explained in detail about the projects objectives and importance of freshwater resources and biodiversity conservation.

The post-monsoon fieldwork was conducted in winter months which is extremely cold in the study area. The sample collection from the stream was bit difficult due to exceptionally cold weather with heavy snowfall. Hence, we had to prepare the fire to warm ourselves and carry on the data collection within determined timeline. The payment for the field assistants were increased. However, we faced difficulties while collecting field data but the outcome of the project is really fruitful mainly because of dedicated and committed team members.

Specimen identification using the various identification keys from Hindu Kush Himalayan region, Aquatic Invertebrates of Alberta, North America and Guide to Aquatic Invertebrate Families of Mongolia was challenging part of the project. Some species that we have encountered are not clearly documented in the identification keys that we have referred. Most of the species were identified at family level and some up to order level. The team has consulted referees and experts from Australia, India and Germany for validating the identification of species.

The conservation education and awareness programme involving dissemination of projects findings was unsuccessful to carry out in some schools as my scheduling occurred to fall during mid-term and annual examination. Informational brochures and other field guides were sent to school management head to be distributed amongst the students.

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

- a) Enhanced taxonomic information through freshwater macroinvertebrates documentation and collection of voucher specimens.

Freshwater rivers and streams still remain least explored creating a huge lacuna in knowledge base. Freshwater has always been home to diverse macroinvertebrates and it has principle role for both aquatic and terrestrial ecosystem with dynamic role in nutrient and food web in nature. The study had recorded 7253 macroinvertebrates belonging to 28 families and nine orders. The voucher specimens are collected from every sampling site and preserved in the Ugyen Wangchuk Institute for Conservation of Environment and Research laboratory. Many of the species are identified to family level and some to order level. These voucher specimens will be foundation of information and knowledge for the students and researchers for future study and reference.

- b) Capacity building

School and college students were actively involved in this research project. During the field work three students from College of Natural Resources, Royal University of Bhutan has worked as field assistants and two students from Sherubtse College, Royal University of Bhutan worked as volunteers. One ranger from the Department of Forests and Park Services has accompanied the team during the whole period of field work. All of them adequately learnt the sampling techniques and identification of macroinvertebrates. Some of them started doing field research independently and confidently. Two groups of students received dedicated and practical training on freshwater macroinvertebrates sampling techniques, equipment handling, macroinvertebrates identification, and specimen collection and preservation methods.

- c) Conservation education and awareness

The study of aquatic biodiversity has become imperative to understand the threats and to take appropriate conservation action. Aquatic macroinvertebrates species are largely threatened by habitat loss and ongoing habitat degradation with threats from developmental activities in the project site. The team had conducted

conservation education and awareness programme with the help of conservationist, forest officials in two colleges, one high school and middle school. Public gatherings are conducted in the study area in collaboration with village head and district environment officer.

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

This project brought together different institutions like National Environmental Commission, District Forest Sector, city cooperation, colleges and schools, governmental and non-governmental organisations and other institutions and entrust them with responsibilities making them stewards of our common environment. The project also has focused much on public education and awareness for conservation of freshwater. Local people are involved in the project directly or indirectly. During public gathering/meetings local people are educated on the importance of the conservation to freshwater resources and its biodiversity. It has also provided opportunity to discuss and share their opinions on freshwater and contributed in enhancing communal stewardship in conservation. High school and college students received educational talks and hands-on training, which allowed them to develop technical skills and knowledge that is lacking in the area.

For the project, a field guide from the locality was hired to guide the team while sampling. Daily subsistence allowance was paid for a guide as per the standard rate fixed by the government. The payment that we have made for food and lodging during the whole field work period has benefited local residents.

**5. Are there any plans to continue this work?**

Yes, I do have plans to continue this field work. This research project answers the question of how diversity, density and distribution of macroinvertebrates differ between pre-monsoon, monsoon and post-monsoon. Nevertheless, further research in this topic is indispensable to study how physicochemical variables affect freshwater macroinvertebrates diversity and density and what are the key factors for freshwater macroinvertebrates conservation in the face climate change. Due to lack of knowledge, awareness and proper concern on the importance of freshwater ecosystem, there is high risk of overlooking on this important subject if no timely interference are made and hence, understanding this issue will help improve the development of conservation and management strategies.

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

The results of the study were presented and shared to the students, public and other stakeholders during the conservation education and awareness programme, seminar and workshop. The copy of results will also be presented to Ugyen Wangchuk Institute for Conservation of Environment and Research, National Environment Commission and Royal Society for Protection of Nature. Moreover, findings of the study will be presented to the Scientists, PhD and MSc students of Forests Research Institute (Deemed) University, Dehradun, India. Currently, we are working on the paper to be published in the freely accessible journals.

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

The Rufford Foundation grant was used for a period of 12 months starting from December, 2016 to December, 2017. I have made slight changes with proposed timeline because of certain condition like weather and release of budget.

Nonetheless, the team has successfully conducted and completed scheduled activities of the study.

**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
Daily wages/ allowances for field Assistants	1344	1449	-105	Payment for field assistants had to be increased during extremely harsh weather condition than initially conceived.
Safety and Extension gears (rain gears, rucksacks, boots, kicknet and pack bags)	500	496	4	Purchased some safety and extension gears at discount rate.
Vehicle rental and maintenance	400	368	32	Vehicle hiring and maintenance charges were overestimated.
Dissecting scope with the provision of camera for	1050	1156	-106	Including shipping charges the cost of dissecting scope has

identification and taking pictures				been increased by £58.
Waterproof multipara meter Tester	100	134	-34	Charged additional £34 as shipping cost.
Digital Camera	200	200	0	
Food during the survey	150	134	16	Food price slightly decreases over the period of field work.
Lodging during the survey	100	100	0	
Germin GPS	300	285	15	Procured at cheaper rate than anticipated.
Trainings, education campaigns and advocacy program	450	300	150	Unsuccessful to conduct conservation education program in 2 schools. But informational brochures and other field guides were sent to the school management head to be distributed amongst the students.
Data processing, report preparation, poster presentation and information dissemination	206	188	18	Data processing and report preparation took less time than what we have estimated.
Pictorial guidebook and brochure printing	150	140	10	Cost of brochure printing was overestimated.
Stationery	50	50	0	
<b>Total</b>	<b>5000</b>	<b>5000</b>	<b>0</b>	

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

Publishing journal paper is one of the important next step in the near term since there is inadequate information presented on this topic in Bhutan. I will also present the results of the study to National Environment Commission of Bhutan, scientists, PhD and MSc students of Forests Research Institute (Deemed) University, Dehradun, India. Educating the public regularly on the importance and threats to conservation of biodiversity brought about by anthropogenic activities and global climate change is a crucial step to carry out a comprehensive study on conservation of freshwater biodiversity.

Furthermore, partnership development with different stakeholders is also perceived as significant part to exchange practical and theoretical knowledge among different stakeholders, conduct joint field expedition and thorough taxonomic

inventorying in nation as a whole in the face of town expansion, population growth, intensified agriculture works and major rivers being targeted for projects like construction of hydro energy power plants.

**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?**

The Rufford Foundation logo was used in the seminar presentation that I have made to the students and different stakeholders; and in the brochures and posters that I have used during conservation education and awareness programme. I have also shared about the Rufford Small Grant with my classmates and with the students of MSc Forestry, MSc Wood Science and to all the students where I have made seminar presentation. Some of the students even received funding support from the Rufford Foundation. The Rufford Foundation will be duly acknowledged in the publication of journal paper and other materials related to this project.

**11. Any other comments?**

This research project was conducted and completed successfully because of the funding support from the Rufford Foundation and we are tremendously grateful for that. This was a very fruitful research project that outshined anticipations in every way and was an exceptional experience. The findings of the study will be useful for species and habitat conservation in Bhutan and contribute in knowledge base for the scientific community on a hardly studied species.

In due course, journal article of the study and outreach materials will be sent to the Rufford Foundation after being published in the freely accessible journal. Almost certainly in the near future we would like to apply to the extension of the grant to uphold the sustainability of this already begun effort to respond to different queries,



concerns and assist local inventiveness that help conserve freshwater ecosystems.