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	Ngawang Dema
Project title	Ecology and Habitat Assessment of Critically Endangered *Nardostachys jatamansi* for Deduction of Conservation Strategies in West Alpine Region of Bhutan- Lingzhi
RSG reference	20558-1
Reporting period	September 2016- August 2017
Amount of grant	£5,000
Your email address	demangawang76@gmail.com
Date of this report	23rd August, 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
Quantitative evaluation of *N. jatamansi* involving the ecology and habitat assessment				Study area of Lingzhi was stratified into three altitudinal zones of 3500-4000 (S1), 4001-4500 (S2) and 4501-5000 m asl. (S3). Within each altitudinal zone, a square plot of 100 x 100 m was identified. Plot I (below Zamithang and above Mitsue yuel) lying in S1, Plot II (near Lingzhi Dzong) in S2 and Plot III (above Panglo- opposite of Lingzhi Dzong). Involving systematic random sampling, nine transects (60 X 30 m^2 each) were laid comprising of three transects each in three chosen plots. In each transect three stands measuring 10 x 10 m^2 were laid at random. In each stand, 10 quadrats of 1 X 1 m^2 size were laid for data collection, totalling 270 quadrats. Associated species counted to 19 showing statistically significant association. The dominant associates are *Bistorta macrophylla, Cassiope fastigiata, Cotoneaster microphyllus, Gentiana urnula, Morina nepalensis, Potentilla flagellaris, Rhododendron anthopogon, R. setosum* and *Saxifraga moorcroftia*. The number of species per transect showed bimodal type with decreasing and stabilising after certain height. *N. jatamansi* had the maximum frequency (M=80) and density (M=11.7) and IVI in majority of the sampling plots. The frequency density, abundance and IVI escalated between 40%-100%, 1.33-22.2 plants/m^2 (mean 11.78 plants/m^2), 2-32.5 and 47.09-124.92 respectively. Physico-chemical analysis significantly exhibited the positive correlation of moisture

				content, water holding capacity and total nitrogen content with the density of *N. jatamansi* favouring sandy loam soil. Below ground biomass showed significant positive correlation with plant height (r=0.680, p=0.044). Plant grows well in 40-68° (r=0.726) and SE (r=0.751) facing slope characterized by alpine shrub and grass.
Qualitative inventory of the species				Focussed group discussion and questionnaire survey aided and supplemented the identification of the sampling sites. Accordingly it showed that the most abundant places for the growth of *N. jatamansi* are near Lingzhi Dzong, in Panglo, Zamithang and Mitsue yuel. Majority of questionnaire respondents' (N-50) opinion in numerous aspects such as ecological and habitat preference, use and harvest pattern, trend of species occurrence and suggestions for continual supply of *N. jatamansi* has been utilised. Besides some extra historical based information shared by the villagers aroused more scientific doubts yet to be analysed.
Investigate anthropogenic threats and the conservation status to the species				The area most at risk from overgrazing and harvesting is plot I being at the reach of human and livestock such as yaks, horses and mules. It possesses a complex reaction to environmental change; being palatable this species is favoured by livestock, easily damaged by trampling causing equivalent loss in associated species and harvesting demand. The highest intensity of grazing was observed in Plot I followed by Plot II; which was being proven by the area coverage by grass, browsed *N. jatamansi* shoots and bare soil. Nevertheless, maximum average density appeared in Plot II. Density and mean species cover of *N. jatamansi* showing contradiction to the grazing intensity (Plot I GI 3: D 1.92: C 0.007, Plot II- GI 2: D 18.3: C 0.008, Plot III- GI 1: D 15.12: C 0.005) revealed

				that plants facing survival threat is not always intensified by grazing threat impact. Several other agents of threat might have caused the change in mean density and mean species cover. The reason can be that the grazing intensity is analysed by counting grazed shoots and not by counting overall dead shoots. Linear increase of per cent cover of dead shoots increased towards plot I. The area most at risk from harvest is Plot I and the least is Plot III as the quantity of harvest is bulky with the most frequent collection at the same time in Plot I. Habitat destruction by road construction and agriculture is negligent in the area with no such developmental infrastructure reaching Lingzhi and unsuitability of growing agricultural crops to such great height, however seemingly true for human settlements. Therefore, trend of livestock grazing, consequently the human intrusion for plant harvest exhibited more pronounced habitat destruction of *N. jatamansi*. However, further intensified and sole research regarding threat availabilities is deemed necessary. Conservation activities held previously for the plant is left scanty in the region.
Propose for raising awareness programme with the effect on developing the basis of peoples' participation and sharing responsibility				Team members made fully aware of the species status and assist in every small ways to help its population thrive. Local communities were made aware on the plant's conservation need and reduce harvesting and livestock grazing in the *N. jatamansi*-abundant area. School children are provided brochures and pamphlets designed for their reach of understanding and guided them to be the young nature enthusiasts and future agent of conservation. Research outcomes were presented

				in Forest Research Institute (DEEMED) University, Dehradun, India and progresses are being made to hold workshop with the stakeholders and Department of Forest and Park Services (DoFPS), Bhutan in the coming of favourable symposiums and workshops. Further distribution of pamphlets and brochure for quick glance capable of imparting research findings as well as the species endangerment has been achieved and will be continued hereafter till the end of August.
Generation of reliable baseline information to aid evolve pragmatic solution and alternatives				Being the first such research in the village block and having worked on complete set of parameters, the data and information compiled are made available to DoFPS and Gewog offices which are the pivotal agency for conservation. Henceforth, articles will be prepared to extend online access and provide conservation baseline readily with needed information in hand.

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

The prime obstruction along the careful fieldwork is the sites geographical location to the northern extreme of the country which required four days trek without reach of roads. Trekking despite the harsh weather conditions risked the lives of the research team ranging from the wildlife encounter to mountain sickness. The incessant rain in all round the year hampered tremendously fuelled by snow-capped passes, all-lifting snow blizzards and terrains having to cross during autumn and winter. Spotting the plant growth in its habitat during winter season was never easy given the same time period for field study. Hence, unbiased data obtainment required more days and equivalent hardship and patience of team members, which they kindly corporated and collaborated. Even the qualitative information regarding the harvest of plant seemed to have low accuracy as the villagers and local collectors fear the sharing of complete truth in order to bar the incoming of consequences. Nevertheless, the information was gathered to the best of our capabilities which proved more useful in threat assessment.

No matter what the rugged terrain and unforeseen difficulties had to offer, the research team always had the great team spirit to overcome adversities and contributed to the timely completion and success of the project.

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

a. Habitat and Ecology of *Nardostachys jatamansi* Assessment: Various ecological (phyto-sociological, physico-chemical and morphometric- trait attributes) and habitat parameters (with threats) were obtained from the region like never before. Research outcomes were both inclusive of the qualitative as well as quantitative aspects making it reliable baseline knowledge and filling the research gap that was left unresolved.

b. Reliable and Complete Knowledge-base for Sustainable Management: Recognising the vulnerability of the species to threats via research findings, and the species rarity well discussed, proposal for its inclusion in the Schedule I of totally protected plant species can be considered by the relevant DoFPS in the near or not too distant future. Upon sharing and publishing the research on authentic websites and journals under the acknowledgement of RSG, other native regions can utilise the outcomes for immediate action or similar investigation.

c. Awareness for Peoples' Participation for Conservation and Benefit sharing: Stakeholders for species conservation ranging from local villagers, school children, research colleagues both at Forest Research Institute, India and Bhutan, and conservation- giant organisations and agencies were made aware and awareness is still being maintained. Such awareness had the great opportunity for people to be the forefront species protector and not just rely on the concerned agencies and conservationists as they are the nearest guard, resource needy and degradation consequence bearers. Thus, concept of their participation, combined effort to conservation and related benefit sharing scheme was elaborated and achieved.

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

Local villagers were the sole informers while identifying the abundance area and their escort to field were never without some incentives. Even the local interviewees were incentivised for their gesture of assistance. Above all, the project's motives and the dire need of target species conservation were made aware to them. Conservation need for common purpose was hence a knowledge gained for them. When a foundation from abroad (RSG's initiative for entire fund) could take the lead for conservation, locals were much roused to their own service delivery while thankful for the foundation's support.

5. Are there any plans to continue this work?

While the current project could successfully cover the planned expectations, a lot needs to be done to study the entire aspects of the species. Since such study on the target plant being first of its kind in the country, some related projects has to be carried out which are as specified under question 9. Even the replication of similar works has to be involved in other sites to provide for proper and valid know how. In the process, conservation awareness and advocacy will be kept as the main mandate. For these recommended activities, I would like to strive to equally (if not

better) at achieving any of these if Rufford Foundation kindly maintains the undying support for the next grant.

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

Just as the outcomes had been shared with intellectuals and colleagues in Forest Research Institute, Dehradun and officials of DoFPS, National Institute of Traditional Medicine (NITM), local people and students of the community schools in the home country, information will be made available to wider range of public. Such spread of research outcomes will be achieved by publishing in Bhutan Journal Association, Bhutan Ecological Society, and other national and international authenticated journals where wider public range can avail the work. Information catchy posters and pamphlets will be delivered to the prime stakeholders. As a reference, master copy will be submitted to the focal agency of conservation- DoFPS while one is deposited in Forest Research Institute, Dehradun.

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 grant was utilized throughout the entirety of the project duration from September, 2016 to August, 2017 according to the proposed length of the project.

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 Equipment: GPS (1 no.) & Digital camera (1 no.)	530	530	0	The price was initially looked upon when applying for the grant
Altimeter (1 no.) & Compass (1 no.)	190	190	0	Beforehand known price remained same
Clinometer (1 no.) & Calculator (1 no.)	102	100	+2	Obtained on discounted rate
Stop watch (1 no.) & Measuring tapes (2 nos.)	123	130	-7	While the expected prize was lower than budgeted, purchase of 4 measuring tapes was found needed costing little higher
Rope (2 nos.) = 60 Hammer and sharp spade (2 nos.); Pole, nails and meter sticks (variable)	140	135	+5	Upon purchase of more quantity from border town, discounted rate was provided

Polythene bags (variable) & Herbarium preparation materials (field presser, mounting paper, gum) (variable)	25	20	+5	Charged lesser than expected
2. Field Gears: Neoprene suit (3 nos.), Gumboot (3 nos.),Tent (4 nos.), Basic utensil (variable)	175	185	-10	An extra tent had to be purchased during final field study and the price could be covered with little higher amount from anticipated price.
3. Safety Equipment: Hand glove (10 nos.), First Aid Kit (2 nos.), Hand sanitizer and soap (variable), Laboratory coat (2 nos.)	113	110	+3	Little amount was left over.
4.Stationery (variable)	22	20	+2	Charged lesser than expected
5. Guide books & reference books (Theory & Practical of Ecology) (2 nos.)	30	30	0	-
6. Laboratory charges along with use of some chemicals and materials	200	200	0	-
7. Chemical purchase	130	130	0	-
8. Printing of questionnaires, data sheets, posters, leaflets & pamphlets (variable)	500	505	-5	Printing of leaflets and pamphlets resulted in slightly higher than expected budget.
9. Report preparation, presentation & dissemination	350	360	-10	Judicious spending could reduce the expected budgetary allotment.
10. Transportation	410	450	-40	Porter charge for 4 separate field visits required higher than expected.
11. Accommodation	400	352	+48	Additional days of field work accounted extra charges.
12. Salary for team Workers	500	500	0	-
13. Training, campaigns & awareness	1,000	953	+47	Some amount was saved with careful expenditure during awareness programs in order to cover escalated overall expenditure.
14. Contingency	60	80	-20	Incentives for villagers had to be involved in it.
Total	5,000	4,980	+20	The balance amount is yet to be spent for the upcoming workshops.

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

Effective conservation, management and recovery of such critically endangered species require deliberation through variability analysis as jatamansi showed variability within its habitat range (plant size, general morphology and intensity of aroma). Sustainable harvest and grazing limit has to be estimated and understand the impact of current harvest protocol by periodic grazing and harvest destruction quantification. Even the pollination of species life cycle enhancement has been the area of concern for complete conservation based endeavours. However comparative studies from habitats apart from Lingzhi can add to the validation of the research findings and similar outreach programme to the wider community.

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 every presentation works, leaflets, pamphlets and brochures. Moreover, in the final master's thesis booklet, the Rufford Foundation was well acknowledged where the logo had been also placed and was distributed to FRI University and DoFPS. All the research crew and people were much awe inspired by the foundation's effort in funding such projects. All future publications and related works will sincerely find a special place for RSGF to be acknowledged.

11. Any other comments?

The undying support from the guides and all the research team members made this project a successful one, and whom I would like to acknowledge here. All the stakeholders involved and research team were equally enthusiastic and helpful without which the project's timely completion will be hindered.

All in all, the project's completion as planned was entirely depended on the foundations utmost financial assistance and in that I am wholeheartedly thankful to the RSGF and for being the leading foundation in biodiversity conservation forefront.

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