

## 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	
Your name	Deep Jyoti Chapagain
Project title	Population Ecology and Harvesting Sustainability of <i>Aconitum spicatum</i> , <i>Allium wallichii</i> and <i>Dactylorhiza hatagirea</i> in Nepal Himalaya
RSG reference	Ref no. 19960-1
Reporting period	June, 2016-October, 2017 (16 months)
Amount of grant	£4980
Your email address	chapagaindeep@gmail.com
Date of this report	1st March, 2018

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
<p>Assess status, distribution and population ecology of <i>Aconitum spicatum</i>, <i>Allium wallichii</i> and <i>Dactylorhiza hatagirea</i> in Annapurna Conservation area (ACA) and Apinampa Conservation Area (ANCA) of Nepal Himalaya</p>				<p>Study sites were defined according to the availability of the species in ACA and ANCA. Thus <i>A. spicatum</i> and <i>A. wallichii</i> were studied only in ACA and <i>D. hatagirea</i> was studied both in ACA (Manang) and ANCA (Chamelia Valley of Darchula).</p> <p><u>For <i>A. spicatum</i> and <i>A. wallichii</i></u>                      During summer of 2015, sampling was carried in all the three sites along the elevation gradient ranging from 3000 to 4200 m. Sampling covered whole range of <i>A. spicatum</i> and <i>A. wallichii</i> in the study sites. A transect of six plots (3 × 3 m) were laid down in each 100 m elevation band at a minimum distance of 10 m. Each plot was divided into nine sub plots of 1×1 m and only five subplots were systematically selected for detailed biological sampling. We laid total of 66 (3×3 m) plots including 330 (1×1 m) sub plots.</p> <p>The plants were classified into four different stages –seedlings (Sd), juvenile (Jv), adult vegetative (Adv) and adult reproductive (Adr) and reproductive status (Ghimire <i>et al.</i> 2005). The plants in different stages were counted in all the subplots and all the vegetative and reproductive traits were recorded. The count of the different stages was used to determine the population structure and density throughout the range. Trampling, harvesting, animal droppings and fire were considered as</p>

			<p>anthropogenic disturbances and recorded in a scale of 0 to 4. For biomass estimation, 20 most vigorous plants from each population were chosen and all the biological details were recorded. The dry biomass was recorded after air drying and laboratory analysis.</p> <p>To estimate the seed number and seed mass we randomly selected 15 mature reproductive individuals and collected 15 fruits from each individual from each population during the seed maturation period in October. To determine the seed germination and seedling recruitment we introduced 100 viable seeds into each of five 1×1 m subplots in each population.</p> <p>To determine the fate of tubers in coming years we transplanted 10 tubers in each five subplot of 1×1 m plots in each population. The recruitment from the tuber was recorded during 2016 and rate of recruitment from tuber was calculated.</p> <p>We followed Beigh et al. 2005 for seed viability tests.</p> <p><u>For <i>Dactylorhiza hatagirea</i></u>      During June-July 2015 and 2016 sampling was carried out in both the study sites. The sampling design was similar to that of <i>A. spicatum</i> however the number of sampling plots (1 x 1 m) in this species was confined to 288 as four subplots (1 x 1 m) from 3 x 3 m plots were systematically selected for sampling. The elevation gradient ranges from 3400 to 4600 m.</p>
<p>Study the population dynamics of <i>Aconitum spicatum</i>, <i>Allium wallichii</i> and <i>Dactylorhiza</i></p>			<p>According to the availability and accessibility of the species the study sites were determined.</p>

<p>hatagirea</p>			<p><u>For <i>A. spicatum</i> and <i>A. wallichii</i></u>        Three populations namely Deurali (3200 m), Bagar (3400 m) and Tonglyo (3700 m) were identified in Annapurna Base camp region. During September - October 2015 three permanent plots (20 x 18 m for <i>A. spicatum</i> and 3x3 m for <i>A. wallichii</i>) were laid down in each population which were further subdivided into nine subplots of 2 x 2 m and 1x1 m respectively. The harvesting procedure followed Ghimire et al. 2005 with some modifications. During September - October 2016 and 2017 the tagged plants were monitored to record survival and recruitment and all vegetative and reproductive traits were also recorded.</p> <p><u>For <i>Dactylorhiza hatagirea</i></u>        For this species, we established permanent plots in Chamelia valley region of Darchula and Bhimthang valley region of Manang. The three studied populations are namely Thadapani (3400 m) , Nwagidanda (3700 m) and Kalidhunga (3900 m) in ANCA (which we considered as the site open for commercial harvest) and Bhimthang (3600 m), Ponker (4100 m) and Salpodanda glacier region (4600 m) in Manang of Annapurna Conservation Area (site protected for commercial harvest). In each site three permanent plots of 20x 20 m were laid down which was subdivided into four subplots of 10x 10 m. In each plot all the plants of different stages were tagged with individual aluminium tags and all vegetative and reproductive traits were recorded. As the plant is protected and banned species</p>
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				harvesting treatment was not applied. In this case also the count data were used for the determination of density and population structure and the biological details were used to document the impact of anthropogenic disturbances especially harvesting on the life history traits in commercially harvested site and community protected site.
Assess the social, economic and cultural aspects related to the study species.				Questionnaires, survey (n=75 individuals in each site), Focus group discussion (n=4 in each site), Awareness cum interaction programmes (n=1 in each site) were carried out during 2016 and 2017.

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

#### **Remoteness and scattered study sites**

The study sites were very remote areas of Nepal in high altitude. Manang, Annapurna Base Camp and Api Nampa Conservation Areas lie in different places. It takes more than a week to reach the study site from Kathmandu and took longer period of time to carry out the field work.

In spite of remoteness, all sites were visited every year (2015 to 2017) with a field team and field work was carried out. At the same time, local cattle herder, sheep herders and harvesters were sensitised on conservation of medicinal plants and their method of sustainable harvest.

#### **Seasonal dependence**

As this research is focused to determine the population dynamics of the species, it is of utmost importance to collect the data at its growing and maturation stage. The research team are obliged to reach the site during the rainy season. On the one hand the study site is remote and on the other hand the rainy season calls for number of natural catastrophes like landslide and glacier outburst. This risks the life of the research team. However, fortunately the field works were carried out successfully in all the sites.

#### **Ethno botanical Survey in ANCA Darchula**

For the ethno botanical survey most of the interviewers were reluctant to respond. It might be due to the banned category of *D. hatagirea* for collection and trade. However, with the help of citizen scientist they were finally happy to respond.

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

#### 1. Status, distribution and population ecology of the studied species:

- a. The temporary plots of 1 x 1 m (330 for *A. spicatum* and *A. wallichii* in ABC) and 576 for *D. hatagirea* in Manang and ANCA) were successfully laid down in all the three populations. Population density and structure were found to be hump shaped structure for *A. spicatum*, *A. wallichii* and *D. hatagirea* in Manang but the population density of *D. hatagirea* in ANCA did not show any specific pattern. Details of these results will be published in the paper entitled: "Sustainability of harvest of a commercially threatened medicinal plant *Aconitum spicatum* in Central Nepal".
- b. The population density of *D. hatagirea* of ANCA was found to be two times lower than that of Manang which might be due to anthropogenic factors especially illegal harvesting and overgrazing. Details regarding the comparison of the distribution and impact of anthropogenic disturbances will be published in the paper entitled "Variation in the life history traits of a medicinal orchid *Dactylorhiza hatagirea* D. Don Soo along the environmental gradient in Nepal Himalaya". Draft manuscript has been prepared and will soon be submitted for peer reviewed journal for publication.

#### 2. Impact of harvesting and other anthropogenic disturbances on the population performance of study species

The population of *A. spicatum* and *A. wallichii* is found to be stable during these 2 years. However, in depth study and further monitoring of low density species is suggested to ensure its sustainability through long term strategy development. We further found that to achieve long term conservation of MAPS the emerging scientific researches should also focus on the impact of the common anthropogenic factors like trampling and frequent fire which were overlooked by many scientific researches. Thus, this research recommends integrating the knowledge of impact of common anthropogenic factors of alpine and subalpine pastures (like trampling, grazing, fire) with sustainable harvest is crucial for the long term conservation of the highly valued MAPS.

Despite the awareness of the banned category of *D. hatagirea* most of the collectors were found reluctant for the conservation of the species and found to be involved in illegal harvest and trade. Besides *D. hatagirea* other highly valued MAPs like *Ophiocordyceps sinensis*, *Fritillaria cirrossa*, *Neopicrorhiza schrophulariflora* are also collected irrespective of its abundance, status and value. 88.7% respondents (in ANCA) were of the view that they were unaware of the population biology of MAPs they collect and trade.

Seasonal migration of cattle which coincides with the peak growing season of most MAPs were found to be one of the important threatening factor for the long term persistence of highly valued maps.

This research further recommends the governmental and nongovernmental organisations working in the field of conservation to come up with the alternative source of incomes for the locals in ANCA so that their dependency on MAPS harvesting to sustain their livelihood can be minimised and the valuable MAPs will bear less anthropogenic pressure in the persistence of available populations. We further recommend ANCA collectors should be trained with population biology of the MAPs they collect. We also like to recommend the concerned authority to allow rotational harvest for the MAPs like *Fritillaria cirrhosa* in ANCA.

### **3. Ethno botanical survey and community sensitization**

Our team carried out ethno-botanical survey in all study sites and did community interactions and sensitisation workshops in all three sites. Basically, my team tried to convince the local herders about harvesting methodology, ecological and social importance of NTFPs in the region. We further focused on the conservation status of the study species in the study sites.

Our survey found that 74.51% of the respondents were aware of the banned status of *D. hatagirea*. Even then this plant is harvested illegally in large volume. Ninety percent of the respondents asserted that the plant is decreasing in alarming rate since a decade. The locals have the opinion that for the conservation of this species the government should have strict regulation policy on the illegal trade of *D. hatagirea*. We also found that the locals are eager for the cultivation of this species as well as other highly valued MAPs. Locals of ANCA further asked our research team to propose management techniques to prevent over exploitation of MAPS. With final report of this study we will be in a position to develop a harvesting guideline for these species.

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

#### **Development of citizen scientist for MAPs research:**

Six local youths from local area were trained for the vegetation sampling, plant tagging and monitoring of the permanent plots, and ethno botanical survey. They can establish plots (temporary and permanent), collect sample (flower, seed and soil), fill designated form and handle GPS, compass and clinometer. They are acting as citizen scientist for this research in Apinampa Conservation Area and Annapurna conservation area. After the termination of the project the citizen scientists will continue to sensitise local community members on the sustainable harvest and ecological importance of the MAPs. The trained citizen scientists have been linked with district forest offices and conservation area offices together with village municipalities in which they will get seasonal jobs and further trainings to strengthen their capacity.

The findings of the study have been very helpful to develop non timber forest products (NTFPs) harvesting strategy and plan (2018) for the ACA by the Government of Nepal. The plan is under revision and will soon be approved by the government.

**Awareness on the sustainable use of MAPs:**

Over 275 community members including community leaders, teachers, students, herders, traders and locals participated in awareness cum interaction programme in Apinampa, Ghandruk and Manang. The workshops mainly focused on availability of MAPs, trade of MAPs, local use of MAPs, harvesting pattern and appropriate mitigation measures for illegal harvesting of banned species like *Dactylorhiza hatagirea*. The communities were sensitised mainly on how important it is to do sustainable harvesting practices to maintain the perpetuity of availability of MAPs in the long run.

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

Yes, I am very much interested to carry out the long term research of the studied species. In depth study and further monitoring of low density species is suggested to ensure their sustainability through long term conservation strategy development. Schmidt et al. (2011) in their review found 46 studies that assessed the effect of harvesting on non-timber forest products. Most of the studies included palm and tree species (33 sp. div. + 1 cycad sp. div.), and only twelve focused on herb species. However, only three papers have focused on harvesting of medicinal plants (Nantel et al. 1996; Ghimire et al. 2008, Rokaya et al. 2018) till date, so further studies on MAPs harvesting are urgently needed. Further, the Department of National Parks and Wildlife Conservation and NTNC have asked us to continue the study on harvesting ecology of other important species including the studied one. Therefore, we will continue the study in different parts of Nepal to fulfill the knowledge gap.

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

**a. Already shared:**

- The findings of the research was shared at community level in the field offices of conservation areas (Ghandruk ACAP, Dharapani Manang, Apinampa Darchula) and at 1-day programme in Kathmandu, Nepal where there was participation of the officials from Department of National Parks and Wildlife Conservation (DNPWC), National Trust from Nature Conservation (NTNC), World Wildlife Fund (WWF) Nepal, Department of Forest (DOF), Department of Plant Resources (DPR), Tribhuvan University and from different NGOs related to NTFP and Trade.
- Six presentations on national (two) and international (four) conferences were made during 2016 and 2017 on different findings of the study.
- Research progress was also presented in one day workshop organized by the project transiting to Green Growth Nepal on 7<sup>th</sup> December 2016 and 4<sup>th</sup> December 2017.

**b. Future planning:**

- At least two papers will be published in international scientific journals by 2018.

- The final technical report will be published in the website of Tribhuvan University and University of Copenhagen.
- The findings will be shared at national level to the enforcement authorities and policy makers for further improvement on conservation management of these species.

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

Although project period was mentioned from June 2016 to October 2017 in application proposal, the first field visit was already organized during June to October 2015 where the establishment of permanent plots and tagging of the individual plants were successfully completed in ANCA and ABC region of Annapurna Conservation Area. The second field visit was organised in late June to October 2016 immediately after approval of support grant by Rufford Foundation where the previously tagged plants were monitored. Additionally, permanent plots were established and all the plants were tagged in Bhimthang valley of Manang in July-August 2016. It was extended additional 4 months to cover the seasonal data collection by considering field accessibility in highly terrain mountain landscape. The third field visit was organised during June to October 2017. Besides field sample collection, it took time for the data analysis and report preparation. During the field work period series of community consultation and sensitisation workshops were also carried out. The field visits and activities were regularly informed to Rufford Foundation with project update.

**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
Field members cost	2500	4550	2050	It covered the cost of field work -1 porter for 70 days @15, 1 Volunteer Botanist for 70 days @15, 1 citizen scientist for 70 days @15 and team leader 70 days @20 [remaining cost was covered by other projects]
Stationery and data sheet LS	200	200	0	Photocopy, printing and stationery costs for the field work were covered.
Field accessories and materials	560	960	400	4 sets of rain gear, four sets of field boots, four sets of Torch light, 2 sets of mountain tents and accessories and 1 set of etrex Garmin GPS

				were purchased
Transportation	1350	1230	120	Vehicle hire for 15 days for field work @90 = £1350
Field workshops-	640	600	40	It included the costs of stationery items sets and Tea/lunch for 100 persons
Central level workshop	190	190	0	It included the costs of stationery items sets and Tea/lunch for 40 persons
Report print and distribution	150	150	0	It included the cost of final report preparation
Total	5590	4980	3060	£3060 was granted by Transiting to Green Growth Nepal (TGG-N), a Danida funded project that works in collaboration with the Central Department of Botany Tribhuvan University Nepal.

Conversion factor: £1= NPR137

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

This study showed that the population of *D. hatagirea* were found to be decreasing in the ANCA; however the population of *A. spicatum* and *A. wallichii* showed stable population during last three years period. The population of *D. hatagirea* in ANCA is in critical situation (population growth rate is declining in alarming rate) if the current anthropogenic factors continue to operate. In contrary, the population of *D. hatagirea* in Bhimthang valley of Manang is stable due to the prevalence of strict regulation on the illegal harvesting. We found that MAPs are harvested irrespective of its knowledge on population ecology and harvesting sustainability in Apinampa Conservation Area region as locals are completely dependent on the harvesting of MAPs especially *Ophicordyceps sinensis*, *Fritillaria cirrhosa*, *Dactylorhiza hatagirea* (illegal collection) and *Neopicrorhiza scrophulariflora*. Due to lack of knowledge and inadequate enforcements on scientific harvesting, harvesting of MAPs has become a haphazard process and is done only on ad hoc basis.

Plant species level research that comprises inventories, impact studies and monitoring is necessary if plant resources are to be harvested sustainably by human populations living adjacent to protected areas.

Studies of population dynamics are an important baseline for understanding the future of plant populations and enable prediction of the effects of different harvesting techniques on the performance of plant populations. For the long term conservation, understanding the population dynamics of these species is of utmost important. So, long term monitoring of the permanent plots established in 2015 is my prime interest. These plots will be monitored in 2018 and if possible in few more coming years as well.

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

Yes, I used the logo of Rufford foundation in posters and oral presentations. The financial support of Rufford Foundation will be highly acknowledged in the upcoming conferences/seminars and paper publications. The research findings were presented in national and international forums and sensitized the global communities regarding their ground conservation realities in which Rufford Foundation was highly acknowledged.

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

The research activities were implemented under my leadership with the close supervision of **Associate Professor Suresh Kumar Ghimire** and **Chitra Bahadur Baniya** from Central Department of Botany, Tribhuvan University and Associate Professor Henrik Meilby from Department of Food and Resource Economics, University of Copenhagen Denmark.

Number of people and organization played crucial role for the successful organisation of research work including field data collection and lab processing. The Unit Conservation Officers and other staff members who were deployed in different units of Annapurna Conservation Area Project (Ghandruk and Dharapani Manang) and Api Nampa Conservation Area had supported for the coordination with local communities and selection of appropriate site for the establishment of permanent plots. Besides, they also supported for the logistic arrangements of field work. The chairperson and community leaders of Conservation Area Management Committees also provided valuable information and support for the selection of probable candidate for the citizen scientist.

The citizen scientist played key role for the identification of the site with good number of study species, establishment of permanent plots, and protection of the permanent plots during the peak harvesting period. The citizen scientist also played great role for the identification of the appropriate candidate for the interview and to conduct the awareness cum Interaction programme. The botanists (especially taxonomists) hired from the Central Department of Botany, Tribhuvan University worked as a field assistants who were trained to record the field data (population data as well as ethno botanical data). Besides these they were also responsible for the identification of the plant species and assist in some of the laboratory work like seed viability analysis and recording the dry biomass.





