

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	Karma Sherub
Project title	Foraging behaviour, Food resources and Habitat use by Rufous-necked Hornbill (<i>Aceros nipalensis</i>) in Jigme Singye Wangchuck National Park, Bhutan.
RSG reference	19003-1
Reporting period	May 2016 to May 2017
Amount of grant	£4940
Your email address	Karmasherub3@gmail.com
Date of this report	11/May/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
<p>To document the habitat composition of Rufous-necked hornbill (RNH) in Jigme Singye Wangchuck National Park (SWNP) of Bhutan</p>				<p>The study was carried out in eight localities in three dzongkhags (districts) under three gewogs (blocks), located at south-eastern part of the park.</p> <p>The vegetation sampling plots were established in five localities- Nabay and Gonphaii under Zhemgang district, and Korphu, Nabji and Nimshong in Trongsa district, to study the habitat characteristics of rufous-necked hornbill, because these sites are the prime habitat that harbours major population of rufous-necked hornbill throughout the year. These areas were regularly visited to carry out the intensive survey to meet the objectives of the project.</p> <p>A short duration visits were made in Berti locality under Zhemgang district, and Chungshing and Chakarhang localities under Sarpang district (district), because the sightings of RNH was very less in these areas.</p> <p>We recorded a total of 560 stems and 98 species of trees with DBH ≥ 20 cm, representing 70 genera under 36 families, with an overall average density of 448 ± 58.13 trees/ha. The Lauraceae was the most dominant plant family in surveyed sites with 18 species. Most common genera found in the sites were <i>Albizia</i>, <i>Beilschmiedia</i>, <i>Cinnamomum</i>, <i>Ficus</i>, <i>Helicia</i>, <i>Lithocarpus</i>, <i>Litsea</i>, <i>Macaranga</i>, <i>Mallotus</i>, <i>Michelia</i>, <i>Morus</i>, <i>Persea</i>, <i>Phoebe</i>, <i>Quercus</i> and <i>Terminalia</i>.</p> <p>The girth of individual tree varied from 20 cm to 244 cm. Most of the GBH of trees species were between 20-40 cm (50.2%) and 41- 60 (22.7%) cm girth class. The average GBH was 49.9 cm.</p> <p>Based on our research effort, the RNH were</p>

			recorded in between 644m-1608m elevation range.
To document the distribution and sighting records of Rufous necked Hornbill in Jigme Singye Wangchuck national Park			<p>The Relative abundance of rufous-necked hornbill (RNH) was obtained from repeated transect walk in eight sampling sites. In 361 km of total sampling effort, a total of 245 (total average sighting=161) RNH was sighted over several visits from June (2016) to April (2017). The result of population density analysis showed that RNH's population density in eight different stations varied from 0.01 – 0.41 birds/km² with a total density of 1.23 birds/km² (± 0.12). We have taken a maximum RNH encountered in a day during the trail walk to estimate the minimum population of individual. The maximum RNH encounter varied from 2 – 17 individuals. The total minimum RNH estimation was 43.</p> <p>Flock size: The frequent sighting of RNH was either lone male or female singly (46.6 %, n=61) or a flock size of two (both male and female) (37.4%, n=49). The largest flock size of eight (0.8%, n=1) was spotted once in the month of January, 2017 from Nimshong locality. The RNH in large group (≥ 5) were spotted usually at the time of feeding on a single fruiting tree during the non-breeding season from September 2016 to March of 2017.</p>
To study the nesting cycle of Rufous-necked Hornbill			<p>The nesting cycle is defined as the period from the female's imprisonment until the fledging of the chick. We have spotted four nests, out of which two were active in 2016 and two in 2017. The imprisonment of females started between 14th April 2016 (date obtained from JSWNP range office, Tingtibi) and 22nd April 2016 and fledging occurred between 25th and 28th July 2016 respectively. The entire breeding cycle of Rufous-necked hornbill took about 93 – 98 days.</p> <p>One of the nests was newly occupied by RNH on 26th April 2017. This nest was previously occupied by the great hornbill (2016) and was just at 21 m away from the nest of RNH. As they occupied a new nest (at the nest of great hornbill), the previous</p>

		<p>nest was abandoned.</p> <p>Additionally, one abandoned nest (abandoned 2 years before, according the personnel of JSWNP) was recorded at Berti locality and detail study was done to understand the parameters that caused the RNH to abandon the nest. It was observed that the next tree was located just a metre from the walking trail, which is used by the cattle herders and local people. Other disturbances seen near the nesting tree were logging, firewood collection and patches of abandoned (before 1 year) agricultural field. A temporary camp sets by cattle herder to hold the night was observed 20 m away from the nest tree. Since the RNH is a shy bird, the listed disturbances factor could be the foremost reasons to abandon the nest.</p> <p>However, we couldn't track the exact time of fledging and number of chick being fledged. However, during the transect walk, twice a single juveniles spotted.</p>
<p>To document the diet composition of Rufous-necked Hornbill in JSWNP</p>		<p>Rufous-necked hornbill was seen feeding on 35 different species of fruits and few invertebrates. Fruit eaten as food were classified to 13 families. The most important families in the diet of RNH were Moraceae (30.3 %, n=10) and Lauraceae (27.3%, n=9). Two fruit food species couldn't be identified Some of the invertebrates fed were larvae of lepidoptera and hymenoptera, adult beetles (coleopteran), two unknown species of insects and fresh water crabs (molluscs).</p> <p>The fruit food consumption by RNH varied monthly/seasonally based on its fruiting period and availability. It was observed that the fruiting species consumed by RNH was available in highest number during the summer (June-August 2016; n=24 species) season, of which first 2 months coincided with the breeding period. The proportion of trees in fruit which were consumed by RNH occurs in lesser number during the autumn (September-October 2016; n=11 species), winter (January-February 2017; n=11</p>

		<p>species) and spring (March-April 2017; n=7 species) seasons.</p> <p>Food consumption in breeding cycle period: A total of 21 fruit species were recorded for the diet of RNH, which was comprised of 18 genera of 11 families. Lauraceae (n=6 species) and Moraceae (n=5 species) represents the highest species that were consumed, showing the food preferences and availability during breeding season.</p> <p>The species recorded were <i>Aglaia lawii</i>, <i>Aphanamixis polystachya</i>, <i>Artocarpus lakoocha</i>, <i>Beilschmiedia gammieana</i>, <i>Canarium strictum</i>, <i>Casearia glomerata</i>, <i>Choerospondias axillaris</i>, <i>Cryptocarya amygdalina</i>, <i>Daphniphyllum</i> sp., <i>Eleocarpus lanceifolius</i>, <i>Ficus benjamina</i>, <i>Ficus roxburghii</i>, <i>Ficus semicordata</i>, <i>Ficus</i> spp., <i>Litsea</i> sp., <i>Neocinnamomum caudatum</i>, <i>Persea</i> spp. <i>Phoebe</i> spp., <i>Terminalia chebula</i>, <i>Prunus</i> spp., and <i>Talauma hodgsoni</i>.</p> <p>An observation was made on the regurgitated food items below the nesting trees and found that the frequently delivered food items to the nest by a male RNH was <i>Beilschmiedia gammieana</i> in the nest located at Nabay (N-1) and <i>Aphanamixis polystachya</i> at Gonphaii locality (N-2) as per the visibility of maximum seeds under the nesting trees. This shows the food preferences and its availability during the breeding season. Other species that were identified from regurgitated items were <i>Aglaia lawii</i>, <i>Canarium strictum</i>, <i>Eleocarpus lanceifolius</i>, <i>Ficus roxburghii</i>, <i>Ficus</i> spp., <i>Litsea</i> sp. and <i>Terminalia chebula</i>; and the invertebrates such as the remnant of crap, beetle, and bee larvae.</p> <p>Diet composition during the Non-Breeding season: The RNH was found consuming the fruits of 18 tree species, comprising of 10 genera under six families. The highest number of tree species, whose fruits were consumed during this period was from the family Moraceae (n=7 species) and</p>
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			<p>Lauraceae (n=6 species). Two species couldn't be identified. The caterpillar and two unknown species of insects were also found being consumed.</p> <p>The species recorded were <i>Alangium chinense</i>, <i>Beilschmiedia assamica</i>, <i>Beilschmiedia gammieana</i>, <i>Choerospondias axillaris</i>, <i>Ficus benghalensis</i>, <i>Ficus elastic</i>, <i>Ficus hederacea</i>, <i>Ficus hispida</i>, <i>Ficus hirta</i>, <i>Ficus semicordata</i>, <i>Ficus spp.</i>, <i>Hovenia acerba</i>, <i>Litsea sp.</i>, <i>Litsea spp.</i>, <i>Mangifera sylvatica</i>, <i>Neocinnamomum caudatum</i>, <i>Parasassafras confertiflora</i>, <i>Terminalia spp.</i>, and two Unidentified species.</p> <p>The fruits that were found consuming in both breeding and non-breeding seasons were <i>Beilschmiedia gammieana</i>, <i>Choerospondias axillaris</i>, <i>Ficus semicordata</i>, <i>Ficus spp.</i>, <i>Litsea sp.</i>, and <i>Neocinnamomum caudatum</i> which makes to 17.1% of all fruit species which are being consumed.</p>
<p>To study the foraging behaviour of Rufous-necked Hornbill</p>			<p>The diet of rufous-necked hornbill (RNH) and the foraging stations (canopy height) differed based on the availability of the predominant foods and where these foods were in the forest strata. Most of the feeding was carried out from small branches (58.5%) or large branches (24.6%) and crown foliage (24.6%). Trunk and ground were rarely used.</p> <p>RNH often feed on the ripen food, resting on a branch or cling on the foliage to reach the ripened fruit. For feeding, they choose to feed by plucking fruits within the height range of 4 to 28 m above the ground. They fed most frequently in the 8-12 m (27.4%) and 12-16 m (27.4%) height classes. The foraging method on the ground was not observed directly, however, twice a RNH were seen near a water hole. It is possible that my presence sometimes may have deterred birds from descending to the ground or the feeding perches.</p> <p>One nest was observed continuously for 4 days from 06:00- 18:00, in order to</p>

			<p>understand how much the male RNH was delivering the food to female or how much time it spent feeding the female. It was observed that the male RNH carry the mixture of food items and feeds the female at the maximum of five times and minimum of four times in a day. The male RNH spent around 30 sec to 75 sec feeding the female with the food items it bought in. The initial delivery time starts at 08:15 to final feeding at 17:17. The time interval for the arrival of male RNH to feeds the female ranges from minimum 19 minutes to maximum 3 hours 25 minutes. It is possible that the presence of disturbances, climatic condition and availability of foods can affect the delivery frequency or the time of feeding.</p>
<p>To examine the potential threats that affects the survival of RNH in JSWNP.</p>			<p>Forest as the habitat of wildlife is mainly composed of natural resources which is dominated by trees and natural environment, are now mostly facing a critical threat.</p> <p>One of the threats to the RNH habitat was clearing of forest patches during the shifting cultivation. The forest was encroached and the plants were being slashed, burnt and land was used for the cultivation of cardamom. The practice was common in Korphu locality. It was observed that many of <i>Phoebe</i> sp. and <i>Ficus</i> sp. trees were cleared, which are the important food plants for hornbills.</p> <p>Grazing was another immediate threat. Almost all sampling areas have been affected by grazing. During the winter, cattle from the high altitude were being migrated to the RNH habitats. Trees were looped and felled, including most of RNH food plant species. They spent almost 2-3 months within the forested area, which coincided with the breeding season of RNH. Twice a forest fire occurred in Korphu locality due to careless of cattle herder in February 2017. Thus the effect of these practices leading to habitat destruction is revealed by the fact that nest holes previously reported occupied by RNH in</p>

			<p>Berti locality was abandoned.</p> <p>The high power transmission lines constructed in Nabay and Berti localities was one of the major threats to RNH habitats. Most of the large trees were being cut down, opening the forested area and creating the gaps. This diverts the RNH, especially during the resource tracking. We were told by the local people that, before the construction of high power transmission tower begin, many RNH were to be seen in the hill side of Nabay locality. However, recently none of the individuals were spotted during the survey. Moreover, the locals inhabiting in the RNH habitats were mostly dependent on the forest for timber and firewood, for the construction of houses. Therefore, big trees were being felled to meet their needs. There are also reports of illegal logging. These all were seen as a threats for RNH in terms of nesting as well as feeding. However, no threats of hunting have been so far reported from the area. This was also confirmed from the local villagers.</p>
<p>Awareness campaign</p>			<p>Awareness campaign was done with the local people and schools residing proximity to RNH habitats. Social gathering and door to door campaign were done to aware the people with the conservation significance of wildlife and its habitat. The brochures were distributed to villagers, schools and students, protected areas, conversationalist, and random people wherever we travelled, in order to spread the conservation works and its importance. A collaborative documentary film was made with Bhutan Broadcasting Service (©BBS) on the nesting and feeding behaviour of RNH and great hornbill from JSWNP, which was later broadcasted on national TV, after which we got lot of support and positive feedback from people around Bhutan for our effort in conserving such species.</p> <p>Moreover, it was observed that the people living in the study sites were cooperative and fully aware of conservation. They were</p>

		<p>enthusiastic and interested to collaborate in terms of habitat management and protection. Still, the gradual disturbances persisted over the habitats. These issues were discussed with the related stakeholders (local leader, forester, and teachers), so that protection of habitat can be strengthened among various groups through oral transmission as well as practically.</p> <p>The research findings will be presented to the scientists, MSc and PhD scholars of Forest Research Institute (India), which is scheduled on 7th June 2017. The result will be made available through publication in international journal. The book (thesis) will be made available to related stakeholders in Bhutan. Further, the findings will be presented to the conversationalist of various fields in Bhutan during the upcoming Bhutan Ecological Society (BES) Research Symposium.</p>
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2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

The terrain of the study sites was mostly rugged and thick primary forest. It was very difficult to sight RNH during the transect walk. However, the research team put lot of effort to collect an unbiased data. Most of the study sites were located at very remote place except for Nabay locality. Travelling to these sites was very difficult, especially during the rainy season (July-September, 2016).

Secondly, it was very difficult to locate the nesting site in the study areas. Whenever a lone male is followed to locate the nest, it always gets lost in the thick canopy cover. However, the team managed to locate two active nests in 2016 breeding season, and one was recently located (on May 26th 2017). This nest was previously occupied by the great hornbill in 2016.

The team couldn't manage to do a survey in the western part of the park. The first reason was that the place was not accessible due to rugged terrain and thick primary forest. Secondly, the RNH encountering rate in those places was said to be very low as per the personnel of JSWNP. Therefore, only eight stations were chosen for the study of which five sites were chosen to carry out the intensive work as it harboured maximum number of hornbill. Overall, the research team has ranked the study at 60 %, based on data collected and work effort.

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

The project was of the great findings. One of the important outcomes was, we were able to do a detail study on RNH in JSWNP such as its food resources, feeding behaviour, population density, nesting cycle, and conservation threats beside habitat characteristics. It was first kind of study in the area.

The study area is one of the hotspot of wildlife in Bhutan. The local people residing in the areas were very cooperative and conservatives. For example, one nests of great hornbill was located just at 30m away from the settlement in Tingtibi area under Zhemgang district (50 m out of study boundary), which shows that people were not a threat. However, the indirect threats were the habitat degradation due to various anthropogenic activities. Some of the indirect threats were logging of fruiting tree species (or could be nesting tree species), cutting the fruiting tree species for fodder and forest fragmentation due to illicit timber extraction. However, no threats of hunting have been so far reported from the areas. This was also confirmed from local villagers. During the awareness campaign, people always have shown keen interest in participating and knowing more about the wildlife. This shows the success of others awareness campaign as well as the success of current project awareness campaign.

Our findings were discussed with the officials of JSWNP Park. They have shown a keen interest in protecting the located RNH nests and their habitat. One of the important outcomes was that the Bhutan Broadcasting Service (BBS) had made a documental film on hornbills, showing the feeding and nesting behaviour of RNH and great hornbill in JSWNP, where our research team were the escorts. This video has influence many people by the beauty of hornbills and it was the first ever video broadcasted on national television, showing the nesting behaviour of RNH from Bhutan. It was a great effort of the research team to locate the active nests and the RNH, proving that area as one of the key habitats of Rufous-necked hornbill.

The presentation of this work is scheduled on 7th July 2017 in Forest Research Institute of India (FRI). I will be sharing the finding to the scientists, conversationalist, MSc and PhD scholars of FRI. Also the finding will be presented in Bhutan at national level during the Bhutan Ecological Services (BES) symposium which is yet to be conducted sooner. The paper will be soon sending for the publication in international journal.

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

We have conducted our activities with the collaboration of Department of Forest (DoF) and local people. Two BSc Forestry students were involved in this project fully for data recording and tree identification during the entire project period. Nine interested forest officials of JSWNP have helped me during the entire project schedule for guarding to the areas, data recording and analysis. 10 local people (tw to three from each study sites) have accompanied during the entire study, guiding towards the study sites, and identifying the tree species in local name. The community people and school students were able to get more knowledge on the

conservation of rufous-necked hornbill (or wildlife) and their importance in nature through conservation awareness programmes. This project has supported to several conversationalist to show interest in hornbill and, the monitoring of nest and protection work are now being held by the forester of JSWNP.

5. Are there any plans to continue this work?

Our study reveals that rufous-necked hornbill needs more conservation work especially in protecting their nest hole from human interference. It is seen important to have a long term monitoring in their habitats. Now that we have very good foundation to continue the project for the effective conservation of RNH habitat, the Department of forest supports the project and conservation work in the area through protection of habitat. Regular monitoring at nesting nest is still going on. We are interested to explore more areas to find out the distribution and population of RNH and great hornbill covering all areas in JSWNP Park and Bhutan gradually.

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

I have presented the partial findings of this work with many environmentalists from Ugyen Wangchuck Institute of Conservation of Nature (UWICE), Royal Society for Protection of Nature (RSPN), National Biodiversity centre (NBC) and Department of Forest in Bhutan (DoF). They all showed a common interest, particular in nesting behaviour. Now that the work is complete, I will be presenting the finding to the Scientist, MSc and PhD students of Forests Research Institute (India), which is scheduled on 7th June 2017. The findings will also be presented to the conversationalist from all over Bhutan during upcoming **Bhutan Ecological Society (BES) Research Symposium**. We are working out to publish the research article in relevant journals for wider communication.

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 field data collection was started from June of 2016 up to the end of April 2017.

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 equipment's (Measuring tape, vernier calliper, GPS, Haga altimeter, binocular, digital camera, compass,	613	700	+87	We didn't purchase the Haga altimeter because it has the same function to that of clinometer and GPS. All the material were purchased from the online

pocket calculator, stopwatch, clinometer, flagging)				shopping of India: www.flipcart.com and www.amazon.com
Safety materials (boot and raincoat)	156	156	0	5 pairs were purchased for the research team, each cost £29.
Standard field kits/stationaries (Printer paper, field notebook, field guide book, lead pencils, plastic bag, ruler)	54	55	+1	Two field guide book for identifying tree species were purchased.
Communication	144	150	0	Mobile phones and email/internet.
Education and Awareness	1582	1431	-151	The refreshment was provided during the entire awareness program and workshop with the forest official, conservationist during the discussion of finding and further improvement or protection program to be doing in the area.
Budget for salaries/wages	1852	1852	0	The wages to the team member were calculated based on the as monthly salaries.
Budgets for printing Poster, Broachers and Pictorial Guide book	485	70	-415	The rest is kept for printing the booklet after completion of drafting the project.
Data analysis and report writing	54	54	0	Refreshment was given to the team member and the colleges who helped in data entry and analysis.
Total	4940	4468	472	

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

- Studying the distribution of both RNH and great hornbill in JSWNP and Bhutan.
- Identifying the key habitats of RNH and great hornbill in Bhutan.
- Exploring more nests and food resources of both the hornbills and engaging in long term monitoring.
- Studying the nesting behaviour of both the hornbills.
- Community based conservation with involvement of local people, students and related stake holders.

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 RSGF logo has been used in poster, brochure, presentations, documentary short video, and will be used in all the materials produced from this project such as thesis, booklet, etc. The logo will also be used in relevant publications of this study in future too.

11. Any other comments?

This study is highly benefitted from expert's suggestions, especially from my Guide Arun P. Singh (Scientist), Mr. Tshering Phuntsho (Conversationalist, RSPN) and Dr Karma Wangchuck (Lecturer, Sherubtse College). We highly acknowledge their time and guidance. The forest official of JSWNP supported this project during the entire fieldwork and the local people of the study sites always gave a warm welcome during the field visits. They have been showing keen interest to collaborate and I want to thank all of them for inspiring us in carrying out the work effectively.