Final Evaluation Report

Your Details	
Full Name	Ashraft Syazwan Ahmady Yusni
Project Title	The application of passive acoustic monitoring as a novel method to enhance our understanding of hornbill behavior and ecology in Sabah, Borneo.
Application ID	33083-1
Date of this Report	27th September 2022

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
Compare the effectiveness of point-count and acoustic recording to collect data for hornbill research.				Manual and acoustic surveys were successfully conducted from March to April 2022. Data collected are now included in the writing of a scientific article.
Produce a baseline data of hornbill occupancy and detection probabilities in Lot 6 and Lot 2 of the LKWS.				As previously reported to The Rufford Foundation, due to COVID19 and Sabah State's Full Movement Control Order plus unusual weather events, our study could only be undertaken within one forest habitat type in Lot 6 of the Lower Kinabatangan Wildlife Sanctuary (LKWS). Therefore, a comparison on hornbill presence across spatio-temporal scale was not possible. However, we did manage to conduct all natural resources surveys for fig and cavity-bearing trees around the survey points in the forest of Lot 6 in November 2021. We then conducted phenology surveys for the fig trees located in the same area later in April 2022 and we plan to investigate these two types of resources further as factors affecting hornbill presence around the established study sites.
Produce protocols for passive acoustic monitoring application for future hornbill research in Sabah, Borneo.				During the pilot deployment of acoustic recorders, unexpected animal interference resulted in one of the microphones being damaged and we also had our recorders stolen and/or disturbed, presumably by monkeys, which resulted in the loss of some audio data. Although we were not able to establish optimum distance ranges for each recorder, as we intended, we have gained valuable experience that will be included in future protocols such as methods to protect vulnerable equipment from animals' interference.

				It is expected that all these protocols will be included in the production of a Hornbill State Action Plan of Sabah in the next two years.

2. Describe the three most important outcomes of your project.

a). Our preliminary results show that aural surveys by human observers is generally more effective in detecting hornbills as compared to a visual survey. We also found that acoustic surveys using ARUs can generally detect hornbills although there is some discrepancy in frequency of detections to that of an aural survey in oriental pied hornbill (*Anthracoceros albirostris*) and black hornbill (*Anthracoceros malayanus*). This discrepancy may be attributed to the inability of ARUs to pick up distant calls or calls that are imbedded in noise.

b). Although small, the forest patch in which this study was undertaken recorded the presence of six out of the eight hornbill species that can be found in Sabah. As expected, wreathed hornbill (*Rhyticeros undulatus*) and helmeted hornbill (*Rhinoplax vigil*) were not detected in this semi-inundated forest area as they are known to prefer forests with high elevations. This finding further supports the high conservation importance of this forest area and its habitat.

c). Our study also demonstrated that low-cost acoustic recorders could significantly improve efficiency in data collection, especially in geographically challenging study sites. Manual survey required our observers to track in the forest in the dark and as early as 05h30 on some days, as it would take an hour to reach some of the survey points. Consequently, semi-automated and automated recorders can offer flexibility and collect data of high temporal scale more efficiently.

Our preliminary results have shown that passive acoustic monitoring application in hornbill research should be adopted and explored further. Not only did our acoustic survey gather high frequency of detection throughout the study, but it also produced 100% specificity when tested against aural surveys for all six species. However, it is worth noting that acoustic survey produced 100% sensitivity when tested against aural survey on all but black hornbill (91.6%) and oriental pied hornbill (60.7%). This discrepancy, however, should not discount the potential benefits of this method when undertaking hornbill research in Sabah on a larger scale. On top of that, the study we conducted was instrumental in gaining knowledge on hornbills and bioacoustics and we are in position to further develop this method for future hornbill research in Sabah.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

We encountered several unforeseen difficulties during this project which led to the introduction of several changes in study design.

During the study, the Lower Kinabatangan Wildlife Sanctuary experienced a series of extreme weather events with an unusually long rainy season. This resulted in the

forests being submerged under a few metres of water, rendering our study sites inaccessible for a few months causing long-term disruption to the planned fieldwork schedule. For example, a pilot survey had to be cut short and was only conducted for 12 days before the study site was submerged underwater and tree climbing activity was almost impossible due to the unsuitable weather and the presence of crocodiles.

Due to the COVID-19 pandemic, the Malaysian Government had imposed a Full Movement Control Order (FMCO) which led to a nationwide lockdown. As DGFC is located in Lot 6 of the LKWS, and although research in that area could continue, our study was not able to be conducted in Lot 2 or in the neighbouring oil palm plantations. This was due to the access point of the forest in Lot 2 being through a village, and the required isolation of oil palm plantation workers from external visitors. This situation resulted in us only being able to conduct our study in Lot 6 of the LKWS.

In addition, unexpected animal interference initially caused damage to the ARUs and our microphone, and one of the recorders was stolen from its deployment site, presumably by monkeys. Following this initial set back, we subsequently securely housed all ARUs inside metal cages before deploying them. Following the introduction of this protective measure, there were three unsuccessful attempts of stealing our recorders.

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

Six local field assistants were employed by DGFC (four of them are indigenous Sungai community) to assist in this project. Although all of them have many years of experience working in wildlife conservation projects, they were not familiar with the use of passive acoustic monitoring. This project provided them with a new experience and the skills required in applying passive acoustic monitoring.

5. Are there any plans to continue this work?

Yes, definitely. Since low-cost acoustic recorders have proven to be able to yield good amount of data, I plan to expand the use of passive acoustic monitoring with computer vision application for future bird research. There are possibilities in automated identification and unsupervised acoustic classification with audio data. This will not only enable ecological monitoring at a larger scale, but also enhance citizen science participation in the conservation scene in Sabah.

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

Findings from this study will be included in the production of scientific articles and my master's thesis. Furthermore, I'll be presenting my finding in future symposiums or conference which I will be attending.

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

Firstly, this study has demonstrated that it would seem beneficial to utilise audio data collection, hence using the audio files gathered at its full potential. This includes annotating the sample calls of all detected hornbill species into a template for pattern matching. This will then allow the researcher to perform automated detection for all future recordings. Should we be able to continue conducting this research in the future, more hornbills, and potentially other bird species, can be studied and have their calls recorded, processed, and analysed for pattern matching templates. These templates can be shared widely especially among community-based NGOs in Kinabatangan which will improve participation of citizen science of indigenous community in the area. This will help the local community to conduct ecological research on their land while helping future researchers in Sabah to adapt this method.

Secondly, this study has further highlighted the need for further hornbill studies along the LKWS and across spatio-temporal scale to have a better understanding of their ecology. This may include activity pattern, intraspecies acoustic individuality, occupancy, and population density. Big audio data management is challenging; however, data processing would be made easier should we create the required templates for automated processing of the audio files.

8. 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?

The Rufford Foundation logo was included, and the foundation was mentioned for its contribution towards this project in every presentation including international field courses which I attended and asked to present. The foundation has also been mentioned in various posts made on the Facebook page of DGFC. The Rufford Foundation will also be acknowledged in my master thesis and the scientific article that will be shortly submitted for publication.

9. Provide a full list of all the members of your team and their role in the project.

Ashraft Syazwan Ahmady Yusni
Role – Team leader: in charge of designing the study and took part in data collection as observer.

Samsir Laimun
Role – Field assistant: helped with data collection as observer and led the pilot survey and hornbill natural resources survey.

Shah Fitri Rosli
Role – Field assistant: helped with data collection as observer and led the tree climbing team.

Roslee Rahman
Role – Field assistant: helped with data collection as observer, led in the process of trail making, and was part of the climbing team.

Jusmawati Latombong
Role – Field assistant: helped with data collection as observer.

Nazrul Moh Natsyir
Role – Field assistant: helped with data collection and trail making.

Dr. Liew Thor Seng
Role – MSc supervisor: advising in study design, data processing, and statistical analysis.

Dr. Ravinder Kaur
Role – MSc co-supervisor: advising in study design and statistical analysis.

Dr. Benoit Goossens
Role – MSc co-supervisor: advising in study design.

Dr. Marc Ancrenaz
Role – Advisor: advising in study design.

10. Any other comments?