Final Evaluation Report

We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF 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 – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please DO NOT fill in and submit this form until the project has been completed.

Complete the form in English. Note that the information may be edited before posting on our website.

Please email this report to jane@rufford.org.

Your Details	
Full Name	Harris Wei-Khang Heng
Project Title	Spatial Ecology from Above: Incorporating drone technology in determining population size and important habitats of dugongs in the Sibu-Tinggi Archipelago, Johor.
Application ID	31008-2
Date of this Report	25 February 2025

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
To determine the density and distribution of dugongs in their habitats				In 2024, we successfully conducted three field surveys as planned. Unlike our previous dugong feeding trail study (1st Rufford Small Grant), which focused only on Sibu and Tinggi Islands, we have expanded our survey coverage to include adjacent islands such as Mentiggi, Nanga Kecil, and Nanga Besar, where dugongs have also been recorded. A total of 114 drone transects were completed, yielding at least 25 hours of footage. The video review process is ongoing to determine dugong counts and detection rates. Ultimately, we will produce a spatially explicit dugong distribution map to serve as a reference for habitat management and long-term population trend analysis.
To identify dugong visual hotspots				We identified two hotspots in Zone B and Zone E of Pulau Sibu. Of these, Zone E was the feeding hotspot we determined back in 2016 and 2017. These are seagrass areas with relatively higher coverage during the inter-monsoon and pre-monsoon seasons but lower during the post-monsoon. The results indicated that dugongs tend to

				gather for feeding in Zone E. As for Zone B, there was no previous record of dugong sightings, which suggests that dugongs shift their use of areas across different seasons, moving towards more sheltered areas with more seagrass immediately during/after the monsoon. Preliminary analysis indicates that visual hotspot areas largely overlap with the dugong feeding hotspots identified in our previous research. Interestingly, we also found evidence of dugongs utilising new areas, suggesting possible shifts in habitat use. Further analysis, such as kernel density estimation, will be conducted to confirm these findings.
To determine the overlap areas between visual hotspots, core foraging grounds and human activities				The overlap between dugong visual hotspots and core foraging grounds will be assessed through analyses conducted under Objective 2. The analysis is currently ongoing as we are exploring automated detection methods using machine learning. However, this objective will be only partially achieved, as we were unable to systematically record human activities, such as boat traffic and fishing activities, during the surveys. Future studies should integrate human activity monitoring to better understand potential threats to dugongs in these areas.

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

a) We collected the most recent data on dugong spatial and temporal distribution. The last population survey was conducted by another NGO named MareCet in 2016 and it relied on helicopter-based observations. To fill in the information gaps, we applied drone technology as a safer, more cost-effective alternative for long-term monitoring, making dugong surveys more sustainable.

   We did encounter some technical problems with the drones; one of the older drones used as backup lost connection with the remote controller while flying, even though we had tested it on land. The drone activated its "Return to home" function when the battery was depleted, and fortunately, we recovered it before it landed on the water because our boat had drifted 1-2 m away from the launching point due to the current.

   Regarding evidence of dugongs being disturbed by the drone, we did not observe any such disturbance, as we maintained a consistent altitude during flight. We had a protocol for flying the drone. We kept the flight altitude at 50 m throughout our transect surveys. At this height, dugongs and other marine animals such as sea turtles showed no signs of stress or evacuation.

   Based on our experience, we found the use of drones to be a very appropriate and useful method to survey dugongs in Malaysia. It is much more efficient in terms of cost, technical skills required, and safety concerns compared to other methods, such as boat-based and manned aerial visual surveys. One major limitation is the short battery life; however, this can be addressed by using additional batteries and a power station on the boat. Another limitation is the restricted spatial coverage. Drone surveys are better managed and ideally should be conducted within the line of sight, so they cannot survey large areas (tens of km^2) within a short time. Currently, we believe rotary-wing drones are very suitable for dugong monitoring efforts in Malaysia, but we plan to explore fixed-wing drones in the future, as they have much longer flight times that allow us to survey protected and non-protected areas in one go.

b) We are developing the first-ever occupancy model that integrates drone surveys with environmental DNA (eDNA) analysis to assess dugong populations. This will provide a crucial baseline for long-term monitoring and conservation planning for the largest dugong population in Peninsular Malaysia. When this project was funded by Rufford in 2020, it was initially intended to focus exclusively on drone surveys. Due to the COVID pandemic, we finally resumed our work in late 2023. At that time, I obtained additional funding from the National Geographic Society to incorporate eDNA work into the project.

c) We launched "Dugong's Diary" social media accounts on Instagram and Facebook to engage the public and raise awareness about seagrass ecosystems and megafauna conservation. To date, we have garnered nearly 200 followers, and our posts have reached over 950 accounts on Instagram alone.

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

Our project combined drone surveys and eDNA sampling to detect dugongs, allowing us to gain a more comprehensive understanding of their habitat use. This required conducting drone transects and collecting water samples simultaneously at each survey location. However, the trade-off was that we could not systematically record human activity data within the limited time spent at each site. After our second field survey, we refined our workflow to improve efficiency, enabling better multitasking on the boat. We have also developed a schematic workflow protocol to guide field assistants in order to ensure consistency in future surveys.

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

We actively engaged with the local community by involving Mr Jhia Bin Ho, a resort operator and passionate dugong enthusiast, in our field surveys. Recognising his interest in conservation, we invited him to be one of the animal observers on the boat. His extensive experience at sea proved invaluable, as he spotted a significant number of sea turtles and dugongs during the surveys. After joining our field surveys, he purchased a drone himself for monitoring dugongs around his resort.

Additionally, we visited the local villagers of Sibu Island when we conducted our field surveys to strengthen relationships and raise awareness about dugongs and seagrass. Through informal interviews we gathered insights on their dugong sightings and observed changes in seagrass conditions over the years. To highlight the continued presence of dugongs in their waters, we shared drone footage of dugong herds—an experience that was particularly meaningful, as many villagers had never seen the animals in the wild due to their elusive nature. Unfortunately, due to time and financial constraints, we could not spend a longer period interacting with the villagers, as boat trips were required to reach the main villages and we needed most of the day to cover all sampling sites. We hope to organise social events in the future to gather the villagers together and enhance the sense of community conservation.

5. Are there any plans to continue this work?

Yes, absolutely. The primary goal of this project was to test a new, integrated approach for more effective long-term monitoring of dugongs and other marine megafauna. Moving forward, I plan to further optimise the eDNA methodology for dugong detection in the region. This includes expanding our survey coverage to additional islands, allowing for a broader assessment and more accurate population estimates.

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

We plan to publish our findings from the drone and eDNA surveys in peer-reviewed scientific journals. So far, I have presented our preliminary results at three key events: the *Tenth Sirenian Symposium* in Perth, Australia; the *9th International Workshop and Symposium for Mangrove Biodiversity Studies by eDNA Metabarcoding* in Iriomote, Japan; and the *International Symposium on Environmental DNA for Conservation and Biomonitoring in Southeast Asia (eDNAConBio) 2025* in Kuala Lumpur, Malaysia. Moving forward, we will continue to present our full results at upcoming scientific *conferences.*

I spoke with the Co-Chair of the IUCN SSC Sirenia Specialist Group, Prof. Helene Marsh, last July about my work. She was pleased to hear about the results and subsequently offered her assistance for the next steps of the project. Once published, we will share our papers with her to inform the IUCN Sirenia Group.

As part of our ongoing commitment to environmental education since the inception of our first project, our team has conducted a series of outreach seminars at various elementary and secondary schools within the Klang Valley, Malaysia, under the **Seagrass and Megafauna Conservation Initiative (SeaMeg).** This initiative has received the logistical support from the State Department of Education, Selangor, as well as the Malaysian Society of Marine Sciences (MSMS). To date, our outreach programs have been held at five different schools, reaching over 1,120 students.

Beyond academic platforms, we will also share our findings with a broader audience through our social media channels. We observed that the public engages more with live-action videos than animated content. In response, we plan to create more engaging and dynamic videos that effectively communicate our scientific findings in an accessible and interactive way.

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

A key next step is optimising the sensitivity of the eDNA assay for dugongs. This is the first-ever qPCR-based eDNA detection of dugongs using samples collected from open waters in this region—possibly even globally. While our current method has shown promising results, we believe the detection rate can be further improved by testing different sample collection and DNA extraction techniques.

With continuous financial support, we hope to expand this work by incorporating samples collected by our colleagues from Thailand, Singapore, and Indonesia. This will allow for a broader regional comparison and stronger validation of our approach.

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?

Yes, The Rufford Foundation logo was included in all oral presentations and posters related to this project. Additionally, we acknowledged The Rufford Foundation, along with our other funders, in various outreach materials, including: Project videos shared on our social media platforms (e.g., Instagram post); A media interview with the Centre for Biodiversity and Conservation Science, The University of Queensland (read here); Presentation slides used in school outreach programs (see Annex 2).

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

Technical Advisors: Dr Daniel Dunn (The University of Queensland, Australia), Dr Alison Kim Shan Wee (University of Nottingham Malaysia, Malaysia), Dr Jillian Lean Sim Ooi (Universiti Malaya, Malaysia), Mr Affendi Yang Amri (Malaysian Society of Marine Sciences, Malaysia)

Project Assistant: Zarifah Zulkaphli (Seagrass and Megafauna Conservation Initiative)

Social Media Manager: Teh Shing Yi (Seagrass and Megafauna Conservation Initiative)

Collaborators: Dr Hiroki Yamanaka (Ryukoku University, Japan), Dr Serina Rahman (National University of Singapore, Singapore)

Field Volunteers: Jaime Restrepo, Melissa Staines, Ho Jhia Bin, Lee Li Keat, Teh Shing Yi, Gautham Raj, Chiaki Yamato, Gan Sze Hoon, Vicki Chew

Outreach Speaker: Asilah Awang (Seagrass and Megafauna Conservation Initiative)

10. Any other comments?

We would like to express our heartfelt gratitude to The Rufford Foundation for continuously supporting our research, particularly for providing us with funding to purchase drones and their accessories to conduct aerial surveys of dugongs in this region. We are thankful to the Foundation for allowing us to postpone the project commencement date due to the COVID pandemic. I believe we did not disappoint the funding committee as we completed our project within the allotted time.

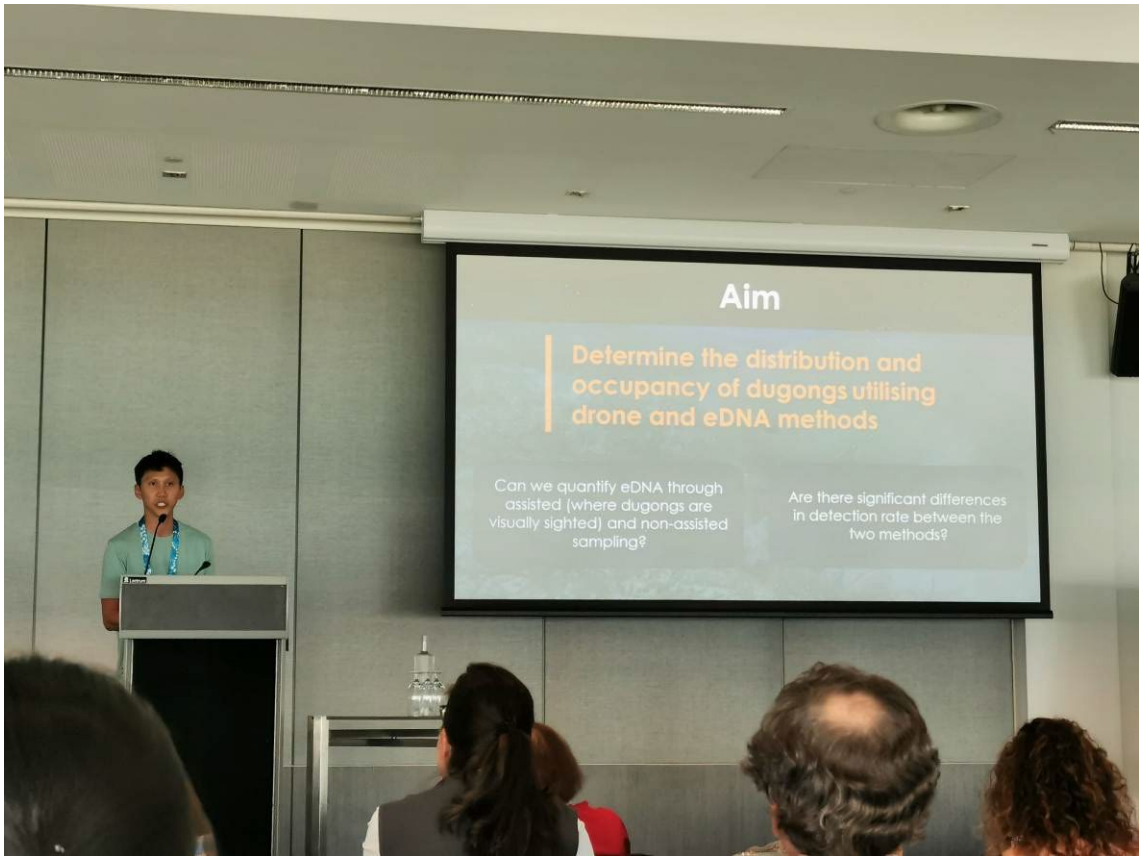
I personally want to thank the Rufford Foundation for giving me the opportunity to participate in the Learning Event in Samarinda, Indonesia, in July 2024. I would also like to thank the Team Sea Habitats at Universiti Malaya for assisting me in preparing the sampling equipment. Thank you, Jane Raymond, for being a wonderful liaison for us.

ANNEX – Financial Report

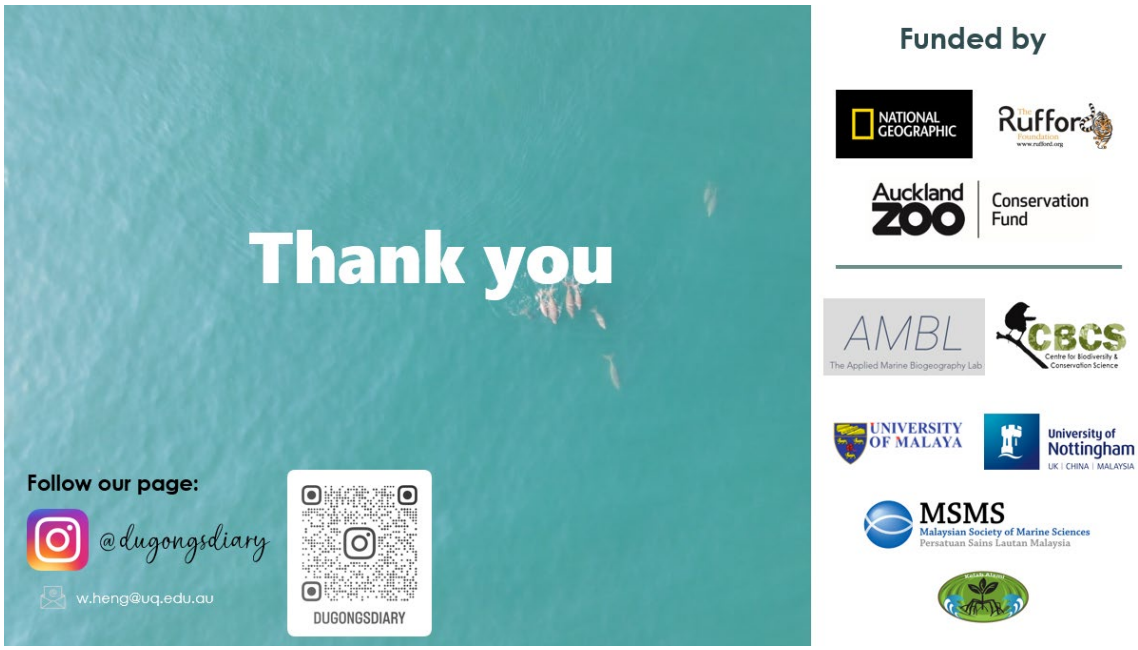
[Intentionally deleted]

ANNEX 2 – Photos

A dugong herd and a mother-calf pair were spotted through aerial surveys.



Harris presented the project at the Tenth Sirenian Symposium in Perth, Australia.



The Rufford Foundation was acknowledged in Harris' presentation.

SK Kantan Permai

SIRAP Abu Dzar Al-Ghifari

Outreach seminars were conducted to raise awareness of seagrass and dugongs.

The logo of The Rufford Foundation was included in the outreach seminar slide.