Final Evaluation Report

Your Details	
Full Name	Muhammad Danie Al Malik
Project Title	Habitat Suitability Assessments and Genetic Connectivity Study of Spinetail Devil Ray (*Mobula mobular*) in Indonesian Fisheries Management Area (FMA) of 573.
Application ID	34956-2
Date of this Report	Dec 2023

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
Online workshop and training				The workshop and training aim to increase knowledge and to standardise the methods and data analysis for mapping the distribution of spinetail devil ray. This online workshop and training were held from 22 -24 March 2022, and we collaborated with Yayasan Konservasi Indonesia. The total of 33 participants joined this event from local governments, NGOs, universities in Indonesia both students and lecturers.
Data collection for Spinetail devil ray (*Mobula mobular*)				In total 77 have been collected *Mobula* sp. tissue samples from three locations, consist of: Palabuhanratu - West Java (33) with 25 samples from *Mobula mobular*, and eight samples from *Mobula thrustoni*. Muncar – East Java (34) with 21 samples from *Mobula mobular* and 13 samples from *Mobula thrustoni* Tanjung Luar – West Nusa Tenggara (10) with two samples from *Mobula mobular,* seven samples from *Mobula thrustoni*, and one sample from *Mobula tarapacana*. In addition, we also collected coordinate information for spinetail devil ray sighting from fishers interview process on Palabuhanratu- West Java.
Laboratory analysis for genetic				We have done lab work for all the samples with mtDNA-ND5 locus
Data analysis for Genetic and Suitability habitat				We have done analysis the genetic data from mtDNA-ND5 locus and habitat suitability to explore the population condition of spinetail devil ray in Fisheries Management Area – 573 (FMA-573)
Publication				We have been published in four

				scientific journals and one article popular (all link lists from these publications were stored in the any other comments section).
Capacity building				We have been doing capacity building to three students from Diponegoro University (Meuthia Maharani – Master Student), Udayana University (Erika Denise – Undergraduate Student), and Mataram University (Rifqi Ansori – Undergraduate Student) that have been conducted their thesis research on elasmobranch topics, including mobulids.

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

1. Increasing the local stakeholders' capacity, including governments, NGOs, and universities, to standardise methods for mapping the habitat modelling, with spinetail devil ray a case study for this online course. We held an online course for three days and invited 33 participants. We train participants the fundamental of species distribution modelling, how to collect data of species distribution, build and validate model. This course using Maximum Entropy (MaxEnt). The overall teaching method that we gave has been increasing participants' knowledge (result grade: pre-test: 57.5 % and post-test: 72.5%). This type of course is expected to help the local stakeholders new insight how to map distribution of species that important for species conservation in the country.

2. Besides holding a workshop activity, another of our efforts was to help a university student conducted capacity building and network on mobulid conservation in Indonesia. This project has helped two undergraduate students from Mataram University (Rifqi Ansori) and Udayana University (Erica Denise) to research mobulid genetic conservation for their thesis, especially for field work, laboratory analysis, and data analysis. Rifqi researched the DNA barcoding of Mobulids species in Tanjung Luar, and Erika researched the population structure of bentfin devil ray (*Mobula thurstoni*) in the South Indonesia Sea. Then, this project also helped one master student from Diponegoro (Meuthia Maharani) research the genetic diversity of the bigeye thresher shark (*Alopias superciliosus*) in Palabuhanratu, West Java.

3. Our MaxEnt analysis indicated that the habitat preferences of the spinetail devil ray (*Mobula mobular*) are influenced by various productivity features. These include proximity to the escarpment area, near the outer limit of the continental slope, in the upwelling zone, near seamounts, with lower sea surface temperatures, and higher chlorophyll-a concentrations. The spatial predictions identified three potential fragmented habitats for the spinetail

devil ray in Fisheries Management Area 573 (FMA-573): South Java Sea, East Java coast to south Sumbawa, and Savu Sea. The dispersal network model unveiled a continuous path from the South Java Sea to the Savu Sea, with notable haplotype exchange potential in South Banyuwangi (east Java) and the South Flores Sea (Savu Sea), as evidenced by their shared higher haplotypes. Spatial connectivity, as demonstrated by this model, was corroborated by genetic results showing low genetic differentiation and a genetic relationship (haplotype network) among these habitats. However, genetic results confirmed the low genetic differentiation among the four locations (west Java, east Java, west Manggarai, and east Flores), indicating a single genetic population. The recognition that habitat fragmentation may contribute to low genetic differentiation and a genetic relationship emphasises the potential formation of subpopulations due to fragmented habitats. Despite this, it underscores the necessity for continued co-management efforts in FMA 573.

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

Collecting samples of spinetail devil ray (*Mobula mobular*) was an obstacle to this project. In one of our locations, Tanjung Luar, we only got two samples (target: 20 samples) from this species, and the other samples came from another species from mobulids. Then, because our sample was based on a landing site, predicting the appearance of mobula caught by fishermen was difficult.

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

We collaborated with local stakeholders such as universities and NGOs in this project. We involved two students from Mataram University and Udayana University in research activity and mentoring their ability to collect samples of mobulid species, laboratory processing for molecular purposes, and molecular data analysis. Their contribution benefited us in collecting sample processes as Mataram University collected samples from Tanjung Luar - Lombok, and Udayana University collected samples from west Java. Then, we also involved local NGOs that are concerned with *Mobula* species, such as Mobula Project Indonesia (MPI) and Elasmobranch Project Indonesia (EPI) which invited to the workshop and training activity as their capacity building and helped to improve their programs. The local NGOs also helped us to collect samples from east Java because one of their working sites is in that location. Their contribution also involved as co-authors any our publications in this project.

5. Are there any plans to continue this work?

It is important to add a location known as the potential landing site for mobulids such as Sumatera, Kalimantan, or different fisheries management areas. Adding location sampling is beneficial to know their genetic dispersal or habitat widely, which is suitable to focus on species-specific or mobile species like mobulids as

effective management conservation tools in Indonesia. Then, investigating other species of mobulids is also interesting to know whether each species of mobulids has the same population condition as this result from spinetail devil ray (*Mobula mobular*) or not. In addition, building working group research with stakeholders and enumerators from NGOs and government at each landing site in Indonesia is also essential. This working group research could help reduce the effort of sampling tissue for mobulids.

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

We presented the result of this project at the 5th Asia-Pacific Coral Reef Symposium, or APCRS 2023, from June 19 to 23 in Singapore. Then, we presented this result to the local government in Palabuhanratu, west Java. In addition, we have published one article in the Journal of Aquatic Science on our results from the Savu Sea and east Java (Lesser Sunda Seascapes) based on genetic results. In the next plan, we will try to submit both our species distribution model and genetic results from Fisheries Management Area 573 (FMA-573) to an article journal. Then, we also have agenda to present our team elasmobranch research results, including this result as our collaborating MoU with the Ministry of Maritime and Fisheries Affairs in February 2024.

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

This second scheme of this grant was a continuity step from the previous one that focused on the Savu Sea. This project has additional results on the population dynamic of spinetail devil ray (*Mobula mobular*) in the Fisheries Management Area 573 or FMA-573 consisting of from Savu Sea, east Java, and west Java. The next step is essential to answer how the spinetail devil ray population in Indonesia is potentially a key tool in knowing effective marine conservation efforts by adding sampling location. Furthermore, the other mobulids, such as oceanic manta ray (*Mobula birostris*) or reef manta ray (*Mobula alfredi*) are also essential to know dispersal and connectivity between conservation areas in Indonesia as their status in Indonesia is fully protected. In addition, any additional mobulid samples from both target locations from this project and other locations will be collected even after this project has been finished.

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?

We have used the Rufford Foundation logo in any events, banners or presentations during the programme held. We also mention this grant in every introduction of every event held during this project.

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

Muhammad Danie Al Malik
His role was to arrange all the activities in this project and conducting lab work & molecular analysis, assist two undergraduate students to conduct research activity on this project and leading in the scientific paper writing.

Mochamad Iqbal Herwata
His role was as a mentor in workshop and training on 22-24 March 2022. Then Iqbal was also responsible on spatial modelling of Spinetail devil ray in Fisheries Management Area -573 (FMA-573)

Ni Luh Astria Yusmalinda, Ni Putu Dian Pertiwi and Andrianus Sembiring
Their roles were to give advice and input for this project on capacity building program and molecular working & data analysis process. They have advanced knowledge about the molecular study used in this project.

10. Any other comments?

List Publications of this project

Article Journal :

- Population structure of endangered spinetail devil ray (*Mobula mobular*) in the Lesser Sunda Seascape, Indonesia, revealed using microsatellite and mitochondrial DNA | SpringerLink
- Population genetic structure of the bentfin devil ray (*Mobula thurstoni*) in the South Indonesia Sea with limited sample based on ND5 gene | Biodiversitas Journal of Biological Diversity (smujo.id)
- Short Communication: Genetic variation of oceanic manta ray (*Mobula birostris*) based on mtDNA data in the Savu Sea, Indonesia | Biodiversitas Journal of Biological Diversity (smujo.id)
- Genetic diversity of bigeye thresher shark (*Alopias superciliosus* Lowe, 1841) landed in Palabuhanratu Fishing Port, Sukabumi, West Java, Indonesia | Biodiversitas Journal of Biological Diversity (smujo.id)

Article Popular:

- Perburuan atau Pariwisata? Pilihan Pengelolaan Ikan Pari Manta di Laut Sawu - Mongabay.co.id : Mongabay.co.id

List of publication on social media:

- https://www.instagram.com/p/CZEfhuLFTNK/?igshid=YzZhZTZiNWI3Nw==
- https://www.instagram.com/p/CZEfhuLFTNK/?igshid=YzZhZTZiNWI3Nw==

Figure 1. Rifqi Anshori is an undergraduate student from Mataram University who was involved in this project to do his thesis.


Figure 2. Erika Denise is an undergraduate student from Udayana University who was involved in this project to do her thesis.

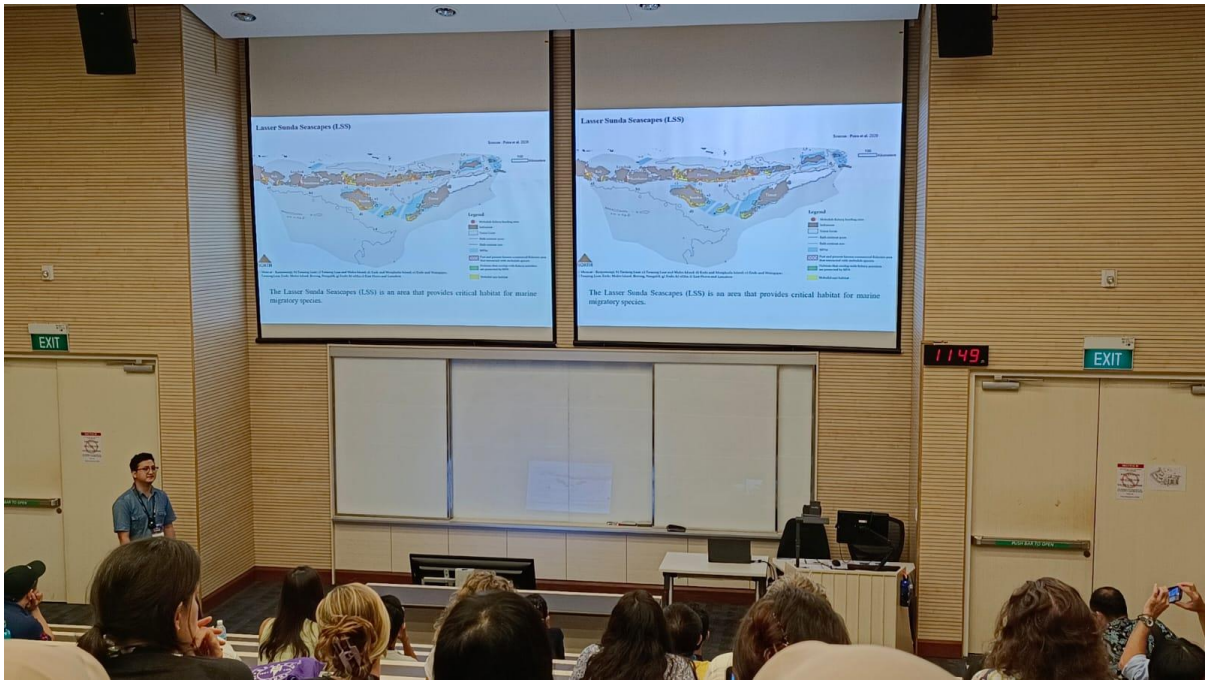

Figure 3. Danie did a presentation about this result project at the 5th Asia-Pacific Coral Reef Symposium, or APCRS 2023, Singapore.

Figure 4. We conducted an interview activity with fishers to coordinate the emergence of the Spinetail devil ray that landed in Palabuhanratu, West Java.