SCIENTIFIC COMMITTEE
NINETHEEENTH REGULAR SESSION

Koror, Palau
16 – 24 August 2023

Progress in addressing key research to inform Mobulid ray conservation in the Pacific Ocean

WCPFC-SC19-2023/EB-IP-09

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Executive Summary

The habitat preference of mobulids for productive tropical and subtropical habitats, where tropical tunas also aggregate, increases their vulnerability to purse seine fishing. However, the rate of interaction of the purse seine fishery targeting tropical tunas with the different mobulid ray species has not been quantified in detail, especially in the western and central Pacific Ocean. One of the difficulties found to understand and quantify this interaction with accuracy is the identification of mobulids at the species level by the crew and observers onboard purse seiners. To evaluate the impact on mobulids it is also necessary to assess mobulid post-release mortality when applying safe handling and release methods. This project aims to address key research to inform mobulid species conservation with the collaboration of 12 purse seiners from the U.S. fleet. Sorting grids were constructed to release the mobulids for each of the 12 purse seiners. Since June 2022, in total ten mobulas were released, most using Bycatch Reduction Devices (BRDs). Seven mobulid tissue samples were collected for species identification through genetic analysis and four of them were also tagged with a Survivorship satellite Pop-up tag to study their survivorship after being released. Lessons learned from applying current protocols and practices will allow developing improved best practices to be implemented by the tropical tuna U.S. purse seine fleet which could be scaled up to other purse seine fisheries and nations in the longer term.

1. Introduction

Manta and devil rays, together known as mobulids, are experiencing global population declines. While national and international fisheries and trade regulations have recently sought to prevent the targeted fishing of mobulids, many are caught as unintentional bycatch (Croll et al., 2016). In the U.S., the giant manta ray (*Mobula birostris*) has been listed as threatened under the federal Endangered Species Act, prompting the need for fisheries to reduce impacts on the species. The tropical tuna purse seine fishery contributes to Mobulid bycatch; however, the rate of interactions and mortalities associated with purse seine fishing is not well understood. Additionally, relatively minor operational modifications have been identified that have the potential to increase post-release survivorship in the fishery (Murua et al. 2019, 2021; Cronin et al. 2022).

This project, funded by NOAA Pacific Islands Regional Office and led by the International Seafood Sustainability Foundation (ISSF) in collaboration with UC Santa Cruz and AZTI, aims to fill key research gaps related to mobulid bycatch in tuna purse seiners, with the collaboration of the U.S tuna purse seine fleet. In particular, this project aims to 1) quantify the rate of interaction of the U.S. purse seine fishery with mobulids, 2) define and test safe handling and release best practices and evaluate mobulid ray post-release survival rate using survivorship tags, and 3) train fishers and observers to identify and sample mobulid rays and educate crew on best safe handling and release practices for mobulids. This document summarizes objectives, preliminary results, and recommendations from the first field trip for the project.

2. Objectives

The objectives of this project are the following:

1. To quantify the rate of interaction of the purse seine fishery with the various mobulid species, with emphasis on giant manta rays, and to collect **tissue samples** to identify unique stocks for management using genomic methods.
2. To **define and test safe-handling** and release best practices for mobulid rays, including gear modification or the use of BRDs and evaluate mobulid ray post-release **survival rate using survivorship satellite tags.**
3. To **train fishers and observers** to identify and sample mobulid rays and educate crew on best safe-handling and release practices for Mobulas.
4. To **disseminate the result** of this project to fishers, scientist, managers, and general public.

3. Purse seine - Mobulid spp interactions and population structure

To quantify the rate of interaction of the purse seine fishery with the various mobulid species, ten tissue sampling kits were distributed to each purse seine vessel participating in the project. Fishers were trained to take the tissue samples and started collecting data in June 2022. Apart from fishers, scientists onboard purse seine vessels, during 3-4 cruises will also collect mobulid´s tissue samples. Those samples will contribute to the identification of unique stocks and species interacting with the purse seine fleet. So far, 7 tissue samples and 2 mucus samples have been collected by the fleet (Table 1).

The target number of samples to be collected by the project was initially set at 100 but due to the low interaction, this number was adjusted to 20 samples. Once the 20 tissue samples are collected, DNA extraction will be conducted using Qiagen DNEasy Blood and Tissue kits. Restriction Site Associated (RAD) Sequencing, a fractional genome sequencing technique that allows for high genome coverage at a relatively inexpensive cost. After genetic library preparation, sequencing will be conducted at the QB3 Vincent J. Coates Genomics Sequencing Laboratory at UC Berkeley. Finally, we will use the UCSC Hummingbird supercomputer cluster to conduct species identification test for population structure and/or the presence of identifiable stocks and calculate effective population size if sample size allows it. This activity will be conducted throughout the duration of the project until December 2023.

Table 1. Tissue and mucus samples collected by the U.S. purse seine fleet as of July 2023

ID	Vessel	Species	Tissue sample number	Mucus sample number
PP_01	Pacific Princess	*M. mobular*	NA	297
PP_02	Pacific Princess	*M. mobular*	315 / PP_02	285
FR_02	Friesland	*M. mobular*	FR_02	NA
FR_03	Friesland	*M. thurstoni*	FR_03	NA
FR_01	Friesland	*M. tarapacana*	FR_01	NA
CF_01	Cape Finisterre	Unknown	CF_01	NA
CF_02	Cape Finisterre	*M. thurstoni*	CF_02	NA
CF_03	Cape Finisterre	*M. thurstoni*	CF_03	NA

4. Best safe-handling practices and post-release survival rate

To define and test safe-handling and release best practices for mobulid rays, including the development of BRDs and gear modification, 12 sorting grids designed by AZTI were constructed for each of the 12 participating PS vessels (Figure 1). For this activity, scientists from UCSC and AZTI will monitor sorting grid use on board purse seine vessels, during 3-4 trips. During those trips, scientists will (i) evaluate the efficacy and time of release mobulid using sorting grids or any other releasing method, i.e, stretchers, manual, etc. and (ii) evaluate post-release mortality using survivorship tags (sPAT tags). Fishers will also evaluate the efficacy of the sorting grid during the fishing operation by filling out a form specifically designed for the project.

Figure 1. Sorting grid lifted with the purse seiner's crane (left) and a mobulid being released using the sorting grid (right)

Up to date, one scientist of the University of California, Santa Cruz, conducted a six-week cruise from December 12, 2022, until January 24, 2023, on board the US purse seiner F/V Pacific Princess. The vessel departed from Mazatlan, Mexico, and fished in the Eastern Tropical Pacific Ocean. The second trip started on April 20, 2023, with another scientist on board the US purse seiner F/V Cape Finisterre. The vessel departed from Pago Pago, American Samoa.

The primary goals of the cruises are to:

- Collect tail tissue samples for species identification and population genetics.
- Collect mucous samples to aid in rapid species identification (led by iCatch).
- Collect size and species data for mobulid bycatch.
- Deploy sPAT (in the EPO and WPO) and miniPAT tags (WPO) to measure post-release mortality.
- Deploy and test a sorting grid bycatch release mitigation device designed by AZTI for rapid Mobulid release.
- Conduct fisher workshops to improve species identification and knowledge of proper handling and release methods.
- Train crew members to deploy tags and collect samples after scientist departs.

4.1 Results from the first cruise

Tagging and sampling: Two mobulids were captured during the cruise, from which one tissue sample was taken. The two individuals were tagged by the scientist. An additional four mobulids were measured and sampled by the crew in other vessels with sampling kits. Of the total six mobulids, four were *M. mobular,* one *M. tarapacana,* and one *M. thurstoni* (Table 1).

Piloting the manta sorting grid: Using designs provided by AZTI, vessel crews fabricated manta sorting grids for release of large individuals. In this trip the grid was not employed as individuals released were small sized and a stretcher was used instead.

Fisher education: In addition to tagging, during the first cruise the scientist led two interactive workshops with the fishing crew and the onboard observer to educate about mobulid species identification and proper handling and release methods. It was noted that the crew were not knowledgeable about how to differentiate mobulids prior to these trainings. Even after trainings, there remained some difficulty to correctly identifying the different species. However, there was a broad interest in improving handling practices and contributing to mobulid conservation.

4.2 Results from the second cruise

Tagging and sampling: Two mobulids were captured during the cruise, from which two tissue samples was taken. The two individuals were tagged by the scientist. Both individuals released were *M. thurstoni* (Table 1).

Piloting the manta sorting grid: The vessel had onboard a sorting grid specifically constructed to assist with the release of large individuals. In this trip the grid was not employed as individuals released were small sized.

Shark release data: In addition to mobulid data, information on the release of sharks using the hopper was collected including brail number, state of the animal at release and lactate blood samples. This data can be used to complement shark survival studies released with BRDs being conducted in other oceans such as the Eastern Pacific, Indian and Atlantic Oceans.

4.3 Total Mobulids released

Up to date, a total of 10 Mobulid rays have been released (Table 2). It is noteworthy that fishers need time to internalize the novel release protocol when a Mobulid arrives onboard. In the case of the first mobulid released by the Western Pacific purse seine vessel, fishers were focused on the release operation and forgot to take the tissue sample. This issue was already discussed with them, and it is expected that the protocol will be fully followed in future interactions with mobulids. The number of tissue samples collected has increased in the most recent months compared to those taken at the beginning of the project in which only one mobulid interaction

was reported. Data analysis will help understand if there is a spatial-temporal effect for the increase in the number of interactions and/or a potential increase in fishers' awareness on the presence of mobulids and commitment to execute the tasks described in the project.

One tag (#234930) was deployed by a fisher on a *M. mobular* on the Pacific Princess on 2/14/23. A stretcher was used for release. Though this tag experienced battery malfunction and reported incomplete movement data, this individual is considered a survival, evidenced by interval release (tag reached full deployment and then popped off at a depth of 24 m on 3/16/23) and behavior during last five days of deployment, which indicate diel vertical movement. Light detection sensor did not indicate predation.

A second tag (#234936) was deployed on a *M. thurstoni* by a scientist on the Cape Finisterre on 05/21/2023. The individual was released manually. Though this tag also experienced battery malfunction and did not report complete movement data, this individual is considered a mortality, evidenced by release from the animal at 1,400 meters (pin intact) at the tag's depth limit shortly after deployment on 5/21/23. Light detection sensor did not indicate predation.

5. Fishers training and education

Finally, one of the key objectives of the project is to educate and raise fishers' awareness on mobulid´s conservation, train them on mobulid species identification, tissue collection and tagging (Figure 2). During the first year of the project online meetings were held with fishers as well as on board the purse seiners during port visits (e.g., Pago Pago, Manta). Scientists will continue visiting the ports to increase training outreach to the different fishers of the U.S. fleet. Neverthess, from the outset fishers have been showing interest in improving handling practices and contributing to mobulid conservation which will likely make for an easier implementation of better bycatch release practices in the long term.

Figure 2. Project scientist training fishers on board purse seiners (left) fishers measuring and releasing a mobulid using a stretcher bed (right).

Table 2. Mobulids released up to July 2023. Four of them were tagged (IDs:1,2,9,10)

ID	Date	Vessel	Set start time	Brailer number	Duration min. (time from brailer to release)	Estimated total catch (tons)	Tag Number	PTT ID	Species	Size (cm)	Sex	Method of release
1	01/12/2023	Pacific Princess	6:39	3	1:00	15	21P2018	234931	*M. mobular*	122	NA	Stretcher
2	01/12/2023	Pacific Princess	5:19	3	1:30	15	21P2165	234935	*M. mobular*	101	NA	Stretcher
3	07/07/2022	Western Pacific	16:30	3	1:30	13.6	NA	NA	*M. mobular*	200		Grid
4	11/22/2022	Friesland	23:30	3	8:00	25	NA	NA	*M. mobular*	160	M	Grid
5	08/31/2022	Friesland	17:25	5	2:00	12	NA	NA	*M. thurstoni*	240	F	Grid
6	11/22/2022	Friesland	23:30	2	5:00	2	NA	NA	*M. tarapacana*	190	M	Grid
7	02/14/2023	Pacific Princess		4	3:00		21P2008		*M. mobular*	185	NA	Stretcher
8	03/12/2022	Cape Finisterre	16:19	2	3:00	20	NA	NA	Unknown	200	NA	Manual from hopper
9	05/21/2023	Cape Finisterre	16:36	5	4:00	80	21P2226	234936	*M. thurstoni*	165	M	Manual from deck
10	05/21/2023	Cape Finisterre	16:36	12	3:00	80	21P2257	234889	*M. thurstoni*	164	F	Manual from deck

6. Conclusion

Field data collection will continue over more cruises planned for 2023 and 2024 onboard U.S. purse seiners. These cruises will continue sample collection and tagging, and also seek captain and crew feedback on the performance of the sorting grid. Given the rarity of mobulids in fishing sets, it will be advantageous to continue distributing tags on more vessels to increase the likelihood of encountering mobulids. Additionally, focusing tagging effort on larger individuals will allow for usage and testing of the sorting grid. The development and distribution of an in-depth species identification guide would be very useful to help fishers with species identification, which remained challenging. Utilizing the guide currently in development by the Inter-American Tropical Tuna Commission (pers. Comm, M. Hutchinson) will be valuable for this project and in general to improve fisher and observer species identifications. Finally, the use of a sorting grid to release mobulas has proven to be efficient for fishers, without disturbing the fishing operation and making the maneuver faster, easier, and safer, both for fishers and mobulids. In addition, the construction of the sorting grid was feasible for all the vessels in the fleet due to easy access and low-cost materials employed.

Acknowledgements

We would like to acknowledge the American Tunaboat Association, and the following fishing companies for their participation in this project: Western Pacific Fisheries, Cape Fisheries, Pacific Princess Partnership, Tradition Mariner, DeSilva Encounter Corp, Friesland Fishing Company, JM Fisheries LLC, AACH Holdings Co., LLC, AACH Holding Co.No. 2, LLC, M & F Fishing Inc.

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