Performance Progress Report
April 2023

Project Title: *Addressing key research to inform Mobula rays conservation in the Pacific Ocean*

NOAA Award #: NA21NMF4520453
Reporting period: 10/01/2022 - 03/31/2023

Award period:

- *Initially requested award period*: One and a half years
  October 1, 2021 to March 31, 2023
- *Current award period*[*]*:*
  Two years: January 1,2021 to December 31, 2023

Project Location: Western and Central Pacific Ocean

Principle investigator:
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Science partners:

- *Dr. Yonat Swimmer & Dr. Keith Bigelow*
  NOAA NMFS Pacific Islands Fisheries Science Center
- *Dr. Nerea Lezama-Ochoa* Postdoctoral Research
  Scientist. Environmental Research Division, NOAA
  Southwest Fisheries Science Center
- *Dr. Melissa Cronin*
  Conservation Action Lab, U.C. Santa Cruz
- *Dr. Jefferson Murua*
  AZTI research institute, Spain

Industry partners:

- **American Tunaboat Association (ATA)**
  Mr. William Gibbons-Fly
- **10 Fishing companies, 12 vessels** (representing 80% of the US-flagged tropical tuna purse seine vessels): Tradition Mariner, Western Pacific Fisheries, Pacific Princess Partnership, DeSilva Encounter Corp, Freisland Fishing Company, JMFisheries LLC, AACH Holdings Co., LLC, AACH Holding Co.No. 2,LLC, M & F Fishing Inc, Cape Fisheries

[*] Note that a no-cost extension was requested and accepted during previous reporting period and that the project started in January 1, 2022 due to COVID pandemic instead of the initially planned October 1, 2021.

Background

Considering the decline of their populations, all Mobula ray species have been recently added to the Convention on International Trade in Endangered Species (CITES) Appendix II (CITES, 2016). The giant manta ray (*Manta birostris*) is listed as threatened under the U.S. Endangered Species Act. While fisheries regulations have sought to prevent the retention and landing of Mobula rays, the vast majority of Mobula captures are a result of unintentional bycatch (Croll et al., 2016). The level of bycatch depends greatly on the fishing method used, with the highest bycatch rates reported from gillnets and purse seiners (Alfaro-Cordova et al., 2017). The habitat preference of Mobulas to productive tropical and subtropical habitats where tropical tunas also aggregate, increase their vulnerability to purse seine fishing. However, the rate of interaction of purse seine fishery targeting tropical tunas with the different Mobula 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 is the identification of Mobulas at the species level by the crew and observers onboard purse seiners. In addition, it remains unclear whether the five species of Mobulas found in the Pacific Ocean are panmictic, genetically similar stocks, or whether there are multiple, genetically distinct sub-populations within each stock (Hosegood et al., 2020). There is an urgent requirement to resolve genetic population structure in the genus Mobula. This is crucial information for management for wide-ranging, data-poor marine species, as it determines whether conservation and management actions should occur at the local, small scale, or at the ocean basin scale. Understanding the population structure of Mobulas will allow for conservation efforts to identify and target unique and threatened populations for bycatch mitigation and conservation. In this regard, it should be noted that bycatch mitigation methods have not been explored in depth for Mobulas, and proposals for mitigating interactions between fishing gear and Mobulas through technological innovations or gear modifications are needed (Stewart et al., 2018) (Cronin et al., in prep). It is also necessary that those studies evaluate the impact of handling and release methods, assessing Mobula post-release mortality. Therefore, a comprehensive study is needed to understand purse seine - Mobula spp. interaction, to advance knowledge on Mobula population structure in order to identify unique stocks for management (Cronin et al., in prep) and finally to reduce the mortality derived from purse seine - Mobula interaction by identifying best practices for handling and release and evaluating post-release mortality. This proposal aims to address that key research with the collaboration of the U.S purse seine fleet. Due to the extensive spatial and temporal coverage of U.S. purse seine vessels that operate in the Pacific Ocean, those vessels represent ideal platforms to collect information on Mobula spp. interactions, test best handling practices learned for Mobulas and collect tissue samples to ascertain their population structure across the Pacific using genomic methods. Resulting protocols and practices will be systematically developed and implemented during the study period and they could be scaled to other fisheries and nations in the longer term.

1. Project Objectives

The specific objectives of the present project are:

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

2. Deviation from the schedule planned at the beginning of the project.

This section intends to clarify the new schedule of the project, after the no-cost extension was approved in the previous reporting period. In this way, the progress in the different tasks can be followed using the new chronogram (Table 1). The reasons for the new schedule are:

Delay in the start of the project:
The project was planned to start in October 1, 2021. Due to the COVID-19 pandemic, American Samoa was essentially closed, and it was decided to wait until early 2022 to start the project, in the hope that COVID-19 restrictions would be relaxed and travel to American Samoa was allowed. Unfortunately, American Samoa remained closed to non-essential travel and it was decided to start the project, conducting the first tasks online, in January 1, 2022, so as to not further delay the start of the project.

Delay in the planned tasks:
The workshops planned in Objectives 1 and 2, were held online instead of in-person, due to the COVID-19 pandemic. The lack of an in-person meeting slowed down progress as solving doubts and explaining things online took longer and the same issues needed to be revisited. The initial online interaction delayed the planned tasks. A no-cost extension was requested in December 2022 and accepted to allow more time to fulfill the different tasks. In addition, due to the low interaction rate of purse seine vessels with Mobula rays, the extension would allow to obtain more data in relation to those interactions, such as the mobula rays species involved, sampling of their tissue and testing the sorting grids for their release.

These delays did not cause any change in the approach of the project's tasks apart from the initial online workshops that were resume in-person once COVID-19 allowed it (see report for the previous reporting period). In addition, there was no impact on the expenditures.

The following table shows the new chronogram after the acceptance of the no-cost extension:

- Start of the project: January 1, 2022
- End of the project moved to December 31, 2023
- Milestones: M1.2; M2.2 and M3 moved later in the year in accordance with the new schedule
- Deliverables: D1.2; D1.3; D2.2 and D 2.3 were moved to later in the year in accordance with the new schedule.

Table 1. Chronogram of the project, showing current reporting period and the no-cost extension.

										Current reporting period						No-cost extension							
Phases and Associated tasks		jan-22	feb-22	mar-22	apr-22	may-22	jun-22	jul-22	aug-22	sept-22	oct-22	nov-22	dec-22	jan-23	feb-23	mar-23	apr-23	may-23	jun-23	jul-23	aug-23	sept-23	oct-23	nov-23	dec-23
Objective 1	**PS-Mobula interactions and population structure**																								
Task 1.1	Training fishers on Mobula spp ID & sampling			M1.1																					
Task 1.2	Data collection from PS																	D1.2				M1.2			
Task 1.3	Data analysis																							D 1.3	
Objective 2	**Design and test of sorting grids for Mobulas**																								
Task 2.1	Defining materials and designs for sorting grids			M2.1																					
Task 2.2	Trials at sea to test sorting grids																	D 2.2				M2.2			
Task 2.3	Data analysis and definition of best handling practices																							D 2.3	
Objective 3	**Reporting and outreach**																								
Task 3.1 Task 3.2 Task 3.3	Outreach to fishers Outreach to scientists and managers Outreach to managers																								M3 D3

M1.1= Protocols for data collection and training completed
M2.1= Design of sorting grids completed
M1.2 and M 2.2= Trials at sea completed
M3= Outreach completed/ End of the project

D1.2:Mid-term report on the number of interactions and number of tissues sampled
D1.3: Report on the results of PS interactions and genetic study
D2.2: Mid-term report on the number of trials and performace of sorting grids
D2.3: Results of the performance of sorting grids
D3: Final report

3. Progress through March 31, 2023

In this section, the specific objectives identified in the proposal (text in *italics*) as well as tasks of the project are listed, and then progress for each task are indicated:

Objective 1: Purse seine - Mobula spp interactions and population structure

Task 1.1. Training fishers on Mobula spp. identification and sampling (Months 1-22): *Scientists from UCSC and ISSF will design protocols for data collection and train U.S.fishers participating in this project to identify Mobula spp. and sample tissue for geneticstudies.*

Progress: During the previous reporting periods, from 10/01/2021 to 10/01/2022, materials to train fishers on Mobula spp. identification and sampling were created and distributed to the fleet online (see progress report April 2022 for more details).

Later when travel was resumed after the pandemic, an in-person workshop, for the following vessels was conducted in Manta (Ecuador): Friesland, Daniela, Cape Breton, Cape Cod and Capt. Vincent Gann (24-29 August 2022). During the workshop, the sorting grid designs were reviewed and the sampling and tagging protocols were taught.

During this reporting period, the first cruise was performed in the Pacific Princess purse seine vessel. During the cruise, in addition to tagging, the scientist led two interactive workshops with fishing crew and the onboard observer to educate them about Mobulid species identification and proper handling and release methods. It was noted that crew were not knowledgeable about how to differentiate Mobulids prior to these trainings. Even after training, there remained some difficulty to correctly identify the different species. However, there was broad interest in improving handling practices and contributing to Mobulid conservation (Figure 1; see Appendix I for more details on the cruise).

Figure 1. The scientist training the crew of the Pacific Princess in Mobula rays tissue sampling and tagging.

Although this task was initially scheduled to end in month 3, it was decided to maintain the training workshops throughout the project, due to the difficulty of gathering all fishers, who are at sea for long time periods, in one room for a common training. Thus, this task has not ended yet, and training will continue until the end of the project, in month 22.

During the next reporting period starting in April 1, 2023 scientists in this project will travel to Pago-Pago to conduct the training to the U.S. fishers in port and also to NOAA staff in Pago-Pago (early May 2023) so that they can continue training fishers.

Task 1.2. Data collection from purse seiners (Months 3-18): *two types of data collection will be conducted (i) fishers as data collectors and (ii) scientists onboard purse seiners:*

(i) *During one year, fishers onboard the participating vessels will record interactions and identify Mobula spp. as well as collect tissue samples, in order to cover different spatial and temporal strata.*

Progress: Ongoing task. Ten tissue sampling kits were distributed to each vessel participating in the project. Fishers were instructed to store the samples in the fridge and send them to the University of California in Santa Cruz (UCSC) as soon as they arrive in port. If only one sample is taken, only that sample will be sent. This activity will be conducted throughout the duration of the project. During this reporting period, 5 tissue samples and 2 mucus samples were taken (Table 2).

Figure 2. Crew of the U.S. purse seine fleet sampling Mobulas

Table 2. Tissue and mucus samples taken by U.S. purse seine fleet by March 2023

ID	Vessel	Date	Lat	Lon	Species	Tissue sample	Mucus sample
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*						

*sample in transit; sheet not yet in hand

(ii) *UCSC and AZTI scientists will carry out 3-4 trips onboard purse seine vessels to record Mobula spp. interactions, test handling best practices onboard (in conjunction with task 2 – see below) and collect as many samples from bycaught Mobulas as possible, with a target of 100 samples.*

Progress: one scientist, Melissa Cronin 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 mainly between 0 - and 10 -degrees latitude N and S. The scientist departed the vessel in Papeete, Tahiti, when it came to port to swap observers. The vessel continued its fishing trip after the scientist departed (see Appendix I. for details of the first cruise).

The main objectives for this cruise were to make progress toward Objectives1-2 of the project including:

- Collect tail tissue samples for population genetics
- Collect mucous samples to aid in rapid species identification
- Collect size and species data for Mobulid bycatch
- Deploy and test the sorting grid designed by AZTI for rapid Mobulid release2
- Deploy sPAT and miniPAT tags to measure post-release mortality
- 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

Two Mobulids were captured in the same set on Jan 12 2023 at 8:30 am at lat/long 0419N, 14424W. Both individuals were spinetail devil ray (*M. mobular*) and both were very small in size (101cm and 122cm disc width). SPAT tags were deployed on both individuals, and crew assisted the scientist to collect two mucous samples and one tail sample for DNA extraction, which will be used to conduct genetic population structure analyses.

The second cruise is already arranged and will start in April, 20 2023 from Pago Pago (American Samoa) in the F/V Cape Finisterre, from Cape Fisheries fishing company. The results of this cruise will be shown in the next reporting period.

Task 1.3 Data analysis *(Months 14-22):*
Information from the cruises on Mobula-PS vessel interactions will be processed and analyzed. DNA extraction will be conducted using Qiagen DNEasy Blood and Tissue kits. We will use Restricted-Site Associated (RAD) Sequencing, a fractional genome sequencing technique that allows for high genome coverage at a relatively inexpensive

[2] During the previous reporting period, using designs provided by AZTI and ISSF, the crew of the Pacific Princess fabricated a manta grid for use to release large individuals. Upon request of the scientist, small modifications were made to the grid on board; in particular changing the release hinges so that the grid could be triggered to drop the manta sideways off the port side of the vessel. Crew practiced maneuvering the grid from the hopper to the side of the vessel to ensure it was in working condition prior to departure.

cost. After library preparation sequencing will be conducted at the QB3 Vincent J. Coates Genomics Sequencing Laboratory at UC Berkeley. 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.

Progress: Not started yet. Data are being collected but genetic analysis will not be performed until all the samples are collected at the end of the scientific cruises, so that they can be analyzed together.

Objective 2: Design and testing of a sorting grid for Mobulas and evaluate post-release mortality

Task 2.1. Defining materials and designs for sorting grids (Months 1-3):
At an early stage, ISSF, AZTI, and US fleet industry (10 companies representing 80% of the US-flagged purse-seine vessels) will organize a series of meetings to develop and refine bycatch sorting grids to be tested and the protocols to test them at sea. These workshops will be held together with the workshops in Task 1.1.

Progress: Completed (see progress report submitted April 2022 for more details).

Task 2.2. Trials at sea to test sorting grids (Months 2-22): *The sorting grids will be constructed for each of the 12 participating PS vessels. Scientists from UCSC and AZTI will be on board PS vessels during 3-4 trips, depending on number of Mobulas encountered, (targeting spatial and temporal strata with the highestprobability of the presence of Mobulas). During trips, scientists will (i) evaluate the efficacy and time of release Mobula using sorting grids and (ii) evaluate post-release mortality using sPAT tags. Fishers will also evaluate the efficacy of the sorting grid astuna-Mobula sorting tools during the fishing operation by filling out a form designed inTask 2.1. These trials will take place together with trials in Task 1.2.*

Progress:

- All 12 vessels have a sorting grid already constructed and have tested it using weights simulating the release of a Mobulid.

- During this reporting period, 6 mobula rays were released (Table 3, IDs from 2 to 8). A total of 7 Mobulas have been released during the project by March 31, 2023.

- It is noteworthy that fishers need time to internalize the protocol when a Mobula arrives onboard. In the case of the first Mobula 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 the next interactions with Mobulas. While in the previous period only one Mobula interaction was reported, in the second period, the number increased to 6. Data analysis will help understanding 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 Mobulas and commitment to the project.

Table 3. Mobulas released by March 31, 2023. Three of them were tagged (IDs:2,3,6)

ID	Date	Vessel	Lat	Lon	Time start of set	Brailer number	Duration min. (from brailer to release)	Estimated total catch (tons)	Total No. Brails	Tag Number	Species	Size (cm)	Sex	Method of release
1		Western Pacific			16:30	3	1:05				*M. mobular*	2	NA	Grid
2		Pacific Princess			6:39	3	1:00	15	7	21P2018	*M. mobular*	122	NA	stretcher
3		Pacific Princess			5:19	3	1:30	15	7	21P2165	*M. mobular*	101,6	NA	stretcher
4		Friesland			23:30	3	8:00	25		NA	*M. mobular*	160	M	Grid
5		Friesland			17:25	5	2:00	12		NA	*M. thurstoni*	240	F	Grid
6		Friesland			23:30	2	5:00	2		NA	*M. tarapacana*	190	M	Grid
7		Pacific Princess				4	3:00			21P2008	*M. mobular*	185	NA	stretcher
8		Cape Finisterre*												

*sample in transit; information not yet in hand

- For large mobulas (>185cm) fishers used the sorting grid while for the smaller ones they used stretchers. Data analysis will be conducted once all data is gathered including metadata on set (operation and catch) characteristics, water temperature, mobula's sizes etc.

Figure 3. Sorting grid and stretcher used to release Mobulas in the U.S. fleet

- From the ten sPATs and two miniPATs the project bought from Wildlife Computers, two sPATs were used to tags mobulas during the first cruise. Two

Mobulids were captured in the same set on Jan 12, 2023 at 8:30 am at lat/long 0419N, 14424W. Both individuals were spinetail devil ray (*M. mobular)* and both were very small in size (101cm and 122 cm disc width). SPAT tags were deployed on both individuals, and crew assisted the scientist to collect two mucous samples and one tail sample for DNA extraction, which will be used to conduct species identification, test for population structure, and/or presence of identifiable stocks and calculate effective population size. The sequencing will be conducted at the QB3 Vincent J.Coates Genomics Sequencing Laboratory at UC Berkeley using the Hummingbird supercomputer cluster.

- Both individuals were released with a stretcher and could not be visually sighted in the water after release. The set in which the individuals were captured was 15 tonnes of mainly bigeye tuna.

- Due to the low incidence of Mobula bycatch in purse seining, it was decided that survival tags will be distributed also in the purse seine vessels and train fishers and observers to tag. This protocol has been followed in the EPO with Ecuadorian fleets. Thus, we coordinated with scientists working with Mobula release in the EPO to program the survival tags in the same way they did, so that our results on Mobulid´s survivorship are comparable with those from the EPO. Scientists will also go onboard to tag with the SPAT and miniPATs tags but having fishers tagging would allow the project to increase the chances of tagging a Mobula.

- The crew from the Pacific Princess successfully tagged a Mobula with a SPAT. (Table 3, ID 7).

Task 2.3. Data analysis and definition of best handling practices (Months 9-12): *Data analysis will be conducted on (i) the efficacy of the sorting grid as a sorting and release tool, and (ii) post-release survival of Mobulas using the sorting grid. From those analyses and with the input of captains and crew, best handling practices will be defined, including modifications to the sorting grid design, if needed.*

Progress: Not started yet.

Objective 3: Reporting, Outreach and Education

The partners will provide a final report including i) results of the quantification of purse seine fleet Mobula spp interactions, ii) results of the genetic study on the advances on population structure and/or the presence of identifiable stocks, iii) results of post release mortality using the sorting grid, and iv) best practices to handle Mobula spp. onboard purse seiners, and v) recommendations and future steps towards the long-term systematic data collection on Mobula spp interactions and tissue sampling with purse seine fleets. These results will be disseminated throughout the project with following tasks:

Task 3.1. *Continue training purse seine fishers* (Months 4-20)**:** *Training of U.S skippers and crew operating in the Pacific Region will be completed taking into account the outputs of this project. Continued training as new information arises on the best-practices to handle and release Mobulas will take place throughout the project. Also, tuna purse-seine fishers from other nations in the Pacific region will be trained through*

the ISSF skippers' workshop program organized since 2009 (Moreno, 2018a; b; Murua et al., 2019) (in-kind contribution from ISSF).

Progress: A workshop has been organized for April 20 and 21 2023 with fishers from different countries (U.S. ATA fleet, France, Spain, Micronesia) on Mobulas, sharks and other vulnerable species´ release practices from purse seiners. The result of this workshop will be presented during the next reporting period.

Task 3.2 *Dissemination to scientific community* (Months 4-20): progress throughout the project and results on best practices will be disseminated in (i) IATTC and WCPFC, through the participation on scientific working groups and Scientific Committee and Commission meetings, (ii) to the scientific community, through a peer-reviewed publication and presentations in scientific symposia. A specific online workshop will be organized with scientists from NOAA participating in WCPFC, IATTC and ICCAT to discuss the results and recommendation of this project. An open-access peer-reviewed publication will be prepared based on results of the project.

Progress:

- The following document was prepared for the scientists attending the Bycatch working group of the Inter-American Tropical Tuna Commission (IATTC) (May 2023) (see Appendix VI for more details):

  Cronin, M., Moreno, G., Murua, J., Murua, H., Ferarios, JM., Lezama, N., Swimmer, Y., Restrepo, V (2023). Progress in addressing key research to inform Mobula rays conservation in the Pacific Ocean. Inter-American Tropical Tuna Commission, 12th meeting of the Working group on Bycatch.

- The following presentation was done in Duke University for scientists in the Program in Ecology, February, 28 2023 (see Appendix VII for more details):

  Cronin, M. Untangling Fisheries Bycatch for the conservation of Sharks and Rays Duke University Program in Ecology Seminar. February 28, 2023.

Task 3.3 Outreach to management bodies *(*Months 4-20): *managers from NOAA/NMFS and from other countries that are active in tRFMOs will be informed about the results of this project and, more specifically, on the potential new management measures that could be adopted, in relation to the degree of effectiveness of handling practices and tools to release Mobulas. Outreach to managers of different member countries will be also conducted through meetings in tRFMOs (ICCAT, IOTC, WCPFC and IATTC), by presentations during scientific committee meetings as well as through side events organized by ISSF on the margins of tRFMO's Commission meetings (see as example: https://iss-foundation.org/issf-pew-charitable-trusts-and-birdlife-international-host-joint-side-event-at-wcpfc-annual-meeting/.).*

Progress: The following document and presentation were prepared for scientists and managers attending the Bycatch working group of the Inter-American Tropical Tuna Commission (IATTC) (May 2023) (see Appendix VI for more details):

Cronin, M., Moreno, G., Murua, J., Murua, H., Ferarios, JM., Lezama, N., Swimmer, Y., Restrepo, V (2023). Progress in addressing key research to inform Mobula rays

conservation in the Pacific Ocean. Inter-American Tropical Tuna Commission, 12th meeting of the Working group on Bycatch.

Task 3.4 Outreach to the general public (Months 4-20)
ISSF keeps the public informed of its work through a variety of communications vehicles. Thousands of users regularly visit the ISSF website — https://iss-foundation.org — which is updated with the latest tuna research findings and data, including data visualization tools. ISSF also distributes a weekly newsletter to more than 8,000 subscribers from across a diverse list of fisheries sustainability stakeholders — retailers, NGOs, charitable foundations, tuna processors, scientists, and more. And the ISSF communications team shares news and updates through popular social media platforms (Twitter, Facebook, Instagram, YouTube, and LinkedIn), while maintaininga robust media outreach effort to ultimately inform the public of critical developments.

Progress:

The following articles were published in ISSF website and Mongabay news

https://www.iss-foundation.org/blog/2023/01/12/update-from-the-field-fishing-for-answers-for-endangered-mobulid-rays-2/

https://www.iss-foundation.org/blog/2023/01/11/update-from-the-field-fishing-for-answers-for-endangered-mobulid-rays/

https://news.mongabay.com/2023/03/manta-grid-provides-a-ray-of-hope-against-industrial-bycatch-threat/

The content in social media regarding this project, Twitter, Instagram, Linkedin, and Facebook are detailed in Appendix VIII.

5. Results or Outcomes, Products Completed:

- First cruise onboard the Pacific Princess completed.
- Sorting grid tests completed.
- Tags (Survival and miniPATs) re-programmed and ready to be used in the second cruise.
- Second cruise with a scientist onboard arranged for April 19, 2023 from Pago Pago, in the Cape Finisterre purse seine vessel, belonging to Cape Fisheries fishing company.
- A total of seven tissue samples have been collected for the project, representing *M. mobular* (n=4), *M. thurstoni* (n=1), and *M. tarapacanca* (n=1) (Table 4).
- A total of eight mobula released from purse seiners using the sorting grid and stretcher (Table 4).

Table 4. Summary of the total tissue samples and Mobula releases.

Vessel Name	Number of captures	Number of tags deployed	Number of tissue Samples	Number releases using grid
F/V Pacific Princess	3	3	3	stretcher
F/V Friesland	3	0	3	3
F/V Cape Finisterre	1	0	1	Unknown (data in transit)
F/V Western Pacific	1	0	0	1
Total	**8**	**3**	**7**	**4**

6. Anticipated problems or delays and actions or plans to resolve them

Malfunction of pop-up tags

Two tags deployed by the scientist and one tag deployed by a crew member from Wildlife computers, failed to report data. After consultation with tag provider, it was discovered that these tags were not properly updated by the manufacturer and had experienced battery passivation making them defunct. Remaining tags were sent back to the manufacturer to check whether they were similarly compromised; these tags were either updated or replaced depending on passivation level and should be functional now for use in the future. Unfortunately, it will not be possible to recover any data from the three mobulas tagged so far.

Low interaction of purse seine and Mobula species

The number of tags in our hands (currently 7 SPATs and 2 miniPATs) and the low interaction of Mobulas with the purse seine fishery would require an extension of the project to use them. In addition, the number of tissue samples taken by March 2023 is a total of eight and the initial target was 100 samples. We have realized that reaching 100 is going to be difficult but ideally, we would need at least 20. Thus, it may be pertinent to ask for 3 month no-cost extension, to fulfill the objective of 20. This situation may change if fleets sample more Mobulas in the coming months and if we tag more Mobulas. The no-cost extension request will be decided depending on the progress in the next months. As stated before, we have realized that the number of tissue samples collected have increased and, thus, if the trend in the coming months remain the same, we may no need another no-cost project extension.

7. Appendices (optional):

The following appendices are attached:

APPENDIX I. Summary of the first cruise onboard the Pacific Princess
APPENDIX II. Tagging protocol
APPENDIX III. Mobulid tissue sampling protocol
APPENDIX IV. Mucus Sampling protocol
APPENDIX V. Data collection sheet
APPENDIX VI. Document for IATTC Bycatch and Ecosystem working group
APPENDIX VII. Presentation in Duke University
APPENDIX VIII. Social Media Content