FINAL REPORT

SOCIO-SCIENTIFIC RESEARCH ON SAWFISH POPULATION IN INDONESIA

CLP ID: 03143220

Socio-Scientific Research on Sawfish Population in Indonesia

Final Report

Prepared for : Conservation Leadership Programme

Project ID : 03143220

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SECTION 1

Summary

Even though international concern for sawfish conservation is rising, these creatures get less attention than they deserve in Indonesia. There is so little scientific information about where they can be found, how extensive their population is, what kind of threats they face and how to sustain their existence. Without this information, the government of Indonesia showed no interest in conserving them in nature, even though there is a national regulation stating that sawfishes are a fully protected species in Indonesia.

This project shows that despite sawfish having been extinct locally in many places in Indonesia, there is still a remnant population in the Arafura Sea. These groups of fish are facing enormous threats from the rising fishing activities from commercial fleets and having them as bycatch products. This project demonstrated that these fishers are the leading actor who can save the sawfish from extinction by releasing them alive every time they unintentionally catch the species, even though they have to damage their nets. Nevertheless, they are looking for compensation from the government for doing so, which will not be a sustainable approach in the future. Our research also shows that sawfish is not only just any biodiversity that needs to be sustained, but it is also Indonesia's cultural asset that directly connected with the cultural value of Papua tribes. Our research was presented at the 3rd Indonesia Symposium for Sharks and Rays and successfully got national attraction towards sawfish in Indonesia.

This project also promoted local involvement in exploring and protecting the sawfish. We managed to train students from a local university during the project lifetime about sawfish conservation and encourage the lecturers to start getting funding for sawfish research on their own. We also managed to create a fishing community group that commits to being the local champion of sawfish conservation. They are now taking the lead in educating more fishing community groups to release the sawfish and do so themselves whenever they go fishing.

Introduction

Sawfish are arguably the world's most imperilled marine fish. All five species are classified as highly threatened with extinction: three are Critically Endangered (smalltooth sawfish *Pristis pectinata*, largetooth sawfish *Pristis pristis*, and green sawfish *Pristis zijsron*); two are Endangered (narrow sawfish *Anoxypristis cuspidata*, and dwarf sawfish *Pristis clavata*). Due to their low intrinsic rates of population increase and high catchability in fisheries, sawfish have encountered a remarkable decrease in their original geographic distribution (Harrison and Dulvy 2014). They are now absent from 20 countries after historically being distributed in the coastal water of 90 countries and territories.

Indonesia was known as a country with four species of sawfish after it is believed that one species (dwarf sawfish *Pristis clavata*) is possibly extinct in Malaysia, Indonesia, and Papua New Guinea (Dulvy *et al*. 2014). Generally, little is known about sawfish in Indonesia. The shortage of science-based information about sawfish in Indonesia remains a challenge as very little research has been undertaken. Enforcement of sawfish protection by the government is low as the black market for sawfish rostra in Indonesia still exists. The effectiveness of the outreach to fishers about these protected animals remains unknown, so we are not sure whether the fishers are ready or not to become the frontier in protecting sawfish from extinction due to continuous bycatch.

However, the Ministry of Marine Affairs and Fisheries Indonesia, through their unit LPSPL Sorong published critical information about the record of incidental capture of Sawfish around Merauke, Papua. They stated that the incidental capture of sawfish spread throughout the shallow coastal or inland water

to the open water of the Arafura Sea. It was not mentioned who the actors of this destructive catch were, whether the commercial fishers or artisanal ones. It is not implied either about the frequency of the bycatch, and the number of sawfish captured every time. While this little information seems likely to have no use, it is enough for us to think that might be a remnant sawfish population in the eastern part of Indonesia.

Revealing this possibility, assessing the situation, identifying the obstacles and opportunities must be done to prevent more local extinction of sawfish in Indonesia. Scientific research is urgently needed to track their presence, identify their possible habitat and identify their current status. Conservation measures are also needed to identify actors behind the sawfish's threat and encourage them to change and become the frontier for sawfish protection in Merauke.

Project Members

Sihar Aditia Benrid Silalahi

Sihar has a strong interest in conservation, specifically in Elasmobranch conservation for sharks and rays. Previously, he had an internship with MantaWatch, working for Manta Rays conservation regarding tourism in Komodo National Park. As the leader of this project, he is responsible for managing overall project activities and maintaining relationships with partners and other collaborators.

Dicky Dwi Rizky Nugroho

Dicky got his bachelor's degree in Marine Science from the University of Brawijaya, Indonesia has and developed an interest in conservation based on geographic information systems. He is responsible for the results of the E-DNA mapping and LEK mapping. He is also a visual designer for our social media content.

Iis Susiani

Susiani earned her bachelor's degree at IPB University, focusing on physical oceanography. She has experience with several organizations on campus to learn about teamwork and field ability. She was involved in the project to help coordinate the activity of water quality research in the sawfish habitat. She also helps to support community outreach through workshops, youth community training, and social media campaigns. Currently, she is expanding her professional career in the leading start-up logistics service in the Southeast Asia region.

Yunita Wakhida

Yunita was a fishery socio-economic undergraduate student and joined Sawfish Indonesia as the Socio-Economic Researcher. She has conducted numerous interviews with fishermen to assess the presence of sawfish and temporal changes in the frequency of sawfish encounters in Merauke, Papua. She also performed social mapping to obtain information on the last year's socio-economic status and fisher distribution in local coastal communities. In 2022, she will conduct further research on sawfish in the Asmat district, Papua, by conducting a distribution survey and assessing of cultural significance.

SECTION 2

Aim and Objectives

Objective 1: The local fishing community members' understanding of sawfish conservation will increase within 3 months of the project started	
Activities	**Outputs**
Perform participatory observation and build an open relation with the fishing community members	Establish one group of sawfish conservation ranger at Waninggap Nanggo village
Informal meetings with stakeholders	Secure information and access from meetings with individual collectors of sawfish's rostrum (more than 5 times), local government LPSPL Sorong and PSDKP Tual (more than 5 times), and fishing company representatives (2 times)
Give a structured sawfish conservation briefing to individual fishers	Five reports from fishers releasing the sawfish, complete with photo or video as proof
Conduct sawfish conservation socialization class to the fishing community	Ten fishers are participated and seven improved their knowledge after the workshop
Conduct a sawfish release technical workshop for a group of fishers	Two fishers well demonstrated how to release entangled sawfish properly
Objective 2: At least 3 of the fishing community members who participated in the workshop will commit to release the caught sawfish as bycatch within 4 months of the project started	
Activities	**Outputs**
Identify a potential fishing group to be a local sawfish conservation group	15 fishing communities across the coast of Merauke were identified, and two were formed to be one sawfish conservation ranger
Conduct Focus Group Discussion (FGD) with the future sawfish conservation ranger	Analysis of where the ranger need assistance (knowledge, skills, tools, etc.)
Agreement signing to form sawfish conservation ranger consists of 5 committed fishers	A group of sawfish signed a commitment letter to be a conservation ranger group
Objective 3: Biological and ecological knowledge of sawfish in Merauke is produced	
Activities	**Outputs**
Collect environmental DNA water samples from Merauke rivers and strait	40 water samples were collected and analysed by Oceanogen, one of the partners of the team
Assess the rivers water quality in Merauke rivers and strait	40 water samples were collected and analysed at IPB University laboratory
Distribute questionnaire to understand the fisher's competency about sawfish conservation	Data and information, soon to be published
Track the history of sawfish rostrum collection in Museum and individual collectors	Data and information soon to be published
Conduct interview to collect fisher's ecological knowledge about sawfish	Data and information, soon to be published
Analyse environmental DNA water samples from 3 rivers and 1 strait in Merauke	Data and information which are not available to be published
Participatory mapping to study sawfish distribution in Merauke waters	Data and information which is available to be published

Assists undergraduate students in Musamus University to conduct final assignment research about sawfish	Undergraduate thesis for two students enrolling at Musamus University

Changes to Original Project Plan

In the beginning, we planned to join fishing vessels operating in the Arafura Sea as observers. We already contacted some fishers and the fishing company to secure access for us to join their vessel, but they refused. There are some reasons why we were not allowed to join those vessels. One of them was that the vessels generally would stay onboard at sea for a minimum four months before returning to land with unpredictable extreme weather that may be appear anytime. The other reason was the thought that our team may burden the fishers who already have a full of workload on the vessel.

We then adapted the plan by reaching out to the fishers who just got back from the sea and conducting a high-quality interview with them. We also had several participatory mapping events with the fishers throughout the coastal of Merauke to identify the potential habitat of sawfish from where the fishers usually catch them. This way, we secure the results we plan to obtain in the beginning.

Methodology

Objective 1: The local fishing community members' understanding of sawfish conservation will increase within three months of the project's start.

Objective 2: At least three fishing community members participating in the workshop will commit to releasing the caught sawfish as bycatch within four months of the project's start.

We conducted site visits to assess the social context of each fishing community along the coast of Merauke, to check whether they have realised that sawfishes are protected or not, what they perceived about it and identified their willingness to be the sawfish conservation ranger by interviewing them. Then we analysed the scoring results to decide which community would likely to participate in the education workshop. We used the workshop's pre and post-test system to measure the participant's increasing cognitive knowledge. We also conducted field trips with the fishing communities to allow them to practice our theory on sawfish conservation such as data collecting and management, socialization, etc. and use tools such as GPS, digital camera, datasheet, etc.

The community that surpassed all the training sessions was chosen to be the sawfish conservation ranger and was given all our tools to allow them to continue the work. We conducted focus group discussions with them and invited other stakeholders such as the chief village, representative of the local university and Merauke Fishery Department before the inauguration event was held.

Objective 3: Biological and ecological knowledge of sawfish in Merauke is produced

We conducted environmental DNA analysis in Merauke waters and Lake Sentani in Jayapura to detect sawfishes' presence when visual observation is too challenging to be performed. As many as ten eDNA water samples were taken from Sentani Lake, Jayapura, and 30 eDNA water samples were taken from across Merauke waters at a depth of 10-30 meters. The ten samples taken from Sentani Lake were representative of the whole area of Sentani Lake, Jayapura (**Figure 1**). Meanwhile, the 30 samples from Merauke consist only of three rivers: Digul, Buraka and Bian, and one strait: Muli (**Figure 2**). There were reports that sawfish had been caught in Digul and Bian rivers, and local government, LPSPSL Sorong, recorded it. At the same time, there were no sawfish records in the Buraka river and Muli strait, but still, there was an excellent opportunity that sawfish may live there due to the high intensity of mangrove.

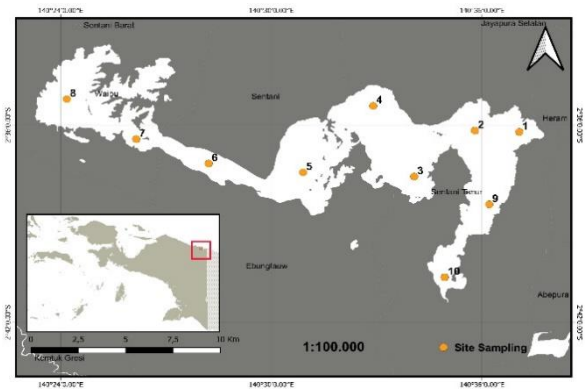


Figure 1. eDNA sampling site in Lake Sentani, Jayapura

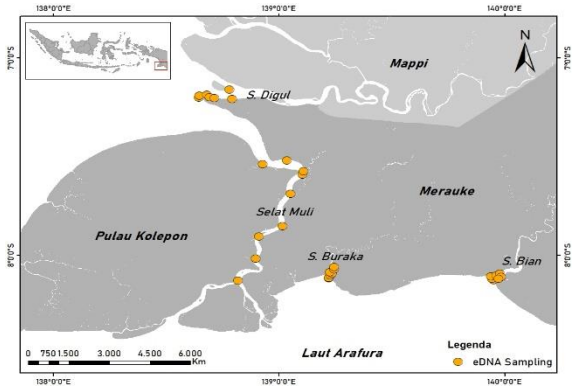


Figure 2. eDNA sampling site across Merauke waters

We also conducted a combination of purposive random sampling and snowball sampling interviews to obtain information on local ecological knowledge about sawfish in 10 villages around Lake Sentani and along the coast of Merauke. Interviews were conducted with men and women involved in fishing activities, either currently or in the past. The interviews were conducted informally according to the availability of each respondent when approached by an interviewer. The questionnaire used in the interview was slightly modified from Leeney *et al.* 2018 by Hollie Booth (Oxford University) and the Sawfish Indonesia team. Before the interview started, each interviewee was shown a colour photograph of a sawfish and was asked whether they recognized the image and knew what kind of fish it was. If the interviewee could not identify the sawfish, the interviewer did not proceed further. If the interviewee could identify the sawfish, the interview was continued.

Outputs and Results

Objective 1: The local fishing community members' understanding of sawfish conservation will increase within three months of the project's start.

We conducted the workshop in Waninggap Nanggo village, Semangga District, Merauke, as our pilot project to establish a future local sawfish conservation ranger. Two fishing communities participated in the workshop with from which there were ten adult fishers. Their pre-and post-test scores assessed the increasing knowledge and understanding of the workshop's fishers. Moreover, of all ten fishers who participated, 70% of them got an increasing score after participating in the workshop, while the other 30% (n=10) remained with the same score in the pre-test (**Figure 3**). In addition, half of the total participants could answer the test correctly above the minimum score indicators we specified. We also showed the fishers the proper technique for releasing sawfish and saving them from nets. The fishers who actively participated demonstrated their ability to handle the entangled sawfish rostra from the nets.

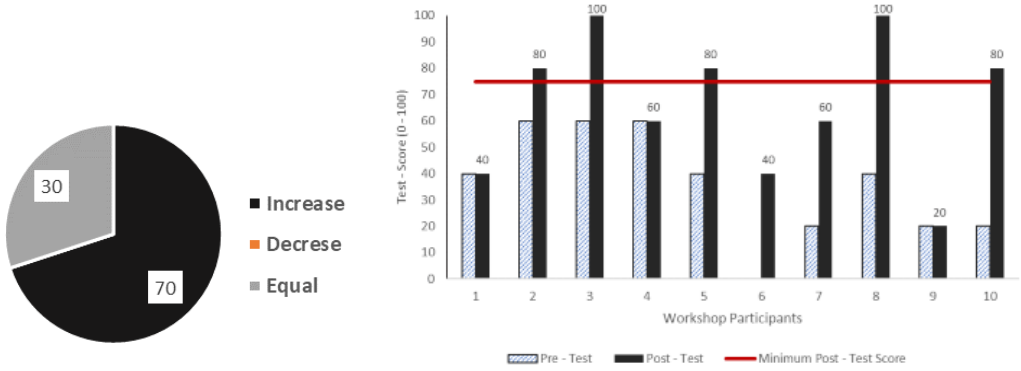


Figure 3. Pre and post-test results of participants attending the workshop

Objective 2: At least three fishing community members participating in the workshop will commit to releasing the caught sawfish as bycatch within four months of the project's start.

We distributed leaflets to inform fishing communities across Merauke about the protection status of sawfish and shared an invitation to participate in the citizen science program by asking them to report every time they capture or see sawfish. At the end, three fishers independently reported their encounters with sawfish; two immediately released the sawfish and one gave the dead sawfish to the authorities when they returned to the port (**Figure 4**). All the sawfish species captured and reported were narrow sawfish (*Anoxypristis* cuspidata) from three different sites: the estuary of Maro, the estuary of Sampan and the coast of Okaba. These reports did not come from the fishers attending the workshop since they did not encounter any sawfish afterwards.

Figure 4. Sawfish bycatch report from fishers in Merauke operating in the Arafura Sea

Objective 3: Biological and ecological knowledge of sawfish in Merauke is produced

<u>Local ecological knowledge on sawfish in Merauke</u>

A total of 245 individual fishers across the coastal region of Merauke have been interviewed for five months, starting from January to May 2021. The surveys took place in Merauke's three main coastal regions covering southern, central, and northern areas (**Figure 5**).

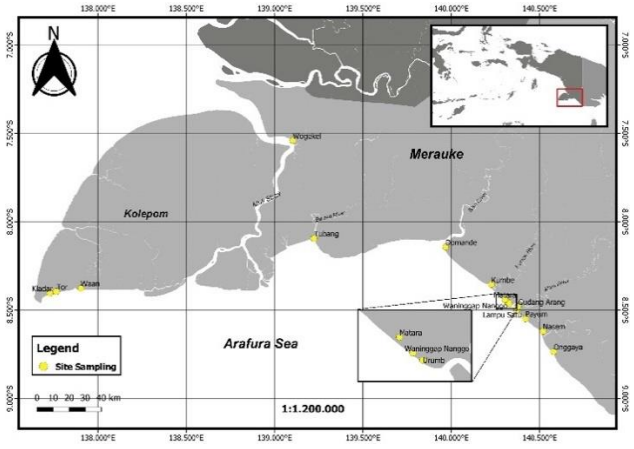


Figure 5. Map of interview site across Merauke

As many as 42% (n=245) of all interviewees stated they had experience capturing sawfish. Based on the recent sawfish caught by the fishers in the past ten years (2010-2020), many occurred offshore in the Arafura Sea rather than in coastal and estuary areas. In 2021 alone, 31 interviewees claimed that they had caught sawfish incidentally, but it mainly occurred in coastal areas.

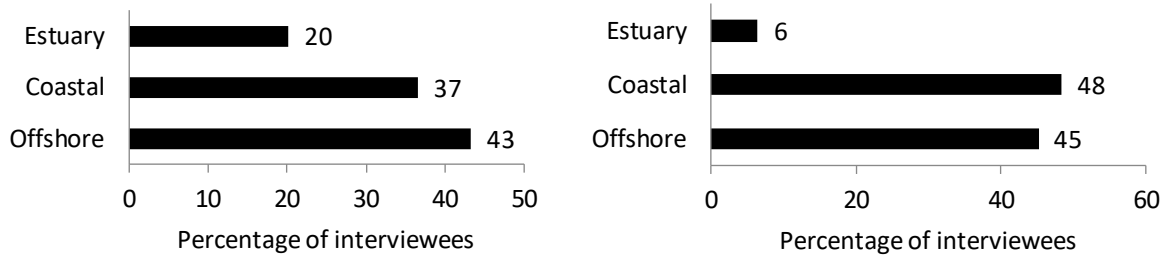


Figure 6. (A) Distribution zone of sawfish fishing areas between 2010-1010; (B) Distribution zone of sawfish fishing areas in 2021

Most caught sawfish (61%) is less than 1.5 meters long. This indicates that most of them were caught before they reached their full size and were not mature yet (Dharmadi 2020). If continues to happen, the number of sexually mature individual sawfish in the Arafura Sea could be deficient, and recruitment to the adult stock will reduce, pushing the population become extinct locally (Hossain *et al.* 2014).

Moreover, more than half of the interviewees who caught sawfish in the past ten years (58%) stated that sawfish bycatch was less frequent than in previous years. They (58%) also expressed that the number of sawfish accidentally caught decreased in previous years. This is conclusive evidence that the sawfish population in the Arafura Sea was declining, and 56% believed the current fishing dynamic with many fishing vessels operating in the Arafura Sea might be the primary cause.

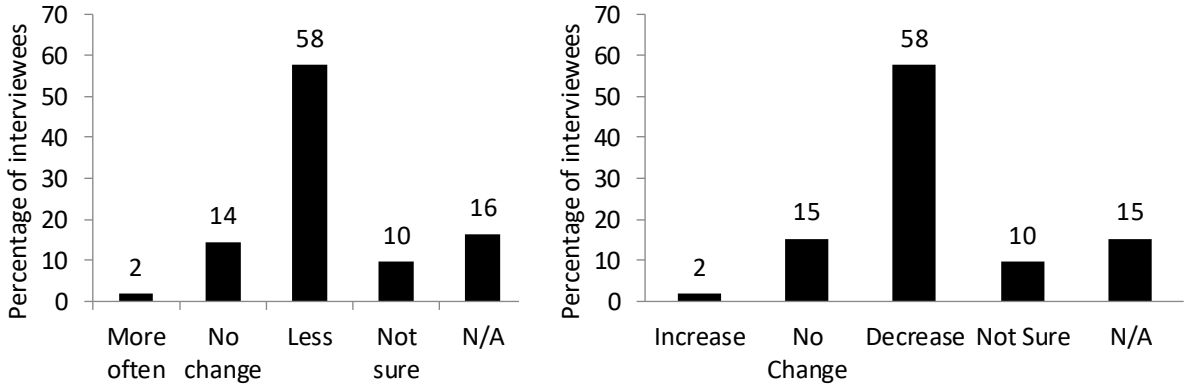


Figure 7. (A) Changes in intensity of caught sawfish; (B) Changes in the number of caught sawfish; n=104 based on the total fishers who have caught sawfish during 2020-2021

Sawfish were often caught accidentally by gill nets, as 93% of interviewees used this kind of net as their main fishing gear. The gill nets they used have various mesh sizes, which adapted to what kind of fish they target. Besides that, the characterization of gill nets is also based on how to operate them (Table 1).

Table 1. Various types of nets that were commonly used by fishers when they caught sawfish accidentally

Fishing Gear Type	Description
Drifted gill net	This is the most used fishing gear type by the fishers; commonly, this type has a 12-14 cm mesh size to trap fishes whose swim bladder is targeted, such as Barramundi; the nets are allowed to drift according to the direction and speed of the current.

Set gill net	This net is usually installed using wooden stakes around the coastline; this type of net operation relies on tides and has various mesh size according to the fishers 'wishes.
Bottom gill net	This net is operated at the bottom of the water, with the main target are demersal fishes.
Sharks net	This type of net is still classified as drifted gill nets with mesh size over 18 cm; the main target of this net is fishes from the Elasmobranch class such as guitarfish and wedge fish, for their fins to be taken.
Beach seine	This net is operated around the coast by being pulled by two people with 1-person on each side of the nets.

Local ecological knowledge on sawfish in Lake Sentani, Jayapura

A total of 72 residents of Lake Sentani were interviewed, with 44% being fishers either currently when the interview was conducted or in the past. In contrast, the others work on different subjects. We also interviewed non-fishers was because the familiar residents strongly interacted with Lake Sentani, just like the fishers. Their life, from chief village to kids, is connected to the lake, and their daily activities are inseparable because they live right next to the lake (**Figure 8**).

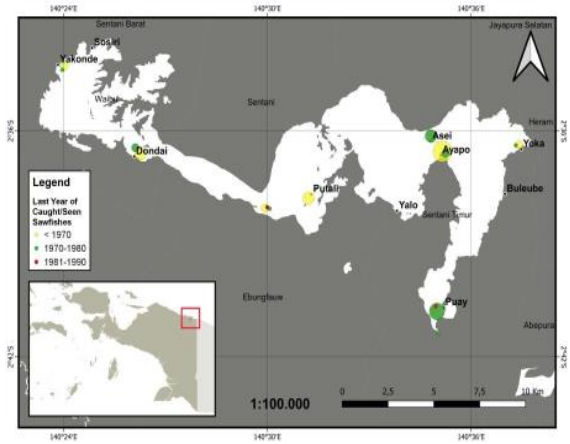


Figure 8. Study area of local ecological knowledge on sawfish in Lake Sentani, Jayapura

Amongst the interviewees, only 44 of them had direct experience with sawfish in the past. At the same time, the other 13 persons knew nothing about sawfish and had never seen or even heard about sawfish in their lifetime. The 16 interviewees stated that they had caught sawfish before in Lake Sentani, while the rest had only heard stories about sawfish from their parents or village elders.

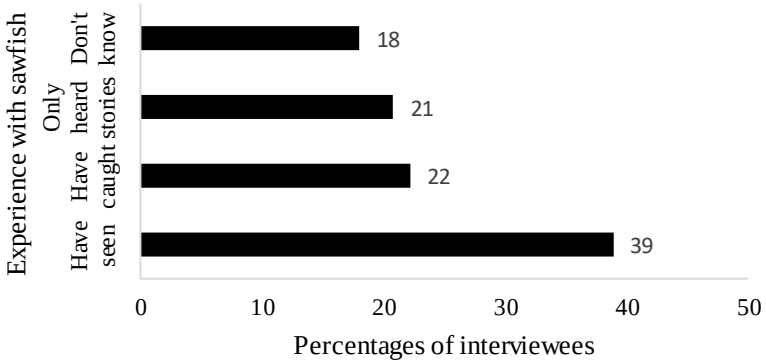


Figure 10. Various kind of experience of interviewees with sawfish in Lake Sentani

33% of interviewees were between 51-60 years old, 22% were more than 60 years old and the others were below 50. We consider that their age was relevant with familiarity to the sawfishes that were formerly present in Lake Sentani because the rumour said that they had been extinct for almost a decade there. It was clearly shown that the older generation (presumably more than 40 years old) was more

familiar with sawfish by having experience in encountering or even capturing that wildlife than the young one (**Figure 9**).

Among the interviewees who had seen sawfish, 13 were from the 51-60 years old class, while another ten were from the over 60 years old class. None of the younger interviewees (20-30 years old) had seen sawfish. Similarly, most respondents who stated they had caught sawfish before were at least 50 years old. Meanwhile, all interviewees below 50 years old stated that they had never caught sawfish. On the other hand, most interviewees who had seen sawfish were more than 50 years old and generally reported that the last encounter in the lake was during the 1970s or 1980s, which means sawfish apparently had been locally extinct around 40 years ago. It is believed that bycatch from gill nets was the main reason for the declining sawfish population that finally pushed them into local extinction (Kadarusman *et al.*, 2008).

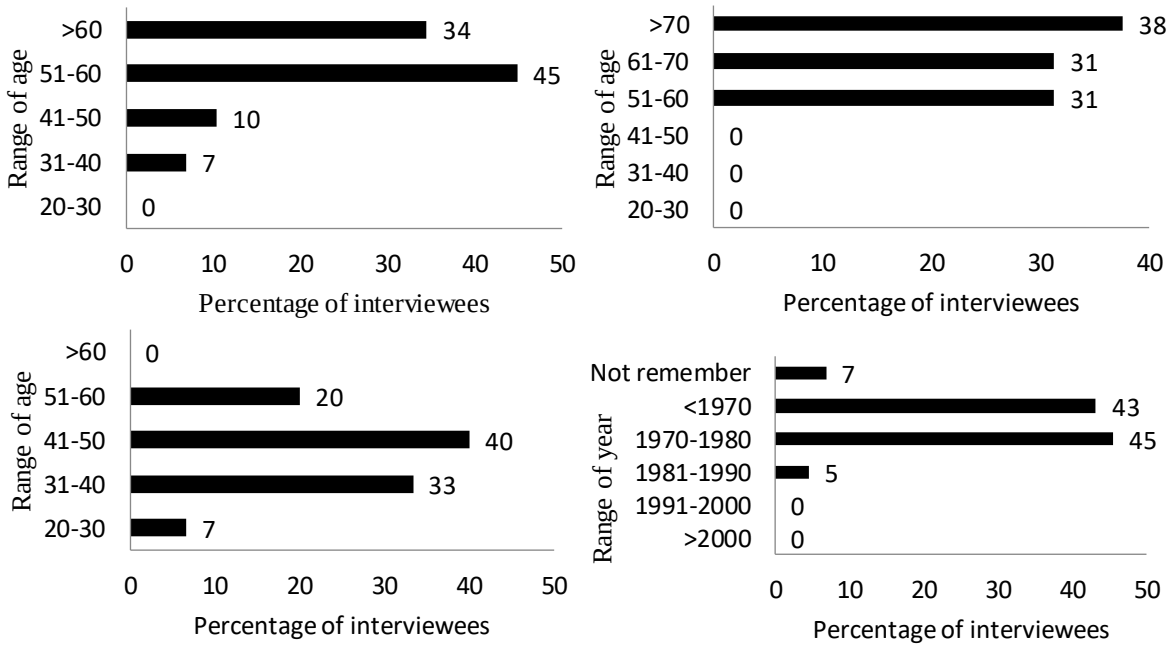


Figure 9. (A) Percentage of interviewees who had seen sawfish in their lifetime; (B) Percentage of interviewees who had caught sawfish in their lifetime; (C) Percentage of interviewees who have only heard about sawfish but never seen or caught; (D) Percentage of interviewees who have most recent experience with sawfish by the range of the year.

Cultural significance of sawfish

The native residents of Papuan in Merauke call sawfish *Gergaji Anim*, *Sesai Anim*, *Kono Anim* and *Lahlohe*. However, none of the interviewees could explain the relevance of these creatures with their tradition or culture as they stated that their ancestors were the ones who could explain such things.

On the other hand, some of the native residents of Papuan living around Lake Sentani knew something about the relation of these creatures with their culture. They call sawfish *Melemai*, a common term for people living in eastern Sentani and Meremai, which is, on the contrary, commonly used by the west Sentani residents. A sawfish carving pattern was found in the traditional house called *obhe* located in Dondai village, the western part of Lake Sentani (**Figure 10**). Sawfish, along with other land and sea creatures, were carved in the pillar of the house because they believed that those animals once were their ancestors whom they needed to give respect even though they do not pray to them anymore.

Another cultural significance of sawfish in Lake Sentani residents is *Khombow* (Sentani language), a bark painting which the international art world has known as "Maro" (**Figure 11**). These paintings are the traditional hallmark of the Sentani people until now.

Fig 10. Sawfish carving pattern in the traditional house

Fig 11. Sawfish bark painting

Communication and Application of Results

The team's research has been presented at the 3rd Indonesia Sharks and Rays Symposium. Through that, the team has managed to urge various stakeholders, from the government to science institutions, to promote more research for sawfish going forward and to produce the National Action Plan for Sawfish in the following years. On the international level, the research also has been presented at the International Congress for Conservation Biology (ICCB) 2021. It has been used to contribute to the assessment of global sawfish conservation status by the Red List IUCN assessment team.

Two local media in Merauke covered the story of the team and the critical message to conserve sawfish – the Merauke Radio Republic of Indonesia and the Noken Enterprise community. We discussed how the youth generation could take important roles in the conservation field and challenge the local youth in Merauke to do the same as we did. Unfortunately, the Merauke Radio Republic of Indonesia provided no recording as the talk show aired online, but the discussion with the Noken Enterprise is stored online on YouTube. For the wider audience, we have a podcast recorded with the Motion for Nature on Spotify to talk about the project done in Merauke. We also collaborated with the My Edusolve to produce a sawfish campaign poster for the "Adobe Certified Professional 2021" event that can be seen on Sawfish Indonesia's Instagram account.

Monitoring and Evaluation

At the beginning of the project, the team had *set a clear plan and timeline* for the project considering various elements such as the scale of priority, cost, potential supportive stakeholders, and human resources from the project member themselves. It made us focus on preparing for what activities were coming before the others. We also *delegated tasks* to all project members accordingly and adequately, preventing us from having an overlapping duty among the member and ensuring that all members could contribute something even if it is not in their speciality area.

The most critical measure we undertook during the project was *evaluation*. It could be an event evaluation or just a weekly/monthly regular evaluation. We also *conducted regular debrief* at the end of the research day to ensure all the data intended to collect was gathered correctly and stored.

Achievements and Impacts

Sawfish release report

After the team had finished conducting sawfish socialization to fishers throughout the coastal of Merauke, we received reports from several fishers who accidentally captured sawfish. One of them handed the sawfish out to the authorities because the sawfish had already been dead. However, the others immediately released the sawfish back alive and sent images and videos to the team as proof. This showed that a more extensive citizen science program could be applied in the longer term to involve more fishers as a whole community to prevent the local extinction of sawfish by releasing them alive and growing the baseline data about the sawfish population and habitat around Merauke.

Best speaker at the 3rd Indonesia Sharks and Rays Symposium
The majority of research presented at the symposium discussed wedge fish and guitarfish. However, we were the only ones speaking about the sawfish amongst dozens of panellists, from Indonesia and other countries. Besides the topic, the jury appreciated how we presented the research, which resulted in us being the best speaker at the symposium. We managed to attract national attention to sawfish conservation in Indonesia.

Invited by Indonesia Ministry of Marine Affairs and Fisheries
Interested to know more about the project under the radar of Indonesia Ministry of Marine Affairs and Fisheries central for almost a year but surprisingly had outstanding results presented at the symposium, they invited us to a dissemination discussion. We again showed the urgency of a having National Action Plan for sawfish in the following years, followed by increasing research capacity towards sawfish, especially in the eastern part of Indonesia.

Contribute to IUCN Red List sawfish reassessment
As the only group that actively engaged in sawfish research in Indonesia, we were proposed by the Indonesian Institute of Sciences to be involved in the sawfish conservation status reassessment conducted by the IUCN Red List in 2021. We then again presented our research in the IUCN Red List workshop as the representative of Indonesia to inform the local status of *Anoxypristis cuspidata*.

Capacity Development and Leadership Capabilities

Sihar Aditia Benrid Silalahi
This project has improved my capacity to manage both people and tasks. It has been challenging to keep the team inspired and motivated to put many efforts into this project since this would be conducted in a remote location for a long time voluntarily. Nevertheless, I learnt to encourage them to onboard the team, give a clear vision and direction, and be there whenever they needed assistance to complete their responsibility. This project also gave me experience of discussing diplomatically with various stakeholders, such as the government or science institutions, to get them involved in our agenda.

Dicky Dwi Rizky Nugroho
This project enhanced my GIS mapping skills and improved my visual design to provide informatics visuals through maps or poster design and allowed me to learn about environmental DNA from water sampling to laboratory analysis. This project helped me get my undergraduate thesis on environmental DNA topics.

Iis Susiani
The project's activities required me to meet many people from various stakeholders, from local youth, lecturers, government, communities, and fishers. It allowed me to learn how to communicate and deal with the parties. This opportunity helped me improve my communication skills in my current career and the future. The project has expanded my knowledge of the strategy to communicate the goals and influence them to act together to save sawfish. This skill is very applicable in many sectors that are useful to me even after completing the project. In my current professional career, it helps me when I need to have collaborated with clients from various backgrounds.

Yunita Wakhida
I have built many relationships with various parties during this project, including local communities, the Indonesian government, and international organizations such as IUCN. In addition, I also had the opportunity to develop skills in the social field, as through this project I conducted many interviews, discussions, and in-depth studies on sawfish through the ecological knowledge of local communities. Finally, through this project, I have had the great opportunity to continue research on sawfish for the next year and become project leader through Save Our Seas Foundation funding.

SECTION 3

Conclusion

This project successfully attracts scientific academics and government officials' attention to the existence of sawfish in Indonesia, especially in the eastern part of Indonesia, the Arafura Sea. We revealed that sawfish can still be found in Indonesian waters, which contradicts some statements saying that sawfishes are locally extinct in Indonesia and leads to the elimination of Indonesia from one priority country to a global strategy for sawfish conservation. We deliver this information in the discussion of the IUCN Red List reassessment for sawfish in 2021, stating that the Arafura Sea is allegedly the last viable population of sawfish in Indonesia because of the considerable range of years that the interviewed fishers have the most recent experience with unintentionally catch the sawfish (1950-2021). Whilst this is good news, the ongoing threats from growing fishing activities in the Arafura Sea will continue to push them to extinction. Their population is declining at an unknown rate and scale. Therefore, further research about sawfish needs to be taken to compile more scientific comprehensive data that can be used to immediately design a national action plan for sawfish conservation.

Problems Encountered and Lesson Learnt

The problem encountered in our research was that the environmental DNA survey results did not end up as we expected. No single sequence of sawfish was detected at our study site. No elasmobranch was detected using universal 12S primer MiFish U/E-adpt. We suspected that the absence of the elasmobranch sequences, including sawfishes (family Pristidae), resulted from PCR bias derived from primer-template mismatches. There is an indication that this primer is not sensitive to reading elasmobranch sequences. Moreover, another factor that can cause the absence of sawfish sequences is the sampling site itself, given that environmental condition plays an integral role in the fate of eDNA once it has been shed from an organism. Therefore, we could not provide sawfish distribution information using eDNA at this moment. Another experimental study must be taken to sequence the reserved eDNA samples in Merauke using different primers. An adaptation of primer, preservation and extraction workflow from Cooper *et al.* 2021 is also recommended for further study. This is how to confirm whether eDNA is the proper tool to detect the sawfish and estimate its relative abundance in muddy waters around Merauke.

While the social research on local ecological knowledge about sawfish in Merauke and Lake Sentani had been well conducted, the team, unfortunately, lacks funding source to publish a scientific article. A scientific article is much needed, especially when a further action plan for sawfish conservation needs to be based on relevant scientific knowledge and effectively attract national-level attention to sawfish research and conservation at.

Due to limited science-based information about sawfish in Indonesia, this project mainly focused on conducting scientific research and hoping we can develop any conservation measurements in the future.

Given that circumstances, very minimum conservation efforts have been taken during this project as we were trying to identify first what the suitable and effective method should be taken in terms of sawfish presence and distribution in the study area and as residents' perspective towards sawfish conservation. Based on our research, it is clear that further conservation measurements need to be taken immediately as the sawfish face unexpectedly huge threats from fishing activities. A more significant and influential fishers' involvement needs to be promoted as our initial action showed that most of these fishers are open to working together. Some of them expect compensation, but it is normal when they sometimes need to sacrifice their catch or gears to save the sawfish from being captured. A further study of how many sawfishes is caught annually and identifying the mortality rate in the Arafura Sea needs to be taken in the future so the government of Indonesia can develop an effective strategy for preventing sawfish bycatch from massive commercial fishing in that area.

In the Future

Indonesia has many endangered elasmobranch species that need to be addressed. Some get the government's full attention as some NGOs are actively promote them by conducting many studies and research and disseminating the results to the government. The same efforts need to be made for sawfish. It is essential to raise an alert on how urgent to save the sawfishes from local extinction. The way to do it first is to supply relevant information and exposure to academic institutions and government officials as much as possible. So currently, we are expanding our research capacity to learn about the cultural significance of sawfish in Papua, especially for the Asmat tribe who has a close connection with sawfish and believe that they are the descendants of these creatures. This cultural value will add urgency to saving one of the valuable cultural assets of Indonesia, aside from its biodiversity. This research is now conducted through funding from Save Our Seas Foundation. For future planning, we will apply for more funding to conduct conservation measurements in the eastern part of Indonesia.

Financial Report

The summary and complete financial report can be seen here. There is a remaining $119, which will be used for research publication.

SECTION 4

Appendices

Table 2. CLP Monitoring and evaluation table

Output	Number	Additional Information
Number of CLP Partner Staff involved in mentoring the Project	1	Simeon Benaya from WCS Indonesia
Number of species assessments contributed to (E.g. IUCN assessments)	1	*Anoxypristis cuspidata*
Number of site assessments contributed to (E.g. IBA assessments)	-	
Number of NGOs established	-	

Amount of extra funding leveraged ($)	$18.000	Conservation International Indonesia supported the payment for eDNA laboratory analysis and Sustainable Ocean Alliance gave a mini grant to conduct series webinar and workshop training for high school students in Merauke
Number of species discovered/rediscovered	4	*Anoxypristis cuspidate, Glyphis, Glyphis garricki, Carcharhinus leucas*
Number of sites designated as important for biodiversity (e.g. IBA/Ramsar designation)	-	
Number of species/sites legally protected for biodiversity	1	We only discovered one species of sawfish, *Anoxypristis cuspidata*
Number of stakeholders actively engaged in species/site conservation management	-	Merauke work unit of Ministry of Marine Affairs and Fishery is the one who should engage in species conservation management, but we wouldn't say that they contributed much
Number of species/site management plans/strategies developed	-	
Number of stakeholders reached	1	Fishing community groups in Waninggap Nanggo village
Examples of stakeholder behaviour change brought about by the project	-	
Examples of policy change brought about by the project	-	
Number of jobs created	-	
Number of academic papers published	-	
Number of conferences where project results have been presented	2	The 3rd Indonesia Symposium for Sharks and Rays and International Congress for International Biology

Environmental DNA results

Species detected in Merauke using environmental DNA showed various numbers in each site (**Figure 12**). This study found that the Digul River has the highest relative abundance of the number of fish species, with as many as 24 fish species detected. In contrast, the lowest relative abundance of the number of fish species is in the Buraka river, with only ten fish species detected. Bian river and Muli strait have 14 and 15 fish species detected each. During this preliminary study, we found that no single assembled reads from the MiSeq Sequencing represented elasmobranchs (sharks and rays). Overall, sawfishes' presence is also not detected using universal 12S primer MiFish U/E-adpt (**Figure 13**). The absences of elasmobranch sequences were unexpected because we witnessed sharks and rays that the local fishers had just caught in Bian River and Muli strait not far from the eDNA sampling site during

and weeks after we conducted our eDNA research. It means some elasmobranch species are present in at least Bian River and Muli strait. Some of them are reticulate whipray *(Himantura uarnak)*, giant guitarfish *(Glaucostigus typus)*, and bull shark *(Carcharhinus leucas).*

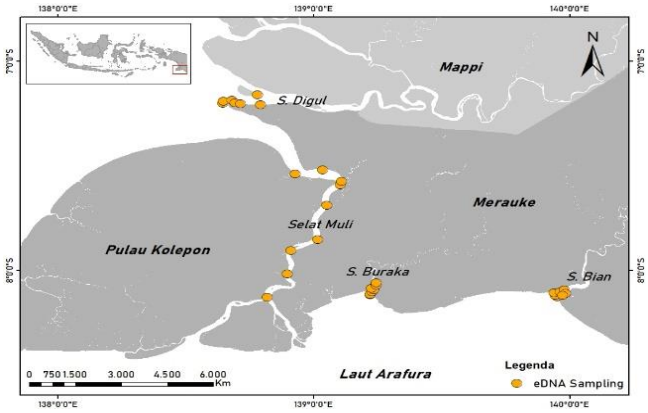


Fig 12. Environmental DNA sampling site across Merauke

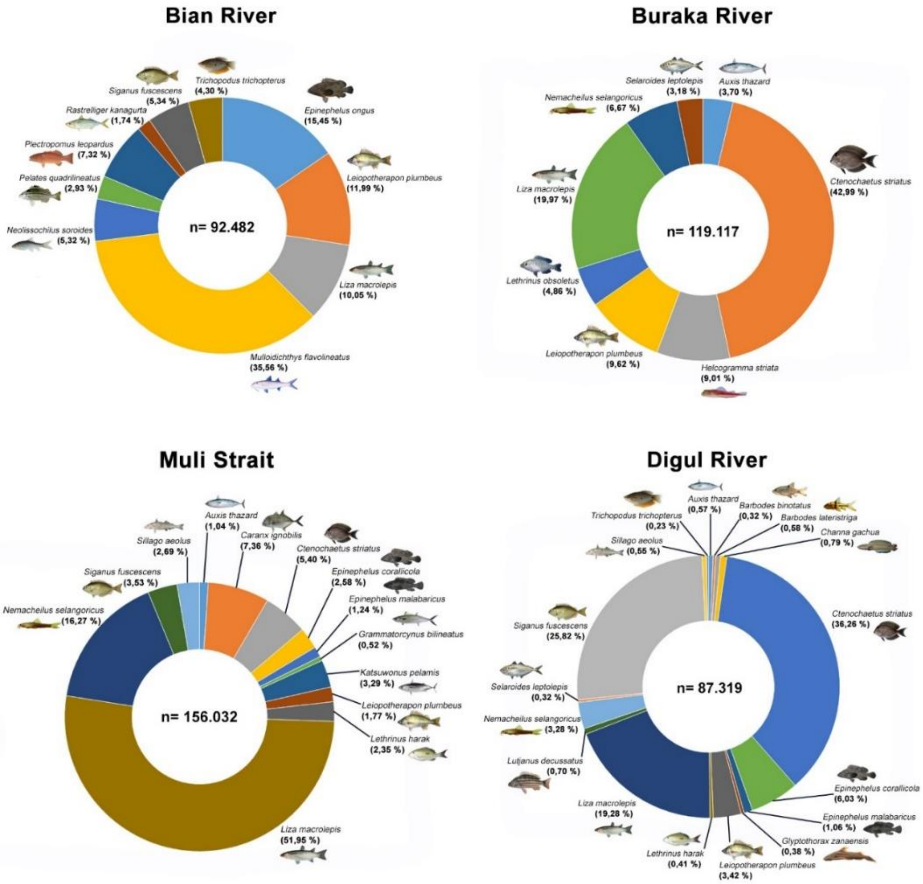


Fig 13. The percentage of species detected using eDNA in Merauke

Table 3. List of fish species detected in Bian River using environmental DNA

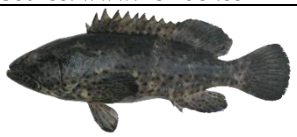
No.	Species	ID Match (%)	IUCN Status	Image
1	*Epinephelus ongus*	98,82	Least Concern	 Source: www.squarespace.com
2	*Leiopotherapon plumbeus*	97,06	Vulnerable	 Source: www.fishbase.com
3	*Mulloidichthys flavolineatus*	100	Least Concern	 Source: www.researchgate.net
4	*Neolissochilus soroides*	99,43	Least Concern	 Source: www.zenodo.org
5	*Pelates quadrilineatus*	100	Least Concern	 Source: www.fishesofaustralia.net
6	*Planliza macrolepis*	100	Least Concern	 Source: www.fishesofaustralia.net
7	*Plectropomus leopardus*	100	Least Concern	 Source: www.stickfigurefish.com
8	*Rastrelliger kanagurta*	100	Data Deficient	 Source: www.fishsource.org
9	*Siganus fuscescens*	99,42	Least Concern	 Source: www.fishesofaustralia.net
10	*Trichopodus trichopterus*	99,41	Least Concern	 Source: www.researchgate.net

Table 4. List of fish species detected in Buraka River using environmental DNA

No.	Species	ID Match (%)	IUCN Status	Image
1.	*Auxis thazard*	98,22	Least Concern	 Source: www.ncfishes.com
2.	*Ctenochaetus striatus*	100	Least Concern	 Source: www.fishbase.com
3.	*Helcogramma striata*	97,06	Least Concern	 Source: www.ids.si.edu
4.	*Leiopotherapon plumbeus*	97,06	Vulnerable	 Source: www.fishbase.com
5.	*Lethrinus obsoletus*	100	Least Concern	 Source: www.fishbase.com
6.	*Planiliza macrolepis*	97,04	Least Concern	 Source: www.fishesofaustralia.net
7.	*Nemacheilus selangoricus*	97,69	Least Concern	 Source: www.researchgate.net
8.	*Selaroides leptolepis*	98,83	Least Concern	 Source: www.bertani.co.id

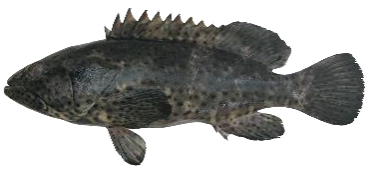
Table 5. List of fish species detected in Muli Strait using environmental DNA

No.	Species	ID Match (%)	IUCN Status	Image

1.	*Auxis thazard*	99,41	Least Concern	 Source: www.ncfishes.com
2.	*Barbodes binotatus*	97,14	Least Concern	 Source: www.seriously.com
3.	*Caranx ignobilis*	100	Least Concern	 Source: www.fishider.com
4.	*Ctenochaetus striatus*	99,4	Least Concern	 Source: www.fishbase.com
5.	*Epinephelus corallicola*	99,41	Least Concern	 Source: www.fishider.com
6.	*Epinephelus malabaricus*	97,04	Least Concern	 Source: www.fishider.com
7.	*Grammatorcynus bilineatus*	100	Least Concern	 Source: www.fishider.com
8.	*Katsuwonus pelamis*	100	Least Concern	 Source: www.fishesofaustralia.net
9.	*Leiopotherapon plumbeus*	97,06	Vulnerable	 Source: www.fishbase.com
10.	*Lethrinus harak*	98,82	Least Concern	 Source: Afrisal *et al.* 2021
11.	*Planiliza macrolepis*	100	Least Concern	

				Source: www.fishesofaustralia.net
12.	*Nemacheilus selangoricus*	97,69	Least Concern	 Source: www.researchgate.net
13.	*Siganus fuscescens*	100	Least Concern	 Source: www.fishesofaustralia.net

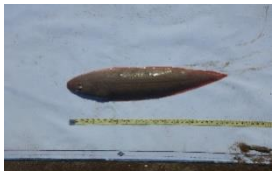
Table 6. List of fish species detected in Digul River using environmental DNA

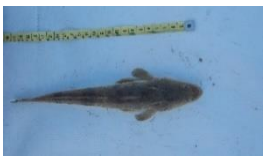
No.	Species	ID Match (%)	IUCN Status	Image
1.	*Auxis thazard*	98,82	Least Concern	 Source: www.ncfishes.com
2.	*Barbodes binotatus*	98,85	Least Concern	 Source: www.seriouslyfish.com
3.	*Barbodes lateristriga*	97,13	Least Concern	 Source: www.researchgate.net
4.	*Channa gachua*	97,62	Least Concern	 Source: www.marulioides.com
5.	*Ctenochaetus striatus*	100	Least Concern	 Source: www.fishbase.com
6.	*Epinephelus corallicola*	99,41	Least Concern	 Source: www.fishider.com
7.	*Epinephelus malabaricus*	97,04	Least Concern	 Source: www.fishider.com
8.	*Glyptothorax zanaensis*	97,69	Not Evaluated	

				Source: Jiang *et al.* 2011
9.	*Leiopotherapon plumbeus*	97,06	Vulnerable	 Source: www.fishbase.com
10.	*Lethrinus harak*	98,82	Least Concern	 Source: Afrisal *et al.* 2021
11.	*Planiliza macrolepis*	100	Least Concern	 Source: www.fishesofaustralia.net
12.	*Lutjanus decussatus*	100	Least Concern	 Source: www.fishider.com
13.	*Nemacheilus selangoricus*	97,69	Least Concern	 Source: www.researchgate.net
14.	*Selaroides leptolepis*	100	Least Concern	 Source: www.bertani.co.id
15.	*Siganus fuscescens*	100	Least Concern	 Source: www.fishesofaustralia.net
16.	*Sillago aeolus*	99,4	Not Evaluated	 Source: www.BOLDsystems.com
17.	*Trichopodus trichopterus*	100	Least Concern	 Source: www.researchgate.net

Table 7. List of fish species caught using traditional survey in Bian Estuary

No.	Species	Total (∑)	IUCN Status	Image
1.	*Cinetodus carinatus*	2	Data Deficient	
2.	*Arius sp*	41	Least Concern	
3.	*Oreochromis niloticus*	6	Least Concern	
4.	*Kurtus gulliveri*	3	Least Concern	
5.	*Polydactylus octonemus*	123	Least Concern	
6.	*Selenotoca papuensis*	2	Not Evaluated	
7.	*Marilyna meraukensis*	58	Not Evaluated	

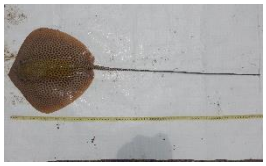
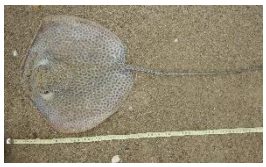
8.	*Mugil cephalus*	35	Least Concern	
9.	*Paraplagusia bilineata*	1	Not Evaluated	
10.	*Paneus indicus*	476	Not Evaluated	
11	*Carangoides malabaricus*	39	Least Concern	
12	*Hryssa scratchleyi*	25	Not Evaluated	
13	*Strongylura*	7	Not Evaluated	
14	*Lobotes surinamensis*	2	Not Evaluated	
15	*Cynoglossus lingua*	16	Least Concern	
16	*Stolephorus waitei*	6	Data Deficient	

17	*Paraplotosus albilabris*	1	Not Evaluated	
18	*Gerres oyena*	1	Least Concern	
19	*Platycephalus sp*	1	Least Concern	
20	*Elops machnata*	39	Least Concern	
21	Macrobrachium rosenbergii	3	Least Concern	

*This survey used fishing gear (gill nets) to catch and see what species was exist there, the catch was conducted one time in three different sites

Table 8. List of sharks and rays encountered during the project

No.	Species	Common Name	IUCN Status	Image
1.	*Stegostoma fasciatum*	Zebra shark	Endangered	
2.	*Carcharhinus albimarginatus*	Silvertip shark	Vulnerable	
5.	*Eusphyra blochii*	Winghead shark	Endangered	

6.	*Glyphis garricki*	Northern river shark	Critically Endangered	
7.	*Dasyatis parvonigra*	Dwarf Black stingray	Data Deficient	
8.	*Pastinachus stellurostris*	Staryynose stingray	Not Evaluated	
10.	*Pteroplatytrygon violacea*	Pelagic stingray	Least Concern	
11.	*Glaucostegus typus*	Giant guitarfish	Critically Endangered	
12.	*Himantura uarnak*	Reticulate whipray	Vulnerable	
13.	*Himantura leoparda*	Leopard whipray	Vulnerable	

*The identification of sharks and rays were confirmed by Simeon Benaya from WCS Indonesia and some even confirmed by Mick Grant from James Cook University

Water Quality Assessment at eDNA Sampling Sites Merauke

The four sites where these water samples were taken were wide rivers in Merauke that have been utilized by local people living along the river or estuary for fulfilling their daily needs. The local people used the rivers for fishing and as a transportation route for boats or vessels, and some people who owned part of the field, used it as a source of plant irrigation system. Therefore, we used class III in this assessment to determine the water quality standard. According to Government Regulation No. 22/2021, the water quality classification in class III is based on its designation for freshwater fish farming, husbandry, and plant irrigations.

The water quality measurement conclusion is presented in **Table 9**. Only the nitrite (NO_2) parameter in all sites has a value higher than the quality standard, while other parameters meet the quality standard. This higher nitrite value also contributes to the STORET score results in determining the water quality status. According to the STORET score results, only Buraka River has met water quality standards and is classified as Class A with a very good quality water category. Bian River, Muli Strait, and Digul River have STORET scores for -4, -2, and -4, respectively, which are classified as class B for slightly polluted water (**Table 10**). The pollution in these three sites is influenced by various factors, such as high boat traffic in the Muli Strait and intensive fishing activities in the Bian River and Digul River. The sampling location near the village along Bian riverbank also contributes to the slightly high value of nitrite measurement results.

Table 9. Water quality status of Merauke water according to STORET score

Sampling Site	Total STORET Score	Water Quality Status
Bian river	-4	Slightly polluted
Buraka river	0	Meet quality standard
Muli strait	-2	Slightly polluted
Digul river	-4	Slightly polluted

Table 10. Water quality data measurement at eDNA sampling sites Merauke

Sampling Sites	Parameter	Unit	Water Quality Standard	Field Mesurement			Total STORET score
				Max	Min	Avg	
Bian river	Temperature	°C	Normal ± 3	30.00	28.10	28.66	-4
	Salinity	ppt	-	13.00	3.00	7.14	
	Turbidity	mg/L	-	300.00	18.00	97.14	
	Current	m/s	-	1.22	0.05	0.55	
	pH	-	6 to 9	7.00	7.00	7.00	
	DO	mg/L	3	4.90	4.00	4.41	
	Nitrite	mg/L	0.06	0.13	0.04	0.08	
	Nitrate	mg/L	20	0.30	0.04	0.20	
	Ammonia	mg/L	0.5	0.41	0.17	0.29	
	Total - Phospate	mg/L	1	0.19	0.00	0.08	
Buraka river	Temperature	°C	Normal ± 3	29.70	28.40	29.10	0
	Salinity	ppt	-	15.00	1.00	4.86	
	Turbidity	mg/L	-	38.00	12.00	23.57	
	Current	m/s	-	0.31	0.09	0.19	
	pH	-	6 to 9	7.00	7.00	7.00	
	DO	mg/L	3	7.70	4.80	6.44	
	Nitrite	mg/L	0.06	0.06	0.03	0.04	
	Nitrate	mg/L	20	0.31	0.14	0.23	
	Ammonia	mg/L	0.5	0.57	0.15	0.28	
	Total - Phospate	mg/L	1	0.06	0.00	0.04	
Muli strait	Temperature	°C	Normal ± 3	33.30	27.60	29.37	-2
	Salinity	ppt	-	15.00	4.00	10.56	
	Turbidity	mg/L	-	530.00	24.00	128.78	
	Current	m/s	-	0.90	0.08	0.43	
	pH	-	6 to 9	8.00	7.00	7.11	
	DO	mg/L	3	4.80	3.40	4.10	
	Nitrite	mg/L	0.06	0.08	0.04	0.05	
	Nitrate	mg/L	20	1.15	0.27	0.48	
	Ammonia	mg/L	0.5	0.02	0.02	0.02	
	Total - Phospate	mg/L	1	0.02	0.02	0.02	
	Temperature	°C	Normal ± 3	28.70	27.60	27.94	

Sawfish Rostrum Tracking

The team tracked individual fishers and collectors who kept sawfish rostrum as decoration and measured them (**Table 10**). We found four species which were Narrow Sawfish (*A. cuspidata*), Largetooth Sawfish (*P. pristis*), Dwarf Sawfish (*P. clavata*), and Green Sawfish (*P. zijsron*). The highest amount of rostrum tracked was Narrow Sawfish (*A. cuspidata*). We also collected the rostrum genetic sample for future research.

Table 10. Measurement of sawfish rostrum from individual collectors

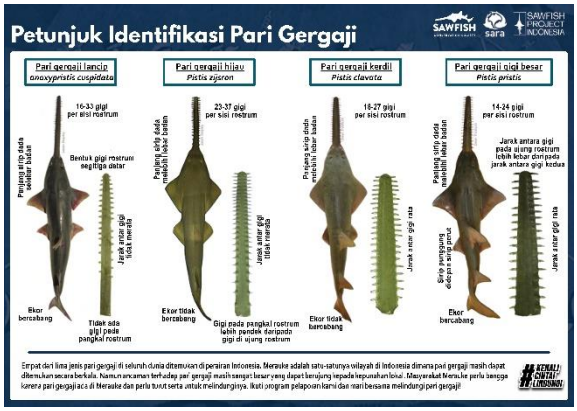
Species	Amount	Average SRL (cm)	Average SRW (cm)	Average TW (cm)
Largetooth sawfish	13	53.72	7.86	3.8
Narrow sawfish	18	54.22	7.77	4.04
Green sawfish	2	52.35	8.56	3.09
Dwarf sawfish	4	54.17	7.42	4.57

Media Articles Relating to the Project

Some media covering the project activities and highlighting the importance of this project, though the majority of them were in the Indonesia language, are as follows:

- IPB University
- Brawijaya University
- Republika
- Conservation Optimism
- Indonesia Ministry of Marine Affairs and Fisheries
- Mongabay Indonesia
- The Revelator
- Media Indonesia

Sawfish Identification Card and Leaflet



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Hossain MDA, Thompson BS, Chowdury GW, Mohsanin S, Fahad ZH, Koldewey HJ, Islam MDA. 2014. Sawfish exploitation and status in Bangladesh. *Aquatic Conserv: Mar. Freshw. Ecosyst.*

Leeney RH, Mana RR, Dulvy NK. 2018. Fisher's ecological knowledge of sawfishes in the Sepik and Ramu rivers, northern Papua New Guinea. *Endang Species Res*. 36:15-26.

Several articles that can be published from this project, even though they are still in hold due to a lack of funding to publish them. Some of them are as follows:

1. Sawfish status in the Arafura Sea using fisher's ecological knowledge
2. Traditional ecological knowledge reveals the status of sawfish in Lake Sentani, Jayapura, Papua
3. First record of the freshwater shark *Glyphis* and *Glyphis garricki* in Bian River, Papua, Indonesia
4. First documentation of the existence of four species of sawfishes in Indonesia waters
5. Fish diversity revelation in Merauke and Lake Sentani using environmental DNA

Documentations

Creation of local sawfish conservation ranger in Waninggap Nanggo village, Merauke

Sawfish bycatch reports from individual fishers

Fishers' ecological knowledge survey

Environmental DNA and water quality survey

Rostrum measurement and tissue sample collection

Sawfish traditional monitoring survey


Local media outreach