Overview of Bycatch Including Endangered, Threatened and Protected (ETP) Species from Indonesian Tuna Longline Fishery Operating in the Eastern Indian Ocean

Report to Indonesia Longline Tuna and Large Pelagic FIP

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EXECUTIVE SUMMARY

Longline is the primary fishing gear type by Indonesian vessels targeting tunas that operate in the Eastern Indian Ocean, with 327 Indonesian longliners operate in 2021 ranged from 10 GT up to less than 200 GT (MMAF, 2022). There is a global concern on the interaction of longline fishery with non-target species, however information on by-catch and discards from the Indonesian tuna longline fishery is still limited.

The purpose of this report is to provide bycatch including ETP species information including proportion and distribution of by-catch (including ETP) from the Indonesian tuna longline fishing activities in the Indian Ocean to support its management strategies. The scope of this report is limited only from Indonesian tuna longline fishery which mainly based in Benoa Port (PU. Benoa) and Cilacap Oceanic Fishing Port (PPS. Cilacap) for the period of 2010-2021. Descriptive statistics were used to describe the catch composition by group species, and catch and effort distribution of Indonesian tuna longline fishery operating in the Eastern Indian Ocean.

Around 25% of the catches are by-product and around 44% are discards. A large portion of the discards are populated by long-snouted lancetfish (55% of the discards), followed by pelagic stingray (*Dasyatis* spp) (~22% of discards), blue sharks (*Prionace glauca*) (~9% of discards) and/or crocodile sharks (*Pseudocarcharias kamoharai*) (~5% of discards), whilst the other were relatively negligible. Among the discard species, long-snouted lancetfish was categorized as high level of interaction (50 - 70%), pelagic stingray and blue sharks as medium level of interaction (25 – 50%), and crocodile sharks as low level of interaction (5 – 25%), whilst others discarded species were very low (< 5%). A by-catch mitigation implementation and its monitoring needs to be improved to decrease fishing mortality of ETP by longline fishery.

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1. INTRODUCTION

By-catch is a term that is frequently used in scientific and semi-popular literature, where it can have a variety of meanings that overlap and even contradict one another. However, by-catch is typically understood to be a portion or percentage of the catch that consists of non-target species (Hall et al., 2000; Pauly, 1984; Romanov, 2002). The decision of whether to keep or discard the catch could be taken place either right away, during the voyage, or when it arrives at the port. By-catch is typically used to identify (1) species non-targeted that are retained and sold, (2) type, size, and sex of non-targeted species that are still allowable to be caught for economic, or personal reasons, and (3) all non-target species retained (for sale) as well as discarded according to Alverson et al. (1994).

By-catch can be categorized into two types. The first is by-product, i.e. non-target species that are kept for sale due to their high economic value, such as beaked fish, pomfret, mackerel, and others (Chapman, 2001). The second one is discards, which are leftovers from the catch that are returned to the ocean due to practical considerations, legal requirements, have no economic value or the skipper's personal preferences (Alverson et al., 1994; Chapman, 2001). Discards might play an important role in the ecosystem, some of them also considered as ETP (endangered, threatened and protected) species which consist of marine mammals, reptiles (sea turtles), seabirds, and pelagic sharks and rays (Morgan et al., 2022) and usually are protected under regional, international and domestic regulation.

The proportion of bycatch and discarded catch is difficult to estimate from data recorded in the logbook due to the reluctance of ship captains to report it (Rochet and Trenkel, 2005). Due to growing concerns on the existence or absence of economic losses, juvenile mortality rates, ecological effects on key species related to the structure and function of the overall ecosystem, and threats to the species involved, which are endangered and of high ethical value, the issue of by-catch and discards has started to receive more attention (Amandè et al., 2010).

Longline is the primary fishing gear type by Indonesian vessels targeting tunas that operate in the Eastern Indian Ocean, with 327 Indonesian longliners operate in 2021 ranged from 10 GT up to less than 200 GT (MMAF, 2022). Longline is considered as a passive gear targeting tuna species. However, the gear has interaction with other species that categorized as bycatch that consisted of by-product and discards. Although it has become a significant problem at the regional level, information on by-catch and discards from the Indonesian tuna longline fishery is still limited. The purpose of this report is to provide bycatch information including ETP species interaction, proportion and distribution from the Indonesian tuna longline fishing activities in the Indian Ocean to support its management strategies.

2. METHODOLOGY

2.1. Data source

Analysis on bycatch and endangered, threaten and protected (ETP) species from tuna longline fishery are conducted through desk study. The ETP species for sharks and rays, under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendices, can be seen in SEAFDEC (2022). It involved of extracting all the data available from published papers, reports and other sources that might be relevant. The primary data was generated from National Reports/Documents submitted by Ministry of Marine Affairs and Fisheries (MMAF) to the Regional Fisheries Management Organization (RFMO), namely Indian Ocean Tuna Commission (IOTC) and Commission on Conservation of Southern Bluefin Tuna (CCSBT). In addition, supporting data was collected from working papers submitted to the respective RFMOs and other peer-reviewed scientific papers.

2.2. Scope of the study

The scope of the study is limited only from Indonesian tuna longline fishery which mainly based in Benoa Port (PU. Benoa) and Cilacap Oceanic Fishing Port (PPS. Cilacap) for the period of 2010-2021. The data taken includes georeferenced information (5x5 degree blocks), species' name and code, observed fate at capture and condition at release. For transparency and reproducibility all of the data sources are publicly available and could be downloaded from the following sites:

- https://www.ccsbt.org/en/content/reports-past-meetings
- https://iotc.org/meetings

2.3. Data analysis

Descriptive statistics were used to describe the catch composition by group species, and catch and effort distribution of Indonesian tuna longline fishery operating in the Eastern Indian Ocean. All statistical analyses were conducted using R version 4.2.0 (R Core Team, 2022). Interaction of bycatch (including ETP species) relative to total catch per setting observed from Indonesian Longline vessels operated in the Eastern Indian Ocean was determined using the following criteria (Table 1).

Table 1. Criteria used to determine level of interaction ETP species with Longline vessels through percentage of occurrence of respective species relative to total catch per setting.

Percentage of occurrence of respective species relative to total catch per setting	Level of interaction
< 5%	Very Low
5 - 25 %	low
25 - 50 %	Medium
50-75 %	High
>= 75 %	Very High

3. RESULTS

3.1. Catch composition

A total of almost 50,000 records consisting of fish, reptiles and marine mammals were identified and recorded during observations period 2010-2021. The catches are then classified into three main groups, namely target species consisting of albacore (*Thunnus alalunga*), yellowfin tuna (*Thunnus albacares*), southern bluefin tuna (*Thunnus maccoyii*), bigeye tuna (*Thunnus obesus*) and some skipjack tuna (*Katsuwonus pelamis*); non-target species (by-catch) consisting of retained (by-product) and discards, including ETP (Endangered, Threatened and Protected) species. On average, only one-third of catches classified as target species, whereas the rest were by-product (25%) and discards as much as 44% (Figure 1). This result was slightly higher compared to study by Setyadji & Nugraha (2015) which stated that the level of discards was around 37% both in live or dead condition.
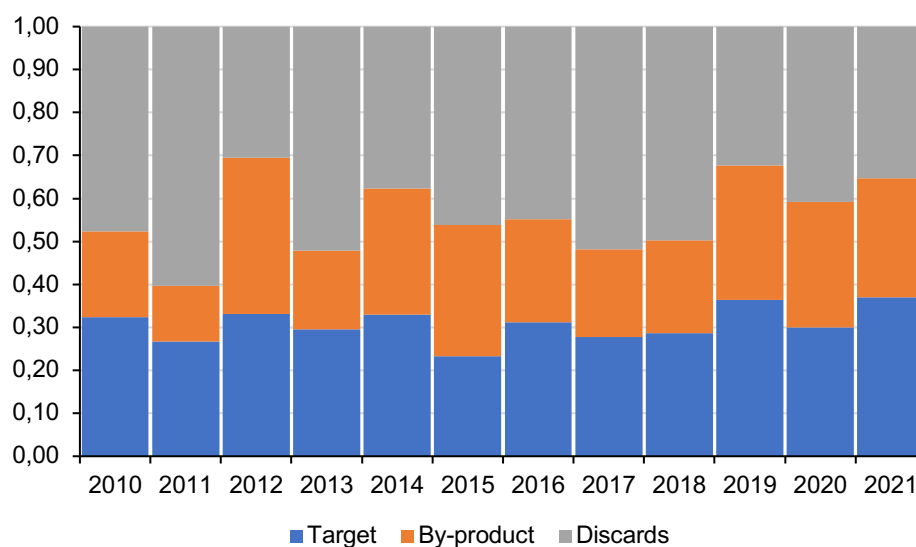

Figure 1. Proportion of catch (no. of fish) according catch category (target, by-product and discards) observed from commercial tuna longline period 2010-2021

Opah and escolar dominated around half of the total by-product from the longline tuna fleet, followed by pomfrets, billfishes and other seerfishes (Figure 2). Almost two-third of the composition of discards group was largely populated by other bony fishes such as long-snouted lancetfish (*Alepisaurus ferox*), whereas the other 20% was consisted of skates and rays, followed by sharks (12%), and very small percentage of marine reptiles and marine mammals and seabirds (Figure 3). A detailed breakdown for discards group (Figure 4) shown that around 55% of the discarded catch was comprised of long-snouted lancetfish. This was followed by pelagic stingray (*Dasyatis* spp) (~22% of discards), blue sharks (*Prionace glauca*) (~9% of discards) and/or crocodile sharks (*Pseudocarcharias kamoharai*) (~5% of discards), whilst the other were relatively negligible.

Long-snouted lancetfish is ever present as a by-catch in longline tuna fisheries, that has no commercial value but it might plays an important role in the pelagic food chain, namely as a predator in micronekton organisms (Romanov et al., 2008) and as prey for beaked fish and tuna (Potier et al., 2007). The existence of the family Bramidae such as the sickle pomfret (*Taractichthys steindachneri*) has long been used as a reference for the presence of tuna, while according to Beverly et al. (2003) species that have economic value such as pomfret, escolar, and opah are found in deep-sea waters and are in groups with bigeye tuna while snake mackerel, long-snouted lancetfish and pelagic stingrays can be caught at any depth of the fishing rod.
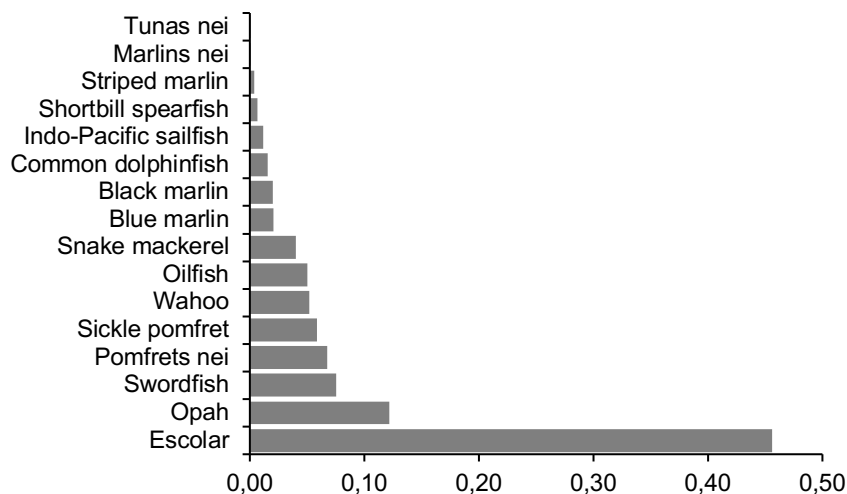

Figure 2. Species composition (by number) of by-product group from commercial tuna longline fleet period 2010-2021
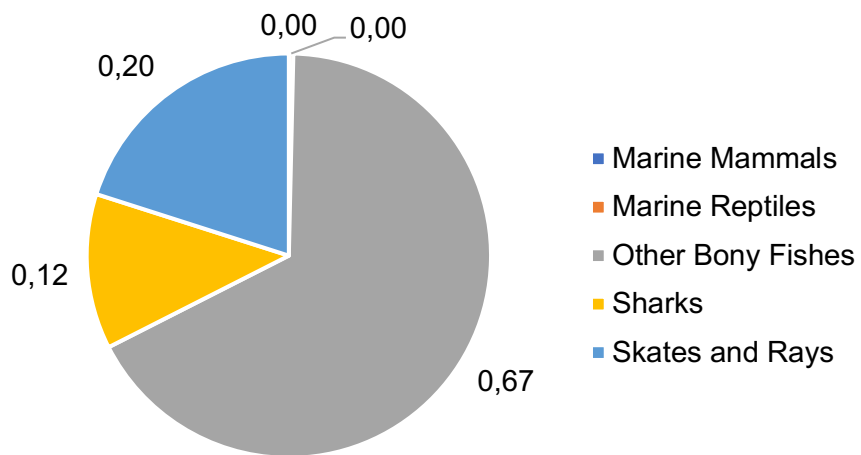
Figure 3. Species composition (by number) of by-catch group from commercial tuna longline fleet period 2010-2021

Figure 4. Species composition (no. of fish) of discards from commercial tuna longline fleet period 2010-2021

3.2. ETP (Endangered, Threatened and Protected) species

ETP species was largely discovered as a result of unwanted catches (by-catch) from longline gears. The government has ratified by-catch mitigation measures that have been established by regional fisheries management organization (RFMOs) through 58/PERMEN-

KP/2020 (Articles 107-113) and 10/PERMEN-KP/2021. In general, if there are by-catches, such as: (1) sharks and rays, if caught alive then it must be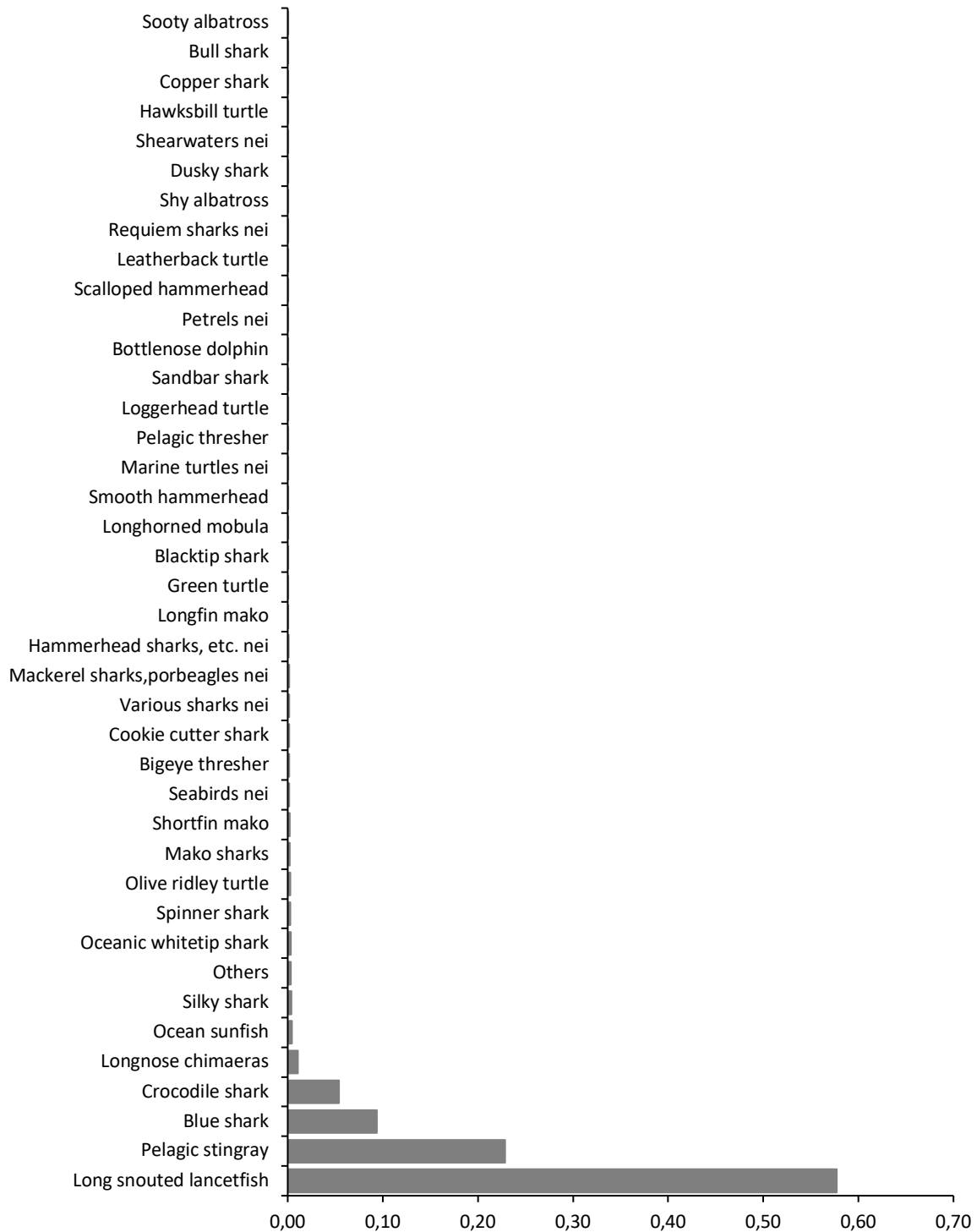 released, if dead can be fully utilized (all fins are still attached to the shark's body when landed). Unless, for prohibited and protected species, it must be released and recorded in the logbook; (2) marine reptiles, life or death must be released and recorded in the logbook; (3) seabirds, life or death must be released and recorded in the logbook; (4) marine mammals, life or death must be released and recorded in the logbook. Based on recent regulations, Table 1 provided the ETP species currently acknowledged by the Government of Indonesia.

Table 1. ETP species currently listed under current Indonesian Government regulations

No	Species/Group	RFMO Regulations	National Regulations
1	Whale sharks (*Rhincodon typus*)	• IOTC Resolution 13/05 • WCPFC Resolution 2012/04 • Appendix II CITES 2003	• 18/KEPMEN-KP/2013
2	Thresher Sharks (Alopiidae)	• IOTC Resolution 12/09	• 58/PERMEN-KP/2020 • 10/PERMEN-KP/2021
3	Blue sharks (*Prionace glauca*)	• IOTC Resolution 18/02	• 58/PERMEN-KP/2020
4	Oceanic whitetip sharks (*Carcharhinus longimanus*)	• WCPFC Resolution 2011/07 • Appendix II CITES 2013	• 48/PERMEN-KP/2018
5	Silky shark (*Carcharhinus falciformis*)	• WCPFC Resolution 2013/08	• 58/PERMEN-KP/2020 • 10/PERMEN-KP/2021
6	Hammerhead shark (*Sphyrna spp*)	• Appendix II CITES 2013	• 48/PERMEN-KP/2018
7	Sharks listed in Annex 1 of the 1982 Convention	• WCPFC CMM 2019/04	• 58/PERMEN-KP/2020 • 10/PERMEN-KP/2021 • 48/PERMEN-KP/2018
8	Sea turtle (marine reptiles): 1) Green turtle (*Chelonia mydas*) 2) Flatback turtle (*Natator depressus*) 3) Olive ridley turtle (*Lepidochelys olivacea*) 4) Leatherback sea turtle (*Dermochelis corieacea*)	• IOTC Resolution 12/04 • WCPFC Resolution 2008/03 • WCPFC Resolution 2018/04	• NPOA Sea turtle Conservation 2016-2020 • 58/PERMEN-KP/2020 • Government Regulation No. 5 Tahun 1990 • Minister of Forestry Decree No. 882/Kpts/-II/1992 & No. 771/Kpts/-II/1996 • Government Regulation No. 7 & 8 Tahun 1999

No	Species/Group	RFMO Regulations	National Regulations
	5) Hawksbill turtle (*Eretmochelys imbricata*) 6) Loggerhead turtle (*Caretta caretta*)		
9	Seabirds	• Resolusi IOTC 12/06 • Resolusi WCPFC 2018/03	• 58/PERMEN-KP/2020
10	Marine mammals 1) Dolphins 2) Fake killer whale 3) etc.	• Resolusi IOTC 12/06	• 58/PERMEN-KP/2020

A further breakdown on the shark's species group showed that the main contributor was blue sharks, which comprised almost 40%, followed by crocodile sharks around 12%, while the others had far lower probability (less than 5%) (Figure 5). Blue sharks is the common by-catch for longline fisheries (Fahmi and Dharmadi, 2015), especially those which targeting swordfish (Carruthers et al., 2011). However, for crocodile sharks it is still one of the least studied and known among group of pelagic sharks (Ferrette et al., 2015). A known distribution of blue sharks and crocodile sharks from Indonesian tuna longline fisheries are shown in Figure 6. High abundance of blue sharks was located below 20°S, whereas for crocodile sharks it's mostly caught in the Indonesian EEZ up to 20°S.
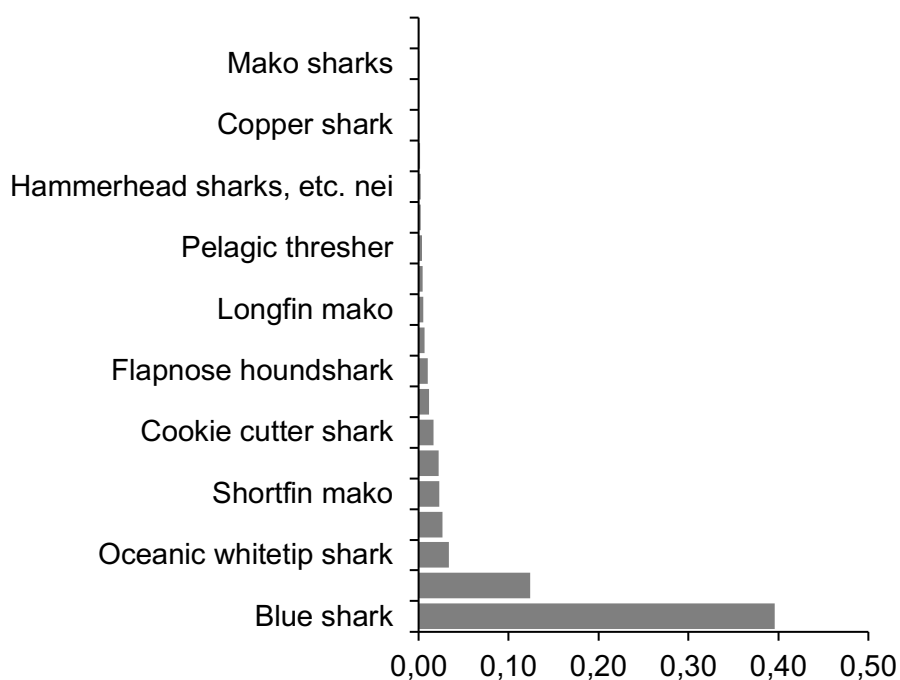

Figure 5. Probability of capture of shark species group from commercial tuna longline fleet period 2010-2021. Data source: National Reports/Documents submitted by MMAF to IOTC and CCSBT.
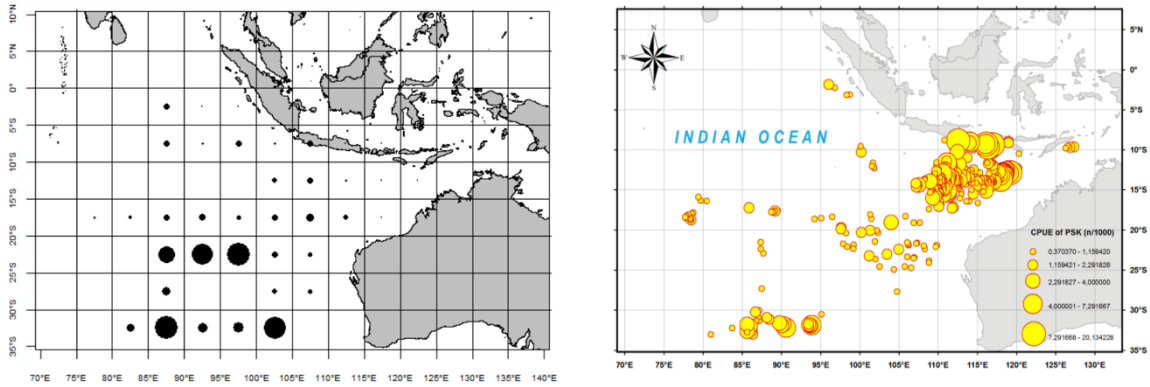
Figure 6. Known distribution of blue sharks (Prionace glauca) and crocodile sharks (P. kamoharai) from Indonesian tuna longline fisheries. Data source: Paper presented by MMAF to Working Party on Ecosystem and By-catch (WPEB).

According to the CITES, long-snouted lancetfish and pelagic stingray are categorized as not evaluated and least concern species, respectively, while blue sharks and crocodile sharks are near threatened species and not evaluated due data deficient under CITES, respectively. Level of interaction of bycatch (including ETP species) relative to total catch per setting observed from Indonesian Longline vessels operated in the eastern Indian Ocean was categorized using **Error! Reference source not found.**. Among the discard species (Figure 4), long-snouted lancetfish was categorized as high level of interaction (50 - 70%), pelagic stingray and blue sharks as medium level of interaction (25 – 50%), and crocodile sharks as low level of interaction (5 – 25%), whilst others discarded species were very low (< 5%) (Table 3).

Table 3. Interaction of bycatch including ETP species relative to total catch per setting observed from Indonesian Longline vessels operated in the Eastern Indian Ocean

Group	Common name	Scientific latin name	CITES Status	Level of interaction
Requiem sharks	Bull shark	*Carcharhinus leucas*	Near threatened	Very Low
	Copper shark	*Carcharhinus brachyurus*	Near Threatened	Very Low
	Dusky shark	*Carcharhinus obscurus*	Vulnerable	Very Low
	Requiem sharks nei	*Carcharhinus spp*	NA	Very Low
	Sandbar shark	*Carcharhinus plumbeus*	Vulnerable	Very Low
	Blacktip shark	*Carcharhinus limbatus*	Appendix II	Very Low
	Oceanic whitetip shark	*Carcharhinus longimanus*	Appendix II	Very Low
	Silky shark	*Carcharhinus falciformis*	Appendix II	Very Low
	Spinner shark	*Carcharhinus brevipinna*	Near threatened	Very Low
Hammerhead sharks	Scalloped hammerhead	*Sphyrna lewini*	Appendix II	Very Low
	Hammerhead sharks	*Sphyrna spp*	Appendix II	Very Low
	Smooth hammerhead	*Sphyrna zygaena*	Appendix II	Very Low
Thresher sharks	Pelagic thresher	*Alopias pelagicus*	Appendix II	Very Low
	Bigeye thresher	*Alopias superciliosus*	Appendix II	Very Low
	Thresher sharks nei	Alopidae	NA	Very Low
Mackerel sharks	Longfin mako	*Isurus paucus*	Appendix II	Very Low
	Shortfin mako	*Isurus oxyrinchus*	Appendix II	Very Low
	Mako sharks	*Isurus spp*	Appendix II	Very Low
	Porbeagle	*Lamna nasus*	Appendix II	Very Low
	porbeagles nei		NA	Very Low
	Crocodile shark	*Pseudocarcharias kamoharai*	Not evaluated	**Low**
	Blue shark	*Prionace glauca*	Near threatened	**Medium**
	Tiger shark	*Galeocerdo cuvier*	Near Threatened	Very Low
	Cookie cutter shark	*Isistius brasiliensis*	Least Concern	Very Low
	Flapnose houndshark	*Scylliogaleus quecketti*	Vulnerable	Very Low
	Various sharks nei		NA	Very Low
Other Fishes	Longnose chimaeras	*Rhinochimaeridae*	Least concern	Very Low
	Ocean sunfish	*Mola mola*	Vulnerable	Very Low
	Long snouted lancetfish	*Alepisaurus ferox*	Not Evaluated	**High**
	Bottlenose doplhin	*Tursiops truncatus*	Near threatened	Very Low
Rays	Banded eagle ray	*Aetomylaeus nichofii*	Not Evaluated	Very Low
	Pelagic stingray	*Dasyatis Spp*	Least Concern	**Medium**
	Spinetail mobula	*Mobula japanica*	Near Threatened	Very Low
	Longhorned mobula	*Mobula eregoodoo*	Endangered	Very Low
Sea Turtle	Flatback turtle	*Natator depressus*	Data deficient	Very Low
	Hawksbill turtle	*Eretmochelys imbricata*	Endangered	Very Low
	Leatherback turtle	*Dermochelys coriacea*	Endangered	Very Low
	Loggerhead turtle	*Caretta caretta*	Endangered	Very Low
	Green turtle	*Chelonia mydas*	Endangered	Very Low
	Olive ridley turtle	*Lepidochelys olivacea*	Endangered	Very Low
	Marine turtles nei		NA	Very Low
Seabirds	Shy albatross	*Thalassarche cauta*	Endangered	Very Low
	Petrels nei		NA	Very Low
	Sooty albatross	*Phoebetria fusca*	Endangered	Very Low
	Flesh-footed shearwater	*Ardenna carneipes*	Near Threatened	Very Low
	Shearwaters nei		NA	Very Low

Note: CITES Status in this table is subject to change according to the most recent updates. This table is not aimed to determine the CITES Status rather being used as an approach to obtain the level of ETP interaction with Indonesian tuna Longline fishery.

4. CONCLUSION

Longline is considered as a passive gear targeting tuna species. However, the gear has interaction with other species that categorized as bycatch that consisted of by-product and discards. Around 25% of the catches are by-product and around 44% are discards. A large portion of the discards are populated by long-snouted lancetfish (55% of the discards), followed by pelagic stingray (*Dasyatis* spp) (~22% of discards), blue sharks (*Prionace glauca*) (~9% of discards) and/or crocodile sharks (*Pseudocarcharias kamoharai*) (~5% of discards), whilst the other were relatively negligible. Among the discard species, long-snouted lancetfish was categorized as high level of interaction (50 - 70%), pelagic stingray and blue sharks as medium level of interaction (25 – 50%), and crocodile sharks as low level of interaction (5 – 25%), whilst others discarded species were very low (< 5%). A by-catch mitigation implementation and its monitoring needs to be improved to decrease fishing mortality of ETP by longline fishery.

5. REFERENCES

Alverson, D.L., Freeberg, M.H., Murawski, S.A., Pope, J.G., 1994. A global assessment of fisheries bycatch and discards, FAO Fisheries Technical Paper. Food and Agriculture Organization (FAO) of the United Nations, Rome.

Amandè, M.J., Ariz, J., Chassot, E., de Molina, A.D., Gaertner, D., Murua, H., Pianet, R., Ruiz, J., Chavance, P., 2010. Bycatch of the European Purse Seine Tuna Fishery in the Atlantic Ocean for the 2003– 2007 Period. Aquatic Living Resources 23, 353–362.

Beverly, S., Chapman, L., Sokimi, W., 2003. Horizontal longline fishing methods and techniques: a manual for fishermen. Secretariat of the Pacific Community Nouméa, New Caledonia.

Carruthers, E.H., Neilson, J.D., Smith, S.C., 2011. Overlooked bycatch mitigation opportunities in pelagic longline fisheries: soak time and temperature effects on swordfish (*Xiphias gladius*) and blue shark (*Prionace glauca*) catch. Fisheries Research 108, 112–120.

Chapman, L., 2001. Bycatch in the tuna longline fishery. Presented at the 2nd SPC Heads of Fisheries Meeting, Secretariat of Pacific Community, Noumea, New Caledonia, p. 33.

Fahmi, Dharmadi, 2015. Pelagic Shark Fisheries of Indonesia's Eastern Indian Ocean Fisheries Management Region. African Journal of Marine Science 37, 259–265. https://doi.org/10.2989/1814232X.2015.1044908

Ferrette, B.L. da S., Mendonça, F.F., Coelho, R., Oliveira, P.G.V. de, Hazin, F.H.V., Romanov, E.V., Oliveira, C., Santos, M.N., Foresti, F., 2015. High Connectivity of the Crocodile Shark between the Atlantic and Southwest Indian Oceans: Highlights for Conservation. PLOS ONE 10, e0117549. https://doi.org/10.1371/journal.pone.0117549

Hall, M.A., Alverson, D.L., Metuzals, K.I., 2000. By-catch: problems and solutions. Marine pollution bulletin 41, 204–219. https://doi.org/10.1016/S0025-326X(00)00111-9

Morgan, A., Mendes, M., Tingley, G., Brian, S.W., Sousa, P., 2022. Have Fishery Improvement Projects (FIPs) adequately addressed key needs to monitor and mitigate fishery impacts on endangered, threatened, and protected (ETP) species? A review, with recommendations to the supply chain. Marine Biology Research 1–14. https://doi.org/10.1080/17451000.2022.2096903

Pauly, D., 1984. Fish Population Dynamics in Tropical Waters: A Manual for Use with Programmable Calculators. International Center for Living Aquatic Resources Management, Manila, Philippines.

Potier, M., Marsac, F., Cherel, Y., Lucas, V., Sabatié, R., Maury, O., Ménard, F., 2007. Forage fauna in the diet of three large pelagic fishes (lancetfish, swordfish and yellowfin tuna) in the western equatorial Indian Ocean. Fisheries Research 83, 60–72. https://doi.org/10.1016/j.fishres.2006.08.020

R Core Team, 2022. R: A language and environment for statistical computing.

Rochet, M.-J., Trenkel, V.M., 2005. Factors for the variability of discards: assumptions and field evidence. Canadian Journal of Fisheries and Aquatic Sciences 62, 224–235. https://doi.org/10.1139/f04-185

Romanov, E.V., 2002. Bycatch in the Tuna Purse-Seine Fisheries of the Western Indian Ocean. Fishery Bulletin 100, 90–105.

Romanov, E.V., Ménard, F., Zamorov, V.V., Potier, M., 2008. Variability in conspecific predation among longnose lancetfish Alepisaurus ferox in the western Indian Ocean. Fisheries Science 74, 62–68. https://doi.org/10.1111/j.1444-2906.2007.01496.x

SEAFDEC, 2022. The Southeast Asian State of Fisheries and Aquaculture 2022. Southeast Asian Fisheries Development Center. http://repository.seafdec.org/handle/20.500.12066/6752.

Setyadji, B., Nugraha, B., 2015. Ikthisar Hasil Tangkapan Sampingan Dan Terbuang Dari Armada Perikanan Rawai Tuna Indonesia Di Samudera Hindia, in: Prosiding Simposium Nasional Pengelolaan Perikanan Tuna Berkelanjutan. Kementerian Kelautan dan Perikanan, Bali, Indonesia, pp. 317–324.