Planet Tracker

IN HOT WATER

Climate change will wipe out tuna profits in Indonesian waters unless investors support nine nature-positive actions

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WHY YOU SHOULD READ THIS REPORT

It is an all too familiar story. **An industry fully relies on nature** to derive economic benefits, **but treats it as an externality**.

After many years of short termism and limited care for the industry's most important asset – nature – growth prospects are faltering and costs are piling up. Opaque and complex supply chains prevent accountability and thus meaningful reparative action; neither corporates nor regulators agree on the path forward.

Meanwhile, the climate clock is ticking, and every year that passes makes inaction costlier. **Future profits decline, nature is depleted and local people bear the brunt of inaction.**

In this investigation of one of the most nature-dependent industries on earth[1], Planet Tracker reveals who controls the fate of one of the most biodiverse waters in the world, and demonstrates that the few **companies who are doing good** relative to the others **are also doing well.**

But transformative action is urgently needed: the climate crisis will take a severe toll on profits. Implementing a series of concrete nature-positive measures could offset this, but at a short-term cost. Will companies and investors realise that it is in their interest to **think of nature as a hedge on climate**, and support these measures?

1 The tuna fishing industry in Indonesia

EXECUTIVE SUMMARY

Tuna: too big to fail

Tuna are keystone species: they help define an entire ecosystem. Top predators in the ocean food chain, they move nutrients throughout the water column, thus fertilising phytoplankton, a key producer of the oxygen we breathe and absorber of the carbon dioxide we release. **For the ocean to be healthy, tuna populations need to be healthy too.** Yet they face major threats, from overexploitation to climate change.

With a 15% global volume share, **no country produces more tuna than Indonesia**. But out of the 791,000 tonnes of tuna caught in 2021 in Indonesian waters, the majority is overfished, subject to overfishing or harvested above recommended limits. Change is needed.

Revealing who controls the world's largest tuna fishing industry

Understanding which companies and investors hold the keys to the future of tuna in Indonesia required the identification of the ultimate beneficial owners of the local tuna fishing industry. Due to data limitations, this investigation focused on large-scale fleets (>60GT), which account for 39% of tuna production. Comparing each of the c.140,000 fishing occurrences recorded by Global Fishing Watch in Indonesian waters between January 2019 & September 2022 to tuna species distribution maps, Planet Tracker identified the large-scale vessels most likely catching tuna, and for each of them traced the ultimate beneficial owner.

Out of a total of 136 different ultimate owners, of which five are publicly listed, **10% control an estimated 70% of the tuna** harvested in Indonesian waters by industrial fleets tracked by Global Fishing Watch. All owners of Indonesian-flagged vessels are located in Indonesia, mostly in Jakarta or Denpasar.

Figure 1: *Tuna Fishing Events By Industrial Vessels In Indonesian Waters (Dots) and Registered Addresses of Vessel owners (Triangles) (Source: Planet Tracker, based on Global Fishing Watch and Indonesian Government data, Jan. 2019-Sep. 2022).*

Transparency is poor: none of the 136 entities disclose the volume of tuna they catch. Three of them were accused of allegedly engaging in IUU[2] fishing in the past, and one of them was accused of forced labour.

Companies that are doing good are doing well

Having scored the sustainability of each tuna vessel, Planet Tracker researched the financials of each of their owners. Contrary to a popular opinion, the least sustainable companies were not found to be more profitable. And encouragingly, **the profitability of those companies ranking top for sustainability was in line with or above the average.**

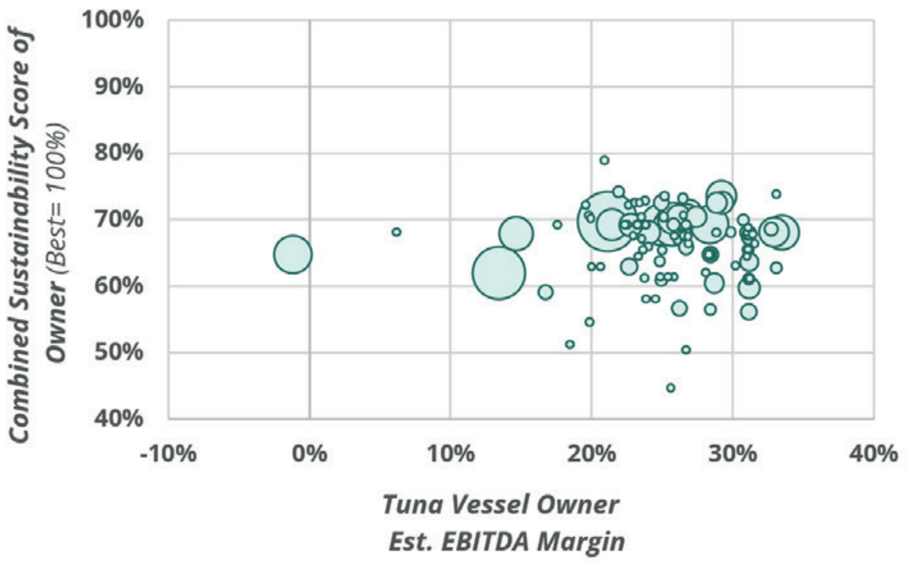


Figure 2: *Profitability vs. Sustainability Score Of Owners Of Tuna Fishing Vessels (Source: Planet Tracker. Note: a) The Size Of Each Bubble Is Proportional To The Tuna Volumes Caught; b) High Loss-Making Outliers Are Not Displayed).*

Climate change to wipe out the industry's profit

With an estimated EBITDA margin of 12%, fishing tuna in Indonesia is a reasonably profitable business, although considerably less so than, e.g. the more sustainably managed Alaska pollock fishery, one of the largest globally (see Pollockonomics). And **without fuel subsidies, it would be heavily loss-making.**

Yet that relative financial health is at risk: comparing the probability of occurrence of each tuna species between now and 2050 under two climate scenarios (RCP[3] 4.5 and RCP8.5), Planet Tracker calculated that the industrial tuna fishing fleet operating in Indonesia will catch between 25% and 31% less tuna by 2050 compared to 2022.

2 Illegal, Unreported and Unregulated

3 The Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory used by the IPCC

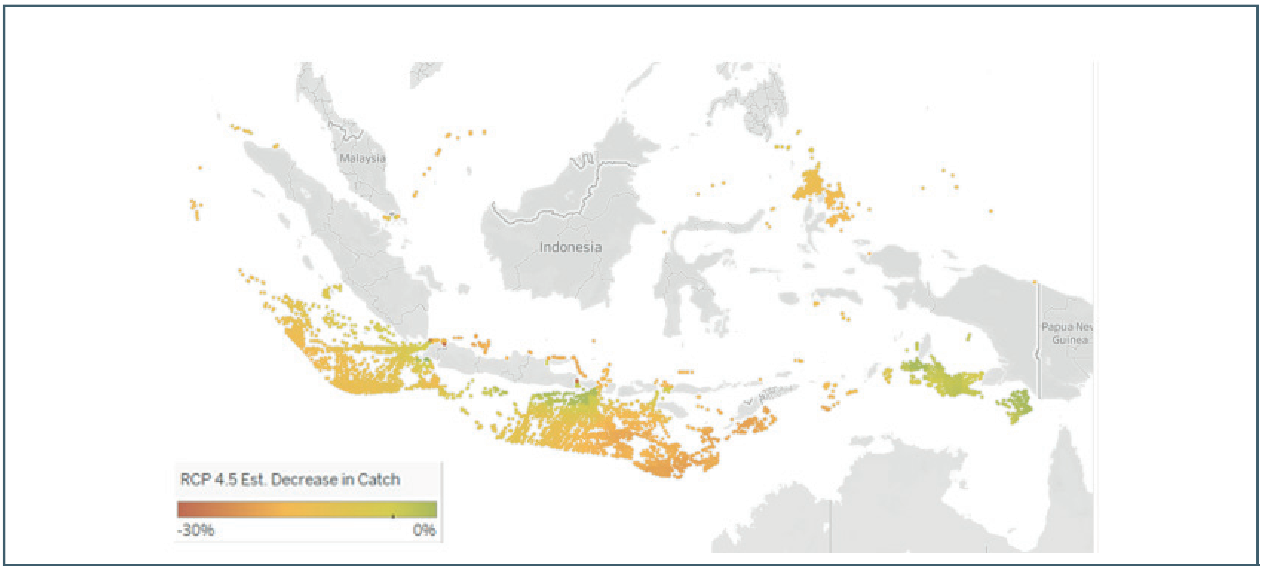


Figure 3: *Estimated Decrease in Catch Attributable to the Changing Distribution of Skipjack and Yellowfin Tuna Due to Climate Change under RCP Scenario 4.5 Compared to Current Values (Source: Planet Tracker, Based On AquaMaps)*

As a result, **the industry's revenue is likely to drop by c. 30% by 2050** compared to current levels (everything else being equal, i.e. excluding any price increases or technology-related efficiency gains). Depending on the industry's and the government's reaction, this is likely to lead to a **near or total disappearance of the industry's profits.**

Investors need to support nine nature-positive actions to rebuild profits

Avoiding that outcome is possible, by investing in nature. The 136 owners identified by Planet Tracker could more than offset the toll the climate crisis will have on their profits by taking the nine following concrete actions:

1. **Reduce pressure on overexploited tuna** stocks[4] by at least 20%.
2. Adopt a **responsible drifting FAD[5] policy.**
3. Invest in GDST[6] - compliant **tuna traceability.**
4. Enable supply chain transparency by **disclosing the volume of species caught.**
5. Choose **selective fishing methods** to reduce bycatch.
6. **Retain all fished tuna**, except those unfit for human consumption.
7. Participate in **sustainable tuna fishing initiatives**, such as AP2HI[7], ATLI[8], Fisheries Improvement Projects (FIP) or Marine Stewardship Council (MSC) certification.
8. Replace crude palm oil by **used cooking oil** as a feedstock for biodiesel.
9. **Link their financial health to the environmental health** of the fish populations they rely on and take action to improve both.

Whilst implementing these recommendations will require a short-term investment, together they will help long-term EBITDA be 16% higher, despite the severe impact of climate change.

4 Bigeye tuna and yellowfin tuna in the Indian Ocean
5 Fish Aggregating Devices: man-made, typically floating wooden structures with hanging nets to attract fish.
6 Global Dialogue on Seafood Traceability, an organisation that set standards for seafood traceability to enable interoperability across supply chains
7 The Indonesian Pole & Line and Handline Tuna Fisheries Association
8 The Indonesian Tuna Longline Association

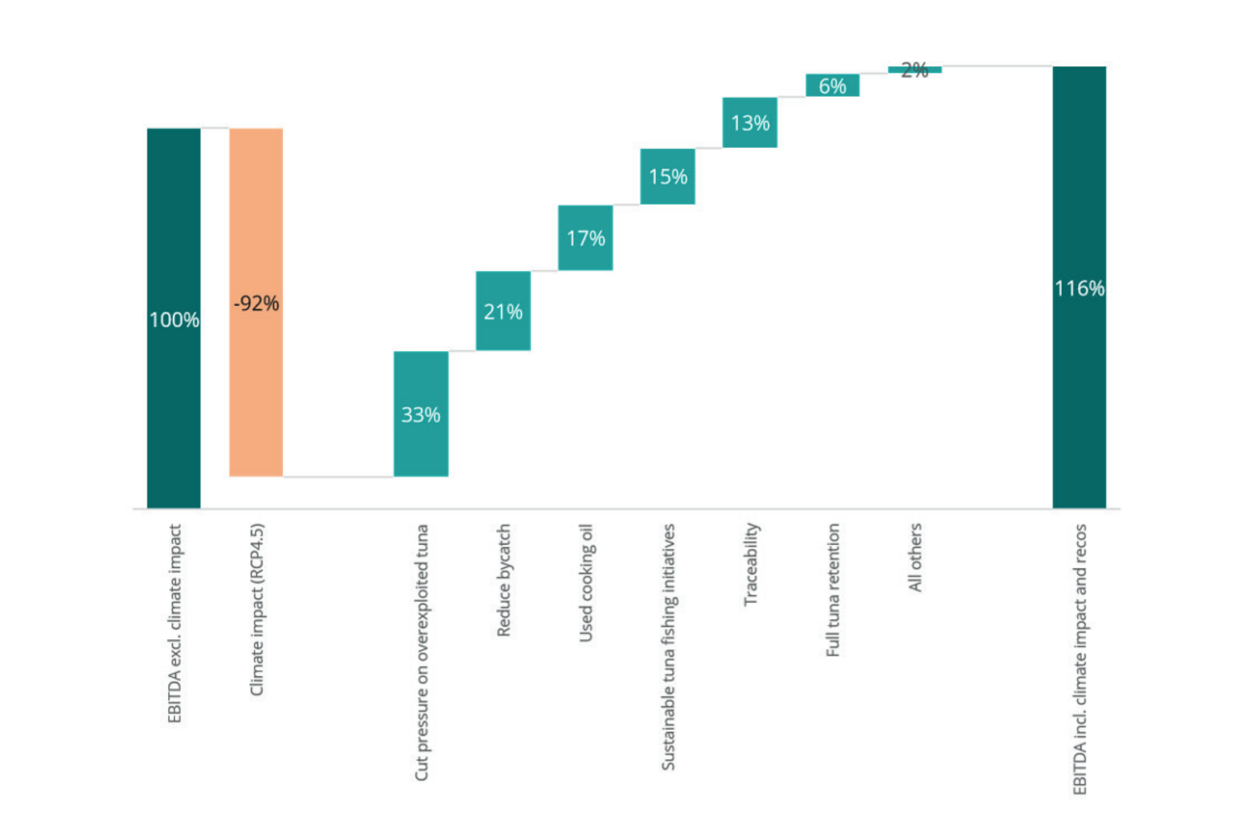


Figure 4: *Impact of Climate Change (RCP 4.5 Scenario) and Planet Tracker Recommendations on Long Term EBITDA as a % Of 2050 EBITDA before Climate Impact*

To reach these conclusions, a combination of third-party data, in-house modelling and on-the-ground research was used. Our methodological approach is summarised below and detailed in **Appendix 1: Methodology**.

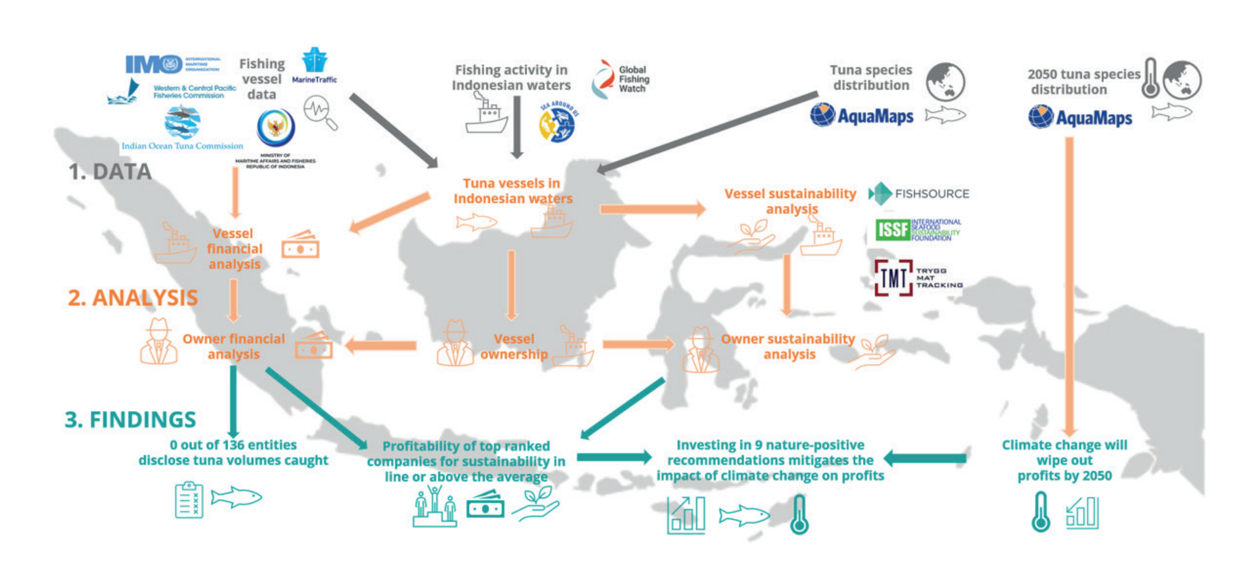


Figure 5: *How Planet Tracker Investigated the Indonesian Tuna Fishing Industry (Source: Planet Tracker, Logos Indicate Key Third Party Data Sources Used)*

INTRODUCTION

This section explains why Planet Tracker focused on the Indonesian tuna fishing industry and outlines our approach to assess the sustainability of that industry and overlay it with its financial health.

Why tuna in Indonesia?

Why tuna?

After a deep-dive on the shrimp (see 'Shell Shock'), salmon (see 'Loch-ed Profits') and Alaska pollock (see 'Pollockonomics') industries, Planet Tracker turns its attention to another top-traded seafood commodity: tuna.

In this investigation of the tuna industry, we reveal who controls tuna populations, what's in it for them (i.e. how profitable fishing companies are), what's in it for us all (i.e., how their operations affect the sustainability of ecosystems and the climate), and how a symbiosis between the two is possible.

We focus on tuna since they are a keystone species, meaning that they help define an entire ecosystem. Tuna are top predators in the ocean food chain that also move nutrients throughout the water column. This helps fertilize the surface waters, thus helping phytoplankton (a key producer of the oxygen we breathe) to thrive.

For the ocean to be healthy, tuna populations need to be healthy too. Understanding who can either support or hurt tuna populations and if needed changing their practices is therefore a key need to safeguard biodiversity and mitigate climate change.

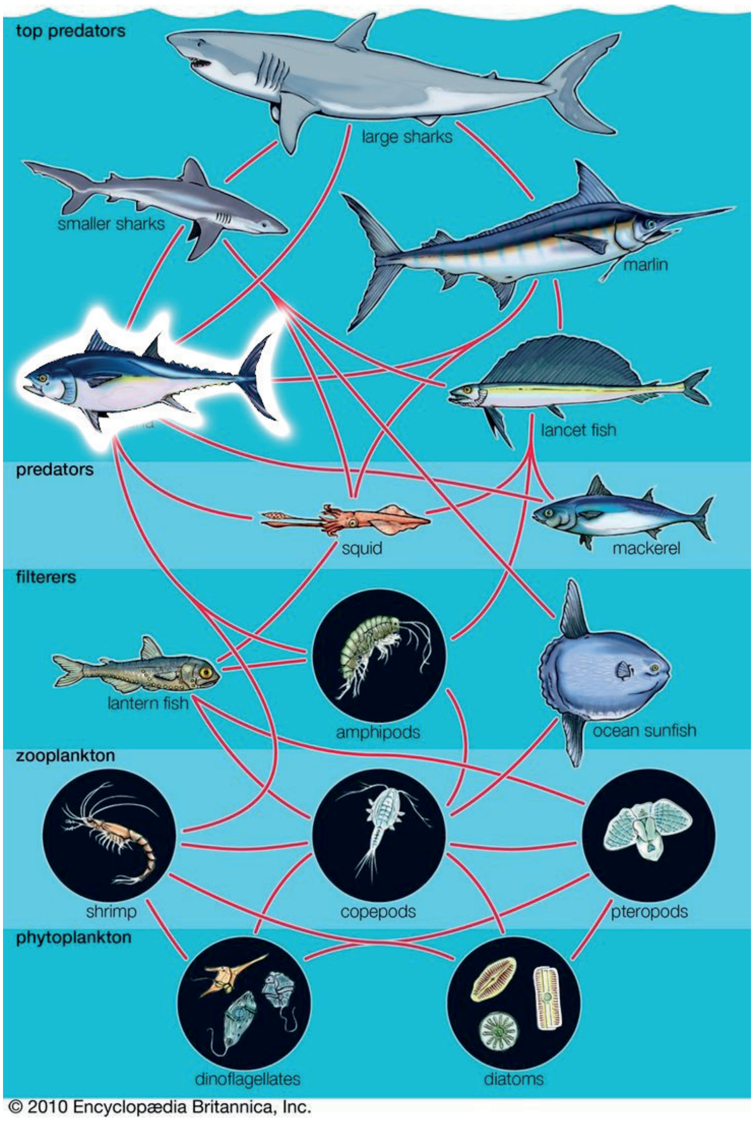


Figure 6: *Tuna in the Aquatic Food Web (Source: Encyclopaedia Britannica).*

Why Indonesia?

Indonesia is the largest tuna producer in the world. In 2021, the country produced 791,000 tonnes of tuna - more than 15% of global tuna supply.[i] Tuna is one of Indonesia's most valuable fish exports.[ii]

Vital to Indonesia's economy and global food security, the local fishing industry contributed 2.77% to the country's GDP in 2021[iii] but has long been challenged by unsustainable fishing practices, including overfishing, Illegal, Unreported and Unregulated (IUU) fishing and destructive fishing practices.

Unsustainable fishing has serious implications for food safety, fish populations, fisheries, marine ecosystems and coastal communities. These negative impacts on the ecosystems can also negatively impact the financials of fishing companies, as seen in the Japanese seafood industry (see Against the Tide).[iv]

This report aims to reveal the beneficial owners and financial backers of the tuna fishing industry in Indonesian waters to analyse its long-term financial health in light of its environmental impact and climate change. In brief, the two main questions we seek to answer are:

Who controls the fate of tuna populations in Indonesia?

Does it pay to be sustainable when catching tuna?

Our approach

To answer the above questions , we followed a step-by-step approach summarised below, and detailed in '**Appendix 1: Methodology**':

1. Identify tuna species that occur in Indonesia *(source: AquaMaps)*
2. Identify fishing vessels in Indonesian waters *(source: GlobalFishingWatch - GFW)*
3. Identify which of these vessels catch tuna *(source: Planet Tracker)*
4. Gather data on each vessel *(source: GFW, RFMOs, Indonesian government, ISSF, Trygg Mat Tracking)*
5. Establish a methodology to assess the sustainability of each vessel *(source: Planet Tracker)*
6. Attribute a sustainability score to each tuna vessel *(source: FishSource, ISSF, IMO, GFW)*
7. Identify the owner of each tuna vessel *(source: Indonesian government, GFW, RFMOs)*
8. Establish a methodology to assess the sustainability of each owner *(source: Planet Tracker)*
9. Attribute a sustainability score to each vessel owner *(source: FishSource, ISSF, Trygg Mat Tracking, MSC,GFW, IMO, EU IUU Fishing Coalition, IUU Fishing Index, Combined IUU Vessel List)*
10. Estimate the profitability of tuna fishing operations for each vessel owner *(source: Planet Tracker)*
11. Compare the sustainability score to the financial health of each owner *(source: Planet Tracker)*
12. Integrate climate impacts on tuna profitability *(source: AquaMaps, Planet Tracker)*
13. Recommend actions to improve the industry's sustainability (*source: Planet Tracker*)
14. Compare the industry's future profitability with or without our recommendations *(source: Planet Tracker)*

Figure 7: *How Planet Tracker Analysed the Financial Health and Environmental Impact of the Indonesian Tuna Fishing Industry (Source: Planet Tracker)*

TRACKING TUNA VESSELS IN INDONESIAN WATERS

This section portrays the tuna fishing industry in Indonesia and discusses its sustainability.

Overview of the tuna fishing industry in Indonesia

The 791,000 tonnes of tuna caught in Indonesian waters in 2021 (up c.6% vs 748,000 tonnes in 2020) are valued at 22 trillion rupiah (about USD 1.5 billion).[v]

Nine species of tuna occur in Indonesia (see **Appendix 1**), but the majority of the tuna catch in volume terms comes from skipjack tuna (62%) and yellowfin tuna (28%).

Globally, tunas are typically caught by purse seine, gillnet, longline, handline, pole-and-line, troll and traps.[vi] In Indonesia, half of tuna is caught by purse seine each year, followed by handline (c. 20% of the catch),[vii] gillnet and other hook and lines.[viii]

The majority of the catch comes from vessels with a relatively low tonnage (< 60 GT, see below).

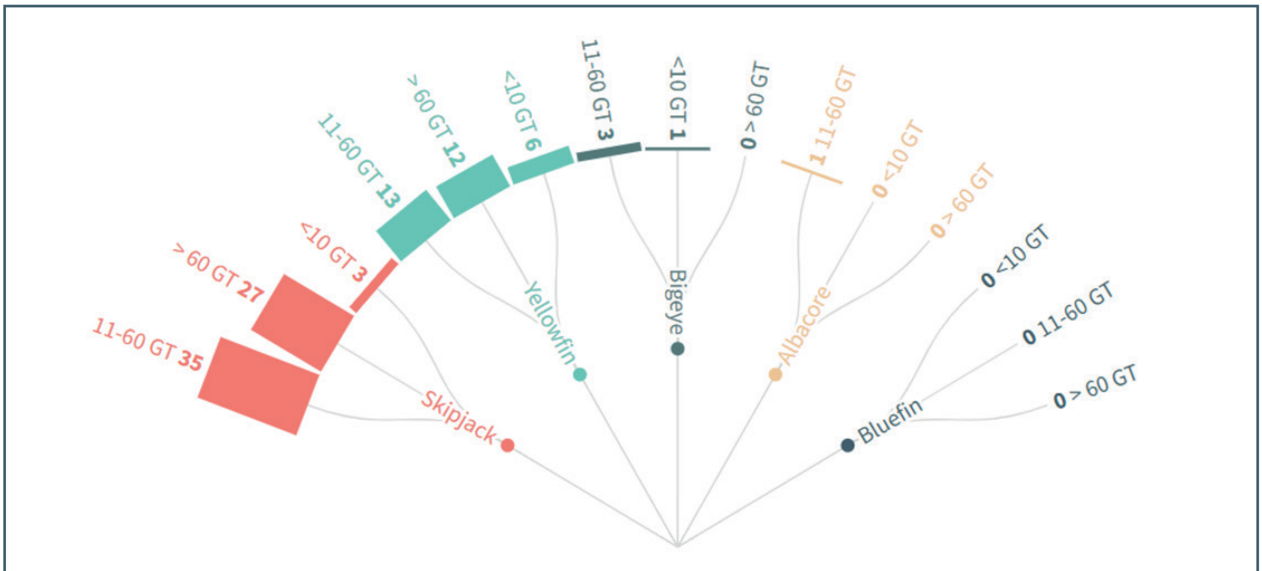


Figure 8: *Percentage Distribution of Tuna Catch by Species and Gross Tonnage in Indonesia (Source: Planet Tracker, based on MMAF)*

Among the tuna species that occur in Indonesia:

- Skipjack is not considered overfished or subject to overfishing, but its catch limits in the Indian ocean have been ignored in recent years[ix]
- Yellowfin tuna is overfished and subject to overfishing in the Indian Ocean[x]
- Bigeye tuna is subject to overfishing in the Indian Ocean[xi]
- Southern bluefin tuna is listed as Endangered by the IUCN,[xii]
- Catches of kawakawa (also called mackerel tuna) in the Indian Ocean have surpassed the maximum sustainable yield (MSY) consistently since 2011.[xiii]

Importantly, the state of a given species varies depending on where the stock is assessed: yellowfin and bigeye tuna caught in the Western and Central Pacific Ocean are not overfished nor subject to overfishing- see Table 3.

***Table 3:** Tuna Stock Status Data Relevant To Indonesian Tuna (Source: FishSource. A score below 6 indicates overfishing unless otherwise specified, whilst 10 is the maximum possible score)*[xiv]

Tuna species	Stock status	Indian Ocean	Western & Central Pacific
Skipjack tuna	Current health	10	10
	Future health	10	8.3
Yellowfin tuna	Current health	<6	10
	Future health	<6	10
Bigeye tuna	Current health	≥ 6	10
	Future health	<6	9
Southern bluefin tuna	Current health	1.3	1.3
	Future health	≥ 6	≥ 6
Bullet tuna	Current health	Not Yet Scored	Not Yet Scored
	Future health	Not Yet Scored	Not Yet Scored
Frigate tuna	Current health	Not Yet Scored	Data Deficient
	Future health	Not Yet Scored	Data Deficient
Kawakawa	Current health	≥ 6	Not Yet Scored
	Future health	<6	Not Yet Scored
Longtail tuna	Current health	8	Data Deficient
	Future health	6.3	Data Deficient

Box 1: Uncertain future for yellowfin tuna in the Indian Ocean

Back in March 2021, Planet Tracker published 'Tracking Overfishing: Preventing Yellowfin Tuna Collapse in the Indian Ocean' in anticipation of the IOTC[9] meeting in the same year, calling for a 20% reduction in catch from 2014 levels for the Indian Ocean yellowfin tuna stock to prevent a collapse by 2026.

Unfortunately, the IOTC has been unable to effectively control fishing for the stock even though five resolutions have been adopted since 2016. In 2020, catches of yellowfin tuna in the Indian Ocean exceeded sustainable levels by 32%.[xv]

The latest stock assessment released in 2022 suggested the stock is still overfished and subject to continued overfishing.[xvi] No agreement was reached on the recovery of yellowfin tuna, (nor setting catch limits for skipjack tuna) during the latest session held in Mauritius in May 2023.

In June 2023, the Indonesian fisheries ministry published a harvest strategy paper which expands on an interim harvest strategy applied since 2018[xvii] and is expected to come into effect no later than 2026, having witnessed the depleting population of skipjack tuna and yellowfin tuna in the country's fishing grounds.

In addition to being an ecological and social catastrophe, a collapse of the yellowfin tuna would have financial consequences for the companies that rely on it.

As per Planet Tracker's Seafood Database, out of 100 seafood companies analysed, at least 22 are sourcing yellowfin tuna (not necessarily from the Indian Ocean, but there is often a lack of transparency on the geographical origin). These include for instance listed companies Dongwon Industries, Maruha Nichiro, Nichimo, Nissui, Oceana Group, OUG Holdings, Sajodaerim, Shanghai Kaichuang Marine International, Thai Union and Tohto Suisan.

9 The Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory used by the IPCC

Zooming in on a sample of 256 tuna fishing vessels

To conduct a thorough assessment of the sustainability and profitability of the tuna fishing fleet, data is needed. Whilst a significant part of the tuna catch comes from the handline and/or artisanal sub-sectors, data availability is better for the largest vessels equipped with an automatic identification system (AIS), a satellite-based communication system. This is why this report focuses on these vessels – see **Appendix 2:** Data limitations.

Based on data from Global Fishing Watch, Planet Tracker identified 772 fishing vessels active in Indonesian waters between 2019 and 2022 and equipped with AIS. This excludes any Indonesian-flagged vessel with a gross tonnage lower than 60 tonnes (see **Appendix 2**: Data limitations) which together account for 61% of local tuna production.

Planet Tracker estimates that 256 out of these 772 vessels targeted tuna. To do so, we interpolated data on fishing location, fishing gear and authorisation records from tuna RFMOs with the geographical distribution of tuna species (see **Appendix 1**: Methodology for more details). In the rest of this report, we refer to these vessels as "our sample of 256 tuna vessels".

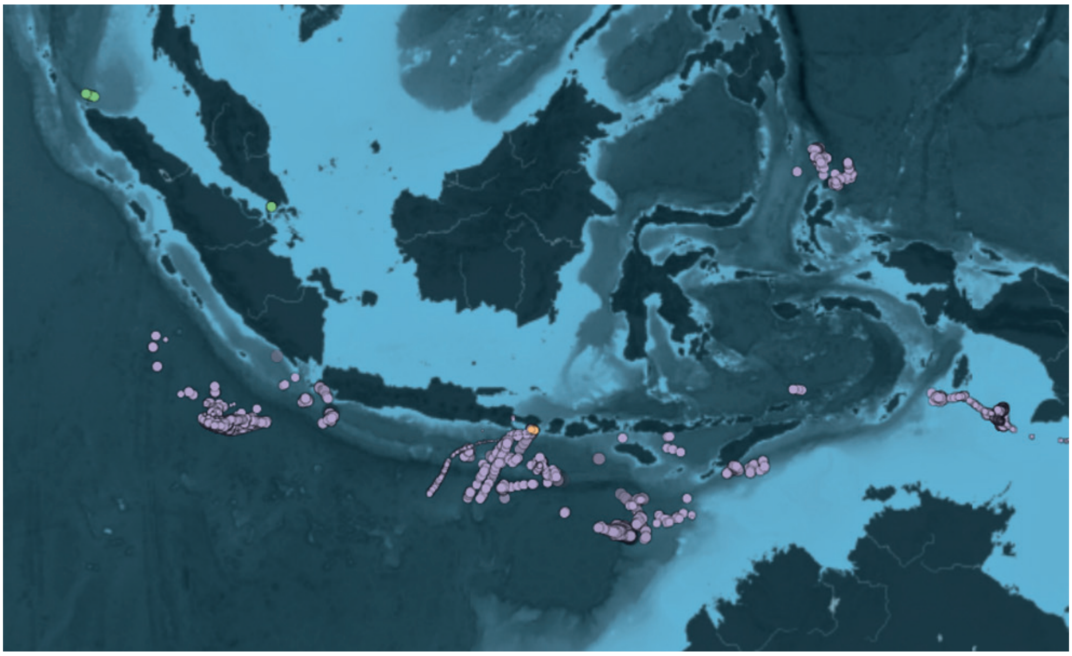


Figure 9: *Positions of Vessels Fishing for Tuna Tracked by Global Fishing Watch in Indonesian Waters in July 2021 (Source: Planet Tracker, based on Global Fishing Watch. Purple Dots Indicate Indonesian-Flagged Vessels while Foreign-Flagged Vessels are in Other Colours – see live version here)*

69% of these 256 vessels fly the flag of Indonesia – see Table 1.

Table 4: *Number of Fishing Vessels by Country by Type of Fishing Gear. (Source: Planet Tracker)*				
Country	**Number of vessels**	**of which Purse seiners**	**of which Longliners**	**of which Handline**
Total	**256**	**87**	**168**	**1**
Indonesia	178	74	103	1
Japan	39	0	39	0
China	14	3	11	0
Taiwan	6	0	6	0
South Korea	3	0	3	0
Cook Islands	1	1	0	0
Micronesia	3	3	0	0
Malaysia	1	0	1	0
Nauru	1	1	0	0
Philippines	2	2	0	0
Seychelles	5	0	5	0
Kiribati	1	1	0	0
Papua New Guinea	1	1	0	0
Tuvalu	1	1	0	0

These 256 vessels have a combined gross tonnage of 64,612 GT, of which Indonesian-flagged vessels only account for 34%. This is partly due to the dominance of Japan in the longliner sub-industry, see Figure 10.

Figure 10: *Gross Tonnage of our 256 Tuna Vessel Sample by Flag Country and Fishing Gear (Source: Planet Tracker)*

Considering different types of gear separately is important, since the way longliners and purse seiners fish is completely different, with important consequences in terms of profitability and environmental impacts.

Environmental risk assessment of our sample of 256 tuna vessels

Environmental impacts of fishing vessels by gear

The impacts of fishing vessels on the ocean ecosystem, habitats and fish populations vary, depending on the type of gear they use and how it is used.

One-by-one fishing: highly selective

Handline, pole-and-line and trolling, which are also known as one-by-one fishing, are seasonal fishing methods that follow the migration patterns of target species. These are highly selective fishing methods, typically resulting in small bycatch rate of non-target species and no interaction with the seabed.[xviii]

Only one vessel in our sample (KM Yordan) uses handline. Yet more than 100,000 tonnes of tuna are caught by one-by-one fishing methods in the country each year. For instance more than 13% of the yellowfin tuna is caught by handline.[xix] Handline fishing is typically done via smaller fishing vessels, not equipped with AIS.

Longline: millions of marine animals caught as bycatch

Longline is a passive type of fishing gear made up of lines with baited hooks. The hooks fish in areas at depths ranging from the subsurface up to 300m to catch bigeye tuna, albacore tuna and yellowfin tuna in tropical waters.[xx] The main environmental impact of longline fisheries is bycatch: the hooks used are typically non-selective and can kill sea birds, sea turtles, dolphins, sharks and many species of non-target fish.

168 vessels in our sample are longlines. Assuming an average of 1,500 hooks per vessel[xxi] and a bycatch rate of 20%[xxii], the number of marine animals caught by accident by these 168 vessels is expressed in hundreds of thousands or millions per year depending on the number of sets and the number of trips per year.

Purse seine: catching tuna too young

Purse seine catch schooling fish by encircling a detected school of fish from both the sides and underneath with the net, and so are not selective in terms of species or fish size.[xxiii]

While unassociated (i.e., sets on free swimming schools of tuna) purse seines typically have a low bycatch rate, associated (i.e., sets on floating objects) purse seines have much higher rates of endangered, threatened and protected species bycatch. They cause significant dolphin, whale and whale shark mortality.[xxiv]

In tropical waters, juvenile yellowfin and bigeye schooling with adult skipjack are increasingly caught as bycatch by skipjack targeting purse seiners with the rapid growth of purse seine fishing with sets made on man-made Fish Aggregating Device (FADs).[xxv] Drifting FADs in particular are a major cause of environmental damage – see **Appendix 3**.

Exposure to Illegal, Unreported and Unregulated (IUU) Fishing

IUU fishing has been one of the major threats to Indonesian maritime security. In 2014 - the year when Indonesia declared an anti-IUU fishing plan - the country lost an estimated USD 4 billion in profits due to IUU fishing.[xxvi] It was estimated that curtailing IUU could generate a 14% increase in catch and a 12% increase in profit.[xxvii]

Combating IUU fishing was done via an arsenal of measures including sinking illegal vessels, banning foreign fishing vessels and banning transshipments[10].[xxviii] In total, Indonesia has sunk more than 500 illegal fishing vessels since October 2014.[xxix]

The anti IUU policies resulted in fishing prohibitions for more than 1,100 foreign-owned vessels and reduced the total fishing effort in the country by at least 25% (foreign fishing effort fell 90%).

10 the transfers of fish at sea

Figure 11: *Indonesia Blows up a Foreign Fishing Vessel, 2016.*[xxx]

The risk of engaging in IUU fishing is considerable. As detailed in Planet Tracker's research 'Do you IUU?', not being able to access Indonesian waters any more caused a 74% drop in revenue for Chinese company Pingtan Marine Enterprise in 2015. Pingtan Marine Enterprise owns one of the 256 tuna vessels we tracked (the FU YUAN YU 7863) and is now subject to economic sanctions by the US Treasury.[xxxi]

Identifying unauthorised tuna fishing vessels

Vessel identity assessment is an important step to combat IUU fishing. In this research, Planet Tracker has analysed the 256 vessels in our sample for that risk.

Vessels not matched with public authorisation records at a given time in any of the records whose area overlaps with the fishing location are referred to as 'potentially unauthorized' – see **Appendix 1**: Methodology. This does not mean that these vessels are engaged in IUU fishing, but it constitutes a potential red flag. Whether fishing by some of these vessels was truly unauthorised is not known, since public records may be incomplete or outdated. This is particularly the case for the IOTC, where fishing with unverifiable authorisation is three times more common than in other tuna RFMOs.[xxxii]

As a corollary, even if vessel identities are matched to authorisation lists, the vessels are only potentially authorised, as we are only able to validate vessels that were authorized to fish in that region without knowing whether they were authorised to target a given species.

In total, eleven out of the 256 fishing vessels that likely caught tuna during their presences in Indonesian EEZ were potentially unauthorised.

Table 5: *Vessel Authorisation by Country and Authorities among Planet Tracker's Sample of Tuna Vessels.*

Country	No. of vessels	Authorised by tuna RMOs	SIUP & SIPI licensed	Potentially unauthorised
Total	**256**	**186**	**172**	**11**
Indonesia	178	118	172	2
Japan	39	39	NA	0
China	14	9	NA	4
Taiwan	6	3	NA	3
South Korea	3	3	NA	0
Cook Islands	1	0	NA	1
Micronesia	3	1	NA	2
Malaysia	1	1	NA	0
Nauru	1	1	NA	0
Philippines	2	2	NA	0
Seychelles	5	5	NA	0
Kiribati	1	1	NA	0
Papua New Guinea	1	1	NA	0
Tuvalu	1	1	NA	0

The location of 'potentially unauthorised' fishing events is mapped below.

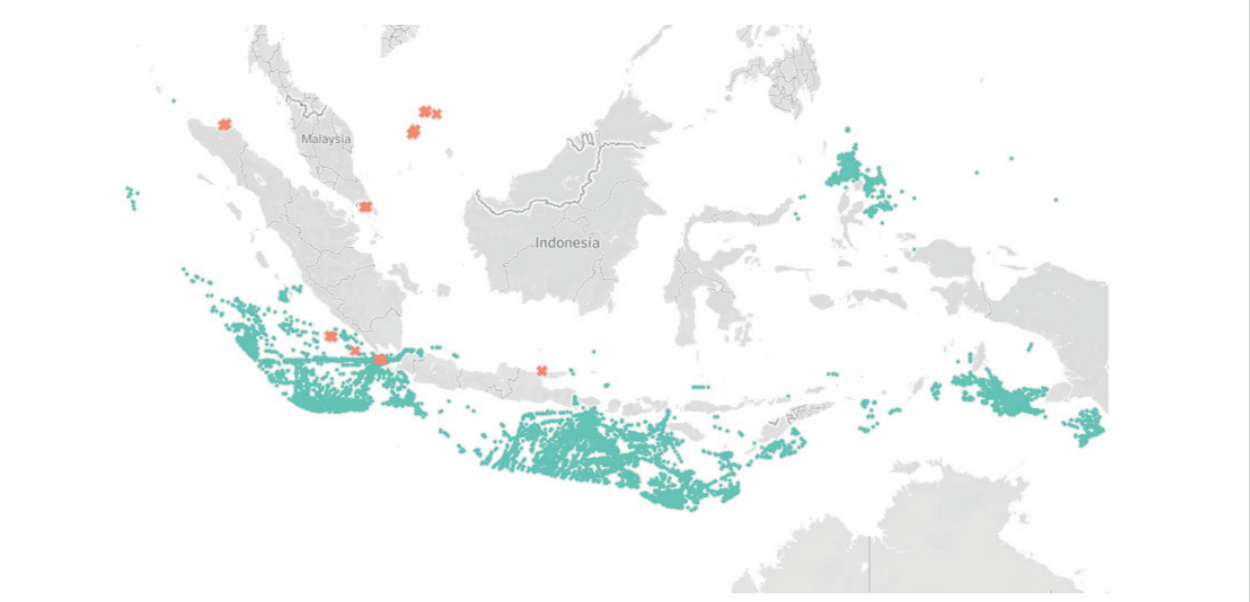


Figure 12: *Authorised (Green) and Potentially Unauthorised (Orange) Tuna Fishing Events in Indonesian Waters (Source: Planet Tracker).*

Forced labour, human trafficking and labour abuse

Illegality and fisheries can be divided into three distinct but overlapping groups – see Figure 13, more details in 'Do you IUU?'.

IUU fishing is often linked to transnational organized crime such as forced labour and human trafficking at sea, resulting an intersection of a humanitarian crisis and environmental emergency. A lack of enforcement of safety and labour standards, and inadequate language skills, make foreign migrant workers particularly vulnerable.[xxxiii]

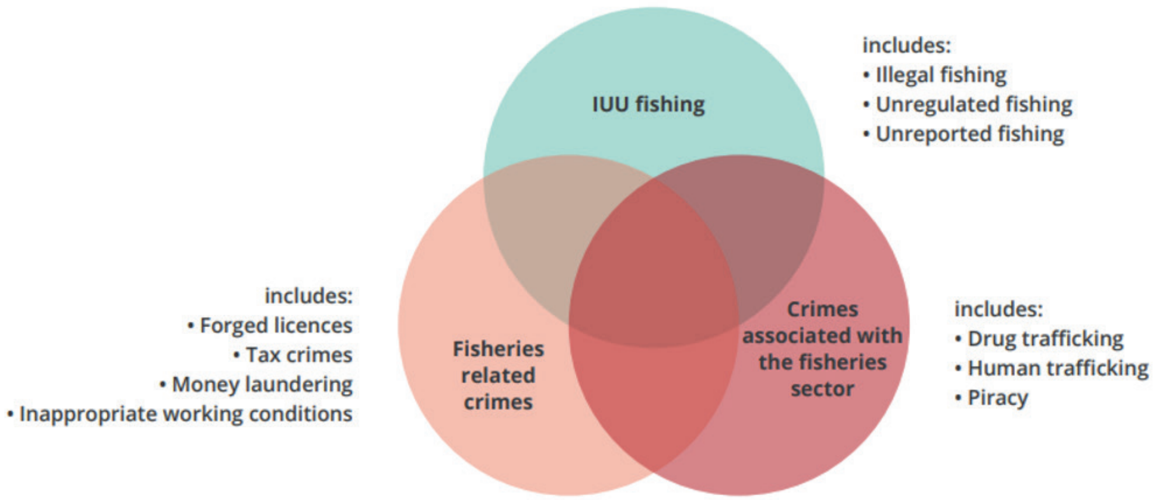


Figure 13: *Overlap between IUU Fishing, Fishery-related Crimes, and Crimes Associated with the Fisheries Sector (Source: Planet Tracker, the size of each circle is arbitrary)*

Working conditions within Indonesia's wild catch industry are incredibly tough: only a few fishers are provided with a written work contract and paid a basic salary on a regular basis. Most of them receive a share of sales of the catch, that can be adjusted downwards for various opaque reasons after working long hours for months.[xxxiv]

In some extreme cases, lack of access to adequate food and fresh drinking water on board, or other labour abuses, occur.[xxxv] The country's seafood industry has been linked to child labour and forced labour by the US Department of Labour (USDOL) and the US Department of State (USDOS) in the past five years.[xxxvi, xxxvii]

In 2015, an investigation conducted by the Indonesian Ministry of Maritime Affairs and Fisheries and the International Organization for Migration in Benjina, Ambon and Maluku found at least 1,000 Burmese victims of trafficking in the Indonesian fishing industry.[xxxviii]
As of 2022, the Seafood Social Risk Tool developed by SeafoodWatch suggests no evidence of a direct link between the tuna fishing industry and human trafficking or child labour,[xxxix] but indicators of forced labour – evidence of debt bondage or risks thereof - were found between March 2017 and December 2019.[xl]

At least one vessel in Planet Tracker's sample is linked to labour abuse

Later in 2020, the Ministry of Manpower (Kementerian Ketenagakerjaan) repatriated nine crew members from Indonesia who were subjected to physical violence and did not receive a salary who worked on Chinese-flagged purse seiner Zhouyu 605.[xli]

This tuna purse seiner is one of the 256 Planet Tracker identified as targeting tuna in Indonesian waters based on Global Fishing Watch data. Its last presence was in Indonesian Central waters (FMAs 711 and 712) on 13 May 2020. The vessel then disappeared from the map.

Forced labour and human trafficking risks are therefore reflected in our vessel sustainability analysis.

Scoring tuna vessels on their sustainability

To analyse the sustainability of each vessel, a preliminary score based on fishing location, country flag, target species and gear was assigned.

The score was then adjusted for other factors such as a participation in tuna sustainability initiatives or history of shifting identities to reflect the potential of working on best practices and exposure to overfishing and other ESG risks - as explained in **Appendix 1**: Methodology.

The sustainability overview of our 256 tuna fishing vessels is presented in Table 6 and Figure 14. 'Needs improvement' is the category where most of the vessels' scores are clustered, with 230 out of 256 vessels.

Table 6: *Vessel Sustainability Score Distribution of Tuna Fishing Vessels in Indonesia. (Source: Planet Tracker)*

Grade	Vessel sustainability score	Number of tuna vessels	Total fishing hours
Poor	Score <6	14	188
Needs improvement	6 <=Score <8	230	47,824
Strong	Score >=8	12	11,328

Most poorly rated fishing vessels (with a score equal to or less than 6) are Japanese longliners fishing in the Indian Ocean that Planet Tracker believes target bigeye and yellowfin tuna in the region. In contrast, the highest scores were assigned to purse seiners fishing in Eastern Indonesia targeting skipjack.

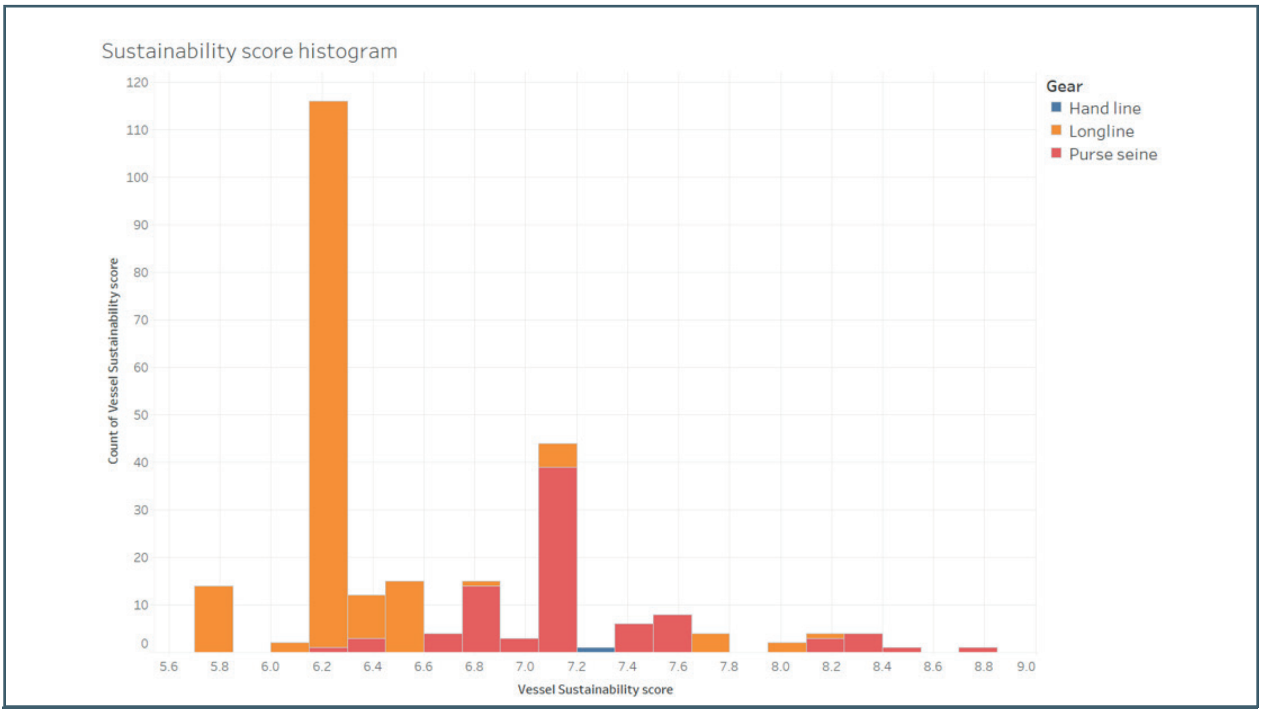


Figure 14: *Tuna Fishing Vessel Sustainability Score Distribution. (Source: Planet Tracker).*

A major limitation of this scoring system is that in many cases public fishing data does not distinguish FAD associated and free school purse seiners, so that all tuna purse seiners were treated equally as 'purse seine', without taking distinct environmental impacts between these two into account. When the distinction was available though, FAD-free purse seiners were scored better.

INVESTIGATING WHO CONTROLS TUNA POPULATIONS

This section identifies owners of tuna vessels in Indonesia and analyses their sustainability

Revealing who owns the world's largest tuna fishing industry

In total, Planet Tracker identified 136 entities from 12 countries that own 256 tuna fishing vessels. 89 domestic entities control 70% of the vessels, which is likely to be due to a large extent to the 2014 moratorium on registering and licensing foreign fishing vessels, as mentioned in the previous section. - see Figure 14.

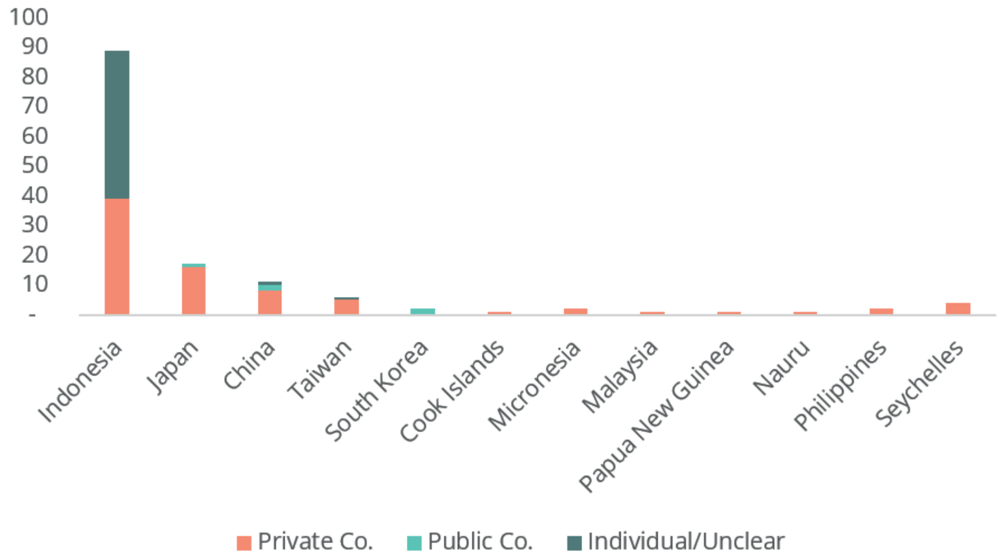


Figure 15: *Ownership Distribution of Tuna Fishing Vessels by Flag Country. (Source: Planet Tracker Based on RFMOs Records, GFW, MarineTraffic)*

In some cases, fishing vessels were registered under an unclear name (e.g., only a first name). These vessels spent 36,937 hours at sea in total, accounting for 64% of the estimated total tuna catch occurred during the period. Limited transparency is another barrier to identify who benefits from tuna fishing in Indonesia.

The dominance of Indonesian-flagged fishing vessels becomes more significant when looking at the combined fishing hours and estimated total catch per country. An estimated 62% of the combined catch of the 256 vessels we tracked comes from Indonesia-flagged vessels.

Overall, 10% of Indonesian entities own vessels that caught an estimated 70% of the tuna harvested in Indonesian waters by our sample of tuna vessel during our research period – see Table 7.

Table 7: *Estimated Catch per Vessel Owner, in Tonnes for the Top 14 Indonesian Owners who together Caught an Estimated 70% of the Total. (Source: Planet Tracker. PMDN = 100% domestic companies, PT Swasta nasional = privately owned companies, IDN = Indonesia)*

Name of owner	Flag	Est. % of total tuna caught	Identity of the owner
SAMUDRA MANDIRI SENTOSA	IDN	13.8%	PT Swasta nasional
SENTOSA	IDN	9.3%	Unclear
PENG HOA	IDN	7.4%	Unclear
SUMBER SAMUDRA SEJAHTERA	IDN	6.4%	PMDN
NUR CHAMDAN	IDN	4.8%	Unclear
ANTONI	IDN	4.4%	Unclear
SEPAKAT TJIPTA HASIL CEMERLANG	IDN	3.8%	PMDN
SARJONO	IDN	3.8%	Unclear
JAYABALI BERSAUDARA	IDN	3.7%	PMDN
KILAT MANDIRI JAYA	IDN	3.4%	PT Swasta Nasional
SINAR ARINDO SEMESTA	IDN	2.7%	PMDN
SENTRAL BENOA UTAMA	IDN	2.4%	PMDN
SEMBILAN ANUGRAH PERSADA	IDN	2.1%	PMDN
SUBROTO	IDN	2.0%	PMDN

Vessel registration requirements in Indonesia include: include: evidence of vessel ownership, identity of vessel's owner (including tax identification number), measurement certificate, safety assessment report, recommendation letter from the Indonesian Ministry of Maritime Affairs and Fisheries (MMAF) and evidence of payment of applicable taxes.[xlii]

Out of the total 89 Indonesian owners, Planet Tracker identified:

- 10 PT Swasta Nasional (National Private) companies,
- 30 PMDN (Penanaman Modal Dalam Negeri, companies with 100% domestic ownership)
- 49 owners identified by a name for which no public record could be found, classified as 'individual or unclear'.

Analysing the beneficial ownership shows individuals typically only control or manage one company. Out of the 140 directors and commissioners identified by our research, 127 control or manage a single company, one controls two, one controls four, and another one controls seven different companies. Please contact Planet Tracker for more details.

People in control of these companies are typically based in Jakarta or Denpansar (or at least the registered address on official company documents says so). None of them is registered abroad – see Figure 16.

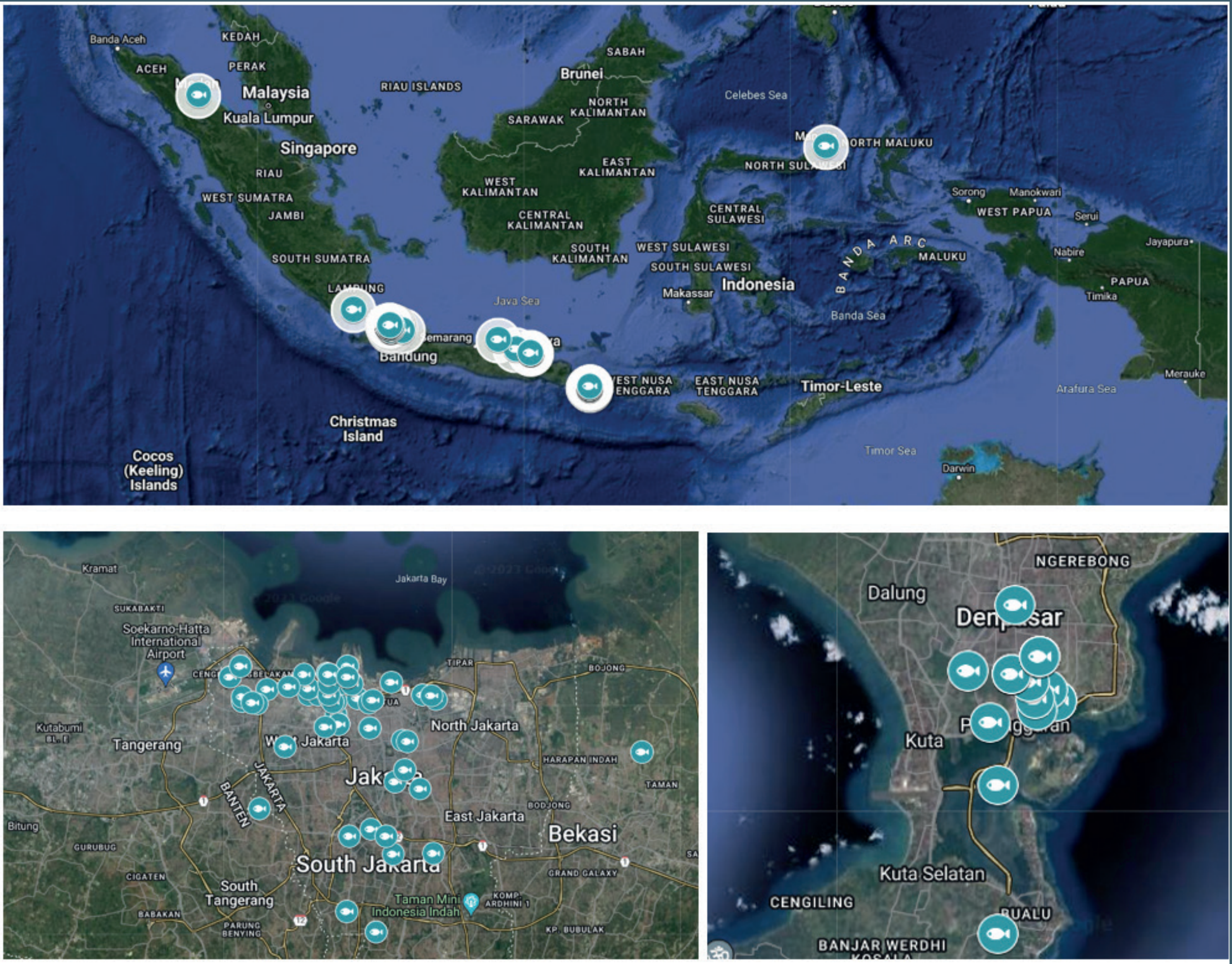


Figure 16: *Registered Addresses of the Beneficial Owners of Indonesian Tuna Fishing Companies (Source: Planet Tracker, Based on Official Public Data. Inlet pictures: Jakarta and Denpasar. Online version available on request. Identities have Been Removed for Privacy Reasons, Only Addresses are Shown)*

Assessing Owners' Sustainability

Having identified the owners of our sample of tuna fishing vessels, Planet Tracker then assessed the sustainability of these entities, using a combination of vessel-level sustainability indicators (see above) and owner-specific indicators, split in three categories: traceability and transparency, IUU fishing risk and social and labour welfare.

Traceability and transparency

Adequate product traceability records are crucial to fishery management and eliminating IUU fishing. Planet Tracker researched whether vessel owners have a website and whether they disclose vessel names, target species, or catch tonnage by species. This is to assess where owners stand on the journey towards fully transparent and traceable supply chains. Companies wishing to progress further in this journey should use our Seafood Accounting Protocol.

In this category we also calculate the proportion of vessels that have an IMO number (effectively a 'license plate' for fishing vessels) as an important criterion to assess an owner's compliance with monitoring and surveillance requirements.

To obtain an IMO number for a vessel, applicants are required to provide comprehensive vessel information, such as vessel identity history, fishing capacity (gross tonnage, net tonnage, LOA, depth, breadth), country, date of build, shipbuilder, engine model, type of gear, etc.[xliii]

IUU fishing

To assess IUU fishing risk at owners, we used our IUU Fishing Detection Toolkit to identify potential red flags, such as changing flags or vessel names often, or using flags of convenience.

This is because research found a strong relationship between IUU activity and frequent changes in a vessel's name, flag and owner and thus owners who have multiple vessels with multiple identity changes are more likely to engage in IUU fishing than others.[xliv]

Similarly, registered owners of vessels flying flags of convenience are more likely to be shell companies.

Country level exposure to IUU risk is also considered, including whether a country is on the top 10 IUU Fishing Index List, and whether a country has received a yellow or red card from the EU. However, a smaller weight was assigned to these indicators to take into account idiosyncratic upside and downside risks that individual owners have.

Social and labour welfare

Lastly, we investigated whether an owner has past allegations of forced labour or human trafficking on vessels affiliated to the owner or its subsidiaries or has vessels with foreign crew onboard.

An overview of the results of our owners' sustainability assessment is shown in Table 8.

Table 8: *IUU Fishing Risk and Sustainability Assessment Questionnaire (Source: Planet Tracker).*

TRACEABILITY AND TRANSPARENCY	
Does the owner have a website?	34% of corporate owners have a website Among those with a website, only...
Are the vessel names disclosed?	8 companies disclose the name, and sometimes the gear type of the vessels they own
Are the target species disclosed by the company?	24 companies disclose the fishing species they target on their websites
Does the owner report the tonnage of fish it catches or sources by species?	0 corporate owners report the tonnage of fish caught or sources by species on their websites
Do owners have vessels that do not have an IMO number even though they should?	35 owners have vessels without an IMO number despite their eligibility
IUU FISHING	
Do the owner's vessels have multiple identities[xlv] (i.e. changed flags or names several times)	31 owners have vessels with multiple identities
Do the vessels used by or belonging to the owner fly flags of convenience?[xlvi]	1 owner is registered in a country which is listed as a flag of convenience[11]
Is the owner headquartered in a country listed by the US as a country where IUU takes place?[xlvii]	17 owners are from such a country
Is the owner headquartered in a country that received a yellow or red card from the EU?[xlviii]	0 owners of vessels fly the flag of such a country
Is the owner registered in a country with a poor IUU risk ranking?[xlix]	18 owners registered in IUU Fishing Index top 10 countries: #1China, #3 South Korea, #6 Taiwan
Has the owner been accused of IUU fishing, or are vessels belonging to the owner on a IUU list (including in the past)?[l]	3 owners are or were mentioned on the Combined IUU List[12]: PT INTIMAS SURYA[13], DONGWON ENTERPRISE[14] and ZHONGYU GLOBAL SEAFOOD (CNFC)[15]

11 The vessel (MMSI: 518100665) is registered in Cook Islands by Adriatic Sea Fisheries. Cook Islands is one of the countries that have been declared Flag of Convenience (FOC) by the International Transport Worker's Federation (ITF). Vessels can be registered in FOCs regardless of the nationality or residence of the vessel's owner.

12 The Combined IUU List is an externally managed resource that aims at listing vessels that appear on the IUU fishing vessel lists published by RFMOs and related organisations. A mention here does not imply any accusation of wrongdoing by Planet Tracker.

13 INTIMAS SURYA PT has 6 vessels that have been IUU listed and subsequently delisted, as of 30 October 2023.

14 DONGWON INDUSTRIES (DONGWON ENTERPRISES) has 2 vessels that have been IUU listed, one of the 2 vessels is currently listed, 1 has been delisted, as of 30 October 2023.

15 CNFC (ZHOUYU GLOBAL SEAFOOD) has 3 vessels that have been IUU listed, one of the 3 vessels is currently listed, two have been delisted, as of 30 October 2023.

SOCIAL AND LABOUR WELFARE

Has the owner been accused of slave labour or other fishery-related crime?	No evidence found
Are there allegations of forced labour or human trafficking on vessels affiliated to the owner or its subsidiaries?	**ZHOUYU 605** is such as vessel[16]

Finally, we converted the aforementioned risk factors into sustainability scores for each vessel owner (see **Appendix 1**: Methodology for the scoring and weighting methodology).

A final aggregated score is then assigned to the 136 unique vessel owners to allow us to analyse the link between sustainability score and financial performance – see Figure 17

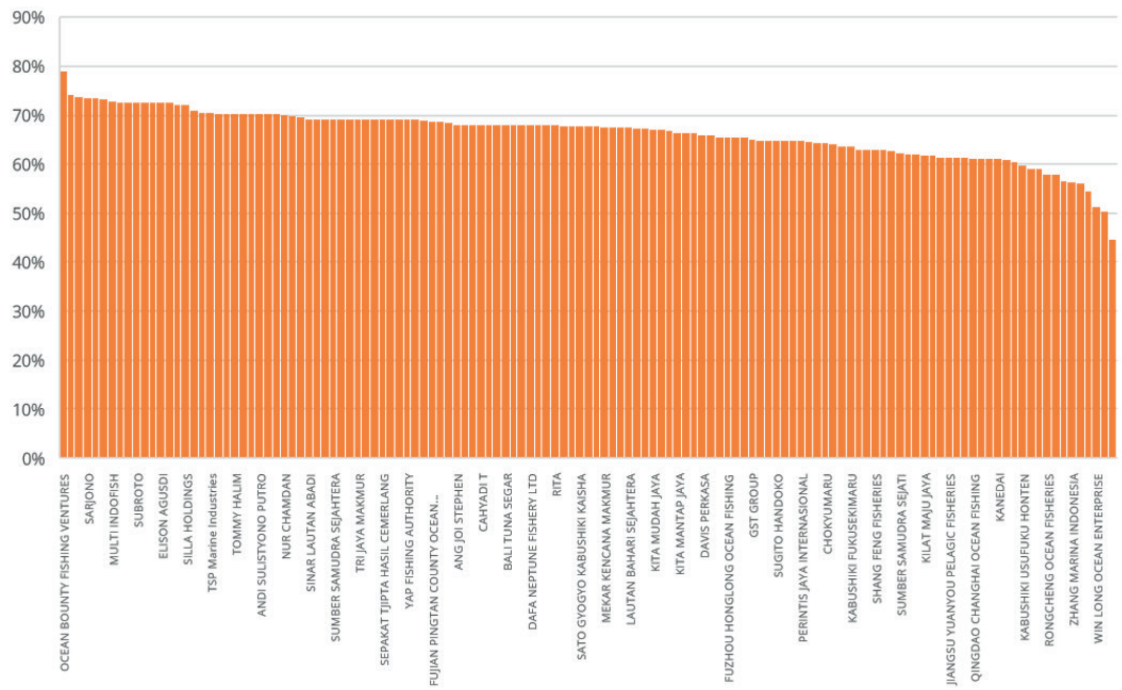


Figure 17: *Combined Sustainability Score of Owners of our Sample of Tuna Fishing Vessels (Source: Planet Tracker, 100% = Best score)*

16 https://www.antarafoto.com/id/view/1206328/sembilan-abk-kapal-tiongkok-tiba-di-indonesia

LINKING FINANCIAL HEALTH TO OCEAN HEALTH

This section compares the financials of tuna vessel owners to their sustainability scores

Owner profitability

How profitable is it for these companies to engage in the wild catch of tuna in Indonesia?

Investigating this was challenging given limited data availability. Still, based on the financials published by the eleven companies (out of 136) that own tuna fishing vessels and multiple other sources, Planet Tracker estimated that engaging in the industrial wild catch of tuna via purse seiners and longliners in Indonesia generates an average EBITDA[17] margin of 12%.

Table 9: *Number Of Owners of Tuna Fishing Vessels Disclosing Financial Performance. (Source: Planet Tracker).*

Owners with financials	Owners without financials
11	125
HANEDA SUISAN YK	All others
KABUSHIKI USUFUKU HONTEN	
KANEDAI	
CHOKYU MARU	
HAMAKO SUISAN	
TSP MARINE INDUSTRIES	
DONGWON ENTERPRISE	
SILLA HOLDINGS	
KOYO SUISAN	
PME PINGTAN MARINE ENTERPRISE	
ZHONGYU GLOBAL SEAFOOD (CNFC)	

This estimate was compiled from the vessel level and aggregated at the owner level. For each of the 256 vessels in our sample, the following data was gathered (when available):

- Gear type
- Gross tonnage
- LOA (length overall, in meters)
- Average speed
- Time at sea
- Engine power
- Fishing hours
- Tuna species caught

17 Earnings Before Interest, Tax, Depreciation and Amortisation, a common measure of profitability

This was coupled with key industry assumptions such as prices for each tuna species (fresh and frozen), subsidies on fuel, or cost of port call. Based on this, tuna catch volumes and revenue including subsidies were estimated for each vessel, as well as each cost component such as:

- Fuel costs (based on speed, engine power, gear type, gross tonnage, LOA and fuel subsidies)
- Costs of port calls (based on distance travelled and time at sea)
- Other costs (such as insurance or MSC certification costs)
- Crew costs (based on LOA, gear type and profit before crew costs)
- Overall, this results in an average EBITDA margin of 12%, with a widespread range among owners (max: 33%, min: -542%, median: 25%).

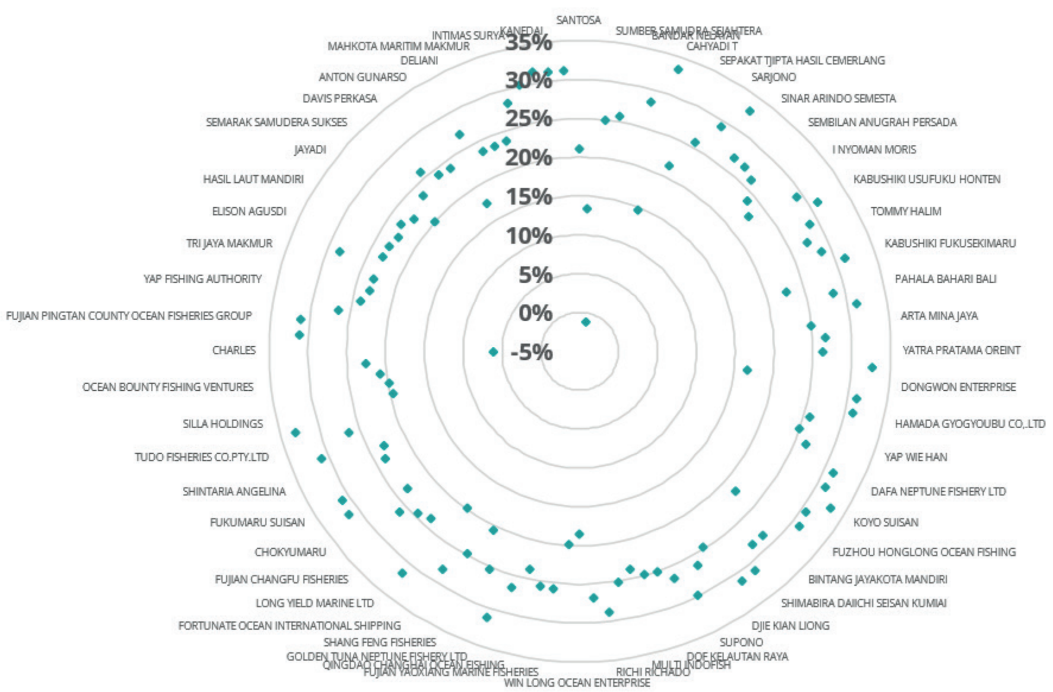


Figure 18: *Estimated Indonesian Tuna Fishing EBITDA Margin by Owner (Source: Planet Tracker, Excl. Outliers With Heavily Negative Margins)*

If the margin of the overall tuna fishing sector in Indonesia were similar, it would mean that this industry generates about USD 180 million in EBITDA per year (c. 3 trillion rupiah).

12% is a relatively profitable level, above the global average for the fishing sector (EBIT margin estimated at 5%, see ‘How to Trace $600 Billion’), but significantly lower than the estimated margin made in one the largest fisheries globally, the sustainably managed Alaska pollock fishery (see ‘Pollockonomics’).

Is there a link between sustainability and profitability?

Doing good and doing well

We found no statistically significant correlation (R^2:3%) between the estimated EBITDA margin generated by vessel owners during tuna fishing trips[18] and their sustainability score[19]. This is in itself an interesting finding, as popular belief might lead us to believe that a lack of attention to sustainability is the price that vessels pay to be highly profitable (although no wrongdoing, such as e.g. not paying staff decently, was assumed to estimate the profitability of the industry).

Encouragingly, **the vessel owners with the highest sustainability scores also generally boast some of the highest estimated EBITDA margins** - see top half of Figure 19. Note that high loss-making outliers are not shown, meaning that the average (12%) is lower than it appears on this chart.

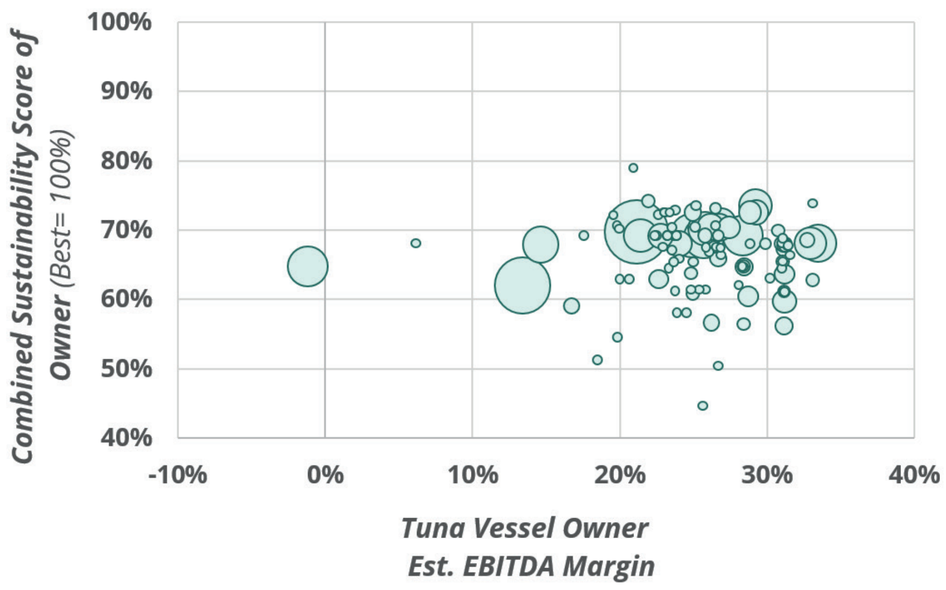


Figure 19: *Profitability vs. Sustainability Score of Owners of Tuna Fishing Vessels (Source: Planet Tracker. Note: a) The Size of Each Bubble is Proportional to the Tuna Volumes Caught; b) High Loss-Making Outliers are not Displayed).*

While it is encouraging to see a convergence between sustainability and profitability, a lot of progress is still needed.

18 calculated as the weighted average of the estimated EBITDA margin of the vessels they own

19 calculated as the average of the sustainability scores of the vessels they own and their own sustainability score

This is particularly the case for the following owners, those in the bottom quartile for their sustainability score on tuna fishing:

***Table 10:** Sustainability Score by Owner (Bottom Quartile Only) (Source: Planet Tracker, 100% is the best score)*

Owner	Est. EBITDA margin of tuna fishing	Sustainability score
WIN LONG OCEAN ENTERPRISE	18%	51%
YIN YU FISHERIES|CHIN I MING FISHERIES	20%	55%
DONGWON ENTERPRISE	17%	59%
KARYA MARINE JAYA	-152%	59%
KITA MAKIN JAYA	-143%	61%
KILAT MANDIRI JAYA	13%	62%
KILAT MAJU JAYA	-159%	62%
KITA MAJU JAYA	-257%	62%
SUMBER SAMUDRA SEJATI	-36%	62%
HAN TAI FISHERIES	20%	63%
SHANG FENG FISHERIES	21%	63%

Unfortunately for everyone involved in tuna fishing in Indonesia,, this relatively comfortable level of profitability is set to vanish.

THE CLIMATE CRISIS WILL WIPE OUT TUNA PROFITS IN INDONESIA

This section calculates the impact of climate change on tuna profitability

Oceans play a vital role in climate dynamics, transporting and storing heat, water and carbon around the globe through their circulation patterns, and have absorbed more than 90% of excess heat from greenhouse gas emissions over the past 50 years.[li]

As a result, climate change leads to, and is exacerbated by, the rise in ocean temperature due to circulation, and ultimately alters the structure of the entire marine ecosystem and the distribution of marine species.

Climate change induced habitat loss

Shifts in fish stock distribution as a result of climate change create both threats and opportunities. As rising sea surface temperatures will force some marine species to move towards polar regions, some high latitude regions will likely benefit from an increase in maximum catch potential, while a significant double-digit drop is expected in the tropics.[lii]

Although overfishing and destructive fishing have been the most widespread threats to Indonesia's coral reefs,[liii] increased ocean temperature, changes in storm patterns and precipitation and ocean acidification are causing an increase in both the intensity and frequency of coral bleaching events globally.[liv] It is estimated that by 2100, Indonesia could lose between 25% (RCP4.5) and 82% (RCP8.5) of its coral cover.[lv] Coral reefs are 'nurseries of the seas': around 25% of known marine organisms depend on coral reefs as habitats, including tunas.[lvi] The lost income resulting from coral bleaching events is already impacting local fishing communities, and in some cases driving food and income poverty.[lvii]

Climate impact on tuna fisheries

Decrease in the total marine fisheries catch potential in Indonesia ranges from 13% -29% by 2050 (or 18%- 63% by 2100), depending on GHG emission scenarios (RCP 2.6 -strong mitigation, and RCP 8.5-business-as-usual)[lviii] - see Figure 20.

Table 11: *Average Change and Variability (Range, in %) Around the Average in Potential Marine Fisheries Catch under Climate Change Scenarios Compared to 2000, Based on Outputs from the Dynamic Bioclimate Envelope Model (DBEM).Source: FAO, 2018.*

	DBEM model: RCP 2.6 Scenario				**DBEM model: RCP 8.5 Scenario**			
	By 2050		**By 2100**		**By 2050**		**By 2100**	
	Average	Range	Average	Range	Average	Range	Average	Range
Indonesia (Eastern)	-12.51	16.37	-17.42	21.19	-31.60	28.27	-64.43	26.00
Indonesia	-12.70	30.76	-18.35	29.62	-28.63	49.59	-62.70	32.52

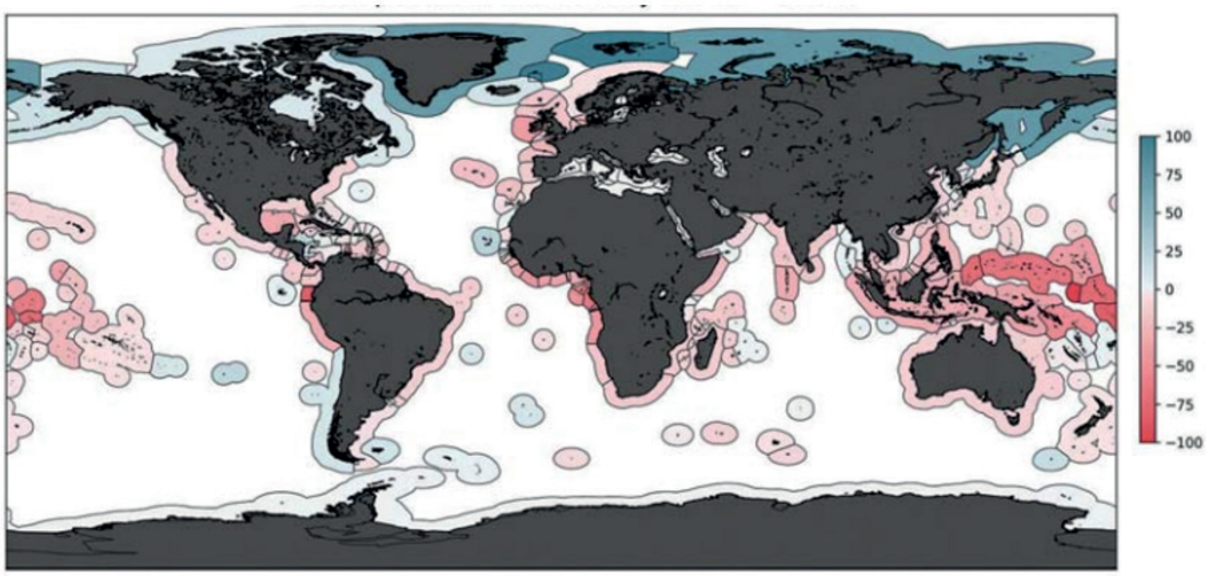


Figure 20: *Change in Catch Potential by 2050 in a RCP 8.5 scenario.*[lix]

Tuna will be forced to migrate to cooler waters as the sea surface temperature keeps rising - see the changes in the probabilities of occurrence of skipjack and yellowfin tuna from now to 2050 [lx] in Figure 21 and 22.

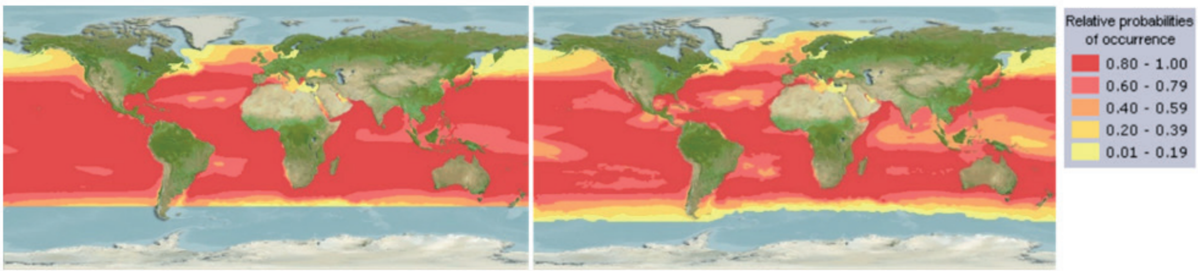


Figure 21: *Skipjack tuna native range now (left) and 2050 (right). Source: AquaMaps.*

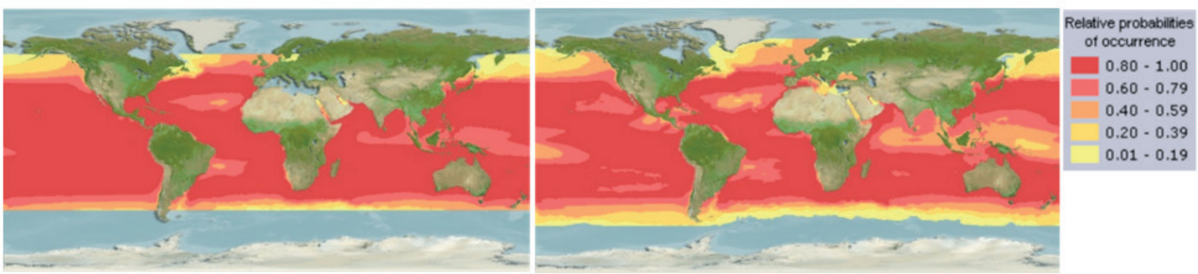


Figure 22: *Yellowfin tuna native range now (left) and 2050 (right). (Source: AquaMaps).*

Research on 10 Pacific island nations, where tuna fishing access fees to distant nations contribute an average of 37% of total government revenue, found that under the RCP 8.5 scenario by 2050, the total biomass of three key tuna species (skipjack, yellowfin and bigeye) within these combined jurisdictions will decrease by an average of 13%.[lxi]

That would cause not only economic loss for local communities that depend on their tuna fisheries for economic development and food security but also higher overfishing risk, since tuna species migrate eastward into high seas, meaning that fishery management policies need to be updated accordingly.

The climate crisis will severely damage the industry's profitability

To understand the extent to which climate change can alter tuna fishing profits in Indonesia, in this research we developed a simple approach to assess the implications of climate change on the profitability of fishing for tuna in Indonesia.

Climate change can negatively impact fishing profits through:

- a decrease in revenue:
  - a decline in the number of tuna caught due to lower abundance or shifting distributions
  - a decrease in fish body size in certain fishing areas

- an increase in costs:
  - fishers have to exploit new fishing grounds in areas progressively deeper and further away from shore, and /or stay longer at sea.
  - a change in fishing methods and techniques can be costly.

An estimated 25-31% decrease in tuna catch in Indonesian waters by 2050

By comparing the probability of occurrence of each species between now and 2050 under two scenarios (RCP 4.5 and RCP8.5), Planet Tracker calculated that the industrial tuna fishing fleet operating in Indonesia will catch between 25% and 31% fewer tuna by 2050 – see Figure 23.

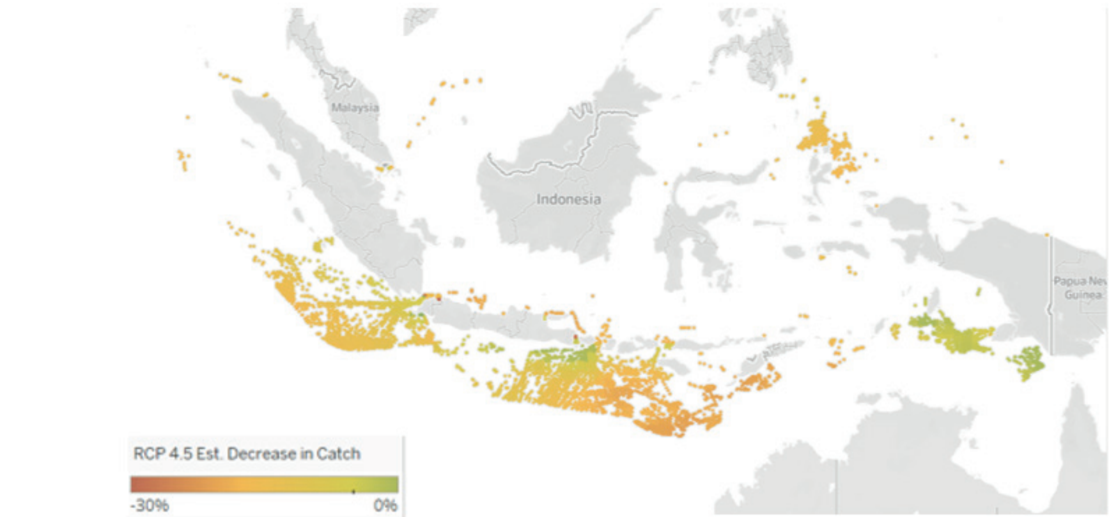


Figure 23: *Decrease in Catch Attributable to Changing Habitat Probability of Skipjack and Yellowfin Tuna, due to Climate Change under RCP Scenario 4.5. Percentage Change from Current Values (Source: Planet Tracker, based on AquaMaps data).*

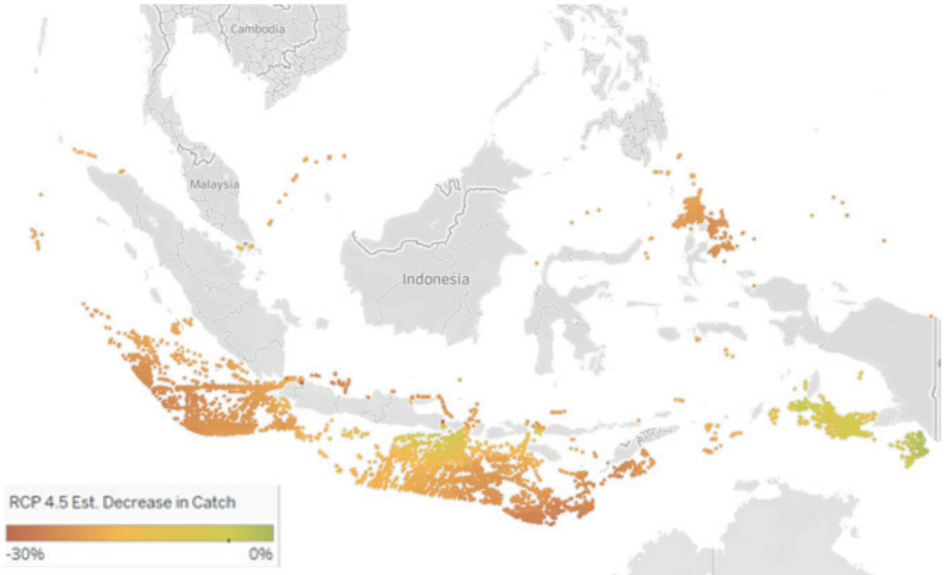


Figure 24: *Decrease in Catch Attributable to Changing Habitat Probability of Skipjack and Yellowfin Tuna, due to Climate Change under RCP Scenario 8.5. Percentage Change from Current Values (Source: Planet Tracker, based on AquaMaps data).*

However, this figure only considers the reduced probability of finding tuna in the same fishing areas.

Warmer waters likely to result in an overall 3% decrease in average tuna body size in Indonesia

In addition, warmer temperatures can also lead to a substantial change in maximum body sizes of tuna. By 2050, the body size of the five major tuna species (bluefin, albacore, yellowfin, bigeye and skipjack tuna) and swordfish is expected to decrease, on average by up to 15% across all oceans (with increases in some cases more than offset by decreases in others).[lxii] Data on projected changes in body sizes is not available for Indonesian waters, but based on the projected changes for the IOTC and WCPFC for all three key species,[lxiii] Planet Tracker calculates an average 3% decrease in body sizes – see Table 12.

Table 12: *Estimated change in average body sizes for key tuna species in Indonesian waters (Source: Planet Tracker, based on Extramiana et. al (2023))*

Yellowfin tuna	Bigeye tuna	Skipjack tuna	Volume-weighted average
+2.0%	-7.5%	0%	-2.7%

Given that bigeye tuna is pricier than skipjack tuna, this change in body size alone is likely to translate into a 1.9% negative impact on revenue for the industry.

A c. 30% decrease in revenue by 2050 for the industrial tuna fishing industry in Indonesia

Coupled with the change in abundance mentioned earlier and assuming ex-vessel tuna prices remain constant for each species, this leads to **an average 26.5% decrease in revenue under RCP 4.5, or 32.4% under RCP 8.5.**

This c.30% estimated decrease in revenue is an indication only as it excludes the difficult-to-estimate actions the industry would take in reaction to these changes, and any mitigation impacts resulting from better technologies.

It could be even worse: tuna fishing and deep-sea mining

What would make things even worse is the potential overlap between tuna fisheries and the deep-sea mining industry – explored in detail in 'The Sky High Cost of Deep Sea Mining'.

Recent research forecasts an average 21% increase in the biomass of three commercial tuna species (bigeye, skipjack and yellowfin tuna) within the Clarion-Clipperton Zone (CCZ), which is located in the eastern Pacific Ocean between Hawaii and Mexico, far away from Indonesian waters.[lxiv]

17 deep-sea mining exploration contracts covering 1.1 million km^2 have been awarded in the CCZ, covering a quarter of its seabed area.[lxv] While the interactions between mining and fish populations are still largely unknown, sediment plumes, wastewater, toxic metals and mining noise caused by deep sea mining are set to be extensive and can substantially affect tuna populations in a number of ways.[lxvi] Because some of the tuna (like some Pacific bluefin tuna populations) that spend part of their year in or near the CCZ migrate to or near Indonesian waters, [lxvii] deep sea mining operations in the CCZ could negatively impact industrial tuna fishing revenue in Indonesia. At the time of writing, it is too early to tell whether deep-sea mining in the CCZ will go ahead. We have therefore not incorporated this possible impact in our modelling.

Profitability to shrink severely in all scenarios

Given the cost structure of the tuna fishing industry, the c. 30% decrease in revenue due to the climate crisis would result in a **very stark decrease in profits.**

Indeed, whilst an estimated 72% of costs are variable (e.g. fuel, crew salaries, cost of port calls), a drop in abundance and body sizes would impact revenue but not translate into a similar drop in variable costs since fishing vessels still need to be operated, even if catch volumes are lower.

To estimate what the likely impact of this decrease in revenue would be on profits, we conceived three scenarios.

Scenario 1: Business as usual

In this scenario, the industrial tuna fishing fleet adapts to a lower catch environment by a reduction in the number of fishing trips, an increase in the average length of each trip, and better fuel management, but without major changes. A 15% reduction in variable costs is achieved, below the c. 30% drop in revenue.

Scenario 2: Higher fuel subsidies

The majority of fuel costs are already subsidised in the Indonesian tuna fishing fleet (by an estimated USD 54 cents for every litre, where the full price is USD 88 cents per litre).[lxviii] Without these subsidies, the industry would be heavily loss-making. In this scenario, the industry succeeds in convincing the Indonesian government to further subsidise its fuel by an additional USD 17 cents and halve its fuel costs, resulting in a 29% decrease in variable costs.

Scenario 3: Cost-cutting

In this scenario, the industry belatedly realises the magnitude of the impact climate has on revenue and responds by an aggressive reduction in costs, including staff compensation, marketing and selling and general and administrative costs. Fixed costs are compressed by 20% and variable costs by 15%.

In all scenarios the climate crisis takes a huge toll on profitability

In all three scenarios, the industry's profitability is severely affected by the c. 30% climate-related decrease in revenue, with the average EBITDA margin moving from 12% excluding climate impact to between 5% at best (RCP 4.5, Fuel subsidy scenario), and minus 16% at worse (RCP 8.5, Business as usual scenario)- see Table 13.

Table 13: *Modelling the Profit Impact of a Climate-Related Decrease in Revenue in the Indonesian Industrial Tuna Fishing Industry (Source: Planet Tracker)*

	RCP 4.5	RCP 8.5
Average 2050 EBITDA margin, before climate impact	12.3%	12.3%
Climate change-associated drop in revenue	-26.5%	-32.4%
Variable costs as a % of total costs	72%	72%
Average 2050 EBITDA margin, incl. climate impact and associated mitigation		
Scenario 1: Business as usual	**-6.6%**	**-15.8%**
Scenario 2: Higher fuel subsidies	**5.1%**	**-3.2%**
Scenario 3: Cost-cutting	**0.2%**	**-8.4%**

Importantly, **none of these three scenarios are desirable** since each of them will negatively affect the industry's profitability, the people working in this industry, and/or the Indonesian people (who would indirectly pay, e.g., for an increase in fuel subsidies).

An alternative needs to be found.

HOW TO IMPROVE BOTH PROFITS AND SUSTAINABILITY

This section presents different recommendations that are both good for the environment and for the companies' profits.

Nine recommendations for tuna fishing companies and their profit impact

Whilst addressing the symptoms of climate change or its causes might not be directly possible by the tuna fishing industry on its own, there are measures that the industry can take to reduce the impact climate change will have on profit, in a way that also benefit the climate. We list nine of these below.

1. **Reduce pressure on overexploited tuna** stocks[20] by at least 20%.
2. Adopt a **responsible drifting FAD[21] policy.**
3. Invest in GDST[22] - compliant **tuna traceability.**
4. Enable supply chain transparency by **disclosing the volume of species caught.**
5. Choose **selective fishing methods** to reduce bycatch.
6. **Retain all fished tuna**, except those unfit for human consumption.
7. Participate in **sustainable tuna fishing initiatives**, such as AP2HI[23], ATLI[24], Fisheries Improvement Projects (FIP) or Marine Stewardship Council (MSC) certification.
8. Replace crude palm oil by **used cooking oil** as a feedstock for biodiesel.
9. **Link companies' financial health to the environmental health** of the fish populations they rely on and take action to improve both.

1. Reduce pressure on overexploited tuna stocks by at least 20%.

Reducing fishing pressure on overexploited stocks is an obvious action to implement in favour of biodiversity. It also benefits the climate: out of the 6.5 billion tonnes of CO_2 that needs to be removed annually from the atmosphere to be in line with the Paris Climate Agreement, **protecting and restoring marine pelagic fish species (like tuna) could contribute to an average of 5.5 billion tonnes.**[lxix]

There are multiple examples of fast recoveries in fish populations, including for tuna (e.g. the Atlantic bluefin tuna, whose population doubled in the 2010s [lxx]).

But is it a good investment? If one looks beyond the immediate future, yes. Assuming that catches of yellowfin tuna and bigeye tuna in the Indian Ocean are reduced by 20%, Planet Tracker calculates that long-term (2050) revenue would be 11.5% higher for the Indonesian tuna industry as a whole, despite a 9.8% short-term, one-off negative revenue impact. This is based on a simple model assuming that populations of the two species double every 4.4 years and a generation time of 6.1 years, based on FishBase data.[lxxi]

A 20% reduction is the minimum level that is suggested to guarantee the viability of the Indian Ocean yellowfin and bigeye fisheries, but other organisations have asked for greater reductions, e.g. 30%.[lxxii]

This could be implemented for instance by specifying quotas 20% below the current level of catch, or via a temporary restriction on the use of drifting FADs. Implementation is challenging but necessary (see 'Tackling Overfishing').

20 Bigeye tuna and yellowfin tuna in the Indian Ocean
21 Fish Aggregating Devices: man-made, typically floating wooden structures with hanging nets to attract fish.
22 Global Dialogue on Seafood Traceability, an organisation that set standards for seafood traceability to enable interoperability across supply chains
23 The Indonesian Pole & Line and Handline Tuna Fisheries Association
24 The Indonesian Tuna Longline Association

2. Adopt a responsible drifting FAD policy

Globally 36% of the principal commercial tuna species are caught with the help of Fish Aggregating Devices (FADs).[lxxiii] Purse seiners, pole-and-line industrial fisheries and artisanal trolling and hand-line fisheries use thousands of these man-made, usually floating wooden structures with hanging nets to attract fish. The industrial tuna purse-seine fishery alone deploys globally an estimated 100,000 drifting FADs every year.

The damage caused by drifting FADs is enormous, (see **Appendix 3**: The many problems with FADs): overexploitation (for instance, but not only, due to the high proportion of juvenile tuna caught before they can spawn), bycatch of other species (fish, sharks, turtles), and pollution. These issues are compounded by a general lack of accountability due to little transparency on FAD management and ownership.

This could be partly resolved by implementing the Minimum Requirements for Responsible Drifting FAD Use [lxxiv], endorsed by over 100 organisations. These include specifications for the responsible construction, operation, ownership and retrieval of FADs. Some of the key requirements include:

- no entanglement, no mesh material
- 100% biodegradable (except buoys)
- FADs marked and tagged with a unique identifier
- ownership of FADs transparent and verifiable
- no supply vessel or support vessel used
- no abandonment of FADs
- FADs to be retrieved at cost to owner

Planet Tracker has estimated the cost of implementing these requirements, assuming that FADs would use the novel 'jelly-FADs' approach. Jelly-FADs use biodegradable materials and minimise entanglement risk without impacting the lifespan of the FADs.[lxxv]

Figure 25: *Building a jelly-FAD (Source: Pacific Community on YouTube)*

Assuming that building and tagging jelly-FADs costs an additional USD 10 per FAD compared to traditional, unmarked FADs and an average of 250 drifting FADs are used per purse seiner, Planet Tracker calculates that using tagged jelly-FADs and retrieving them at the end of their lifespan (leading to an estimated 5% increase in fuel costs) would necessitate **a combined increase in operational expenditures of c. USD 600,000** for our sample of tuna vessels.

No increase in long term revenue was modelled, even though a lower bycatch of non-target species is likely to have positive consequences for the local marine environment, ultimately benefitting tuna populations.

3. Invest in tuna traceability

In 'How to trace $600 billion', Planet Tracker found that on top of being a necessary condition for sustainability, seafood traceability could add 60% to global seafood profits, assuming it is only implemented where feasible.

Zooming in on tuna in Indonesia and using the traceability-readiness scoring system developed in 'How to track $600 billion', 100% of the catch of bigeye, yellowfin and skipjack tuna was found to be traceability-ready, with challenges. This means that the catch of these three species could be traceable if a traceability solution were in place and if challenges (e.g. corruption, lack of digitalisation, lack of data, etc.) were overcome.

Applying the same methodology as in 'How to Track $600 bn", Planet Tracker calculates that **an investment in seafood traceability** (where it is not yet present) equivalent to 1% of sales **would improve the EBITDA of the Indonesian tuna fishing industry by 13.5%**.

Key assumptions retained include:

- a USD 19,000 annual average fee for the traceability solution and associated maintenance and support costs
- a decrease in unproductive fishing trips leading to a 2% reduction in staff time and fuel costs (when PT. Nutrindo Fresfood - an Indonesian tuna fishing company- trialled Pointrek, a low-cost traceability solution, it experienced a 10% reduction in unproductive vessel trips)[lxxv]
- an increase in catch quality due to co-ordinated efforts and shorter trips (based on previous USAID research in Indonesia) leading to a 1% price premium (excluding any additional benefits linked to 'storied fish'[25]).

Planet Tracker therefore recommends the Indonesian tuna fishing industry invests in seafood traceability.

25 the ability to sell fish deemed as more sustainable at a higher price

4. Enable supply chain transparency by disclosing the volume of species caught

Not a single one of the 136 owners of tuna fishing vessels we identified publicly discloses the volume of tuna they caught. This means that potential investors in these companies, or lenders to these companies, cannot even estimate the many risks associated to these companies, such as exposure to yellowfin tuna in the Indian Ocean (on the verge of collapse if nothing is done). It also makes it harder to achieve transparency throughout the supply chain. This needs to change.

The good news is that such **disclosure is likely to be profitable** (see 'How Retailers Can be Profitable in Seafood'). Assuming total costs of USD 1,000 per company related to data gathering and publication of this data and a 0.1% increase in volume growth due to market share-related gains associated with higher transparency, Planet Tracker calculates that the long-term EBITDA of the industry could increase by 0.3%.

Disclosure of tuna volumes by species can be done on each company's website or via The Ocean Disclosure Project. Companies in the tuna supply chain like Thai Union already do so.[lxxvii]

5. Choose selective fishing methods to reduce bycatch

Amongst tuna fishing gear, longline and gillnet have the highest bycatch rates of non-target species, such as sea turtles, sea birds and sharks.[lxxviii]

In 2021, Indonesia reported more than 2,395 bycatches by longline fishery – 245 shark and more than 2,000 other ecologically sensitive species (e.g. marine mammals) within FMAs 571-573 (the Indian Ocean waters of Indonesia).[lxxix] This is likely to be a major understatement of the reality, due to the limited number of observers (16) on board these vessels: assuming an average of 1,500 hooks per longliner[lxxx] and a bycatch rate of 20%[lxxxi], the number of marine animals caught by accident only by the 168 longliners in our sample should be expressed in hundreds of thousands or millions depending on the number of sets per trips and the number of trips, not thousands every year.

Deploying effective mitigation measures – see Table 14, is generally economically viable and effective in reducing bycatch with no, or minor, negative impact on target catch.[lxxxii]

Table 14: *Bycatch Mitigation Methods by Species in Tuna Longline and Purse Seine Fisheries (Source: Swimmer et al., 2020)).*[lxxxiii]

Species at risk of bycatch	Longline	FAD- associated purse seine
Elasmobranchs (sharks, skates and rays)	Circle hooks Nylon leaders Deep sets Reduced gear soak time	Restrict the number of FAD sets Avoid FAD sets Modify FADs
Sea turtles	Circle hooks and Use finfish (rather than squid) bait Reduced gear soak time	Restrict the number of FAD sets Avoiding FAD sets Modifying FADs
Seabirds	Night setting, side-setting Line weighting Streamer lines	Minor or no
Marine mammals	Circle hooks Encasing catch/hook	Avoid night sets Avoid dolphin sets 'Backdown' after dolphins are captured
Juvenile tunas[lxxxiv]	Circle hooks Restrict the use of light attractors Avoid grounds like shallow seamounts	Restrict the number of FAD sets Avoid FAD sets Modify FADs

For example, several studies have confirmed an initial research that argued that switching from J-style hooks to circle hooks results in **an increased catch rate while simultaneously reducing bycatch rate**.[lxxxv] This was evidenced for instance in the US Atlantic yellowfin tuna longline fishery,[lxxxvi] and in the Brazilian bigeye and albacore longline fishery.[lxxxvii]

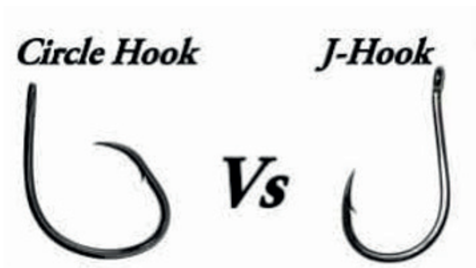


Figure 26: *Difference between circle hooks and J hooks.*[lxxxviii]

In addition, there is strong evidence in other fisheries that the use of circle hooks improves the catch condition of target species because fish tend to be hooked in the corner of the jaw rather than get gut or gill hooked using J hooks.[lxxxx]

Bycatch of non-target species can also be reduced by setting hooks deeper, since most longline tuna is caught during the day at depths of 100 to 400 meters, whilst most bycatch is caught in the top 100 meters.[xc]

A one-off investment of USD 3,000 per 1,000 hooks to install lead weights in order to set hooks deeper in the water column would cost the industry a total of USD 712,000. It could be paid off through a long-term increase in tuna biomass due to healthier ecosystems on one hand, but also importantly a reduction in the catch of juvenile tunas. **An assumed 5% reduction in the bycatch of juvenile tunas would increase long-term revenue by an estimated 10%**. However, there have been only a few scientific studies with adequate controls to confirm that circle hooks reduce the catchability of juvenile tunas,[xci] for which bycatch rates are very high in longline fisheries.[xcii]

Still, **switching from J-style hooks to circle hooks is an action the industry needs to implement to reduce its impact on marine ecosystems while maintaining or even improving its profitability.**

6. Retain all fished tuna, except those unfit for human consumption

Tuna that is considered undesirable by the fishing industry in terms of size, marketability or species, or that becomes spoiled on board, often gets dumped at sea.

This is mainly the case in purse seine fisheries and distorts our understanding of the actual impact on the tuna populations by fishing operations. It also results in additional fishing.

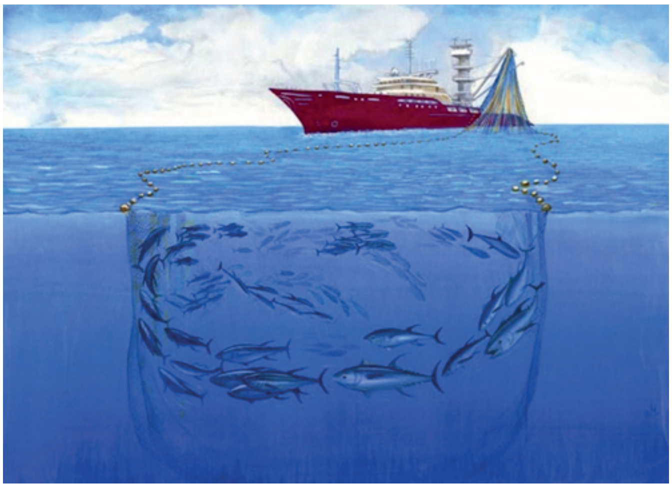


Figure 27: *A Purse Seiner Catching Tuna (Source: FAO).*

Planet Tracker recommends that fishing companies retain all caught tuna, except those unfit for human consumption, i.e. tuna that is either meshed or crushed in the net, damaged due to predation, or tuna that died and spoiled in the net due to gear failure.[26] Tuna considered less desirable because of its size, species or marketability should still be retained.

Assuming that 3% of tuna catches is normally dumped at sea and ‘replaced’ by additional catch, Planet Tracker calculates that **a full tuna retention policy could increase long-term revenue by 6%**, if the industry can overcome the initial associated 5% drop in sales (due to the non-replacement of the less desirable catch).

26 This is using the ISSF definition of unfit for human consumption

7. Participate in sustainable tuna fishing initiatives

There is a growing number of company-wide commitments from seafood giants to source sustainable tuna around the world. Reports from the Sustainable Fisheries Partnership (SFP) and WWF show a strong preference from companies such as Cargill, Ahold Delhaize USA, Aldi, or McDonald's over sourcing tunas from MSC-certified or FIPs that are listed on fisheryprogress.org.

For instance, earlier this year, Walmart announced plans to have all Walmart and Sam's Club shelf-stable private and national brand tuna coming from a FIP or MSC-certified fishery by 2025.[xciii] Some other global brands that also made strong commitments to sourcing tuna caught by MSC certified fisheries include Edeka, Netto, Bumble Bee and Lidl.[xciv]

In 2021, the EMEA and North America region consumed 91% of MSC-labelled tuna[xcv] - see Table 15.

Table 15: *Top 6 Markets for MSC Labelled Tuna Products (Tonnes) In 2020/21 and Total Tuna Import in 2021. (Source: MSC,[xcvi] and ITC Trade).[xcvii]*

Top 6 markets for MSC labelled tuna	Tuna products (tonnes)	Percentage of world total	Total tuna import (tonnes)[27]	MSC labelled % total import
DACH (Germany, Austria, Switzerland)	38,860	39%	95,736	40.6%
Southern Europe (Spain, France, Italy, Portugal)	12,943	13%	478,009	2.7%
US & Canada	12,783	13%	263,552	4.9%
Benelux (Belgium, Luxembourg, Netherlands)	7,873	8%	92,336	8.5%
Oceania	6,995	7%	62,341	11.2%
UK & Ireland	4,909	5%	91,087	5.4%

The Southern European (Spain, France, Italy, Portugal) and North American markets together consumed 68% of Indonesia's frozen tuna exports in 2022 (focusing on HS code HS030487[xcviii]) - see Figure 28.

27 Aggregating the total imports of the following products: HS16041441, HS030487, HS030232, and HS030342 per region in 2021.

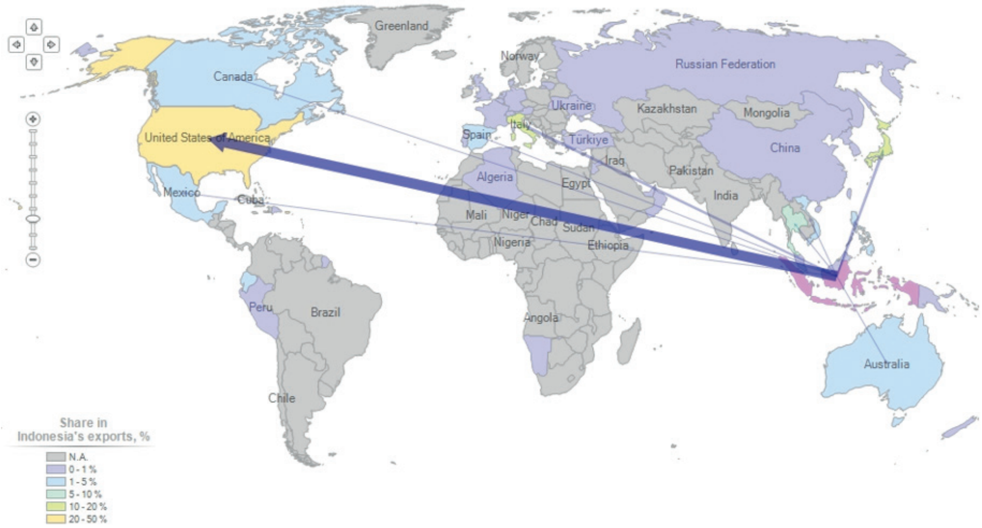


Figure 28: *U.S. is the single largest importer of Indonesian tuna around the world, followed by Italy, Japan, Thailand, and Spain. (Source: ITC Trade Map).*

Growing demand for certified tunas from these top export nations is a strong incentive for tuna traders and distributors to increase their sourcing from certified fishers in Indonesia.

Failing to work towards or achieve certification could cause substantial loss for fishers in the foreseeable future, as major retailers source tunas from elsewhere.

In Indonesia, the key sustainable tuna initiatives companies should join are (depending on the gear and fishery):

- AP2HI, the Indonesian Pole & Line and Handline Tuna Fisheries Association),
- ATLI (Indonesian Tuna Longline Association),
- Fisheries Improvement Projects (FIP)
- Marine Stewardship Council (MSC) certification.

Assuming that joining a FIP would incur average costs of USD 20,000 and becoming MSC certified would cost USD 50,000 per company, an estimated one-off investment of USD 3.6 million is needed for our sample of tuna vessels. We estimate it could result in a long-term increase in revenue of 5% (higher volume plus price premium).

8. Replace crude palm oil by used cooking oil as a feedstock for biodiesel

Fuel is the greatest single cost for the Indonesian tuna fishing fleet, even though it is heavily subsidised (by as much as USD 54 cents per litre of diesel, vs. a real cost before subsidy of USD 88 cents).[xcix] It is also the key source of fossil fuel emissions.

Since 2008, the Indonesian Government has supported the use of biodiesel, with a blending rate initially set at 2.5% and now at 35%. The Government explored several kinds of biodiesel feedstock, as part of this biodiesel programme, including crude palm oil, used cooking oil and jatropha, but eventually focused only on crude palm oil.[c]

Even though palm oil-related deforestation has slowed significantly in recent years, encouraging palm oil plantations has obvious negative land use and biodiversity impacts. It also reportedly contributed to the recent cooking oil crisis in the country. **Policymakers are now considering other feedstocks to produce biodiesel.** One potential avenue to reduce fossil fuel emissions in the fishing industry without affecting land use and biodiversity would be for **used cooking oil to become the preferred feedstock for biodiesel**, since its carbon intensity is more than four times lower than that of diesel or gasoline.[ci]

Despite scale constraints, it was estimated that used cooking oil could replace 16% of the energy demand of the Indonesian fishing fleet. If used cooking oil were incorporated into the National Energy Plan of Indonesia as an approved feedstock for biodiesel production and added to the national biodiesel mandate (to make it eligible for subsidies), it was estimated that it would be a cost-friendly alternative to crude palm oil.[cii]

Planet Tracker calculates that replacing 10% of the industrial tuna fleet's biodiesel from crude palm oil by used cooking oil could generate savings of USD 2.2 million for our sample of 129 owners, based on the projected difference in prices between the two feedstocks.[ciii]

9. Link their financial health to the environmental health of the populations they rely on and take action to improve both

Overarching the previous recommended actions is the realisation that environmental health and financial health are intrinsically linked in the tuna fishing industry. To improve both simultaneously requires: collecting data either internally or from third party, assessing the sustainability of the catch based on this data and lastly analysing the interlinkage between the sustainability of the seafood offered and its profitability to be able to design and implement a strategy that maximises both.

Planet Tracker designed a simple and short tool (the Seafood Accounting Protocol) to allow any seafood company to do so.

It is very challenging to estimate the financial impact of **implementing a strategy that better connects sustainability and profitability**, but assuming that it results in a 0.5% increase in staff time and an increase in long-term revenue of the same magnitude (thanks to better strategies), this would **raise long-term EBITDA in the industry by 1.5%**.

Overall financial impact of our recommendations

In addition to being positive for the environment, the combined impact of our recommendations is financially attractive, since together they more than offset the expected impact of the climate crisis on the industry's revenue and profit – see Figure 29.

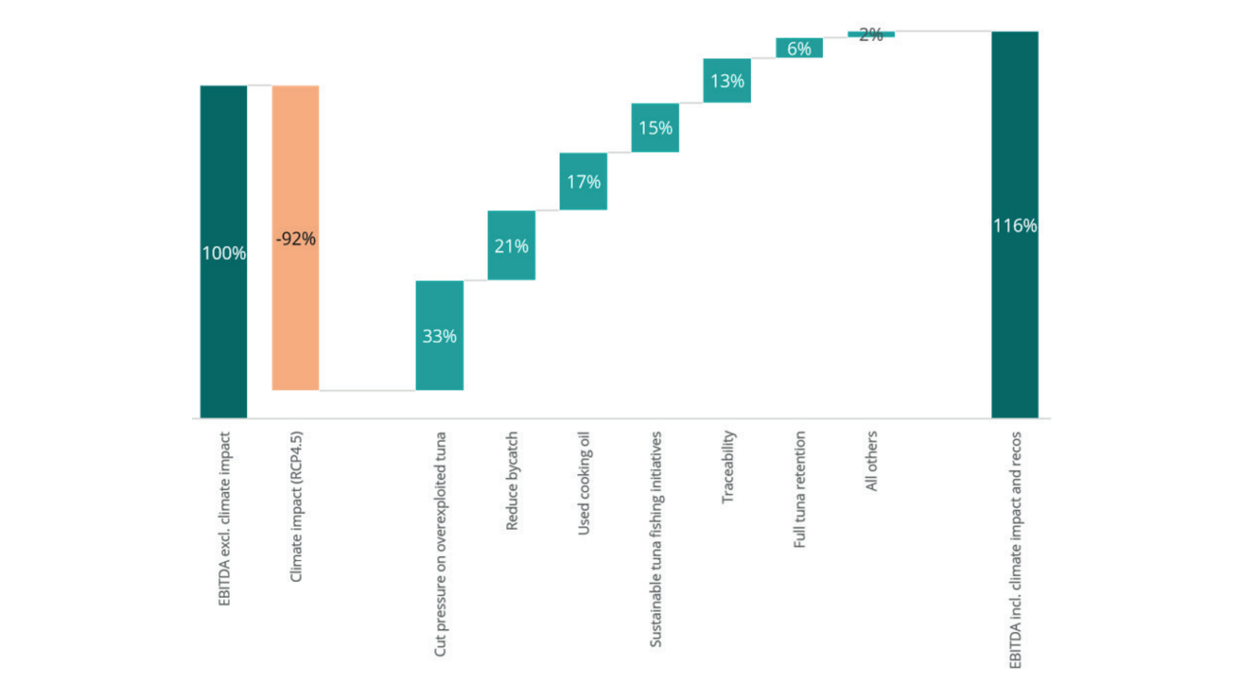


Figure 29: *Impact Of Climate Change (RCP 4.5 Scenario) And Planet Tracker Recommendations On Long Term EBITDA As A % Of 2050 EBITDA Before Climate Impact*

It will, however, require an initial investment of a total of USD 16 million, of which c. USD 6 million in upfront, one-off capital expenditures and the rest in short-term negative impact on EBITDA – see Figure 30.

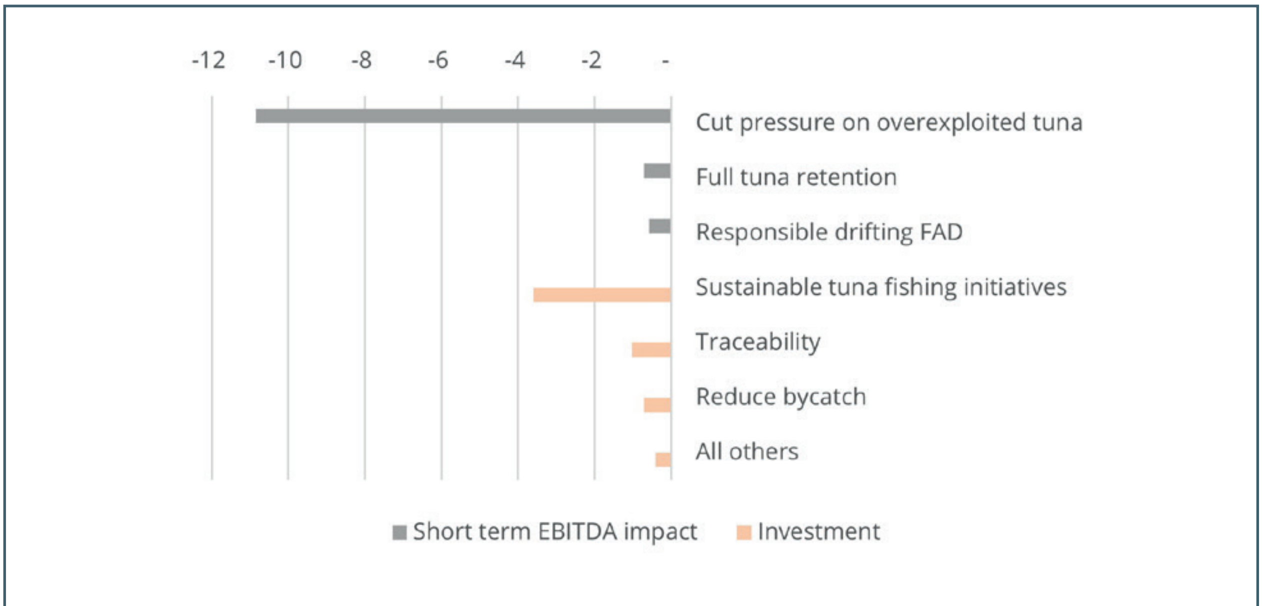


Figure 30: *Investment Necessary To Implement Planet Tracker's Recommendations at our Sample of 256 Tuna Vessels (In USD Millions)*

For the net present value of such an investment to be positive, the discount rate retained has to be low (below the Indonesian average), meaning that impact investors and/or blended finance (e.g. including grants) are the most appropriate source of capital for these investments. This is because the long-term benefits we modelled are assumed to materialise only from the 2040s.

CONCLUSION AND CALL FOR ACTION

The climate crisis will deeply affect the Indonesian tuna industry, possibly wiping out all of its profits by 2050. The good news is that mitigating that shock is possible. If the industry is willing to invest in a series of nature-positive measures, it could recoup its future climate-driven losses while simultaneously improving its long-term sustainability.

Financial backers of the tuna fishing sector and the Indonesian Government also have a key role to play, as detailed in the next section.

Tuna fishing companies should:

1. **Reduce pressure on overexploited tuna** stocks[28] by at least 20%.
2. Adopt a **responsible drifting FAD policy.**
3. Invest in GDST[29] - compliant **tuna traceability.**
4. Enable supply chain transparency by **disclosing the volume of species caught.**
5. Choose **selective fishing methods** to reduce bycatch.
6. **Retain all fished tuna**, except those unfit for human consumption.
7. Participate in **sustainable tuna fishing initiatives**, such as AP2HI, the Indonesian Pole & Line and Handline Tuna Fisheries Association), ATLI (Indonesian Tuna Longline Association), Fisheries Improvement Projects (FIP) or Marine Stewardship Council (MSC) certification.
8. Replace crude palm oil by used cooking oil as a feedstock for biodiesel.
9. **Link their financial health to the environmental health** of the fish populations they rely on and take action to improve both.

Tuna Investing Toolkit: six questions investors should ask

Investors in tuna fishing companies can help drive that change by asking the following questions, and requiring answers to be made public:

Sourcing
What proportion of tuna volumes caught/sourced by the company are from vessels in MSC certified fisheries or in a FIP?
What proportion of tuna volumes caught/sourced by the company are yellowfin tuna and bigeye tuna caught in the Indian Ocean?
Bycatch
Does the company measure and take steps to reduce its bycatch of juvenile tuna species or other marine life?
Out of the drifting FADs deployed by the company every year, how many are retrieved?
Traceability and Transparency
How many tonnes of each tuna species are caught/sourced by the company every year?
What percentage of the company’s catch is traceable back to the vessel level?

28 Bigeye tuna and yellowfin tuna in the Indian Ocean

29 Global Dialogue on Seafood Traceability, an organisation that sets standards for seafood traceability to enable interoperability across supply chains

In addition, fishery management authorities can significantly contribute to improving the long-term sustainability of Indonesian waters.

The Indonesian Government should:

Require an IMO/unique vessel identifier

- 49.6% of the tuna fishing vessels in our dataset do not have a IMO even though they should
- A unique, permanent IMO is a key tool for the effective and reliable monitoring of a vessel's activity at sea and combat IUU fishing

Require 100% observer coverage/electronic monitoring

- The observer coverage rate in Indonesia is low, at 3.53% for longliners in the Indian Ocean.[civ]
- On-board observers collect catch-related data and monitor the implementation of conservation and management measures including bycatch, discards, setting on FADs, etc.
  The data collected can be used for compliance purposes, national laws, licenses or access agreements.[cv]

Require responsible FAD management; including at minimum:

- Use only fully non-entangling FADs without netting that reduce entanglement and minimise bycatch
- Require mitigation measures for main bycatch species in FAD sets
- Release practices for sharks, rays and sea turtles

Prepare and implement a restoration plan for yellowfin tuna and bigeye tuna in the Indian Ocean via the IOTC

Enforce national legislation to implement conservation and management measures adopted by the tuna commissions

Enforce legislation to reduce fishery crimes and improve foreign worker protections

- The Indonesian seafood industry has been linked to child labour and forced labour by the US Department of Labour (USDOL) and the US Department of State (USDOS) in the past five years
- Fish from Indonesia is listed in the USDOL's 2020 List of Goods Produced by Child Labour or Forced Labour[cvi]

Require full traceability of all tuna products back to the individual vessel and vessel owners, verified by third-party audits

Standardise the definition of ultimate beneficial owner and mandate the disclosure of beneficial ownership, particularly for industrial fishing vessels

APPENDIX

APPENDIX 1: **METHODOLOGY**

This appendix presents a full overview of the methodological steps followed from the identification of tuna vessels to the sustainability scoring used.

To investigate the Indonesian tuna fishing industry, Planet Tracker used a combination of third-party data (from e.g. Global Fishing Watch, AquaMaps or the Indonesian Government, see below), in-house modelling (to estimate the profitability of each vessel and each owner when financials were not published), and on-the-ground research (only Indonesian citizens can purchase the notary acts to secure ownership data) - see Figure 31.

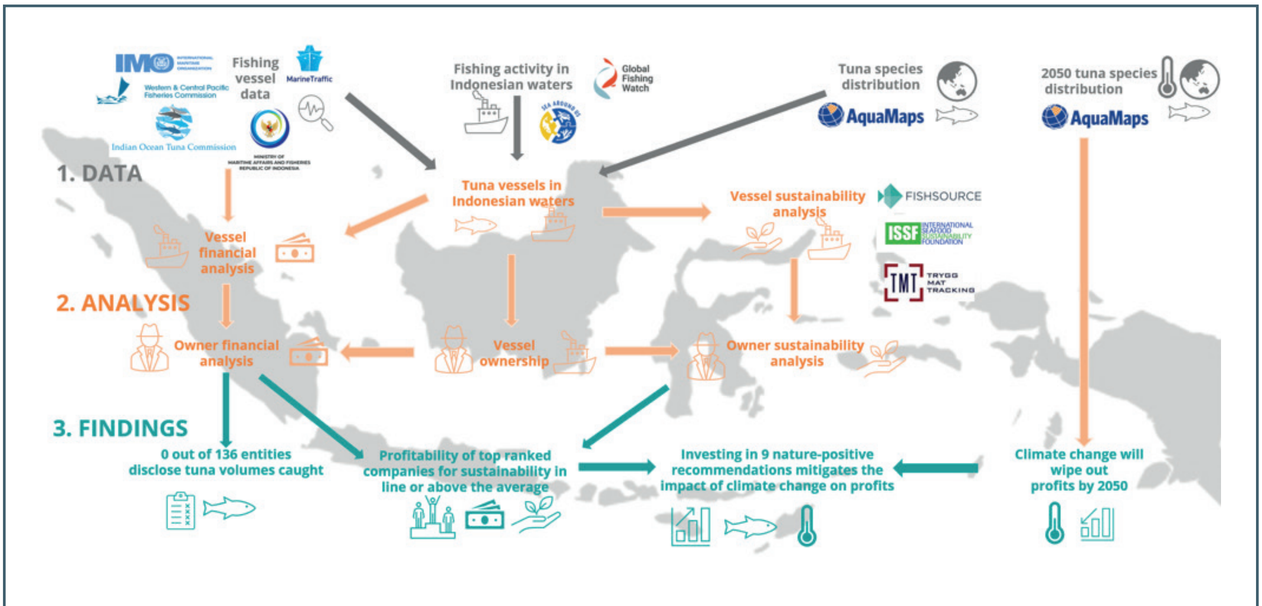
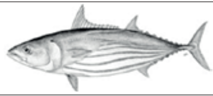
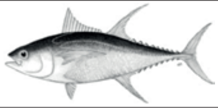
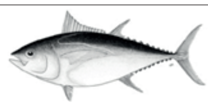


***Figure 31:** How Planet Tracker Investigated the Indonesian Tuna Fishing Industry (Source: Planet Tracker, Logos Indicate Key Third Party Data Sources Used)*

Identifying tuna species

We defined tuna as species belonging to the Thunnini tribe.[cvii] Nine of these fifteen tuna species occur in the Indonesian Economic Exclusive Zone (EEZ), according to the tuna distribution maps from AquaMaps and FishBase[cviii] – see Table 16.

Table 16: *List of Tuna Species. Species with a Tick Occur in Indonesian Waters.*

	Scientific name	English name	Illustration
✓	*Auxis rochei*	**Bullet tuna**	
	Auxis thazard	**Frigate tuna**	
✓	*Euthynnus affinis*	**Kawakawa**	
✓	*Katsuwonus pelamis*	**Skipjack tuna**	
✓	*Thunnus alalunga*	**Albacore**	
✓	*Thunnus albacares*	**Yellowfin tuna**	
✓	*Thunnus maccoyii*	**Southern bluefin tuna**	
✓	*Thunnus obesus*	**Bigeye tuna**	
✓	*Thunnus tonggol*	**Longtail tuna**	
✗	*Allothunnus fallai*	**Slender tuna**	
✗	*Euthynnus alletteratus*	**Little tunny**	
✗	*Euthynnus lineatus*	**Black skipjack**	
✗	*Thunnus atlanticus*	**Blackfin tuna**	
✗	*Thunnus orientalis*	**Pacific bluefin tuna**	
✗	*Thunnus thynnus*	**Atlantic bluefin tuna**	

Only major commercial tuna species highlighted by the International Seafood Sustainability Foundation (ISSF)[cix] are considered in our financial analysis, due to the relative difference in their economic value compared to other species.

According to the Indonesian Ministry of Marine Affairs and Fisheries (KKP) 2020, the most dominated tuna species caught in Indonesian waters is skipjack, as the species can be easily found in many Indonesian waters. Albacore and Bluefin tuna are mainly caught by smaller fishing vessels such as 11-30GT and 31-60GT. However, only fishing activities of vessels with a gross tonnage of 60 GT and over might be collected by Global Fishing Watch using AIS data.

As a result, this research only focuses on three major tuna species, - skipjack (SKJ, Katsuwonus pelamis), yellowfin (YFT, Thunnus Albacares) and bigeye (BET, Thunnus obesus) as the amount of Albacore and Bluefin tuna caught by vessels in our dataset can be largely ignored – see Table 17. The Indonesian Government no longer publicly shares VMS data on Global Fishing Watch, so we focused on AIS data.

Table 17: *Distribution of Tuna Commodity Production Volume by Vessel's Size. Source: MMAF, 2020.*[cx]

Production by Vessel's Size	Albacore	Skipjack	Yellowfin	Bigeye	Bluefin	Total
<5 GT	0.0%	1.0%	2.2%	0.3%	0.0%	3.6%
5-10 GT	0.0%	2.5%	3.3%	0.2%	0.0%	5.9%
11-30 GT	0.8%	29.0%	10.2%	2.6%	0.0%	42.7%
31-60 GT	0.1%	5.9%	2.8%	0.1%	0.0%	8.8%
61-100 GT	0.0%	26.6%	12.1%	0.2%	0.0%	38.9%
101-150 GT	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
Total Catch per Species	0.9%	65.0%	30.6%	3.4%	0.0%	100.0%

Identifying fishing vessels in Indonesian waters

We first collected data on fishing vessels and fishing events as identified by Global Fishing Watch[30] using an automatic identification system (AIS). During the period January 2019 to September 2022, we tracked a total of 907 vessels with 139,489 fishing events.

The AIS system includes a GPS receiver and was designed to be a safety equipment that enables vessels to identify other vessels' presence and avoid collisions. The tracking dataset thus allows us to identify when and where a vessel is fishing and the gear type used, based on its movement patterns - see Figure 32.

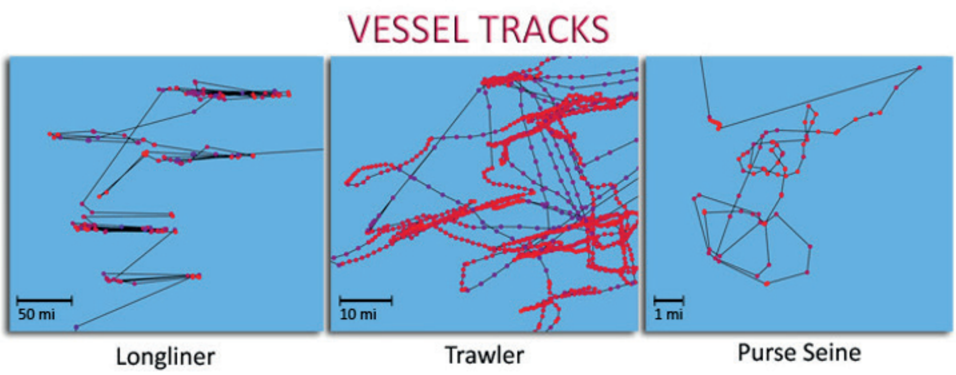


Figure 32: *What does a fishing pattern look like? Source: Global Fishing Watch*[cxi]

In an effort to combat IUU fishing in Indonesian waters, the Indonesian KKP introduced a moratorium on banning foreign fishing vessels and transshipment in Indonesian FMAs in 2014.[cxii] GFW reported a significant decrease of apparent fishing hours of vessels transmitting AIS data since the moratorium came into force.[cxiii]

Later in August 2019, the Ministry of Transportation of the Republic of Indonesia made AIS mandatory for vessels sailing in Indonesian waters.[cxiv] This resulted in a substantial increase in fishing activity transmitted by AIS - see Figure 33.

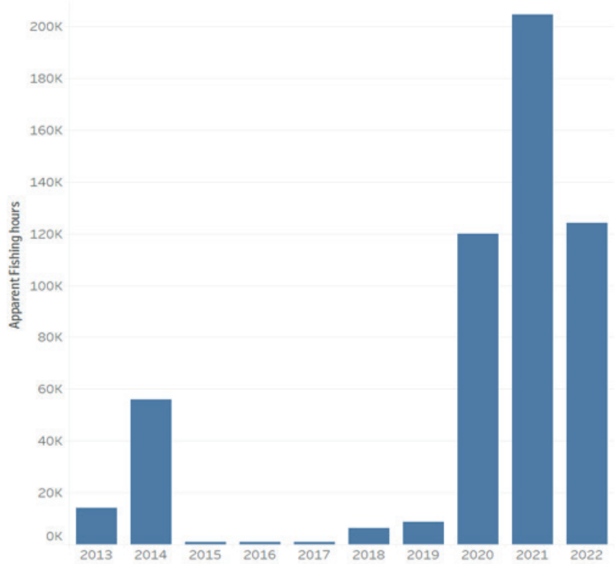


Figure 33: *Total apparent fishing hours of fishing vessels in Indonesian EEZ from 2013 to 2022. Source: GFW*

While the rule applies to all foreign vessels sailing in Indonesian waters with no minimum gross tonnage limit, only Indonesian flagged vessels to which Safety of Life at Sea (SOLAS) applies - typically, commercial vessels over 299GT which engage on international voyages[cxv] - must carry a functional AIS Class A while other Indonesian flagged vessels over 60 GT may have on board a Class B AIS.

As a result, our dataset is limited by the fact that more than 98% of the total marine fishing vessels in Indonesia are less than 60GT and thus do not carry AIS – see Figure 34. This is a major limitation of our study due to data availability.

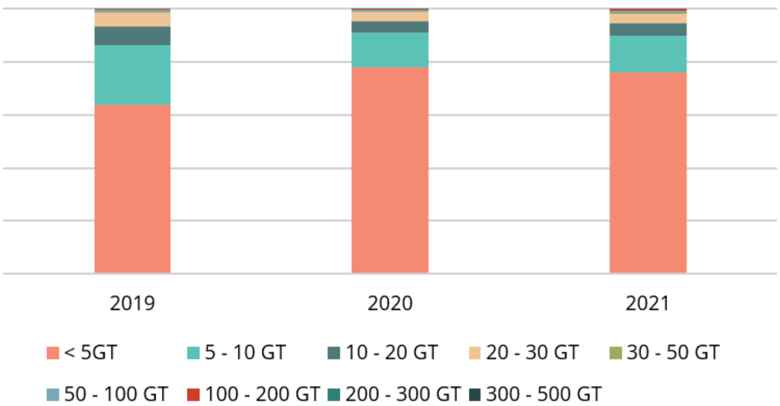


Figure 34: *Number of Indonesian-Flagged Motorized Marine Fishing Vessels by Size (Source: KKP)*[cxvi]

Identifying which of these vessels catch tuna

Out of the 907 vessels that fished in Indonesian waters during the period and were tracked by Global Fishing Watch, we retained only those ones that we estimate caught tuna using the following method:

- If a vessel was categorized by Global Fishing Watch as 'tuna purse seiner', it was assumed to catch tuna
- If a vessel was authorized by tuna RFMOs, it was assumed to catch tuna
- If a vessel was equipped with gear which are clearly not tuna-related, such as a 'squid jigger', it was assumed not to catch tuna.
- For all other vessels, we matched the location of each fishing event with the tuna habitat map provided by AquaMaps,[cxvii] which display probabilities of occurrence for skipjack, bigeye and yellowfin tuna. We then computed the probability of targeting tuna as: mean habitat probability minus one standard deviation for each of the locations the vessel fished in. If that probability was above 70%, we assumed the vessel was catching tuna. For an example, see Figure 35 below.

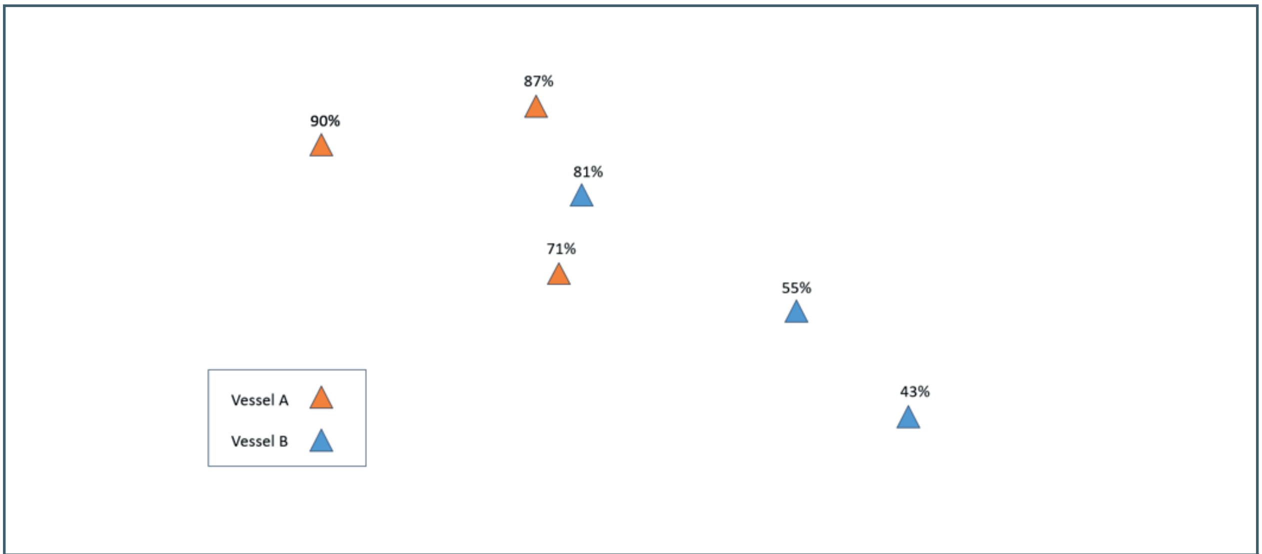


Figure 35: *Identifying vessels catching tuna, habitat probability step. Vessel A and Vessel B fished in 3 locations each. Each location has a different habitat probability (as provided by AquaMaps) for the 3 tuna species considered. For Vessel A, the probability of targeting tuna is 75% (the mean habitat probability is 83%, minus a standard deviation of 8%). For Vessel B, the probability of targeting tuna is 44% (60% minus 16%). We consider Vessel A likely to be catching tuna, and Vessel B not likely to be catching tuna.*

Gather data on each vessel

In Indonesia, skipjack is the most caught tuna species, followed by yellowfin and bigeye tuna.[cxviii] To fully understand the sustainability of each vessel, ideally we need to ascertain the target species caught by each vessel during every fishing event. Unfortunately, this data is not currently publicly available.

In addition, unlike handline, pole-and-line, or trolling, which are highly selective fishing methods, the majority of large-scale industrial vessels collected in our dataset - purse seines and longliners - are generally multipurpose, or less selective in terms of both species and fish size.[cxix]

It is therefore not possible to determine with any degree of certainty which of the three tuna species is being targeted and caught in each fishing event. Instead, Planet Tracker assigned a catch probability for each species and each fishing event.

Planet Tracker estimated the most likely target species of each fishing vessel using the information collected from Global Fishing Watch, including locations of fishing events, gear type, country flag, total apparent fishing hours and the gross tonnage of each fishing vessel, with the reconstructed data of Indonesia' marine fisheries catch which we collected from *Sea Around Us*.

To calculate this, we combined the habitat probability data from AquaMaps with the information from Global Fishing Watch, and the reconstructed data of Indonesia's marine fisheries catch which we collected from Sea Around Us.

The three datapoints used for matching Sea Around Us, with Global Fishing Watch are gear type, flag and EEZ area (one of the 3 Indonesia EEZ areas from Sea Around Us: the Indian Ocean coast of Indonesia (WPP571- 573), Central Indonesia (WPP711 and 712) and Eastern Indonesia (WPP713-718).

For example, according to Sea Around Us, Indonesian flag purse seiners in Indian Ocean Indonesia EEZ caught mostly skipjack (>75%), followed by yellowfin and bigeye. The probability that each of these tuna species was caught by each vessel is the combination of this data from Sea Around Us with the mean habitat probability in all its recorded fishing event locations.

Total catch estimates

We estimate the total tuna catch for each fishing vessel by taking apparent fishing hours multiplied by the fishing power of the vessel, i.e. the catch it takes from a given density of fish per unit fishing hour.

In this research we assume undifferentiated fishing method and associated technology amongst vessels for each gear due to lack of data. We are however mindful of the fact that different fishing methods and techniques deployed by the same vessel could result in significantly different species composition and catchability (this is particularly true for longlines).[cxx]

Without the aid of technology, the catch rate of fishing vessels is closely related to the vessel's gross tonnage.[cxxi] For purse seiners, catch goes up as the gross tonnage increases, but less than proportionately - a 60GT purse seiner catches more tuna than a 30GT does per set, but not twice as much.

The fishing power of longline is increased by deploying more sets and hooks, while fishing operation efficiency decreases along the duration of the operation:again, a 10 hour-long longline set catches more than a 5-hour long set but not twice as much.

A power relation between vessel gross tonnage and catch volume was therefore developed for each gear, based on empirical research and statistics of catch rate per species[cxxii, cxxiii, cxxiv, cxxv] - see Figure 36 and 37.

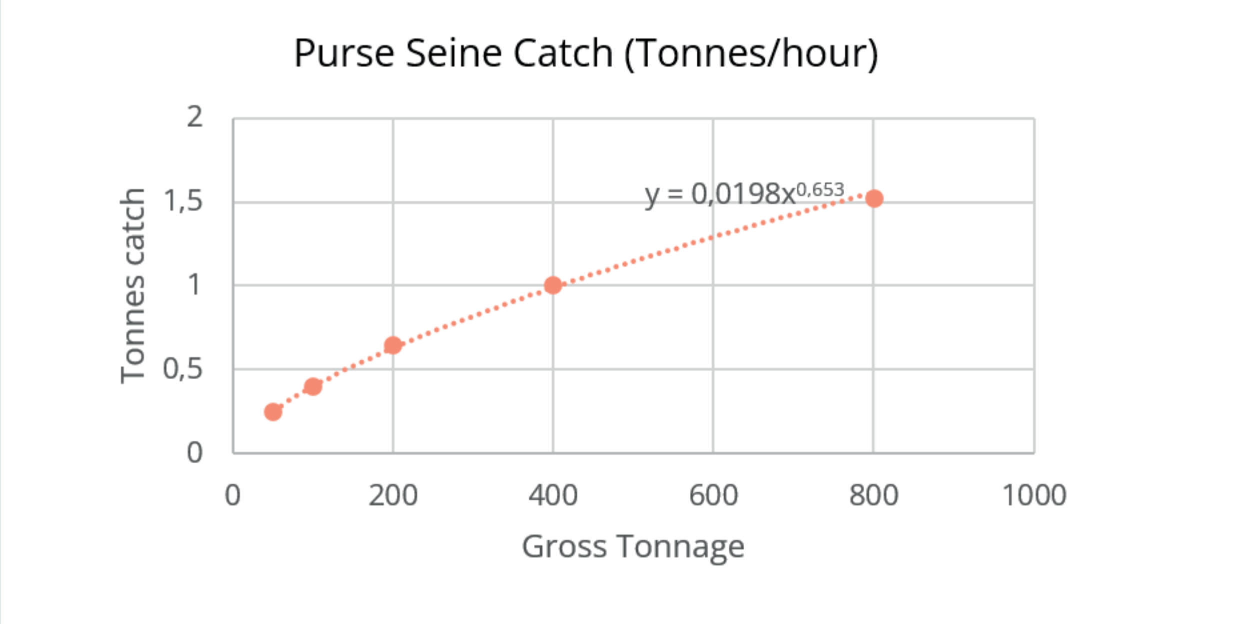


Figure 36: *Estimated Relation between Gross Tonnage and Catch Estimate for Purse Seiner, Tonnes per Hour.*

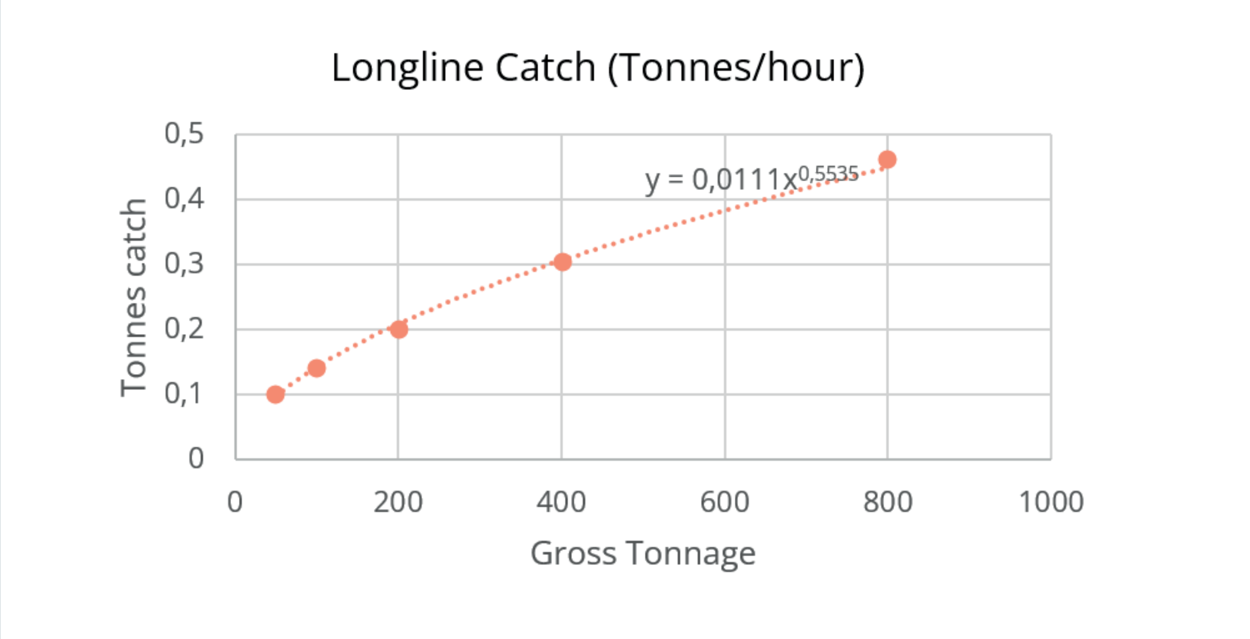


Figure 37: *Estimated Relation between Gross Tonnage and Catch Estimate for Longliner, Tonnes per Hour.*

Establish a methodology to assess the sustainability of each vessel

This report investigates the sustainability level of each fishing vessel from several angles: target species stock status, fishing method and corresponding environmental impacts, fishery management, alignment with science-based best practices.

Planet Tacker measured this through indicators based on data from Fish Source[31], the International Seafood Sustainability Foundation (ISSF)[32], Marine Stewardship Council (MSC) Fishery Certification[33], Fishery Improvement Projects[34], and the International Maritime Organization (IMO)[35], as detailed below.

FishSource wild capture scores

FishSource scores assess the sustainability of a fishery on three aspects: quality of the management, the state of the resource, and environmental impacts of the fishery. For a given FAO species, a management unit, where a jurisdiction intersects with its distribution is created. Then vessel flag countries fishing under that jurisdiction are considered, and in turn under each flag country, types of fishing gear in use by that country are considered– see Figure 38. One example could be assessing a Russian longliner fishing Atlantic cod in Norwegian part of the Barents Sea.

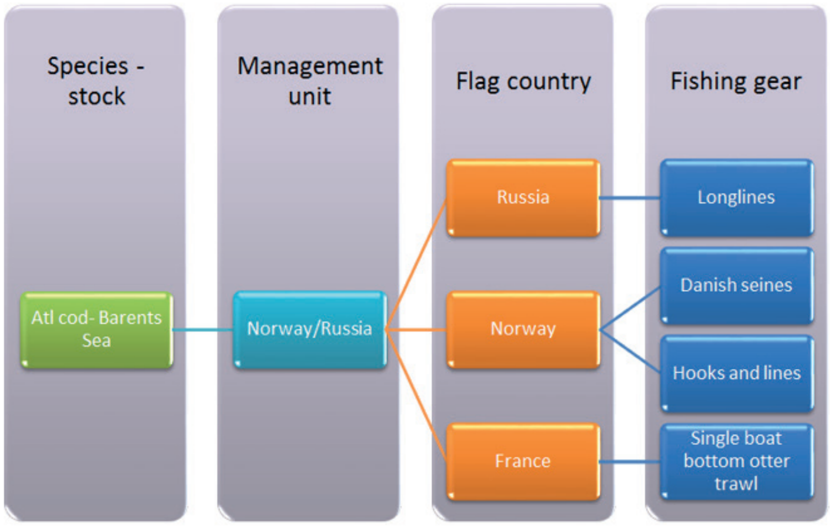


Figure 38: *An Example of a Fishsource Scoring Profile Structured Around a Biological Stock. (Source: FishSource).*[cxxvi]

Management quality examines managers' decisions regarding following scientific advice, setting total allowable catch and other measures undertaken and compliance – how strong the compliance enforced is, as compared to set goals.

31 https://www.fishsource.org/
32 https://www.iss-foundation.org/
33 https://www.msc.org/uk
34 https://fisheryprogress.org/
35 https://www.imo.org/

Stock status reflects the stock assessment, scientific advice, current status and trends of a FAO species or taxon[36] based on distribution in a certain FAO fishing area.

The environmental impact of the fishery is a function of both what and how the gear is used in that fishery.[cxxvii]

The scores are calculated on a scale from 0 to 10 (where 10 is the best score), with cut-off points of “6” and “8” on the scores’ scale, reflecting “acceptable standard but with improvements required” and “unconditional pass”, respectively.

ISSF transparency tools

ISSF ProActive Vessel Register (PVR) is a transparency tool which provides information about fishing vessels and their practices. Fishing vessels can be registered on the PVR to show how they are following best practices that support sustainable tuna fisheries.

As of 2023, 652 known large-scale purse seiners - those with at least 335 cubic meters fish hold volume and a total fishing capacity of over 841,000 cubic meters – harvest about 69% of the world’s tropical tuna. Out of these, 27 fly the Indonesian flag.[cxxviii]

Large-scale tuna purse seiners are often equipped with FADs, speed boats, helicopter, and other equipment (e.g. substantial freezing and storage capabilities) which an significantly increase the vessels’ ability to catch target species. All of that makes large-scale tuna purse seiners capable of catching more fish, in turn making them more at risk of contributing to overfishing. [cxxix]

The ISSF Record of Large-Scale Purse Seine Vessels (LSPSR) fishing for tropical tunas allows tracking and assessment of the fishing capacity of vessels in Indonesian waters and an understanding of which large-scale purse seiners have made a public commitment to sustainable fishing as reflected on PVR.

IMO number: greater transparency

S&P Global Market Intelligence provides the International Maritime Organization (IMO) numbering system for the unique identification and registration of vessels.

An IMO number is a unique seven-digit vessel number that is issued to each vessel. It stays with the vessel regardless of the vessel owner, country of registration or name until the vessel is scrapped. It is therefore a powerful tool in the fight against shifting identities of fishing vessels and IUU fishing.[cxxx]

According to the IMO, fishing vessels with a length overall (LOA) of 12 meters or above authorised to operate outside waters of national jurisdiction, and/or any fishing vessels over 100 gross tonnes (GT) regardless of their fishing grounds, are eligible for an IMO number without a charge.[cxxxi]

The WCPFC has amended its authorised vessel register measures as a response to the new IMO regulation in 2018,[cxxxii] requiring IMO numbers for all fishing vessels greater than 12 meters. On the other hand, IOTC only requires IMO numbers for those with LOA larger than 24 meters.[cxxxiii]

36 A taxon is a group of one or more populations of an organism or organisms seen by taxonomists to form a unit.

Attribute a sustainability score to each tuna vessel

The vessel sustainability score is calculated in steps.

We first categorised tuna fishing vessels by fishing location, target species, country flag and gear type to fit in the wild capture scoring mechanism provided by FishSource.org.

Given one vessel could simultaneously harvest different species of tuna in one fishing event, we calculated each vessel's FishSource sustainability score by taking the weighted average using the probability of each target species as the weight - see Table 18 for more information.

Table 18: *Vessel Sustainability Scoring Framework. (Source: FishSource.org, compiled by Planet Tracker).*

Fishing indicator	Weight	Description
Quality of management	Target species probability – Skipjack, Yellowfin, Bigeye	Whether harvest rates are reduced at low levels Whether management set catch limit to scientific advised catch limit Whether the actual catches are in line with the catch limit goal set by managers
Stock assessment	Target species probability – Skipjack, Yellowfin, Bigeye	Whether the current biomass is at long-term target levels Whether current fishing mortality is at the long-term target level
Environmental impact	Target species probability – Skipjack, Yellowfin, Bigeye	Fishery impacts on bycatch species; Endangered, Threatened, or Protected species (ETP), habitat and the ecosystem

Adjusting Fish Source score for sustainability initiative

After having determined a FishSource score for each vessel, we adjust it to account for the positive contribution of a vessel participating in sustainability initiatives.

Vessels not participating in any initiative are attributed a 6/10 score whilst vessels in a MSC certified fishery, a FIP and on the ISSF ProActive (PVR) list are assigned a 10, 8.5 and 7.5/10 score respectively to reflect their effort to follow best practices. Large-scale purse seiners which are not registered on ISSF PVR list are assigned a 4.5/10 score to account for potential overcapacity (therefore overfishing) risk - see Table 19.

***Table 19:** Vessel Sustainability Initiative Scoring Framework (Source: ISSF, MSC, FisheryProgress.org, IMO, compiled by Planet Tracker).*

Sustainability Initiative	Scoring	Description
Not part of any initiative	6	Vessels not part of any of the below
MSC certified	10	Vessels in MSC certified fishery
In a FIP	8.5	Vessels in fishery improvement projects (FIPs) seeking MSC certification
Registered on ISSF PVR list[35]	7.5	Voluntarily registered to demonstrate how a vessel is following best practices
On the ISSF LSPSR[36] **record but not on the PVR list**	4.5	Large-scale vessels fishing for tropical tunas that are not on the PVR list

The final sustainability initiative scores are then converted into an adjustment factor, calculated as (Sustainability Initiative Score – 6)/6, to add on to the FishSource score.

That means that a vessel in an MSC certified fishery will gain an extra 0.67 points while the score of a large-scale purse seiner not on the ISSF PVR list will be reduced by 0.25.

If a vessel has multiple identities, another 0.5 points are deducted from its overall sustainability score.

Identify the owner of each tuna vessel

The next question is: who owns the vessel?

We firstly collected ownership of fishing vessels from Park et al. (2023)[cxxxiv], which provides an extensive research on vessel identity on a global scale.

For other vessels, ownership information was filled using vessels' authorisation records when data are available. Data were collected from tuna RFMOs and the Indonesian MMAF fishing licensing system using the vessel Maritime Mobile Service Identifiers (MMSI) number, IMO number, callsign and vessel names.

And finally, we collected further information on vessels unmatched to registries by going through several public websites, including, but not limited to, Marine Traffic[37], FleetMon.com[38] and VesselFinder[39].

If the vessel's ownership changed, we picked the owner that owned the vessel at the time the fishing event in our dataset occurred.

The ownership data we collect at this stage is considered as 'first layer ownership' which contains registered owners of these fishing vessels only. This is because the aforementioned data sources do not exclusively distinguish between registered and beneficial owners, even though Park et al. (2023) has integrated possible beneficial ownership information when available.

37 marinetraffic.com
38 fleetmon.com
39 vesselfinder.com

Mapping the beneficial owner of each tuna vessel is a challenging endeavour, which is particularly true for Indonesian fishing vessels due to relatively lax registration requirements. Around half of the Indonesian owned tuna vessels in our dataset are registered under a name where no public record could be found.

As a result, we conducted an exacting manual desktop research from multiple sources: individual owner names were matched with various company registry data to identify whether this individual possesses controlling shares of a seafood-related corporation; corporate owners' holdings and subsidiary companies were also checked to determine the ultimate beneficial owner.

Indonesian companies were cross checked on the KKP government website[40] and Indonesian Ministry of Law and Human Rights (AHU)[41] to obtain shareholder and business segment information.

Establish a methodology to assess the sustainability of each owner

Traceability and transparency

Adequate product traceability records are crucial to fishing management and eliminating IUU fishing. Owners can contribute to this by simply creating a website and disclosing vessels as well as target species information on this website.

Monitoring and surveillance

Owners of vessels that should be attributed an IMO number but do not are assigned a minus one point malus. Seafood processors, traders and others in the seafood industry should refrain from transactions in tunas caught by these vessels as suggested by ISSF.[cxxxv]

40 http://infoproduk.kkp.go.id/company

41 https://ahu.go.id/pencarian/profil-pt

IUU fishing risk

Vessel identity assessment

For the purpose of fisheries management, the Indonesian EEZ is divided into 11 fisheries management areas (FMAs, or Wilayah Pengelolaan Perikanan, WPPs).

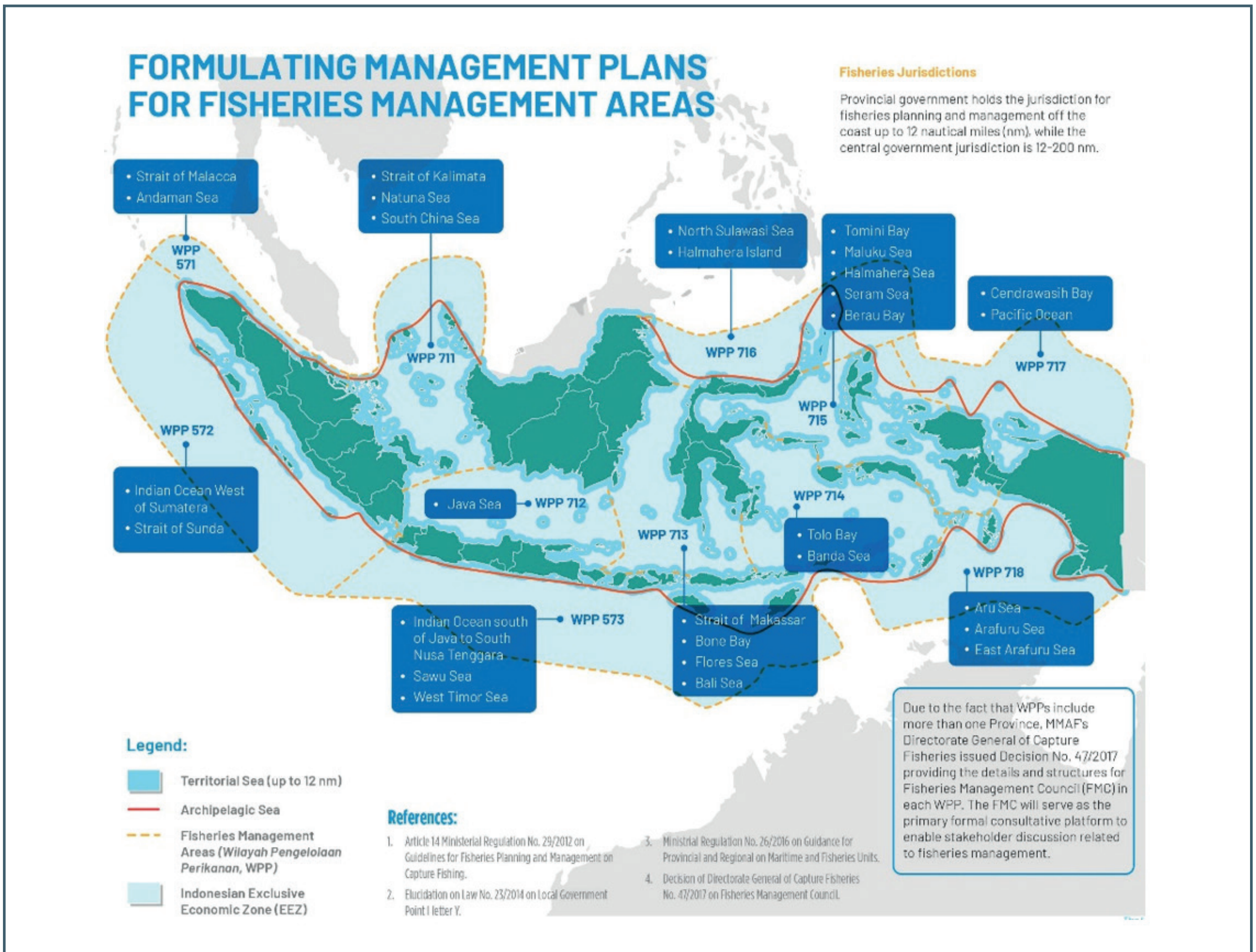


Figure 39: *The Distribution of 11 Fishery Management Areas (WPP) in Indonesia.*[cxxxvi]

Indonesian FMAs overlap with the IOTC (fishing area WPP57) and the WCPFC convention area (fishing area WPP71), but also with the convention area of Conservation of Southern Bluefin Tuna (CCSBT) for the management of southern bluefin tuna.[cxxxvii]

Vessels are considered illicit if they conduct fishing without access agreement with the Indonesian government or the three RFMOs within the corresponding convention areas in Indonesian waters.

Under the current registration and licensing system by the Indonesian Ministry of Marine Affairs and Fisheries (KKP), fisheries entities operating vessels larger than 10GT that wish to undertake fishing in Indonesia are required to apply for the Fisheries Business License (Surat Izin Usaha Perikanan - SIUP in Indonesian) along with further operational or commercial permits: Fish Capture License (Surat Izin Penangkapan Ikan, SIPI) and transport license (Surat Izin Kapal Pengangkut Ikan, SIKPI), which are valid for one year after issuance.[cxxxviii]

Issuing new SIUP, SIPI and SIKPI to foreign vessels involved in capture fishery ceased in 2016, as part of the moratorium policy implemented by Susi Pudjiastuti.[cxxxix] Yet if a foreign vessel is authorised by tuna RFMOs (in the case of Indonesia: IOTC, WCPFC, and CCSBT) whose convention area overlaps with Indonesian EEZ, the vessel can still carry out fishing activities in the area of competence of that RFMO within Indonesian waters for a specific authorised time range.

To determine whether fishing is authorised at a given time and location, we matched spatiotemporal authorisation records from RFMO registries and the Indonesian Online Single Submission (OSS system)[42] to AIS fishing vessel data from Global Fishing Watch. During the research period, Indonesia had no bilateral arrangements and direct licensing of foreign vessels to operate in their EEZ.

Owners' IUU score

To assess vessel owners' involvement or exposure to IUU fishing, we used Planet Tracker's IUU detection toolkit to score fishing owners based on the number of potential IUU fishing red flags they accrue.

If an owner has been accused of IUU fishing before or if an owner has multiple (more than two) vessels that changed their names, a minus one point malus is assigned. Shifting vessel identity is not necessarily a pitfall but can be a potential IUU risk indicator when an owner has multiple vessels which have shifted identities.

Vessel owners registered in a country listed as a flag of convenience see their score reduced by one point as ship owners can take advantage of minimal regulation and workers onboard might have very low wages, poor conditions, long periods of work and inadequate food and clean drinking water.[cxl]

Owners registered in a country on the top 10 IUU Fishing Index list are assigned a minus one point malus to consider their exposure to the state's high IUU risks.[cxli]

Owners headquartered in a country that has received a yellow or red card from the EU are assigned a minus one point malus for failing to meet EU's standards for fisheries management and might have their seafood banned from export to the EU market (red card).[cxlii]

Social and labour welfare

For owners with past allegations of forced labour or human trafficking on vessels affiliated to the owner or its subsidiaries, a minus one point malus is assigned.

Integrate climate impacts on tuna profitability

To calculate the change in tuna catch by 2050, we collect the habitat probability data from AquaMaps, which offers predictions of natural occurrences of marine species with respect to depth, water temperature, salinity, primary productivity, dissolved oxygen and association with sea ice or coastal areas.

Current habitat probability data was compared to future climate change scenarios RCP 4.5 and 8.5. As catch changes proportionally to the change in future maximum catch potential – a function of the change in primary productivity and the maximum catch at current stage,[cxliii] for each fishing event and tuna species we computed the percentage decrease in habitat probability and translated it into percentage decrease in catch.

If a fishing event by a purse seiner was estimated to have caught 1 tonne of skipjack in 2021, the catch under scenario RCP 4.5 and 8.5 would decrease proportionally to the percentage decrease in skipjack habitat probability of that location (on average to 0.75 tonnes under RCP 4.5). This assumes that vessels do not change their behaviour, use the same gear and fish in the same locations.

APPENDIX 2: **DATA LIMITATIONS**

This appendix outlines the data limitations faced and how they were overcome

AIS can be subject to manipulation and gaps in transmission

This report relies on AIS data to track fishing events in Indonesian waters.

However, AIS data do not provide all the vessel characteristics necessary to ascertain its identity.

Secondly, AIS is most effective as a tool for tracking vessel activity when satellite reception is strong, while areas with a high density of vessel traffic can limit the number of signals processed and/or result in interference with other signals and thus create gaps in transmission.

Thirdly, there are occasions when vessels intentionally turn off AIS to keep fishing grounds confidential from rivals or hide illegal fishing activities. AIS dropouts, intentional or not, mean that the total apparent fishing activity of vessels can be underestimated.[cxliv]

Finally, AIS data can be manipulated. Vessels could easily 'go dark' by switching off the transponder, or broadcasting false signals and location data to mask their actual activities[cxlv] AIS falsification allows an illegitimate vessel to use the MMSI or IMO number of a legitimate vessel as cover.[cxlvi]

Ultimate Beneficial Owner vs. Registered Owner

Identifying vessel ownership is an important step to towards improved transparency in the fishing industry and combatting IUU fishing. However, the link between the ultimate beneficial owner (UBO) and the legal registered owner of a vessel can be opaque.

There are often multiple layers of individuals and corporations between the registered owner and the UBO. UBO information is rarely collected for vessel registration, licensing and the authorisation process.[cxlvii]

Mechanisms such as flag of convenience – registering vessels and flag regardless of the nationality or residence of the vessel's owner – further obscure the ownership structure of the fishing sector.

'People who hide their beneficial ownership are not necessarily committing a crime, but the opacity of the UBO, which can flummox even the best-trained financial investigators, has helped many IUU fishing perpetrators evade legal punishment. And although 83 countries, including the United States, have laws mandating a beneficial ownership registry, that information is not always available to authorities - let alone the public - or even verified when submitted, further complicating investigation and prosecution of illegal fishing.'[cxlviii]

SeaAroundUs total catch vs. RFMOs

The reconstructed data combines officially reported catch data from the FAO FishStat database,[cxlix] adjusted for artisanal catch, and reconstructed estimates of unreported catches, discards, catches of subsistence fisheries and recreational landings[d] by *SeaAroundUs*. It was then spatialised to the standard 0.5° x 0.5° degree cells based on reported proportions in the spatial data by gear type and country flag[cli] - see Figure 40.

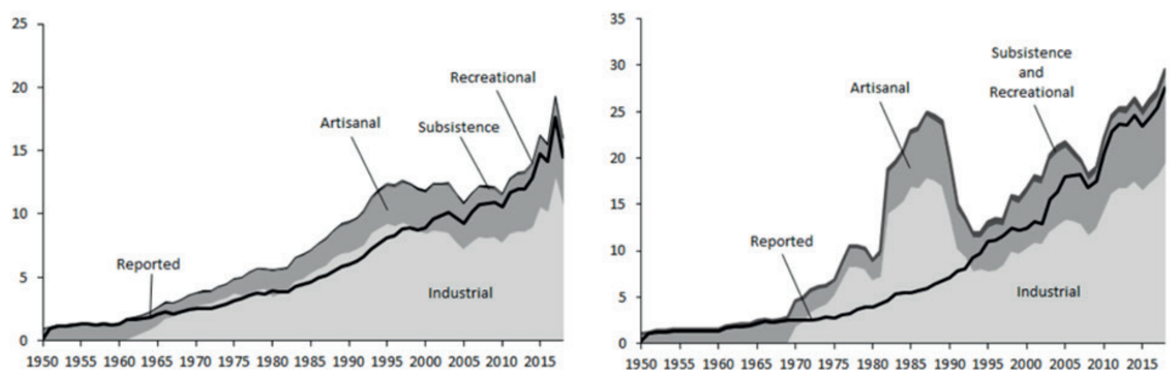


Figure 40: *Reconstructed Catches from within Indonesia's Indian Ocean (Left) and Eastern (Right) EEZ for 1950-2018. (Source: SeaAroundUs).*

However, we discovered large discrepancies between the total reconstructed tuna catch allocated to Indonesian EEZ by SeaAroundUs with the number reported to IOTC and WCPFC committee by Indonesia: for instance 162,584 tonnes of the five commercial tuna species as per SeaAroundUs vs 721,582 tonnes reported to RFMOs in 2019 - see Table 20.

Table 20: *Reconstructed Catch of Major Tuna Species by Gear and by Species of 2019, in Tonnes (Source: Sea Around Us).*

Tuna species	Catch by species, tonnes	Purse Seine	Longline	Handline	Gillnet	Pole-and-line	Artisanal/small-scale fisheries	Mixed gear	Other
Albacore	976.737	326.30	421.30	0.88	-	-	0.06	227.50	0.63
Skipjack	124,403.454	87,529.30	1,560.30	97.50	363.06	0.73	21,945.85	4,318.53	8,588.10
Yellowfin	27,828.165	17,517.80	2,042.80	1,928.04	9.14	0.03	996.00	566.88	4,767.40
Bigeye	9,375.404	6,383.87	1,607.10	89.03	1.29	77.65	529.87	81.26	605.30
Southern Bluefin	0.001	-	0.001	-	-	-	-	-	-
Total catch	162,583.76	111,757.27	5,631.50	2,115.45	373.49	78.41	23,471.78	5,194.16	13,961.43

This difference is partly due to the spatial precision implied by the ½ x ½ degree data used by Sea Around Us and is potentially problematic for offshore and high seas areas.

Catch data provided by RFMOs are often reported in much larger spatial cells (up to 20-degree lat./long. – see Table 21). The location of catches being taken from each ½ degree cell within each RFMO cell is not likely an optimal estimate. SeaAroundUs, in collaboration with Global Fishing Watch, is developing improvements in spatial allocations of catch data that address this and any related issues.[clii]

***Table 21:** Overview of the Various Data Sources Used for the Creation of Global Catch Maps of Industrially Caught Tuna and Other Large Pelagic Fishes. (Source: SeaAroundUs).*[cliii]

Ocean	RFMO	Sources	Spatial resolution	Countries/gear Nominal catch Spatialized catch	/species
Atlantic	ICCAT	ICCAT website	ICCAT website	1°x1°, 5°x5°, 5°x10°, 10°x10°, 10°x20°, 20°x20°	114/48/142
Indian	IOTC	IOTC website	IOTC website	1°x1°, 5°x5°, 10°x10°, 10°x20°, 20°x20°	57/35/45
Eastern Pacific.	IATTC	IATTC website	FAO Atlas of Tuna and Billfishes	5°x5° c	28/11/19
Western Pacific	WCPFC	WCPFC website	WCPFC website	5°x5°	41/9/9
Southern	CCSBT	Via CCSBT staff	CCSBT website	5°x5°	11/8/1

Despite that, the proportion of each species within total catch is more comparable and we believe the detailed breakdown of catch by species, gear type, country flag and location by SeaAroundUs provides us the best possible estimate given the data available.

SeaAroundUs total catch vs. GFW fishing hours

From January 2019 to September 2022, the total apparent fishing hours reported by Global Fishing Watch for vessels which Planet Tracker estimates catch tuna was 190,409 hours. Even under the most ambitious estimates of the tonnage of fish each type of fishing vessel can harvest per hour, the total catch reflected by the apparent fishing hours account for less than 4% of the total marine capture as reported by SeaAroundUs.

This can be caused by the fact that most of the tuna was caught either by small-scale fishers or medium-sized fishing vessels that are not required to carry AIS. It can also reveal a significant underestimation of apparent fishing hours. This is evidenced by a poor data coverage in Indonesia, particularly for the Class B AIS – see Figure 41.

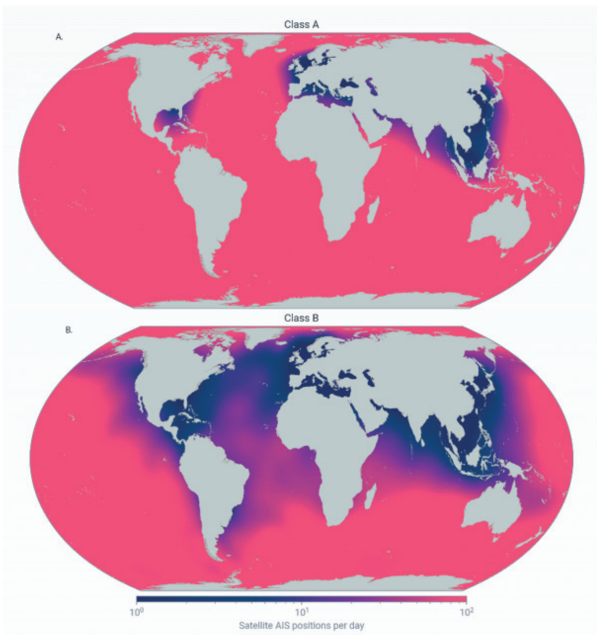


***Figure 41:** Reception Quality of Satellite AIS Data, Represented as the Average Number of AIS Positions you can Expect to Receive from a Single AIS Device per day in Different Parts of the World. (Source: Global Fishing Watch)*[cliv]

APPENDIX 3:
A DEEP-DIVE ON FADS

This appendix provides more details on the environmental impact of Fish Aggregating Devices

Fish Aggregating Devices (FADs) are floating objects with hanging nets used to attract pelagic fish. There are two types of FADs: free drifting and floating (known as drifting FADs) or tethered to the seabed (known as anchored FADs)[clv] - see Figure 42.

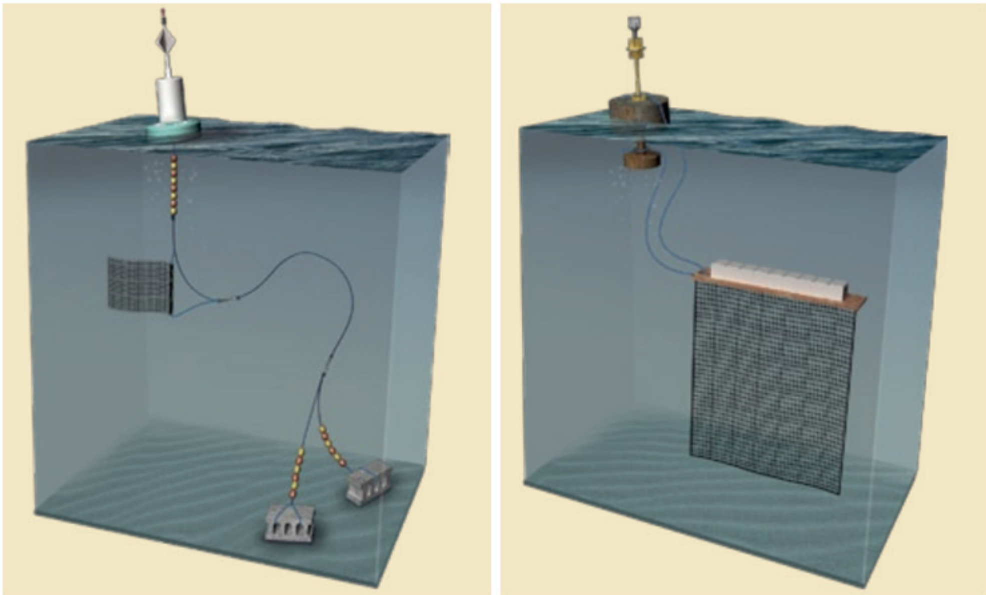


Figure 42: *Anchored FAD (left), and Drifting FAD (right). Source: Pew Trusts.*

Deploying fishing nets close to these floating objects can substantially increase the catch of tuna as pelagic fish naturally aggregate under floating objects – logs, seaweed mats or even near larger animals such as whale sharks.[clvii]

Today, the use of drifting FADs, particularly large-scale industrial FADs, is extensive: drifting FADs are now responsible for at least half of the global tuna production.[clviii] There are however, several environmental issues associated with drifting FADs.

Contribution to overfishing

The indiscriminate catch of tuna by industrial-scale purse seining on FADs leads to a high catch of juvenile yellowfin and bigeye tuna species which school with adult skipjack tuna species.[clix] Around 97% of the yellowfin tuna caught in the Indian Ocean by FAD-associated purse seiners were juveniles.[clx]

Catching tunas before they can spawn increases pressure on the already overfished Indian Ocean yellow tuna population.[clxi]

Bycatch of other species

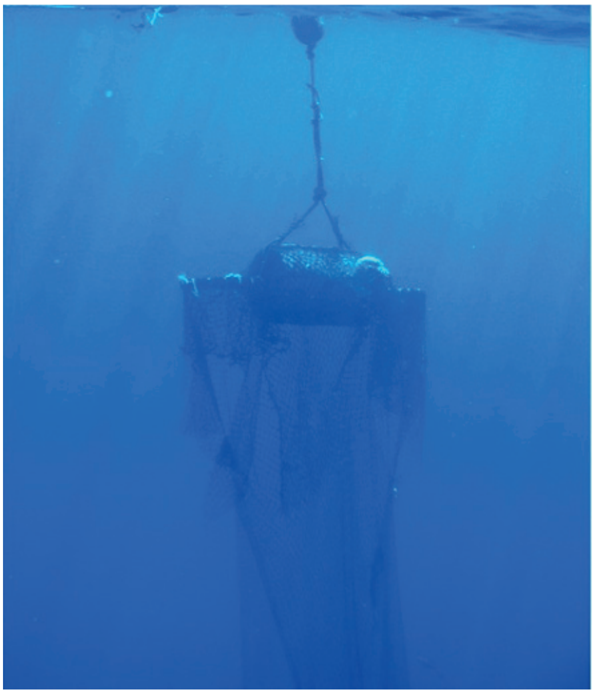


Figure 43: *Underwater Panels of Loose, Large-Mesh Netting Pose an Entanglement Hazard (Source: ISSF)*[clxii]

In addition, the loose, large-mesh nettings can potentially entangle animals, such as sharks and sea turtles.

Abandoned drifting FADs

Ghost gear - abandoned, lost or discarded fishing gear - is posing a threat to marine wildlife and causing significant marine pollution. Drifting FADs can end up beached or drift into deeper water as a result of ocean currents moving them. It is estimated that around 7% to 22% of drifting FADs end up stranded.[clxiii] In the western Pacific c.80% of the drifting FADs deployed by purse-seine fleets "have an unknown fate" (i.e., there is no information regarding the end of their lifespan).[clxiv]

Even anchored FADs, much less used than drifting FADs, can break free of their anchors in bad weather.[clxv] This contributes to the global issue of 'ghost gear', one of the deadliest forms of marine plastic since it can trap, entangle, smother or kill marine animals and wash up on remote coastlines. In 2019, around 640,000 tonnes of ghost gear entered the ocean, making up 10% of the plastic waste in oceans.[clxvi]

Responsible FAD management

Developing more robust FAD management is an area of focus for tuna RFMOs. In February 2023, IOTC declared its Resolution 23/02 on the management of drifting FADs that mandated an annual 72-day closure period for drifting FADs, reducing the number of drifting FADs allowed per vessel from the current 300 to 200 in 2025 and establishing a mandatory FAD register.[clxvii]

The EU, the single largest harvester of yellowfin tuna in the Indian Ocean,[clxviii] objected to the resolution, arguing 'some provisions of the resolution are unclear and lack scientific basis.[clxix] As a result, this resolution does not apply to EU fleets.

ABOUT PLANET TRACKER

Planet Tracker is a non-profit financial think tank producing analytics and reports to align capital markets with planetary boundaries. Our mission is to create significant and irreversible transformation of global financial activities by 2030. By informing, enabling and mobilising the transformative power of capital markets we aim to deliver a financial system that is fully aligned with a Net-Zero, nature-positive and just economy. Planet Tracker proactively engages with financial institutions to drive change in their investment strategies. We ensure they know exactly what risk is built into their investments and identify opportunities from funding the systems transformations we advocate.

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