ENVIRONMENTAL JUSTICE FOUNDATION

SCOURGE OF THE SEAS

Analysing the impact of bottom trawling on Thailand's marine ecosystems.

Abbreviations:

AIS : Automatic Identification System
AND : Andaman Sea
CPUE : Catch per unit effort (measured in kg/hr)
DOF : Department of Fisheries
EJF : Environmental Justice Foundation
GOT : Gulf Of Thailand
GT : Gross tonnes
IUCN : International Union for Conservation of Nature
JTED : Juvenile and trash excluder device
MPA : Marine Protected Area
MSY : Maximum Sustainable Yield
RTG : Royal Thai Government
SEAFDEC : Southeast Asian Fisheries Development Center
TAC : Total Allowable Catch
TAE : Total Allowable Effort
VMS : Vessel monitoring system

"For the majority of fishers, policies to manage fisheries resources do not exist because they apply to commercial fisheries which only make up 15-18 percent. The rest of the fishermen in 22 provinces are indigenous fishers. The sea is our resource foundation. The destruction of this resource will create poverty and inequality.

- ***Banjong Nasae,*** *senior activist and consultant of the Thai Sea Watch Association.*

The Environmental Justice Foundation (EJF) is an international non-profit organization working globally to protect natural environments and the human rights of people who depend on them. EJF is committed to combatting illegal, unreported, and unregulated (IUU) fishing as well as associated human rights abuses in the fishing sector. EJF has worked in Thailand on these issues since 2014, engaging in a combination of in-depth independent investigations into these potential crimes, high-level advocacy with Royal Thai Government ministries and frontline enforcement observations of Thailand's fisheries monitoring, control and surveillance mechanisms.

Executive Summary

Thailand has one of the largest fishing fleets in the world with almost 61,000 fishing vessels as of 2022. Approximately 5% of these vessels are trawlers, using nets which are either dragged near or along the seafloor.[1/2/3] Despite representing such a low proportion of the total fleet, these trawlers are responsible for almost 50% of total marine catch landings as of 2020.

Trawlers are increasingly regarded both within Thailand and internationally as having a disproportionate environmental impact.[4] This is because trawling nets can catch seafood species indiscriminately, even catching juveniles of economically important species before they have had a chance to reproduce.[5]

The catching of juveniles of fish and seafood is especially damaging to marine ecosystems as it prevents fish populations from reaching maturity and reproducing. This can rapidly decimate populations and threaten livelihoods.[6]

Often trawler catches are so badly bruised and mixed together that they are no longer classified as fit for human consumption. Instead much of their catch is branded as 'trash fish' and is sent to factories to be made into fishmeal and subsequently livestock or aquaculture feeds instead.[7]

Trash fish is worth a fraction of the value of adult specimens of the main species that often make up trash fish. Trash fish might fetch a price of approximately 6 baht/kg whereas one kilogram of short mackerel could be worth 100 baht/kg and squid worth up to 280 baht/kg.[8]

Pair trawlers – one subsection of the trawler fleet – have been found to have the greatest impact. Despite conducting less than 20% of trawler fleet fishing trips, pair trawlers are responsible for over 50% of the total trawler catch. Pair trawlers also contribute the greatest amount of trash fish with 55% of all trash fish landed in 2019 coming from this sector.[9]

From 1990 until the present, half of pair trawler catches were made up of trash fish. Over 80% of this trash fish was made up of juveniles of economically valuable fish species.[10/11]

It is only a matter of time before such fishing practices leave vast areas of Thailand's fishing grounds bare of any life or in such a degraded state as to have little to no economic value. In some provinces it is already too late, with trawlers having reduced marine biodiversity to such an extent that catches are a mere fraction of what they used to be even 20 years ago.[12]

The Royal Thai Government must urgently review the practice of bottom trawling in Thailand's fisheries and consider taking drastic measures to ensure that the country's precious seafood resources are not degraded even further.

EJF recommends that a carefully structured and planned decommissioning plan that targets the most impactful pair trawling vessels first is developed and implemented within three years. The Department of Fisheries should also consider increasing inshore exclusion zones to provide larger buffers to commercial trawlers, expand monitoring capacity to smaller commercial fishing vessels, and improve catch data collection systems so that the true environmental impacts of trawlers can be better understood.

Figure 1: Fishing piers in Samaesan in Chonburi province show a wide variety of fishing vessels moored alongside.

Introduction

Thailand's fishing fleet is vast, with a total of 61,832 vessels split between artisanal (83%) and commercial (17%) vessels. The Thai commercial fleet has shrunk in size from 13,456 vessels (recorded in May 2016) by 21% to 10,595 as of 2021.[13] The total trawler fleet has also declined during this time, falling from 3,796 vessels in 2016 to 3,370 vessels in 2021 (a 11.2% decrease).[14] Trawl gears in Thailand are classified by the Thai Department of Fisheries (DOF) as 'high-efficiency gears' alongside purse seine gears and light luring devices.[15] Rather than having any relation to sustainable fishing practices, this classification means that they are extremely effective at catching marine animals. Trawling gears can be broadly described as consisting of a fishing net being towed behind a vessel either at the surface, sub-surface or along the bottom using weights (Figure 2 & 3).

Figure 2: A trawler drags its net far out in the Gulf of Thailand.

Trawls can be divided into two general types: benthic or demersal trawling and midwater or semipelagic trawling . Benthic trawling (also referred to as bottom trawling) involves towing a net along the bottom, whereas midwater trawling involves dragging a net above or off the benthic zone in the water column. Three categories of trawls exist based on how their horizontal opening is maintained: beam trawls, otter trawls and pair trawls (Table 1). Bottom trawlers catch both bottom-living fish (groundfish) and semi-pelagic species such as cod, squid, shrimp, and rockfish whereas midwater trawling is more likely to catch pelagic and semi pelagic fish species such as anchovies and mackerel.

Although the number of total commercial vessels has dropped in recent years, long-term trends show a significant increase in the average engine size per vessel across all three subcategories of trawler since 2007.[16] This is shown by an increase in the average gross tonnage per vessel. Investments in larger vessels have and continue to be an attractive option for commercial fishers and companies as they can reduce license acquisition pressures. Larger vessels can also pull larger nets, fish for longer and further from land, ultimately resulting in higher catches by fewer vessels. Larger vessels may also allow vessel operators to subscribe to the lucrative subsidised 'green oil' fuel scheme. More information about the green oil scheme is found on page 20.

Vessel gear	GT/vessel (2007)	GT/vessel (2021)	% increase/decrease
Otter board trawler	34 GT	49 GT	45%
Pair trawler	52 GT	79 GT	53%
Beam trawler	16 GT	42 GT	161%

Table 1: Thai Fishing Vessels Statistics from DOF show the average gross tonnage (measure of the size of a vessel) for different trawl gears for 2007 and 2021 showing significant increases in vessel size.[17]

Global spotlight on trawling

Figure 3: A trawler off the coast of Songkhla prepares to bring its net in.

Bottom trawling is increasingly regarded as one of the most problematic types of trawling.[18] Globally, bottom trawling is estimated to catch more than 30 million tonnes of seafood per year, more than any other fishing method.[19] 50% of all bottom trawled fish is caught in the Exclusive Economic Zones (EEZs) of Asian countries or by the foreign fleets of Asian countries.[20] Concerns have arisen due to the detrimental impact that such gears can have on fish stocks, non-target species, endangered and charismatic species as well as the overall condition and health of the seafloor. Research from across the globe has shown that such gears can leave large scars in the seabed, destroy coral reefs (Figure 4), disrupt sediments and silt, and devastate surrounding habitat for marine animals that rely on the seabed for shelter, feeding and reproduction.[21/22]

Bottom trawling has also been estimated through scientific studies to contribute 600-1,500 million tonnes of carbon dioxide emissions per year.[23] In other words, bottom trawling contributes to greenhouse gas emissions in two ways; through the direct use of fuel to drive vessels, as well as through the disturbing of carbon-containing sediments on the seabed that mixes into the water column. Such emissions would put bottom trawling on par annually with those of the aviation industry.[24]

Figure 4: Trawlers illegally fishing in areas such as coral reefs can devastate these fragile ecosystems.

Spatial distribution of trawlers in Thailand

Thailand's trawling fleet is concentrated primarily in the Gulf of Thailand (GOT) with 2,752 trawlers (82% of total trawlers) registered there compared to 618 in the Andaman Sea (AND) (Table 2).[25] Five major ports dominate trawler registrations with two of these based across the lower Gulf of Thailand and Samut Songkhram and Samut Prakan located in the upper Gulf.

Province	Region	Otter board trawls	Pair trawls	Beam trawls	Total	% of total
Nakhon Si Thammarat	GOT	547	58	48	653	19%
Samut Songkhram	GOT	92	381	5	478	14%
Songkhla	GOT	218	18	2	238	7%
Samut Prakan	GOT	101	126	14	241	7%
Ranong	AND	157	52	-	209	6%
Top five provinces	-	1,115	635	69	1,819	53%
Total	-	1,812	1,124	434	3,370	-

Table 2: The top five ports for trawler registrations in Thailand. (Additional data on these gears is available upon request).

Fishing activity by small, medium sized and pair trawling vessels is shown in Figure 5. It is important to note that this data is taken from a study conducted by the DOF in 2011.[26] Even so, these diagrams help to illustrate the primary fishing grounds of trawler vessels and demonstrate how the geographical focus around the southern provinces of Nakhon Si Thammarat and Songkhla is longstanding.

Figure 5: These maps depict fishing activity by small-sized otter board vessels (red), medium-sized otter board vessels (green) and pair trawling vessels (blue).

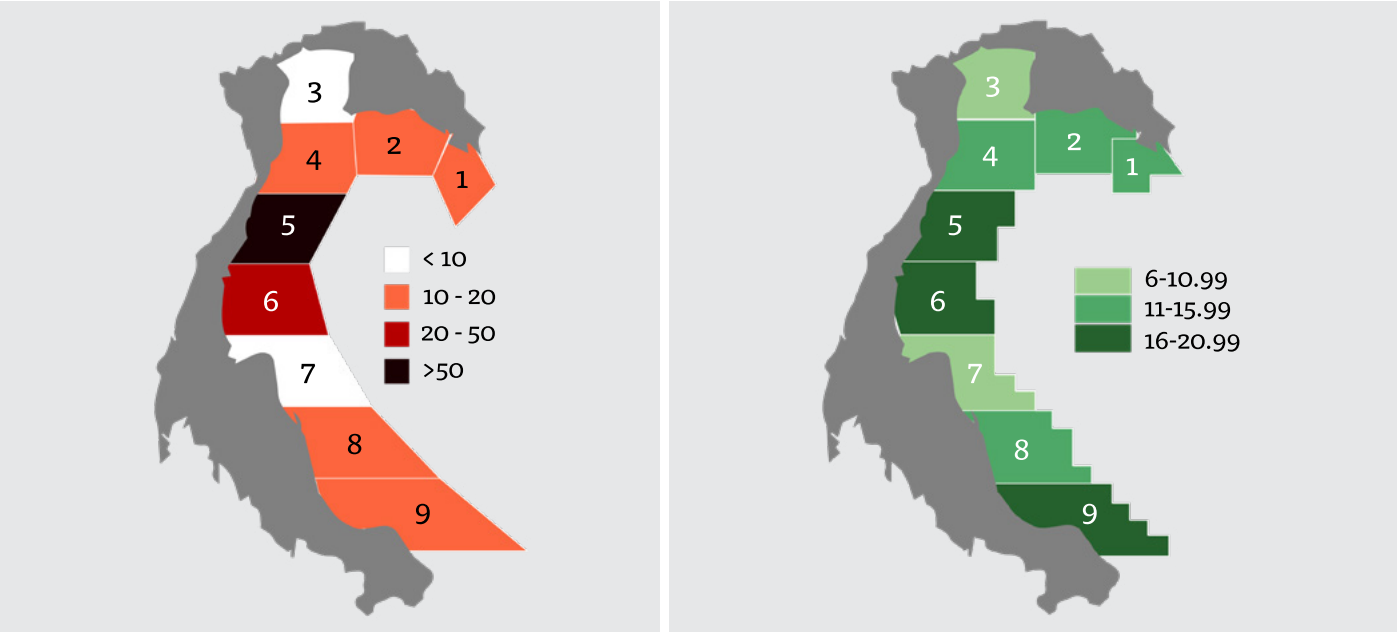


Figure 6: These maps show the recorded catch per unit effort (CPUE) statistics for different segments of the Gulf of Thailand (measured in kilograms of seafood caught per hour) for 2011 (left) and 2020 (right).[27]

Catch per unit of effort (CPUE) is a proxy measure of stock abundance and can be used to measure general trends over time. Three of the main ports for trawler registrations (Nakhon Si Thammarat, Samut Songkhram and Samut Prakan) are located in two of the Gulf's fishing areas (Region 3 and 7) with the lowest CPUE figures in the country at 8.990 kg/hr and 9.480 kg/hr respectively. As of 2020 these fishing areas still recorded the lowest CPUE figures in the Gulf (Figure 6).[28]

Since 2015, all Thai commercial fishing vessels over 30 gross tonnes have been required to fit Vessel Monitoring Systems (VMS). Out of a total 3,370 trawler vessels, 21.5% of these are below 30GT which means that they are not required to be fitted with VMS nor are they required to pass through regular so-called Port in, Port out (PIPO) vessel inspections whenever they leave or enter port. Without regular inspections and catch documentation, it could allow this group of 700 vessels to drastically underreport their catches, further degrading fish populations. If vessels are not monitored effectively then they can conduct IUU operations in protected areas such as coral reefs (Figure 7).

Thailand's CPUE collapse

Figure 7: Divers removing discarded nets tangled among protected coral reefs.

It should be noted that although CPUE can be used to measure overall stock abundance, it is reliant on consistent and accurate data collection. In Thailand, CPUE is measured according to whether fish populations are classified as pelagic or demersal species, squid, shrimp, crab, clams, trash fish (also referred to as forage fish) and others.[29] Trash fish can be defined as a mixture of low economic value species that is often made up of heavily degraded marine biota at the back of the trawl net which is not suitable for human consumption. However, the term also encapsulates diminutive juvenile target species, including (and not limited to) endangered, often critically, seahorse species. The widespread adoption of single-species population assessments instead of multi-species community assessments means that drawing concrete conclusions is sometimes difficult.

CPUE measurements for Thailand began in the 1960s with measurements for the GOT first available in 1961 and the AND in 1966. Between 1960 and 1981, CPUE fell by 76.5% in the AND and by 83% in the GOT.[30] Such dramatic declines coincided with sharp increases in the number of trawler vessels across Thailand, rising from just 99 registered vessels in 1961 to 7,525 vessels by 1981 as seen in Figure 8. The total trawler fleet peaked at 13,111 registered vessels in 1989 before stabilising and gradually declining to the 3,370 trawlers that are registered as of 2021.[31]

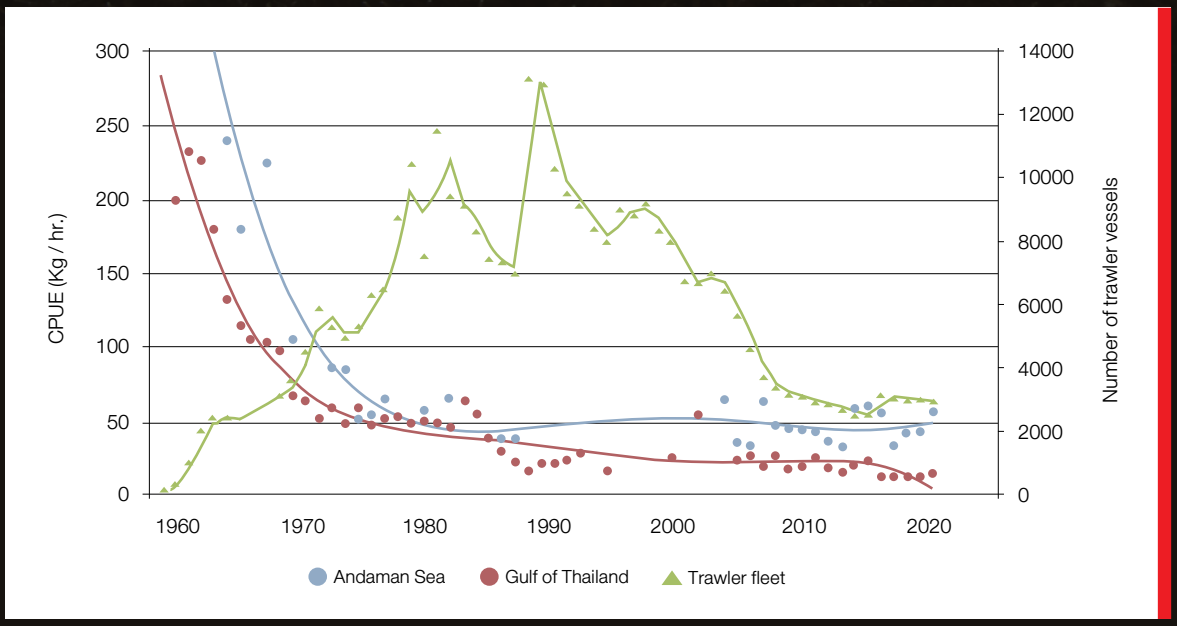


Figure 8: CPUE (measured in kg/hr) data is shown alongside trawler fleet figures. It should be noted that the number of trawler vessels rises and falls dramatically during some periods (especially in 1989) due to fluctuating licence renewals and the introduction and revocation of a tenure system – freezing the total number of fishing licences given out each year.[32]

Linkages between unsustainable fishing and labour abuses

As fish populations decline, vessels are forced to take longer fishing trips. These in turn drive up costs. The most likely way that operators can slash rising costs is by paying workers less, making labour exploitation more likely.

Unsustainable or destructive fishing practices such as bottom trawling have also been linked to labour exploitation and serious human rights abuses in fishing industries. EJF has documented such linkages between environmental degradation and marine ecosystem destruction with labour abuses in multiple geographies including Thailand, Ghana and distant water fisheries across the globe.[33/34] In the case of Thailand, decades of neglect in fisheries management and a lack of transparency in fishing operations provided the primary catalysts for driving ecosystem declines and subsequent labour abuses.

Broadly speaking, as fish populations and CPUE decreases, fishing effort must increase to maintain catches resulting in smaller profit margins. Labour costs can account for up to 60% of vessel operating costs and subsequently, the demand for cheap labour - often in the form of migrant workers - increases as does the chances of labour exploitation and IUU activity.[35/36] EJF's previous investigations across Thailand have documented these linkages in great detail.[37/38]

At-sea trans-shipments can take place hundreds of kilometres away from shore and any potential monitoring authorities, thus allowing illegitimately caught seafood to slip into markets undetected.

Thai fishing vessels have, in the past, been documented conducting fishing practices for months or even years at a time and fishing illegally in neighbouring countries. Long periods of time at sea can enable labour abuses as there is little chance for workers to escape and little chance of scrutiny by enforcement agencies.

Vessels have also engaged in the practice at-sea trans-shipment of catch. This is where fishing vessels meet with carrier vessels and transfer seafood so that they can remain fishing for longer.[39] This can help boost vessel profits by enabling vessels to minimise transit times and fuel burn.

The practice has however been linked to facilitating IUU fishing and a lack of transparency in fisheries.[40/41] At-sea trans-shipments can take place hundreds of kilometres away from shore and any potential monitoring authorities, thus allowing illegitimately caught seafood to slip into markets undetected.

Previous EJF investigations have also found how at-sea trans-shipments have been tied to incidents of forced labour and slavery at sea.[42] Undocumented workers may be rotated amongst fishing vessels in order to prevent them from escaping or alerting the authorities on shore. Workers might not see shore for months or even years at a time.[43] Without effective monitoring of at-sea trans-shipment practices it can be difficult to achieve a truly sustainable, legal and ethical fishing industry.

Effective reforms to fisheries management efforts and implementation of transparency mechanisms in fisheries can allow authorities to resolve opaque aspects of both fishing and labour practices on vessels. Improved registration of fishing vessels, for example, can help verify vessel and owner identities, restricting the ability for vessels to operate without a license. Addressing unsustainable fishing practices can also make fisheries more productive and profitable, thus reducing the necessity for suppressed worker wages.

Analysis of recent fisheries trends in the Thai trawl sector

Nowadays, the Phuket artisanal fishers can fish only within the 1.5 nautical mile zone. There are very limited resources and it's really hard to find fish. If we go further out than this, the commercial trawlers will drag all of their equipment with their big boats.

– Mr. Somsak, *head of Phuket artisanal fisher group, interviewed in December 2021.*[44]

Even as of 2021, several years after fisheries reforms were instigated in 2015, there were few signs of ecosystem recovery with CPUE figures for both the AND and GOT still mere fractions of what they were 10 years ago (see Table 3). Available catch data for the bottom trawl fleet for 2008 until 2019 also showed that the weight of landed product (measured in tonnes) had fallen from 784,991 tonnes in 2008 to 637,213 tonnes in 2019, a drop of 19%.[45] At the same time, total vessel gross tonnage across the bottom trawl fleet had increased significantly from 154,972 tonnes in 2008 to 201,426 tonnes in 2019 (an increase of 30%) (Figure 9). Such a trend is indicative of overfishing due to the fact that the presence of larger, more industrialised vessels should translate into higher catches.[46] However, this is not the case.

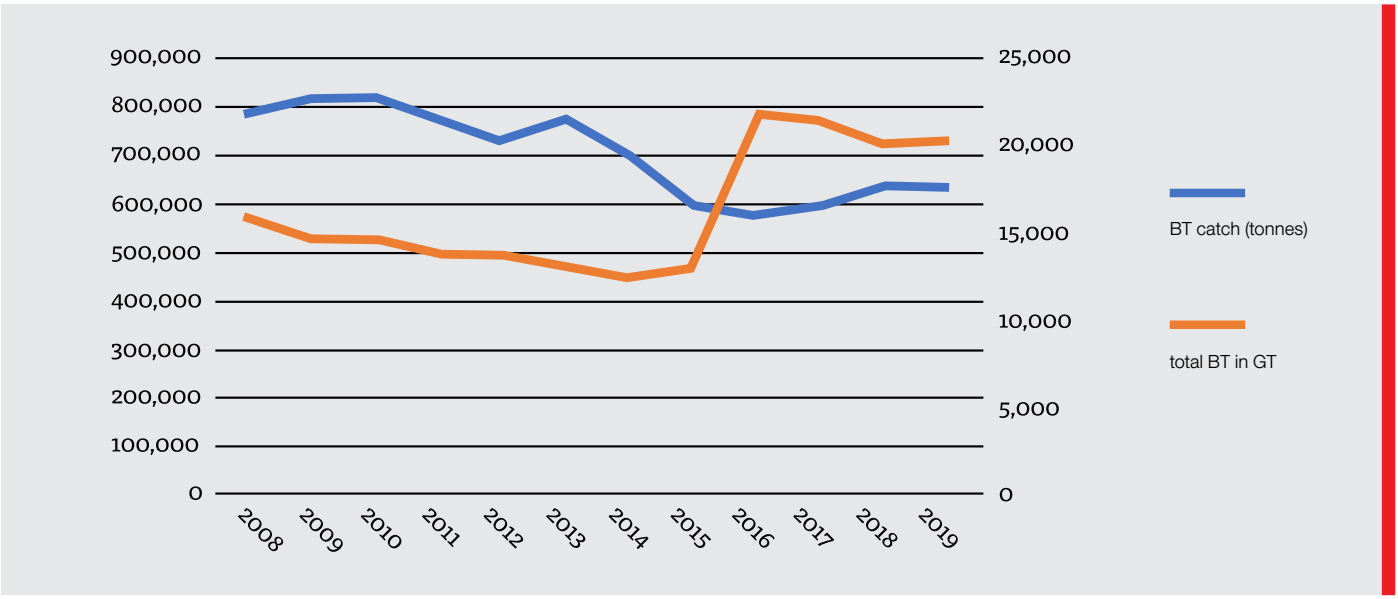


Figure 9: Total catch by bottom trawlers (measured in tonnes) alongside bottom trawl fleet gross tonnage from 2008 until 2019.[47]
The sudden increase in gross tonnage between 2015 and 2016 was due to renewed vessel registration efforts initiated by the DOF.

Usually, a single trip takes 30 days. It can use ten thousand litres [of fuel]. We keep dragging all day and night. If the fuel is gone, we will ask the tanker boat to fill it up in the middle of the sea. When the fish is fully loaded, then we return. Nowadays, we can catch only a small amount of fish, which is not worth the trip. Fishing grounds are far away. Workers are hard to find. Nothing to do but keep dragging back and forth.

- Trawler boat owner at Phuket Port, interviewed in December 2021.[48]

A more specific example that assesses otter board operations in the Gulf of Thailand since 2016 recorded abundance declines for pelagic species, squid and crab catches - all economically important species. At the same time, Trash/ forage fish and demersal proportions increased (Table 3.). It should be noted that comparable analysis is not available for earlier years nor for beam trawlers

or pair trawlers, exemplifying a chronic lack of reliable, consistent data collection across Thai fisheries. Without such data it is all but impossible to accurately determine or compare the true environmental impacts of these destructive fishing gears. These trends indicate a worrying decline in the ecosystem health and economic productivity for the Gulf of Thailand (Figure 10).

Figure 10: Thailand is renowned for the wide variety of fish and seafood species that are on offer in its seafood markets. Continued depletion of economically important species put this at risk.

CPUE trends for the Gulf of Thailand (KG/hour) by otter board vessels						
Species Group	2016	2017	2018	2019	2020	% increase/decrease
Pelagic	0.74	0.690	0.924	0.862	0.459	-38%
Demersal	4.735	4.260	4.669	5.324	5.723	21%
Squid	3.055	3.177	2.511	2.176	2.359	-23%
Shrimp	0.017	0.029	0.017	0.034	0.016	-6%
Crab	0.277	0.135	0.125	0.132	0.191	-31%
Clam	0.354	0.426	0.342	0.307	0.532	50%
Others	0.077	0.049	0.069	0.053	0.068	-12%
Trash/forage fish	3.356	2.232	3.078	3.719	4.176	24%

Table 3: Catch declines over the past five years for pelagic species, squid and crab - some of the most important economic species in Thailand - are juxtaposed by increases in Trash/forage fish catches.

Data gaps in measuring the health of Thailand's fisheries

"Despite Thailand having most elements of a developed fisheries governance system, negligible progress has been made towards restoring fish stocks to sustainable levels. Nearly all of Thailand's catch comes from unassessed stocks, with unknown sustainability status.

- Global Fishing Index, Minderoo Foundation (2021).[49]

The inaugural Global Fishing Index first released by the Minderoo Foundation in 2021 conducted a global assessment of countries' efforts to assess their fish populations. This assessment covered 142 countries and analysed countries on their fish population data availability, number of populations assessed and population sustainability among other indicators.[50] Thailand received a final grade of E (out of A to F) with its progress towards improving population assessments and sustainability only ranked 7.9 out of 100. According to the study, 88% of Thailand's catch is currently unassessed with only 11% being assessed and 1% covered by Regional Fisheries Management Organisation (RFMO) assessments.[51]

The Thai DOF does provide statistics in the form of an annual report and data on fleet composition and size. However, publicly accessible data on catch statistics, catch composition and fish population assessments for economically important species have become limited in recent years. This is due to both restricted access to data as well as growing data research gaps.

Data gaps in estimating maximum sustainable yield (MSY), total allowable catch (TAC) and CPUE for Thailand's multitude of fisheries hinder the effective management of the country's marine resources. MSY in Thailand is currently only measured for demersal and pelagic species as well as for anchovies. This has historically been adequate because distinct vessel groups targeted specific species. As fishing vessels have increased in size and new fishing methods or gears such as pair trawlers have proliferated, the clearly defined fisheries have begun to overlap. Pair trawlers, for example, can catch both demersal and pelagic species due to the sheer size of their nets. Light-generating vessels that use lights to lure marine animals towards the vessel can catch juveniles of all three species groups.

To rectify this situation, the DOF should expand the number of species that it collects stock assessment data for.

Maximum sustainable yield as a measure of healthy seas

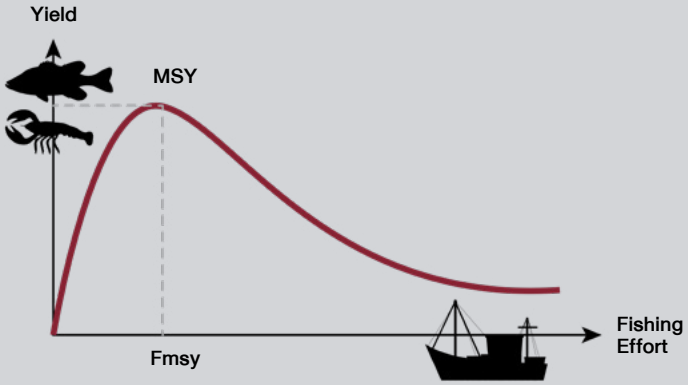


Figure 11: The relationship between fisheries yields and fishing effort and where MSY may lie.

After the MSY of a target stock is calculated, a total allowable catch quota (TAC) or total allowable effort (TAE) can be assigned to each commercial fishing vessel as a way to prevent overfishing. For Thailand the DOF uses fishing days as a means of distributing TAC across the two main fishing areas; the GOT and AND.

A more accurate method of calculating fishing effort could be to calculate it by vessel engine power measured in kilowatt day units. This is because engine power can have a stronger impact on the total catch for each fishing gear than simply measuring fishing days which does not take into consideration vessel size, engine power or other vessel characteristics. Other techniques such as managing fisheries by maximum nutrition yield are also worth consideration.

Cutting corners in data collection and compliance

Although much effort has been made to reform Thailand's catch monitoring and verification systems since 2015, such as introducing electronic catch logging and documentation systems, the current catch reporting system allows for significant leeway for fishers if they misreport catches. This issue is exacerbated by the fact that TAC for vessels is set at 95% of estimated MSY - giving little margin for error. The current catch documentation system allows total vessel catch to be either 20% under or over the declared amount in the vessel's logbook. This has increased from a more conservative limit of 10% set in 2016.[52]

Species group	2019	2021	% increase/decrease
Gulf of Thailand MSY (tonnes)			
Demersal species	790,985	775,548	-2%
Anchovies	202,077	200,092	-1%
Pelagic species	251,547	247,880	-1%
Andaman Sea MSY (tonnes)			
Demersal species	230,115	228,348	-1%
Anchovies	33,007	32,090	-3%
Pelagic species	118,344	117,514	-1%

Table 4: Estimated MSY divided to Gulf of Thailand and Andaman sea sides.[53/54]

Furthermore, there is currently no strictly enforced sanction system for vessel operators who consistently exceed this threshold meaning there are no disincentives to non-compliance. TAC quotas are also not implemented or enforced, meaning that vessels which consistently exceed the 20% threshold are not required to reduce their catch on subsequent trips. This was not always the case. However, the National Fisheries Association has been successful in gradually watering down the regulation to make it more in their favour.

Figure 12: Workers help to unload Trash/forage fish from a vessel.

A precautionary approach should be implemented to prevent MSY limits from being breached. If the DOF wishes to continue using TAC as a means of restricting fishing effort then fishing quotas should be enforceable to prevent overfishing. This would be in the interests of preserving Thailand's fragile fish populations and would be an appropriate response in the face of mounting evidence from recent years of such declines.[55]

Lack of access to data is also restrictive and prevents the effective study of current fishing efforts to assess whether fishing practices are truly in line with sustainable levels. Crucial data on vessel statistics, historical fishing effort and fleet capacity are difficult to source and in some cases are not accessible to the public. Such a lack of data has meant that this report has had to rely in certain areas in historical studies on the impact of trawler and specifically pair trawling gears on Thailand's fish populations. EJF acknowledges the limitations of using such historical studies however also stresses that these studies are currently the best known resources to be able to conduct such an assessment.

Trawlers' impact on ecosystems and marine biodiversity

> ***What the authorities should do is stop environmentally destructive fishing altogether. It should not be allowed near the coast, nor out in the open seas.***
>
> **– Jaroen Toh-eetae,** *community leader at Tambon Tha Sala, Nakhon Si Thammarat (2014).*[56]

Figure 13: Trash/forage fish is heaped into the back of a truck in Chonburi.

In many trawl fisheries, catch can become bruised and crushed by the nature of the dragging operation, degrading it to the classification of trash fish. Catch data for 2019 indicates that out of 637,213 tonnes of fish caught by the trawling fleet, 46% of this was classified as trash fish.[57]

The proportion of catch that can be defined as 'true trash fish' - that is, trash fish that is purely of low to no economic value species - can sometimes be difficult to determine. This is because heavily degraded specimens or juveniles of economically valuable species may be mixed in. This subcategory can be classified as 'fake' trash or forage fish as they will not be consumed anyway.

Analysis conducted by both the Thai DOF in 2003 and the Southeast Asian Fisheries Development Center (SEAFDEC) in 2013 and 2014 on the catches of otter board trawlers and pair trawlers found that 'true' trash fish only accounted for 14-15% of total catch whereas 'fake' trash or forage fish accounted for 40-72% of total catch.[58/59] Such a high proportion of juvenile catches raises serious concerns for the true impact of trawl fisheries on Thailand's marine resources.

The average income for a pair trawler in the SEAFDEC study was 205,965.51 THB per trip with the bulk of the income coming from squid (representing 68.3% of total revenue but only 15.0% of weight).[60] Pelagic and demersal fish species both contributed 5% of revenue each but only 5.4% and 5.2% by weight. This means that the remainder of the catch - trash fish - made up 74.2% of total catch weight but only 18.8% of total revenue (2.6THB/KG).[61] Such a low proportion of total revenue originating from Trash/forage fish begs the question of how such a damaging and wasteful practice can be allowed to continue in Thailand's fisheries.

Trash/forage fish focus is a threat to sustainable fisheries

"Through your actions you are breaking your own rice pot. When all these corals are gone, then you will feel that what you have done cannot be undone… please help solve this problem before there is nothing left in the sea for your children.

- Varawut Silpa-archa, *Minister of Natural Resources and Environment, speaking about fisheries operators who conduct fishing activities in coral reef areas.*[62]

The vast majority of juveniles caught by Trash/forage fish trawlers are from species such as Indo-Pacific mackerel, anchovies and squid, that if left to mature over a period of 3-6 months would be worth many times more in value. They would have also had the opportunity to reproduce, thus replenishing the population. Fishing these juveniles before their first maturity[63] – a measure of whether an individual has had the opportunity to reproduce and therefore replenish the population – has a negative impact on marine biodiversity, disrupts the ability of Thai fish populations to remain at sustainable levels and threatens incomes of both commercial and artisanal fishers.

The SEAFDEC study conducted in 2013 analysed the length of specimens caught by otter board and pair trawlers to assess whether or not they had reached their size of first maturity. The average length of all species identified as Trash/forage fish were smaller than this and almost 100% of the short mackerel,one of the most important economic species in Thai fisheries, caught by the pair trawler were smaller than this crucial reproductive size.[64]

	Otter board 1		Otter board 2		Pair trawl	
Food fish	% of total catch	% of food fish	% of total catch	% of food fish	% of total catch	% of food fish
Pelagic fish	1	2	1	1	21	47
Demersal fish	27	74	36	62	16	36
Cephalopod	3	8	9	15	8	17
Shrimp and prawn	4	12	5	9	0.5	0
Other invertebrate	1	4	7	13	0.5	0
Total economic fauna	36	100	58	100	46	100
Trash/forage fish						
Small-sized pelagic fish	2	3	2	5	23	42
Small-sized demersal fish	40	62	20	47	13	24
Small-sized cephalopod	1	1	1	2	3	6
Small-sized shrimp and prawn	0	1	1	3	1	1
Small-sized other invertebrate	7	11	3	7	0	0
Total small-sized economic fauna	50	78	27	64	40	74
True trash fish	14	22	15	36	14	26
Total trash fish	64	100	42	100	54	100

Table 5: Catch composition analysis (2013) for Otter board 1 ; a small-sized otter board trawler based in Prachuap Khiri Khan, Otter board 2 ; a medium-sized otter board trawler based in Chumphon, and Pair trawl ; pair trawlers operating in both areas.

From 1990 until the present, half of the catch of pair trawlers is made up of Trash/forage fish. Over 80% of this trash fish was made up of juveniles of economically valuable fish species.[65/66/67]

Figure 14: Trash fish comprises both low value species as well as the juveniles of economically important species.

The market price for one kilogram of trash fish is significantly lower than that of adult specimens of the main species that are found in Trash/forage fish. The average price of one kilogram of Trash/forage fish in October 2020 as stated by the Thai Fishmeal Producers Association was 5.87 baht/kg – having dropped by 32% since 2018.[68] In comparison one kilogram of short mackerel can be worth 100 baht/kg whilst squid can be worth up to 280 baht/kg (as of 2022).[69]

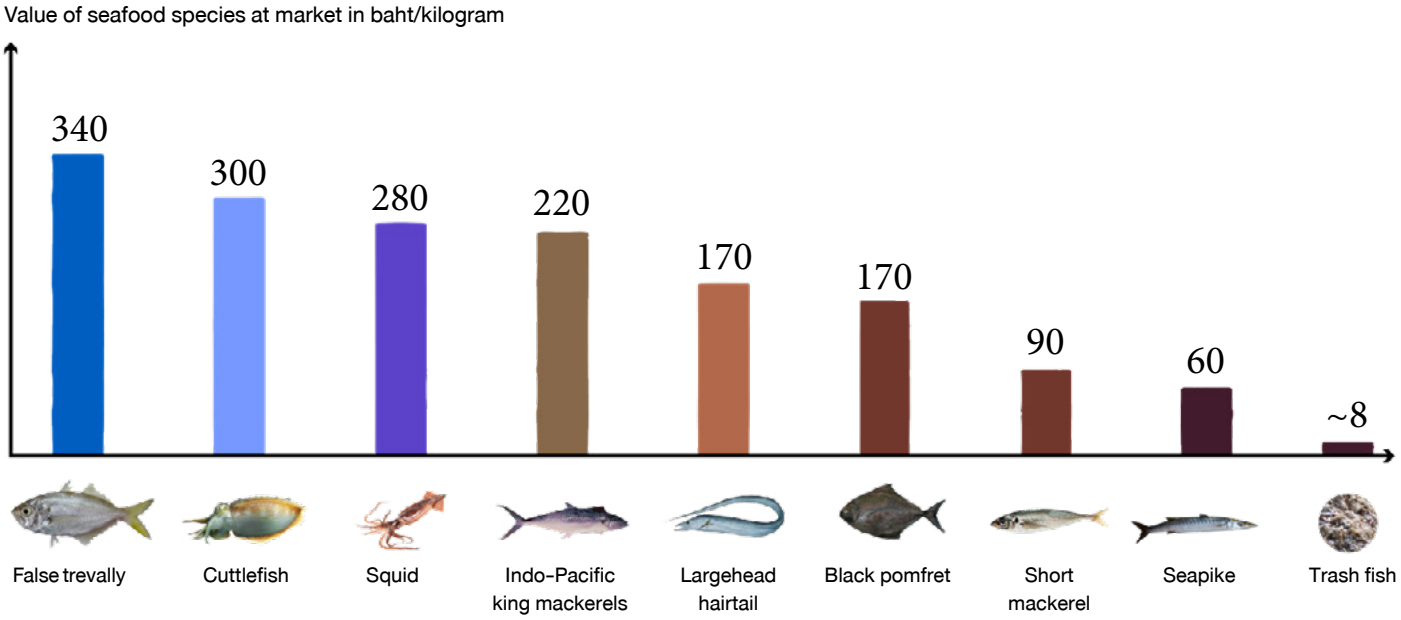


Figure 15: A range of different seafood products are ranked by their price (THB) per kilogram. Trash fish has the lowest price at only 5.87 baht/ kg - a mere fraction of the average price of 217.5 baht/kg for many economically important species if left to mature.

Fish caught using trawling nets may also fetch a lower price compared to the same species caught by purse seine vessels because of quality degradation such as bruising and squashing in the back of trawling nets.[70] Trash/forage fish originating from purse seine vessels for example fetches on average 7.78 baht/kg at market.[71]

Figure 16: Vessels targeting economically important species will ultimately suffer if juveniles do not have the opportunity to reproduce.

Figure 17: A pregnant whale shark is hauled onto a pair trawler in Phuket province. On discovery of the whale shark, the vessel captains were fined a record three million baht and their fishing licences were revoked. Such punishments are necessary to act as an effective deterrent against such wildlife crimes in the future and must be preserved.[72]

Pair trawling's disproportionate impact on marine resources

The nature of pair trawling–dragging a large net between two boats–means that it is highly effective at catching an extremely large amount of marine animals during trawling operations. Pair trawler net openings can stretch almost 100m, far wider than the openings of beam trawlers (7.5m) or otter board trawlers (60m).[73] This enormous net size can allow these vessels to target both demersal and pelagic species at the same time.

The 2013 SEAFDEC study found that 44% of pair trawler catches were made up of pelagic species with over half of this amount made up of juveniles.[74] In addition, out of almost 330,000 tonnes of Trash/forage fish landed across Thailand in 2019 by all 21 commercial fishing gears, pair trawlers contributed 55% of the amount.[75] These factors lead to pair trawling being one of the most destructive and least well managed fishing methods racticed in Thai waters.

Trawling gear	Total catch by trawl fleet in 2019 (tonnes)	Trash/forage fish caught in 2019 (tonnes)	% of Trash/forage fish of total gear catch
Beam trawls	14,995	793	5%
Otter board trawls	255,494	107,537	42%
Pair trawls	366,724	184,056	50%
Grand Total	**637,213**	**292,386**	

Table 6: Total and "trash" fish catches for the three different types of trawler. This shows how pair trawlers are responsible for the majority of trash fish catches.

A DOF study conducted in 2017 demonstrates just how much more destructive pair trawlers can be compared to other trawler gears.[76] Despite conducting less than 20% of trawler fleet fishing trips for the year, pair trawlers were responsible for catching 56% of the total trawler catch. Pair trawler CPUE for 2017 was three times higher than the CPUE for otter board and beam trawl gears combined.

Gear	Number of trips		Operating days		Catch amount (tonnes)		CPUE (Kg/day)
	Amount	%	Amount	%	Amount	%	
Pair trawl	14,921	19.48	138,616	21.97	328,533	56.40	2,370.09
Otter board	44,362	57.91	408,313	64.72	238,134	40.88	583.21
Beam trawl	17,316	22.61	83,949	13.31	15,856	2.72	188.88
Total	**76,599**	**100**	**630,878**	**100**	**582,523**	**100**	-

Table 7: Comparing catch rate (CPUE) and effort between bottom trawling gears in Thailand (2017).[77]

In terms of total catch, pair trawler catches have steadily increased since 2003 (264,814 tonnes) peaking in 2019 (366,724 tonnes)- a rise of 38%.[78] This is despite a DOF decree in 2015 to enlarge the cod-end of the net (catching portion of the net) to ensure a net mesh size of at least 4 centimetres. This regulation was designed to make the gear more selective in targeting economically important species rather than indiscriminate accumulation of vast volumes of Trash/forage fish.[79/80] As both the proportion of catch classified as "trash" fish and total pair trawler catches have increased, this would indicate that this has not been successful. EJF field investigations conducted in 2022 have also found pair trawlers continuing to use net mesh sizes that are smaller than 4 cm.

Figure 18: (Clockwise from top left) A legal net used by pair trawlers shows how the body of the net has a significantly finer mesh size than the cod-end of the net. (Top right) Cleaned net ready for installation. (Bottom right & left) Clean nets obscure finer mesh nets underneath.

Regardless of gear effectiveness, DOF proposed a fishing day quotas transfer campaign in 2021 which risks further destabilising the situation. This scheme allowed vessel owners to scrap older vessels and transfer licences along with fishing quotas to other vessels they owned using similar gears.[81] Since these quotas could be transferred to higher efficiency gears such as pair trawlers from otter board or beam trawlers, this could result in a dramatic shift in fishing effort even though the total number of vessels remains the same.[82] Previous studies conducted by DOF have revealed that with the same amount of fishing days, pair trawlers are able to catch four times the amount of seafood that otter board trawlers catch.[83]

Commercial fishing vessels received fuel subsidies worth 3.98 billion THB (US $ 115 million) in 2021.[84]

How green oil keeps the trawling sector afloat

"I can't take my boat out anymore. The green oil price is almost as high as diesel prices on shore. Fish is not worth it. It's easier to order fish from Indonesia."

- Trawler owner in Samut Prakan province, interviewed in April 2022.[85]

Many pair trawler vessels can only maintain consistent profitability due to the use of lucrative fuel subsidies known as 'green oil'. Green oil is a specially dyed diesel fuel that is sold to Thai fishing boats at a subsidised price of around 23.5 baht per litre - around 21.5% less than typical diesel used on land as of February 2022.[86/87] Green oil is unique in that it can only be sold beyond 12 nautical miles of the shore.[88] This requirement makes registering for the subsidy beneficial to large business owners who own larger, more capable seaworthy vessels. This indirectly incentivises the building or buying of larger vessels to accrue these benefits. Green oil is just one type of capacity enhancing fisheries subsidy which has increasingly been regarded as 'harmful' to sustainable fishing practices.[89]

Year	Green Oil usage (million litres)	Subsidy amount/year (million THB)	Oil discount rate (THB/litre)*
2016	639.43	3293.23	5.15
2017	615.13	3587.32	5.83
2018	597.08	3613.01	6.05
2019	599.48	3860.65	6.44
2020	610.07	3928.88	6.44
2021	618.58	3983.65	6.44

**estimated value*

Table 8 : Total green oil usage and total subsidies

The total value of green oil subsidies has steadily increased since 2016, rising by 21% by 2022 despite usage declining by 3.3%. Previous studies have shown that pair trawler fuel costs were on average 168,389 THB/month in 1995.[90] In 2021, even accounting for inflation, the same amount of fuel would cost 138,762.68 THB/month due largely to the support of the green oil subsidy.

As of May 2022, EJF has learnt of plans to pursue the mandatory installation of Automatic Identification Systems (AIS) on all fishing vessels that are signed up to the green oil scheme.[91] This would cover approximately 4,865 vessels.[92] If these plans go ahead it could represent a great victory in terms of transparency in Thai fisheries as it would ensure that even vessels below 30GT that partake in the scheme are now monitored for their fisheries compliance.

Impact of banning pair trawling

Figure 19: Pair trawlers fish in the Gulf of Thailand.

The damaging impacts of pair trawling on Thai marine ecosystems have been well recognised for many years. The fact that almost three quarters of pair trawler catches are non-target species with low economic value should signify a catastrophic warning sign that such practices should be heavily curtailed if not banned entirely.[93] A study conducted as early as 2003 on the status of demersal fishery resources in the Gulf of Thailand concluded by saying that a ban on pair trawling at the time would lower excess fishing effort

by 22%.[94] Even in 2021 the pair trawl fleet represents a third of the total trawl fleet with 1,124 registered pair trawlers. 75% of these are between 60-149.99GT and 24% of these are between 30-59.99GT.[95] The average number of workers on pair trawlers is thirteen people.[96] This means around 14,612 workers across the sector would be directly affected by implementing a ban.

Such a large number of vessels and workers potentially affected by a blanket ban on pair trawling therefore warrants a carefully considered approach. EJF recommends that a carefully structured and phased approach is deployed which targets the largest and most powerful pair trawling vessels first. Such an approach would have to take into account:

• Undertaking further fish population assessments across Thailand's fisheries to see how the fishing effort of banned vessels could be reallocated most appropriately and fairly amongst the remaining fishing fleet.
• Studying alternative fishery-related activities for vessel operators and workers affected by such bans.
• Providing financial incentives and assistance for those fishers who want to change to non-destructive fishing gears/practices such as fish gillnets[97], as well as for those who are willing to change livelihoods completely.
• Providing a voluntary scrapping or buy back scheme for pair trawler fishers who wish to leave the sector regardless of vessel size or engine power.
• Ensuring that a sincere participatory approach is employed for any consultation with affected fishers, local communities, small-scale fishers and civil society organisations.

One additional solution to addressing the disproportionate impacts of pair trawling on marine ecosystems would be the trialling and rollout of Juvenile and Trash/forage Excluder Devices (JTEDs). These could be used to minimise the remaining pair trawling fleet's impact on juveniles of economically important species. Such a device has already been promoted by the SEAFDEC Training Department in the interests of making regional trawl fisheries more selective in what they catch.[98]

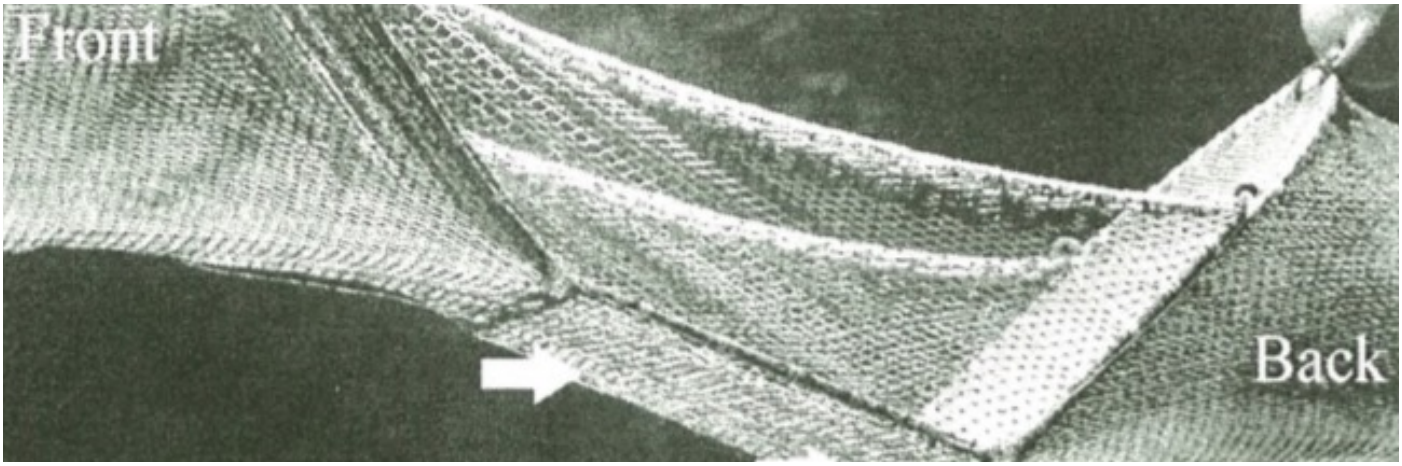


Figure 20: An example of a JTED device with arrows indicating a window within the net that can be opened and closed to release non-target species.

Recommendations

The following recommendations are designed to address identified capacity gaps in the regulation, monitoring and enforcement of particularly destructive fishing gears in Thailand's fishing industry. It is important to note that these recommendations are not exhaustive.

The Royal Thai Government should:

• Seek to phase out the most destructive pair trawling fishing gears that are devastating Thai marine ecosystems and disproportionately contributing to economically viable fish population declines in Thailand's waters. Such a phasing out should be conducted according to a carefully planned, staggered approach that focuses attention on the largest pair trawling vessels first and should aim to be completed within three years.

• Improve the effectiveness of monitoring, control, surveillance and enforcement mechanisms to effectively deter prohibited bottom trawling activities within Inshore Exclusion Zones and other protected marine areas within two years. Efforts should also be made to improve detection, investigation and prosecution mechanisms to maximise compliance.

• Accelerate the adoption of EJF's 10 principles for transparency in global fisheries with particular focus on addressing vessel monitoring gaps across the Thai commercial fleet as well as enforcement and prosecution of illegal fishing vessels. EJF strongly recommends that in order to address significant gaps across the trawler fleet that special attention be paid to adopting the following principles:

- Transparency principle 4: Publishing punishments handed out for fisheries crimes.
- Transparency principle 5: Re-introducing and enforcing a ban on at-sea trans-shipment of catch.
- Transparency principle 9: Punishing anyone involved in illegal, unreported and unregulated fishing.

• Publicly endorse EJF's Charter for Transparency in Fisheries and promote its implementation across Southeast Asia. Only through regional and international adoption and implementation of the principles within the Charter can Thailand and its neighbours hope to effectively end IUU fishing and associated overfishing issues.

• Restrict the use of capacity-enhancing subsidies such as the 'green oil' fuel subsidy that are provided to many trawler vessels. The use of such subsidies does little for sustainable fisheries development and is increasingly making commercial vessels dependent on such subsidies in the face of dwindling profits from catching low value seafood products such as "trash" fish.

• Facilitate the use of VMS data for research purposes including stock assessments, spatial planning and worker safety.

• Re-introduce an Inshore Exclusion Zone (IEZ) of at least 5 nautical miles in the Gulf of Thailand and Andaman Sea to prevent overfishing and damaging trawling activity near sensitive marine ecosystems and marine protected areas.

• Trial and implement alternative vessel monitoring technologies (such as Automatic Identification Systems) as appropriate in conjunction with transparency and monitoring efforts proposed by the Ministry of Finance and Excise Department. EJF is encouraged to hear that such plans are already in discussion as of the time of writing.

Figure 21: A DOF officer checks the VMS of a fishing vessel.

The Department of Fisheries should:

• Scale up existing VMS trials for fishing vessels under 30GT as a matter of urgency with particular focus given to pair trawler vessels and otter board trawlers which have been found to be particularly destructive.

• Ensure that the Fisheries Monitoring Centre is effectively monitoring and investigating VMS outages by fishing vessels to determine whether or not any wrongdoing has taken place.

• Tailor bottom trawl fleet management strategies according to vessel size, with vessels over 30GT, 60GT and 100GT receiving increasingly stringent regulations on their operations.

• Trial and implement gear modifications such as Juvenile and "Trash" Excluder Device (JTEDs) with particular focus given to pair trawler vessels and otter board trawlers.

• Re-evaluate current minimum net mesh sizes due to the high proportion of juvenile catches in current nets. Enlarge the net mesh of the body portion of pair trawler nets to help limit the catching of juveniles.

• Introduce more accurate catch monitoring and verification methodologies so that the true impacts of trawling fishing gears on marine ecosystems can be better evaluated. Again, pair trawler catch verification should be prioritised.

• Adopt a precautionary approach towards the design or implementation of MSY, TAC, future catch and fishing effort limits for fisheries or fish populations where there is a lack of information or where the authorities are reliant on inaccurate datasets.

• Enforce TAC catch quotas to prevent overfishing and keep fishing effort at consistent and sustainable levels in accordance with MSY levels.

• Trial and implement single species population assessments for important economic species such as squid and short mackerel across all trawling gears and other destructive gears. Similar population assessments as those conducted for otterboard trawlers should be conducted for beam trawlers and pair trawlers as a priority.

• The Marine Fisheries Research and Development Division should reconsider fishing effort quota for the trawling fleet and especially pair trawlers. Current fishing day quotas are allocated based on multi-species assessments, which are not accurate enough to ensure that overfishing does not occur.

• Enforce existing regulations on the prohibition of catching juveniles by trawler vessels and decrease permissible limits on the allowable bycatch of juveniles.

Conclusion

EJF's investigations and collated research from the last 20 years reveal a number of critical deficiencies in the management, regulation and enforcement of Thai trawl fisheries. A lack of substantive scrutiny of these vessel activities has led to unsustainable growth across the sector, trawler vessels growing in size and little to no measurable improvement in the overall health of demersal fish populations in either the Gulf of Thailand or Andaman Sea.

Of most concern is the highly damaging pair trawling fleet.[99] These vessels have been shown consistently since as early as the 1990s and early 2000s to be the most damaging subcategory of trawler in the Thai fishing fleet. Pair trawlers are responsible for a fraction of trawler fishing effort and yet were responsible for the bulk of Thailand's total Trash/forage fish landings as of 2020.

Thai fisheries are sacrificing millions of baht in lost revenues through allowing these damaging pair trawlers to continue to operate, catching juvenile mackerel, squid and other species well before they are fully grown or have had the chance to reproduce and replenish the population.

It is EJF's recommendation that the Royal Thai Government and Department of Fisheries considers the carefully staged phase-out of these damaging vessels with a particular focus on the largest, and most destructive pair trawlers over 60 GT first. Only through taking substantive steps to limit the impacts of these vessels now can Thailand hope to reverse the devastating impacts of these trawlers.

The situation is compounded by a lack of recent government supported studies on stock assessments, catch composition, ecological impacts of trawlers or the profitability of the trawling sector as a whole. Trawler operators are currently not punished for misreporting their catches, with only superficial warnings given out even if their figures are incorrect by over 20%. A chronic absence of such information or inaccurate catch reporting data for government agencies such as the DOF make it difficult to accurately and fairly regulate these fisheries.

MSY and TAC are also still only being calculated for three species groups rather than the diverse number of marine species which are harvested across Thailand's fisheries. This is despite commercial fishing vessels adapting their technologies and fishing techniques to highly efficient, non-selective gears which can harvest an ever-growing number of marine species. EJF strongly advises that such data gaps should warrant a strict precautionary approach to future fish population management plans.

The situation is aggravated by the widespread use and exploitation of green oil subsidies, allowing vessels to operate for longer periods of time than would otherwise be profitable. Without subsidies, many of these operations would not be economically viable given their reliance on catching low value economic seafood or Trash/forage fish. Some trawler vessels may only accrue 5% of their total revenue from three quarters of their entire catch.[100]

The concept of transparency in fishing is crucial for all relevant stakeholders to accurately and confidently manage, monitor and enforce fisheries compliance. Through improved and expanded data collection from trawl fisheries, rollout of vessel monitoring systems to smaller commercial vessels and better public access to relevant data, the Royal Thai Government can begin to rectify the situation.

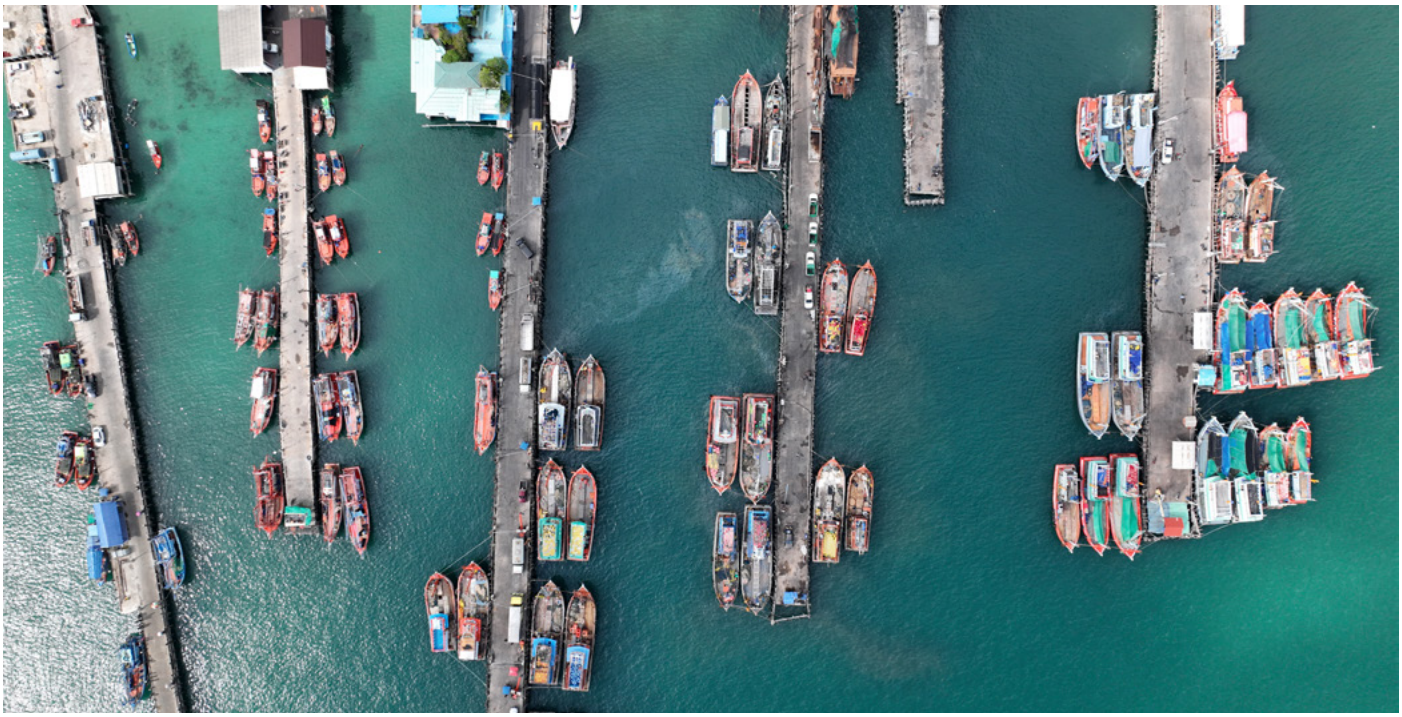
EJF's 10 principles for transparency in global fisheries are designed to address these challenges through the implementation of cost effective and realistically achievable transparency mechanisms. These include the robust enforcement of IUU fishing violations as well as the online publication of successful prosecutions can act as an effective deterrent against future IUU violations, helping to bolster overall compliance. The banning and enforcement of unmonitored at sea trans-shipments within domestic waters can also help to prevent the laundering of illegally caught seafood amongst legitimate product.

Thailand has shown over the last six years that it has the resources and capability to reform large segments of the fishing industry for the better. In order to institutionalise these changes and ensure the continued recovery of Thailand's fisheries, the Royal Thai Government must show resolve in addressing critical issues across the trawling fleet. At the same time, any approach must be rooted in elevating transparency whilst ensuring the sincere participation of all relevant stakeholders in any future reform discussion.

Appendix

Appendix 1 : Type and size of Thai fishing vessels by licence type and size for 2021 (measured in Gross Tonnes - GT). Note vessel size categories marked in green indicate those vessels currently monitored by VMS.

Type and Size	Vessels	% of fleet
1) Artisanal fishery vessels	51,237	82.86%
0 - 4.99 GT	45,997	74.39%
5 - 9.99 GT	5,141	8.31%
10 - 14.99 GT	99	0.16%
2) Commercial fishery vessels	10,593	17.14%
0 - 9.99 GT	232	0.38%
10-19.99 GT	2510	4.11%
20.00-29.99	2123	3.62%
30.00-39.99	1067	1.89%
40.00-49.99	943	1.70%
50.00-59.99	819	1.50%
60.00-69.99	577	1.08%
70.00-79.99	464	0.87%
80.00-89.99	392	0.75%
90.00-99.99	336	0.64%
100.00-109.99	214	0.41%
110.00-119.99	143	0.28%
120.00-129.99	97	0.19%
130.00-139.99	67	0.13%
140.00-149.99	35	0.07%
มากกว่า 150.00	88	0.17%
Total number of vessels	61,344	



Appendix 2 : Region and province for Thai commercial fishing vessel registrations as of 2020. Provinces marked in red indicate those that harbour the most significant number of vessels.

Region and Province	Number of Vessels	%
Andaman	1,904	18.33%
Krabi	113	1.1%
Phang Nga	509	4.9%
Phuket	344	3.3%
Ranong	370	3.6%
Satun	351	3.4%
Trang	217	2.1%
Gulf of Thailand	8,484	81.7%
Bangkok	4	0.0%
Chachoengsao	39	0.4%
Chanthaburi	142	1.4%
Chonburi	516	5.0%
Chumphon	411	4.0%
Nakhon Si Thammarat	873	8.4%
Narathiwat	54	0.5%
Pattani	1,017	9.8%
Phetchaburi	524	5.0%
Prachuap Khiri Khan	621	6.0%
Rayong	819	7.9%
Samut Prakan	358	3.4%
Samut Sakhon	434	4.2%
Samut Songkhram	547	5.3%
Songkhla	518	5.0%
Surat Thani	905	8.7%
Trat	702	6.8%
Grand Total	10,388	

Appendix 3 : Number of trawlers by engine size in 2021.[101]

Engine size (GT)	Otter board trawls	Pair trawls	Beam trawls	Total vessels	Bottom trawlers as % of total vessels	Pair trawlers as % of total vessels	Pair trawlers as % of trawler fleet
0-9.9	104	2	9	499	23.05	0.40	1.74
10-19.9	203	0	45	5,386	4.60	0.00	0.00
20-29.9	253	2	107	4,527	8.00	0.04	0.55
30-39.9	244	15	75	2,370	14.09	0.63	4.49
40-49.9	257	90	72	2,011	20.84	4.48	21.48
50-59.9	243	167	47	1,609	28.40	10.38	36.54
60-69.9	144	186	33	1,106	32.82	16.82	51.24
70-79.9	104	159	17	891	31.43	17.85	56.79
80-89.9	73	142	16	745	31.01	19.06	61.47
90-99.9	84	137	6	647	35.09	21.17	60.35
100-109.9	38	100	3	416	33.89	24.04	70.92
110-119.9	16	58	3	282	27.30	20.57	75.32
120-129.9	16	41	0	191	29.84	21.47	71.93
130-139.9	15	15	0	131	22.90	11.45	50.00
140-149.9	2	5	1	66	12.12	7.58	62.50
≥150	16	5	0	176	11.93	2.84	23.81

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> *Pair trawlers shouldn't exist in this country. It shouldn't even exist on the planet at all because it's a very destructive fishing practice. From seabed to water surface, it catches everything. It is impossible for aquatic animals to escape, whether small or large. It is a fishery that takes advantage of people all over the world.*
>
> – ***Wichoksak Ronnarongpairee,*** *Thai Sea Watch Association President*

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