Report

Fishy Business

Estimating the impact of irregular and unsustainable fishing of distant-water fishing fleets in Ecuador, Ghana, Peru, the Philippines and Senegal

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Acronyms

AIS	automatic identification system
BFAR	Bureau of Fisheries and Aquatic Resources
CNFC	China National Overseas Fishery Corp
CNN	convolutional neural networks
DGI	General Tax Directorate
DWF	distant-water fishing
EEZ	exclusive economic zone
EJF	Environmental Justice Foundation
EU	European Union
FAD	fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FoC	flag of convenience
GDP	gross domestic product
GEP	growth elasticity of poverty
GFW	Global Fishing Watch
GIS	geographic information system
GT	gross tonnage
IATTC	Inter-American Tropical Tuna Commission
IHH	Illuminating Hidden Harvests
IMO	International Maritime Organization
IUU	illegal, unreported and unregulated fishing
MSC	Marine Stewardship Council
MMSI	Maritime Mobile Service Identity (number)
MPA	marine protected area
NGOs	non-governmental organisations
NT	net tonnage
PRC	People's Republic of China
PSMA	Agreement on Port State Measures
RFAB	regional fisheries advisory body
RFMO	regional fisheries management organisation

RUC	Registro Único de Contribuyente (Single Taxpayer Registry)
RUT	Single Tax Registry
SMEFF	sustainable management of external fishing fleets
SOLAS	International Convention for the Safety of Life at Sea
SPRFMO	South Pacific Regional Fisheries Management Organization
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNODC	United Nations Office on Drugs and Crime
VMS	vessel monitoring system
WTO	World Trade Organization
WWF	World Wide Fund for Nature

Glossary

Automatic identification system (AIS): The AIS is a tracking system that employs transponders on vessels and is used by vessel traffic services for collision avoidance. A ship-borne transponder sends signals on a vessel's position, heading and speed. AIS data typically includes longitude, latitude, timestamp and other information.

Distant-water fishing (DWF): The commonly accepted international definition of DWF covers activities outside a nation's 200-mile exclusive economic zone (EEZ), whether on the high seas or in foreign waters, including in another nation's EEZ (refer to annexes).

Exclusive economic zone (EEZ): A sea area up to 200 nautical miles from the coast over which a state claims exclusive rights over marine resources.

Flag of convenience (FoC): Describing the permitted registration by a state of a vessel owned by foreign nationals. FoCs are commonly used to denote flag states with low environmental, safety or labour standards.

Geographic information system (GIS): A system that acquires, stores, collects, analyses, manages and visualises spatial or geographic data.

Illegal, unreported and unregulated (IUU) fishing: A range of offences covering fishing without permission or in violation of regulations of the flag state or host nation, misreporting or failure to report catches to relevant authorities where required to do so, fishing vessels without a flag, national registration or fishing on stocks without management measures in place.

International Convention for the Safety of Life at Sea (SOLAS): This determines the minimum standards for the construction, equipment and operation of ships, compatible with their safety.

International Maritime Organization (IMO) number: A vessel's unique number, usually maintained throughout the vessel's length of service. It is not required for all fishing vessels but is standard for security, taxes, certification and insurance on industrial DWF fishing vessels.

Longliners: These are fishing vessels equipped with long fishing lines that have baited hooks. They are used particularly for species like tuna and swordfish

Maritime Mobile Service Identity (MMSI): A unique identification number used in radio communications. MMSI numbers are country specific and, in principle, are changed when a vessel is reflagged.

Panama Papers: 11.5 million documents, obtained from an anonymous source by the German newspaper Süddeutsche Zeitung, revealed financial and attorney-client information for more than 214,488 offshore entities. The leak exposed a network of 214,000 tax havens involving wealthy individuals, public officials, and entities from 200 nations.

Regional fisheries management organisation (RFMO): Multilateral organisations governing fishing interests for important areas or species. While some RFMOs have a purely advisory role, most have management powers to set catch and fishing effort limits, technical measures and control obligations.

Single Taxpayer Registry (RUC) or Single Tax Registry (RUT): A registry that identifies companies within a country. Depending on the case, it depends on both the Ministry of Economy and the General Tax Directorate (DGI) of each country.

Seiners: Seiners are fishing vessels that practise a method called seining, which involves using a large net to encircle a school of fish. The net is then pursed at the bottom to trap the fish. This method is often used for catching fish such as herring, mackerel and salmon.

Squid jiggers: Squid-jigging vessels are specifically designed for the process of squid jigging, which involves the use of barbless jigs to catch squid. These vessels are equipped with powerful lights to attract squid to the surface at night, making them easier to catch.

Ton: A ton (called a 'metric ton' in the US and Canada) equals 1,000 kilograms.

Trans-shipment of fish: Transfer of catch between two vessels.

Trawlers: Trawlers are commercial fishing vessels that use trawl nets to catch fish. These nets are pulled through the water to capture the fish. Trawlers are commonly used for catching seafood such as cod, haddock and shrimp.

Executive Summary

This study reveals the scale, form and behaviour of the domestic and foreign fleets operating within the exclusive economic zones of Ecuador, Peru, Senegal, Ghana and the Philippines. It also investigates the domestic and foreign companies that own or operate vessels in these countries' exclusive economic zones (EEZs). For the first time, this analysis estimates the impact of fishing businesses with a track record of unsustainable practices on these five countries' economies, employment and well-being. The report expresses in human terms the loss of opportunity these five countries face by allowing companies with a history of misconduct to operate in their waters, offering a powerful argument for transparency and grounds for reform. The study – which includes data from 2021 and 2022 – uses data analytics, maps, deep learning algorithms, probabilistic statistics and contextual data to analyse, compare and interpret registry data, satellite data and economic, employment and poverty indicators – highlighting the importance of data availability and representativeness for sustainable development, too. This study fills a crucial knowledge gap in fisheries, as effective policies hinge on transparency and understanding illicit practices.

Main points

- A handful of large conglomerates – 19 companies – owning or operating 657 vessels in these EEZs were previously implicated in wrongdoing or involved in diverse unsustainable practices, including incidental fishing, lack of transparency, participation in the *saiko* barter system and shark finning. Allowing access to fishing grounds and port infrastructures to vessels with a prior record of unsustainable behaviour results in a danger of backsliding (Belhabib and Le Billon, 2022). It signifies, too, a missed opportunity for sustainable development and the long-term well-being of local fishing communities in Ecuador, Peru, Senegal, Ghana and the Philippines.
- These companies' potential economic impacts on gross domestic product (GDP), employment and people's well-being in the five countries are substantive. Together, their joint fishing activities amount to a potential opportunity cost of 0.26% of these countries' combined GDP, 30,0174 jobs and 142,192 people living below the poverty line.
- Looking at distant-water fishing (DWF) presence indicated by automatic identification system (AIS) positions, the largest fishing nations in the countries under study are Ecuador (with 493 vessels flagged to Ecuador detected via satellite data in any of their EEZs), China (191), Peru (189), Spain (126), Japan (84), Panama (68) and Taiwan, Province of China (64). Senegal (with 57 vessels flagged to Senegal detected via satellite data), Ghana (33) and the Philippines (25) are relegated behind.
- Looking at ownership, operation address and other indicators, Chinese vessels stand out inside the domestic fleets of four of the countries under study. A total of 192 vessels were found to be connected to Chinese interests but flagged to Ghana (107), the Philippines (67), Senegal (16) and Ecuador (2). The incorporation of foreign vessels into domestic fleets raises questions, as it can generate market distortions, encourage the excess of sustainable catch limits and threaten food security and livelihoods (Belhabib, 2017; Belhabib et al., 2014; Belhabib and Le Billon, 2022; Okafor-Yarwooda and Belhabib, 2020).

- Connected with the last two points, the analysis of fishing manoeuvres of the vessels in these EEZs shows intense competition between domestic and foreign fleets of the same fishing type (for example, longlining in Ecuador or trawling in Senegal). Foreign DWF vessels' technical capacity to fish non-stop and travel to remote areas often awards them a competitive advantage. Foreign DWF competes with people's livelihoods and food security in low-income nations (Toppe et al., 2017) and unfair access by foreign DWF fleets to developing countries' EEZs can threaten food security (Okafor-Yarwooda and Belhabib, 2020).
- Flags of convenience (FoC) play a significant role in the foreign fleets present in the five EEZs under study; a fifth of the foreign vessels were registered with an FoC and 3% were registered with the blacklisted FoCs of Cameroon, Vanuatu and Comoros (Paris MOU, 2023), instigating concerns about safety standards, environmental risks and labour conditions.

1 Background

By 2016, the uncontrolled growth of global fishing had harshly and negatively impacted global fish stocks; 90% of commercially exploited marine fish stocks were overfished or fished to their maximum sustainable limits (FAO, 2016). Subsequent reports tell the same story. In contrast, total fisheries and aquaculture production has massively grown from 19 million tons in 1950 to about 179 million tons in 2018, with an annual growth rate of 3.3%, declining to 178 million tons in 2020 (FAO, 2022b). The global seafood market is projected to expand from $333.25 billion in 2022 to $605.46 billion by 2029 (Fortune Business Insights, 2023). In the Philippines, for example, the Bureau of Fisheries and Aquatic Resources (BFAR) (2022) finds a general increase in fishing vessels. Except for subsistence fishing, in all the phases of the production chain – from the sea to the table – there is a company involved. Fishing is a big business.

Here, we conduct an in-depth investigation of distant-water fishing (DWF) vessels and the companies behind them in Ecuador, Peru, Senegal, Ghana and the Philippines. The cases have been selected based on three criteria: a) these countries' vulnerability to overfishing and illegal, unreported and unregulated (IUU) fishing; b) their geographical diversity and fishing sector's variety in terms of size and fishing types, to capture as much information as possible and make comparisons; and c) the significant presence of foreign fleets in their exclusive economic zones (EEZs). Here, we investigate the domestic and foreign companies that operate in these waters. Finally, we estimate the economic impact of those companies with a previous a track record of unsustainable practices.

These countries are compelling choices for studying IUU and overfishing because of several factors. Although they represent different geographical regions, providing a wide-ranging perspective, each one of them heavily relies on their fisheries for both sustenance and economic growth, while facing similar challenges in regulating and enforcing fishing laws. On the one hand, some of the firms found operating in these countries' waters have engaged in IUU fishing, overfishing and other irregularities and wrongdoing, including working in restricted areas, under-reporting catches and using illegal gear, as the exhaustive literature review included in this report reveals. On the other hand, the IUU Fishing Index – developed by Poseidon Aquatic Resource Management and the Global Initiative Against Transnational Organized Crime – ranks these countries from 1 (best) to 5 (worst) in this order: Ghana (1.89), Peru (2.21), Senegal (2.24), Ecuador (2.39) and the Philippines (2.71) (IUU Fishing Index, 2021).

This report is focused on the business side of fishing and its impacts. Although most firms comply with the rules, those that do not can contribute to the depletion of fish stocks, the destruction of marine ecosystems and the impairment of local communities reliant on fishing. DWF ships' abuse, especially those flagged to registries with a history of poor control and corruption, is pervasive (Global Slavery Index, 2018; Gokkon, 2022; ILO, 2022). For example, Selig et al. (2022) find 'high-risk areas for trans-shipment or places with high concentrations of risky trans-shipments, off the coasts of Argentina, Peru, Chile and Western Africa'. Unmonitored fish trans-shipments at sea can facilitate IUU fishing (Daniels et al., 2016: 45). To study the companies' behaviour, we considered not solely IUU fishing but also other irregularities, such as document fraud or human rights abuse. We argue that allowing companies of dubious standards or prior issues to operate in countries vulnerable to IUU fishing and overfishing represents a missed opportunity for sustainable development, the long-term well-being of fishing communities and the possibility of a sustainable local industry.

Importantly, based on descriptive data, satellite data and deep learning algorithms, we first analyse and map the scale, form and behaviour of the domestic and foreign fleets operating within the EEZs of Ecuador, Peru, Senegal, Ghana and the Philippines. And specifically, which are the most prominent DWF foreign fleets in these waters. Second, we detect the companies that operate or own DWF vessels fishing in these waters. Based on previously published reports, we investigate whether they have ever been involved in or denounced for IUU fishing, wrongdoing or unsustainable behaviour (e.g. generating bycatch). Third, to build a case for reform, we estimate these companies' potential economic impacts on gross domestic product (GDP), employment in the sector and people's well-being.

The first steps towards tackling an issue as multifaceted as IUU fishing are transparency and knowledge. Transparency in fisheries is understood as open, accessible and accountable information sharing regarding all aspects of the fishing industry, including stocks, catch, capacity data and fishing activity (Wiser, 2008). Wiser (2008) emphasises how transparency fosters trust among stakeholders, enhances compliance with regulations and ultimately contributes to the sustainability of marine resources. Meanwhile, a lack of data or concrete information on fisheries resources translates into inadequate fisheries management (UNDP, 2021). Because of its unlawful character, IUU fishing is hard to estimate. But without 'knowledge and research on the nature and behaviour of the fleets that are fishing illegally', there cannot be effective policy-making, monitoring or enforcement (Hudson, 2021). Namely, transparency is the first pillar of good governance (Geiger and von Lucke, 2012).

The investigation of overfishing and IUU fishing typically focuses on biodiversity loss or detecting where irregular manoeuvres happened; this report innovatively connects the detection of fishing activity with the businesses behind it, filling a gap and offering transparency. The uncontrolled growth in global fishing – driven by technological advances, public subsidies, overcapacity, destructive fishing gear and a mounting demand for fish protein (Tickler et al., 2018) – may make business sense in the short term for a minority of companies. The larger picture, however, is quite different. Global fishing has resulted in overfishing, stressing fish stocks and impacting coastal communities and the oceans' well-being. This adds to the dire situation of the oceans. The Intergovernmental Panel on Climate Change's Special Report on the Ocean and Cryosphere notes, among other issues, that the global ocean has warmed and sea level rise has accelerated; as a result, marine species are undergoing significant shifts, while coastal ecosystems endure heatwaves, acidification, loss of oxygen and salinity intrusion (Pörtner et al., 2022). Ocean warming has contributed to an overall decrease in catch potential, intensifying the impacts of overfishing and IUU fishing. The ocean is under siege by climate change stressors alongside human-driven impacts, such as overfishing, IUU fishing and plastic pollution. If human effects on the ocean continue unabated, declines in ocean health and services are projected to cost the global economy $428 billion yearly by 2050 and $1.979 trillion annually by 2100 (ibid.: 77). Changes in the ocean further disrupt ecosystem services, challenging their governance and upsetting the health of local communities dependent on fisheries.

Yet overfishing continues to be a lucrative business. Knowing which companies contribute to it and their economic impact is essential so that governments can make decisions and irresponsible corporations can be held accountable.

1.1 Contextualising this report: overfishing and illegal fishing

Overfishing – understood simply as fishing beyond sustainable levels – is a significant phenomenon related to IUU fishing and other unsustainable practices that can be legal, such as bycatch or using destructive gear. Bycatch refers to the unintentional capture of non-target species. Overfishing is the withdrawal of fish at a rate the species cannot replenish, resulting in those species becoming underpopulated.

More than 90% of global fishery stocks were fully exploited, overexploited or depleted by 2018 (Kituyi, 2018). The average distance travelled by fishing vessels to access fishing grounds has doubled since the 1950s, with catches diminishing from 25 kilograms (kg) per kilometre to 7 kg per kilometre (Tickler et al., 2018). These developments result from various drivers, including increased seafood and protein demand, fishing technology advancements, damaging subsidies and inadequate fisheries management.

Meanwhile, IUU fishing involves activities that violate national or international fishing laws and regulations; it encompasses, for example, fishing without proper licences or permits, catching fish in prohibited areas or drifting into a neighbouring country's waters to fish without a licence, exceeding catch quotas, using prohibited gear and not reporting or misreporting catches (FAO, 2001a). For example, illegal fishing practices include fishing by unregistered vessels in another country's waters in violation of regulations or international waters, violating international agreements or the country's laws under whose flag the ship is operating or violating the laws of the coastal state (International MCS Network, 2014).

The countries selected for this study provide examples. For example, 20% of the global IUU catch comes from just six neighbouring West African countries (Mauritania, Senegal, The Gambia, Guinea-Bissau, Guinea and Sierra Leone). In West Africa, the overexploitation of fishery resources and harmful activities such as illegal fishing has produced devastating social, economic and human consequences. The Environmental Justice Foundation (EJF) – an environmental organisation – has denounced that 'the Ghanaian government's failure to tackle illegal fishing has resulted in a second EU yellow card – a formal warning that could lead to a seafood export ban to the EU' (EJF Staff, 2021a).[1] In Ghana, the incomes of artisanal fishers have fallen by 40% since the turn of the century and there is a growing tide of criticism on social media of the damage Ghana's politicians are doing to their own country (Clover, 2020a). On the other side of the world, Peru's fisheries suffer from the overfishing of anchoveta and other issues, such as the mislabelling of endangered species (Tegel, 2018), which is not illegal fishing per se but document fraud that can

1 Countries identified as having inadequate measures in place to ensure their catch is legal are issued with a warning (a 'yellow card'). Today, these countries include Vietnam, Cameroon, Ghana, Liberia, Sierra Leone, Trinidad and Tobago, Ecuador, Saint Kitts and Nevis and Panama (European Union, 2022).

lead to significant revenue loss. In Peru, fishing has increased faster than catches, particularly since 2006, resulting in declines in catches and revenues and suggesting that 'the growing fishing effort is unsustainable and uneconomic' (De la Puente et al., 2020), referring to small-scale fishing.

Additionally, investments are needed to address climate change adaptation in Peruvian fisheries (UNDP, 2011) and to support artisanal fishers in reaching markets (3BL Media, 2019; World Bank, 2020). A challenge is the lack of coordination among organisations supervising the sector, as well as not having a specific ministry dedicated to fisheries (currently under Ministerio de la Producción). This is despite the relevance of fishing for the economy (contributing to 7% of exports) and the prevalence of IUU fishing (World Bank, 2017). Likewise, although the Philippines was among the top global capture producers in 2018 (in 11th position) (FAO, 2020a), 70% of fish stocks are estimated to be overfished in that country, causing a decline in fisheries production since 2010 (Orlowski, 2017).

IUU fishing accounts for as much as a fifth of the global catch and generates between $10 and $25 billion, representing 11 to 26 million tons of fish annually (Agnew et al., 2009). In 2021, about 17% of fishing hours on the high seas were conducted by 'vessel identities that were either not publicly authorised or were internationally unregulated' (Park et al., 2023). IUU fishing is a substantial business threatening the livelihoods of millions worldwide – especially those living in coastal communities in developing countries already impacted by the Covid-19 pandemic, armed conflicts and climate change – and facilitating other crimes, such as drug trafficking (Ommati, 2022). The international community has long been concerned about criminal activity in fisheries, prompting a 2008 General Assembly call for increased understanding of the link between illegal fishing and transnational organised crime at sea; current findings now provide comprehensive evidence of the pervasive impact of organised crime on global economies, societies and environments (Witbooi et al., 2020). Fisheries resources available to bona fide fishers are taken away by IUU fishing, which can lead to the collapse of local fisheries, with small-scale fisheries in developing countries proving particularly vulnerable. Products from IUU fishing can find their way into markets, choking the local food supply.

IUU fishing exacerbates overfishing. When IUU fishing activities go unchecked, fish are removed from the oceans without considering sustainable fishing practices, putting additional pressure on fish populations already experiencing overfishing due to legal and regulated fishing activities (Gutierrez et al., 2020). Removing large numbers of key fish species can upset the balance of aquatic food chains and ecosystems, affecting the target species and their predators and prey, leading to cascading effects throughout the ecosystem (Worm et al., 2006). Furthermore, IUU fishing weakens the efforts of fisheries management organisations and governments to regulate fishing activities and promote sustainable practices (Seafood Watch, 2023). When IUU fishing is widespread, it becomes challenging to accurately assess the health of fish populations and set appropriate catch limits (Widjaja et al., 2020). IUU fishing often involves crossing national boundaries and operating in areas governed by multiple countries; this makes it challenging to enforce regulations and address the problem effectively and can lead to conflicts between countries over shared fishery resources (High Seas Task Force, 2006).

At the same time, overfishing, IUU fishing and illegal or criminal actions along the whole fisheries supply and value chain can have other negative impacts. In Senegal and Ghana, fish provide more than 60% of the animal protein needed for healthy growth, while in isolated coastal communities, almost all protein comes from fish. Illegal fishing in Senegal generates an annual loss of $272 million (Blédé et al., 2015). Meanwhile, the Philippine Strategic Forum mentions that losses to IUU fishing could range from $88 million to $10 billion (Vergara, 2021), while the US Agency for International Development and the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) estimates that the country is losing $1.2 billion annually to IUU fishing (BFAR, 2022). Overfishing and IUU fishing can also have significant social implications, since depleted fish stocks can lead to job losses in fishing communities (Daniels et al., 2016: 45). The opportunity cost of IUU activities to the economies of western Africa has been calculated at $2.3 billion a year and 300,000 jobs (Belhabib 2017; Belhabib et al., 2014; Daniels et al., 2016). More than 58 million people are estimated to be engaged in fisheries and aquaculture (ILO, 2022); most vessel crews come from developing countries, such as Indonesia and the Philippines (Gokkon, 2022). Labour abuse on IUU fishing vessels violates human rights, jeopardises food security and deprives governments of revenues (UNCTAD, 2019).

The focus on DWF is justified here. Several studies also highlight the associations between distant-water fishing and IUU fishing. DWF fleets are relevant in IUU fishing because they operate globally and utilise state-of-the-art technologies. Pauly and Zeller (2016) contend that IUU fishing is one of the biggest challenges associated with DWF fleets. Concurring, Gutierrez and colleagues analysed the vast capacity of DWF vessels by focusing on the Chinese fleet (2020). When trans-shipments are appropriately managed and have 100% observer coverage (as the Inter-American Tropical Tuna Commission (IATTC), the International Commission for the Conservation of Atlantic Tunas or the Indian Ocean Tuna Commission tuna fisheries demand), the problem of illegal transfers has moved from at-sea trans-shipment to in-port trans-shipment (Daniels et al., 2016: 45). Where these operations can be monitored efficiently, the rates of IUU fishing have gone down (FAO, 2021b). However, when unmonitored, DWF fleets can engage in fish trans-shipment practices that enable illegal activities to go unnoticed (Daniels et al., 2016: 45; Global Fishing Watch, 2017: 18). Senegal and Ghana are in the two trans-shipment hubs, where fish is sometimes illegally or irregularly transferred from one fishing vessel onto a reefer capable of processing, deep-freezing and exporting fish (Daniels et al., 2016: 45). Senegal bans trans-shipment operations in its waters (FAO, 2023), while, as part of the West Africa Task Force, Ghana prohibits fish trans-shipments, too (West Africa Task Force, 2022). Using data analysis and visualisations for the first time in 2016, ODI visualised behaviour indicating irregular trans-shipments by international DWF fleets within Senegal's and Ghana's EEZs (Daniels et al., 2016: 45). Belhabib and Le Billon (2022) connected fishery-related offences – including IUU fishing – in West Africa with DWF vessels, many of which were foreign flagged. An analysis found that in low-income countries' EEZs, 84% of the industrialised fishery was from foreign countries and 78% came from vessels flagged to high- and upper-middle–income nations (McCauley et al., 2018). Foreign DWF competes with people's livelihoods and food security in low-income nations (Toppe et al., 2017). Economically vulnerable countries often negotiate disadvantageous fisheries agreements with industrial fleets, without scientific advice on sustainable catch limits (Englander and Costello, 2023).

The European Union (EU) differs from most other regions and countries by introducing sustainable management of external fishing fleets (SMEFF) authorisations that must show a surplus through a stock assessment before being allowed to fish (European Union, 2017). Adequate stock assessments take the risks and quantity of IUU fishing into account.

Given the secret nature of IUU fishing, it might prove impossible to define IUU fishing with any degree of reliability. Although there is no consensus about what overfishing, IUU fishing or DWF precisely mean (refer to Section 1.3 on the challenges of tackling IUU fishing), this discussion serves as context for the analysis in this report.

1.2 Addressing overfishing and IUU fishing

Fisheries are in crisis in many countries; to implement their rights under the UN Convention on the Law of the Sea (UNCLOS), governments in developing countries are introducing new procedures, including restrictions favouring domestic fishing vessels against foreign ones, such as offering licence preferences, allocating quotas and imposing access restrictions to specific areas of an EEZ (Foley and Mather, 2019).

Besides, in May 2019, the UN General Assembly agreed that the next UN Ocean Conference should adopt a global treaty focusing on 'science-based and innovative ideas' to conserve the oceans sustainably, implementing Sustainable Development Goal 14. Postponed due to Covid-19–related restrictions, the Ocean Conference took place in 2022 in Lisbon, Portugal, without such an agreement. Meanwhile, the new High Seas Treaty (United Nations, 2023) is an international agreement aimed at protecting the biodiversity of the high seas, which are areas beyond national jurisdiction. Sustainable fishing is essential to the treaty and several fundamental principles should be followed to ensure sustainable fishing practices. First, sustainable fishing – that is, an ecosystem approach to fisheries management – should prioritise the long-term health and resilience of fish populations and the marine ecosystem. This means that fishing quotas and practices should be based on scientific assessments of fish stocks and should consider the impacts of fishing on other species and the environment. Second, fishing gear and methods that minimise bycatch and habitat damage should be prioritised, as habitat damage can come from lost and discarded fishing gear, such as drifting fish aggregating devices (FADs) that get stuck on coral reefs and other sensitive habitats. Bycatch can occur when fishing gear is dragged along the ocean floor, destroying important habitats such as coral reefs and seamounts (underwater mountains). Third, sustainable fishing should be managed through a transparent and participatory process that involves all stakeholders, including fishing communities, industry representatives and environmental organisations, to ensure that fishing practices are socially and economically sustainable. Finally, sustainable fishing should be implemented through effective monitoring, control and enforcement mechanisms. This can include measures such as satellite tracking of fishing vessels, onboard observers, remote-electronic monitoring when observers are impractical or impossible to deploy and penalties for non-compliance. Overall, sustainable fishing under the High Seas Treaty should aspire to balance the needs of fish populations, the marine ecosystem and human communities.

Meanwhile, the World Trade Organization (WTO) Agreement on Fisheries Subsidies, adopted at the 12th Ministerial Conference in 2022, established the prohibition of harmful fisheries subsidies

(WTO, 2023). The agreement – the first WTO binding agreement to focus on the environment – represents an historic achievement. However, negotiators failed to determine how to proceed equitably between more and less developed nations on curbing overcapacity and overfishing, which some considered 'a major weakness' (Fitt, 2022). The agreement needs to be ratified by 109 members (Fernandez Monge, 2023).[2] Despite previous agreements, only 43 out of 164 members had ratified the 2022 Fisheries Subsidies Agreement at the time of writing.

Governments and regional fisheries management organisations (RFMOs) have implemented regulations and monitoring systems to fight IUU fishing. These measures include banning fish trans-shipments at sea, monitoring land trans-shipments, reporting irregularities and wrongdoing to responsible flag countries and reporting if the suspected IUU fishing occurs in another country's waters or waters regulated by a regional fishery organisation. Also, the UN Food and Agriculture Organization's (FAO's) Agreement on Port State Measures (PSMA) is the first internationally binding instrument to prevent, deter and eliminate IUU fishing by denying port access to foreign vessels that engage in or support such practices (FAO, 2019). According to FAO Director-General Qu Dongyu, 'Rising consumer demand and transforming agri-food systems in fisheries and aquaculture have driven global fish production to its highest levels and there is broad recognition of the need to step up the fight against IUU fishing' (in FAO, 2022d). So far, FAO has assisted more than 50 countries in reviewing their legislation, strengthening their capacity and improving their monitoring, control and surveillance systems to implement the agreement.

The ability to monitor fishing fleets and observe their behaviour has been revolutionised by leveraging the shipboard automatic identification system (AIS), initially crafted as a collision avoidance tool (Weatherdock, 2016). About 70,000 large commercial fishing vessels transmit their global positioning system (GPS) locations via the AIS, a transponder designed for safety at sea. However, many fewer fishing vessels are required to transmit. This data can be utilised to tackle IUU fishing (Gutierrez et al., 2018).

Data analytics offer unique opportunities to support fisheries monitoring and control, particularly for countries without the capacity to patrol their waters or enforce legislation against IUU fishing and overfishing (UNDP, 2022). Vessel tracking data from the AIS can be a powerful tool for combating IUU. In 2016, this new data source was employed to visualise suspected trans-shipments in western Africa for the first time (Daniels et al., 2016: 45). Until then, estimations were based on vessel monitoring system (VMS) data and other data sources, case studies and

2 In particular, small island developing states and some other large ocean nations (for example, Norway) have issues with some provisions of the agreement.

individual sightings.[3] Based on AIS data for the first time, Daniels et al. (2016) showed irregular trans-shipments conducted, for example, in Senegal's waters, where this type of operation is banned and identified two main trans-shipment hubs in West Africa. Since then, AIS data has been used to produce unparalleled views of global fishing vessel position information, assess the impacts of conservation actions, such as marine protected areas (MPAs) and to offer insights into wrongdoing (for example, Bradley et al., 2018; McCauley et al., 2018; Sala et al., 2018).[4]

The countries under study are part of different regional fisheries management organisations (RFMOs) and form alliances for better monitoring. For instance, Ghana is a member state of the Atlantic Regional Convention for Fisheries Cooperation (ATLAFCO) and the regional fishery body, the Fishery Committee for the Eastern Central Atlantic (CECAF). Their functions include promoting research, analysing socioeconomic data and other marine fishery information and establishing a scientific basis for regulatory measures to conserve marine fishery resources. In 2021, platforms Global Fishing Watch (GFW) and Trygg Mat Tracking partnered with Senegal and Ghana, among other African nations, in a project to provide authorities with satellite tracking data and analysis (Global Fishing Watch, 2021). In 2022, Ghana announced a new National Integrated Maritime Strategy, developed with support from the Centre for Maritime Law and Security and the United Nations Office on Drugs and Crime (UNODC) with funding from Denmark (Africa Defense Forum, 2022). Ecuador also has an agreement in place to share data with GFW (Global Fishing Watch, 2023a).

This study focuses on the companies operating in five countries vulnerable to IUU fishing and overfishing – Senegal, Ghana, Peru, Ecuador and the Philippines – asking fundamental questions about the scale, form and behaviour of the domestic and foreign DWF fleets. This investigation estimates potential economic losses derived from the presence of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices in the past (refer to Table 29).

The goal is to build a business case for policy and enforcement reform. We combine fisheries expertise, data, maps and deep learning tools to respond to these questions.

1.3 The challenges of tackling IUU fishing

Because of its illicit nature, IUU fishing is challenging to detect, estimate and mitigate. Weak governance and enforcement mean that

3 The vessel monitoring system (VMS) and automatic identification system (AIS) are two different methods used for monitoring fishing vessels. VMS's purpose is fisheries management and enforcement. It is mandatory for larger fishing vessels. VMS data is transmitted via satellite systems to fisheries authorities. Meanwhile, AIS was originally designed for collision avoidance and vessel safety in maritime traffic. It is compulsory for larger vessels, but not universally mandated for all fishing boats. Data transmission broadcasts information such as vessel identity, position, course and speed to nearby vessels and shore stations. AIS data is broadcast openly, allowing anyone with the right equipment to receive and analyses it. VMS data tends to be more regulated and controlled and is often restricted to fisheries authorities; AIS data, being more openly broadcasted, is accessible to a wider range of users. While VMS might provide more specific fishing-related information, AIS offers more vessel information that can still indicate fishing behaviour.

4 It is hard to prove fishing activity without more information (refer to annexes on the difference between presence versus fishing).

low-income countries are most at risk from widespread problems of IUU activities by DWF fleets. The absence of effective monitoring, combined with a fragmented legal framework in which requirements vary across nations and international waters, has allowed IUU fishing to function on a large scale (Welch et al., 2022). For example, enforcing the new programme to tackle IUU fishing across the 266,000 square kilometres of coastal waters of the Philippines is a massive task for authorities challenged by limited resources (Fabro, 2021).

Meanwhile, DWF vessels' capacity to fish non-stop and travel to remote areas plays a huge role in the depletion of the oceans. Looking at foreign vessels' adjacency – or legal presence within or in proximity to domestic fishing grounds and fish landing points – in West Africa, Belhabib and Le Billon (2022: 1) find that it is 'a characteristic of a third of licensed vessels with reported fishery-related offences in the region', 60% of which could be categorised as DWF fleets. In West Africa, vessel operators using legal cover to commit infractions were mainly linked to China and Spain (Belhabib and Le Billon, 2022: 1).

Despite improvements in some areas, 'real progress in addressing the critical threats of living aquatic resources has not been substantive' (UNCTAD, 2019). Often, regulations are insufficient to prevent foreign-driven overexploitation. Such regulations are motivated in part by the surplus rule, as dictated by UNCLOS, which offers foreign states access to a surplus of the allowable catch (UNCLOS, 2013) in exchange for support in local stock management, employment, entrepreneurship and food security (Gagern and van den Bergh, 2013). The surplus rule requires coastal states that do 'not have the capacity to harvest the entire allowable catch' to 'give other states access to the surplus of the allowable catch' (UNCLOS, 2013: Art. 62(2)). This can motivate coastal states to establish joint ventures between domestic companies and foreign interests. This behaviour can be detrimental to coastal communities, as it can generate market 'distortions', such as 'very low access fees, access to fish catch quotas and local subsidies, access to domestic landing infrastructures and local fish markets and lower fines for illegal fishing offences' (Belhabib and Le Billon, 2022: 2). This practice presents several challenges. For example, unfair but legal access agreements that allow foreign DWF fleets to operate in developing countries' EEZs can threaten the food security and livelihoods of the countries in question (Okafor-Yarwooda and Belhabib, 2020). 'Distant-water fishing' refers to vessels from one country operating in another country's EEZ or international waters, often in regions far from their home ports (Gutierrez et al., 2020).[5] Previously, fishing agreements between the European Union and West African countries targeted fragile fish stocks (Okafor-Yarwooda and Belhabib, 2020); however, the introduction of SMEFF authorisations is designed to provide transparency on EU external fishing activities (European Union, 2017).

Meanwhile, economic gains drive companies to exploit marine resources beyond sustainable limits and advanced fishing technologies enable larger catches with less effort, making it easier to engage in illegal fishing practices without detection. The European Union has acknowledged failing to control fish and fish products harvested by flag states engaging in IUU fishing practices entering the Union. A report by the European Court of Auditors admits that, although some

5 Refer to discussion in the annexes

improvements have been made, 'ensuring the legality of a product does not guarantee that it is sustainably sourced' and that the 'differences in the scope and quality of checks' by the different countries undermine the effectiveness of the measures in place (European Court of Auditors, 2022: 4).

Despite improvements in the capabilities of data analytics for monitoring and enforcement, a recent study concludes that more global fishing efforts in data quality and quantity are needed (Stäbler et al., 2022) since a vital element for addressing IUU fishing is to track the activity of all vessels at sea. Thus, IUU fishing remains one of the greatest threats to marine ecosystems.

The companies that engage in IUU fishing exploit corrupt or weak administrations and use defective management regimes, particularly in developing countries that lack the capacity and resources for effective monitoring, control and surveillance. IUU fishing is found in all types and dimensions of fisheries: it occurs both on the high seas and in national waters, concerns all stages of fish capture and processing and may be associated with organised crime (Witbooi et al., 2020). Many countries have inadequate resources for patrolling vessels and remote surveillance, leaving their EEZs susceptible to illegal operators.

IUU fishing can also undermine port and maritime security, as criminal elements may use similar trade routes, landing sites and vessels to traffic endangered species, weapons, migrants, drugs and other contraband (FAO, 2022d). Besides, illegal fishing is known to perpetuate conflict (refer to, for example, Glaser et al., 2019) and has been linked to human rights violations (Bray, 2000; FAO, 2001b; Minichiello, 2021). This complexity makes it even more challenging to tackle.

IUU fishing is part of an ill-defined legal area of activities. IUU fishing is sometimes considered as equal to criminal activity in the fisheries sector; for example, money laundering and tax havens (Blaha, 2018), document fraud, drug trafficking and money laundering (UNODC, 2017). Due to illegal fishing, developing countries lose billions of dollars in illicit money flows (Collyns, 2022). According to UNODC (2017: 12), 'Criminal activities in the fisheries sector are often regarded as synonymous with illegal fishing, which many States do not view or prosecute as criminal offences, but rather as a fisheries management concern, attracting low and usually administrative penalties'. Organised criminal organisations thus engage in fisheries crime with relative impunity due both to low risk and high profits and uncoordinated, ineffective domestic and cross-border law enforcement efforts (ibid.: 12).

Nonetheless, monitoring fishing activity at sea remains a challenge. Several issues hinder the development of AIS tools to their full potential. Gutierrez et al. (2018) identified obstacles such as the failure of developed countries and multilateral organisations to exploit these opportunities and produce a single, public global fisheries information tool; the limited size and insufficient quality of private initiatives' datasets; the lack of collaboration among private and public initiatives; alongside poor fisheries governance and rampant practices such as the use of flags of convenience (FoCs).

As such, intentional AIS disabling may or may not signal illegal activities. The utility of AIS as a monitoring tool is impeded by vessels intentionally turning off their AIS devices. Besides, AIS devices are not universally required, nor do vessels always need to keep them on. However, many DWF fishing vessels that are required by law to keep their AIS on still 'go dark', often for months (refer to, for example, Bunwaree, 2023).

Fishing vessels are sometimes exempted from AIS requirements because fishing locations are confidential (Marine Management Organisation, 2014). Vessels might also turn off their devices to avoid hostile interactions in waters prone to piracy (NeRF, 2002) and to avoid disclosing prime fishing grounds. However, disabling AIS devices can obscure illegal activities, such as unauthorised fishing activity in EEZs and MPAs or unauthorised trans-shipments, in which fish from fishing vessels are off-loaded to refrigerated cargo vessels at sea, along with fuel, services or labour. Welch et al. (2022) estimate that AIS disabling in commercial fisheries obscures up to 6% of vessel activity. 'Disabling hot spots were located near the EEZs of Argentina and West African nations and in the Northwest Pacific, all regions of IUU concern' (ibid.). Trans-shipment can reduce fisheries' operating costs by eliminating the need to call to port and allowing the catch to be transported more efficiently; yet, when poorly monitored, it can provide a means to launder illegally caught seafood into the market and, in some fisheries, has been linked to IUU fishing, forced labour and human trafficking (Daniels et al., 2016: 45). According to Welch et al. (2022), tuna purse seiners had the highest fraction of vessel activity obscured by disabling events (up to 21%), followed by squid jiggers (up to 7%) and drifting longlines and trawlers (both up to 5%). This also includes fishing in areas where vessels are not required to have AIS on board. For instance, piracy in the Indian Ocean allowed purse seiners to turn off AIS in high-risk areas, as the pirates allegedly used AIS to target vessels (Chase, 2023).[6] Challenges with AIS data include noise (AIS messages containing errors and incorrectly broadcast positions), spoofing (the use of an invalid number or that of another fishing vessel) and offsetting (broadcasting locations that are far away from a vessel's actual location) (Taconet et al., 2019).

Unintentional poor AIS reception also reduces the ability to monitor fleets. AIS reception varies because of several factors; for example, the density of vessels broadcasting AIS in an area, the type of AIS device used by the ship and the type of receiver (that is, satellite or terrestrial). Southeast Asia has the worst overall AIS reception, while other regions with poor satellite reception include East Asia (ibid.).

Besides, reflagging offers opportunities for opacity. There is a 'high likelihood of offence occurrence associated with the reflagging or "domestication" of foreign vessels' (Belhabib and Le Billon, 2022: 1). Belhabib and Le Billon (2022: 2) state that a critical issue is whether domestication and other forms of adjacency facilitate 'fisheries-related crimes'. These authors suggest that adjacency has two main consequences.

One is that adjacency enables a vessel with no record of previous fishing offences to fish illegally more easily as a result of adjacency-related conditions of access, control and rules and regulations (for example, more lax landing inspections and lower fines) and the other is that granting access to local fishing grounds and landing infrastructure to vessels with a prior

6 Since 1 January 2023, the Indian Ocean has been removed from the High-Risk Area for Piracy, as defined by shipping bodies BIMCO, International Chamber of Shipping (ICS), International Marine Contractors Association (IMCA), INTERCARGO, INTERTANKO and Oil Companies International Marine Forum (OCIMF).

record of illegal fishing results in a high risk of re-offence (for example, through legal presence within the host's EEZ) (ibid.: 2).

Another study by EJF estimated that Chinese beneficiaries owned at least 90% of the IUU trawlers in Ghana, contravening Ghanaian laws on foreign ownership (EJF Staff, 2018). There is a need for more transparency and accountability about access, offences and ownership of the fleets operating in Ghana and elsewhere (Gutierrez et al., 2020).

Second, fisheries subsidies continue to produce overcapacity in industrial fishing fleets, incentivise IUU fishing and promote the depletion of fish stocks. Total subsidies amount to $35 billion annually (European Commission, 2016; Sala et al., 2018) or 30 to 40% of all fish's value worldwide. The Global Ocean Commission has estimated that 60% of all fisheries subsidies encourage 'unsustainable, destructive and even illegal fishing practices' (Global Ocean Commission, 2016: 7). Industrial fishing fleets of growing capacity have exhausted fish stocks in the waters of advanced economies and are now fishing further afield, predominantly in low-income countries' waters (Pauly, 2008). Subsidies are driving not only global fleets but also domestic ones. For instance, in Ghana, government subsidies on fuel and engines, alongside other fishing gear and the licensing of foreign vessels as Ghanaian, have accelerated the development of the domestic sector, which has grown at an unsustainable rate (Abdullah, 2018). A report by Friends of Ocean Action, which refers to an EJF film focusing on Ghana, says that despite 'vast overcapacity and widespread illegal fishing', foreign corporations – primarily Chinese – with vessels flagged to Ghana in the trawling business are still able to benefit from subsidies (Friends of Ocean Action, 2020).[7] However, the Agreement on Subsidies and Countervailing Measures of the World Trade Organization provides a framework for using government subsidies and applying remedies to address subsidised trade with harmful commercial effects (WTO, 2023).[8]

There are contradictory signals. Senegal is among the best-performing countries for port state responsibility and Ghana is showing 'political will' and a good response to IUU fishing (IUU Fishing Index, 2021). The Government of Ghana stopped the saiko trade in late 2021, which is illegal under Ghanaian law. The saiko trade was a barter system whereby unwanted catch of industrial fishing vessels would be exchanged at sea for food and livestock brought by canoes; today, industrial vessels target species specifically for the saiko trade, distorting the local markets and industry and facilitating juvenile fish trade (Far Dwuma Nkɔdo, 2018). However, another EJF investigation says, 'instead of disappearing, the activity has only become more open' (EJF Staff, 2022b). As part of an investigation, EJF tracked large volumes of small pelagic species and juvenile demersal fish, placed them in cartons and sold them at the country's major industrial port for onward distribution across the country (EJF Staff, 2022a).

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7 Fisheries on the Brink (EJF Staff, 2020) (https://player.vimeo.com/video/462717055)

8 At the time of writing, there were ongoing negotiations among WTO members regarding fisheries subsidies, aiming to address issues of overcapacity and overfishing caused by subsidies and aligning with the Sustainable Development Goals. The current phase focuses on a draft text proposed by the Chair of the talks before the next WTO Ministerial Conference in February 2024. There is a push from countries like India to offer support for the fishing interests of less developed countries at WTO

1.4 Why this report?

The big picture of DWF, overfishing and IUU fishing remains unclear. Even if they are starting to deliver some intelligence and results, big data analytics and remote surveillance have yet to live up to the promise. Through an extensive census of fishing vessels and based on AIS satellite data analysis, this study of some of the most critical EEZs in the world allows comparisons to determine patterns and dissimilarities for policy-makers and civil society organisations to generate awareness and act.

The lack of precise information on how fishing vessels behave is challenging. First, no unique global DWF vessel registry exists, including of holding companies and immediate subsidiary owners. That means nobody knows the number of DWF vessels or where they operate. This report offers a landscape view of ten fleets (the domestic and foreign fleets in each of the five EEZs under study).

Second, many international, regional and national policies have been put in place to reduce IUU fishing without lowering it significantly. For example, indicator 14.6.1 of Sustainable Development Goal 14, 'Life Below Water', was devoted to gauging achievements towards eliminating IUU fishing by 2020. The PSMA, the first binding international agreement to target IUU fishing, entered into force on 5 June 2016 (FAO, 2019). The last wide-ranging account on IUU fishing was published over a decade ago (refer to Agnew et al., 2009). Although there are relevant case studies (for example, Doumbouya et al., 2017; Blaha 2018; Gutierrez et al., 2020), there are no updated estimates of IUU fishing and no standardised methodology to generate across-the-board volumes and values for IUU fish catches[9]. At the same time, circumstances, regulation, monitoring and enforcement capacity vary from country to country.

Third, opaque bilateral agreements and licensing practices remain an obstacle to sustainability. While there are international agreements and organisations, such as UNCLOS and RFMOs, enforcing these agreements can be challenging due to weak compliance mechanisms and limited legal authority. Overcapacity in the fishing industry can increase pressure on fish stocks and make IUU fishing more attractive to those unable to secure legal fishing licences or quotas. Big industrial IUU fishing vessels have access to advanced technology, making evading detection easier. For instance, they may use satellite technology to track fish schools or employ tactics that make them harder to identify. Many agreements governing DWF in developing countries' waters are framed in terms of economic development (Gutierrez et al., 2020). Vessels gain access to marine resources in exchange for investment, industrial development, jobs and the generation of exports (Dahir, 2018). Deals may see more catch licensed than stocks can stand, while local fishers lose income and governments can lose tax revenue if landings are not appropriately measured (Clover, 2016). Reflagging is also an issue; fragmented and opaque ownership, joint venture operations, secret bilateral agreements and reflagging of vessels challenge the ability to monitor the position and activities of all DWF fleets.

Developing countries can lose revenue and opportunities when foreign companies that operate in their waters engage in tax avoidance, overfish, benefit from unfair subsidies, under-report their catch or work under FoCs.

9 FAO is currently working on this.

This is a loss of opportunity or the cost of continuing with one course of action instead of implementing a more viable or lucrative alternative. Here, we first examine, describe and categorise each of the five EEZs to reveal the scale, form and behaviour of the domestic and foreign fleets operating within the EEZs of Ecuador, Peru, Senegal, Ghana and the Philippines. More specifically, we also examine which are the most prominent DWF foreign fleets. Then, we identify the companies owning or operating vessels in these countries' waters that have been involved in irregularities, transgressions or wrongdoing in the past. The report's Part II estimates the impact of companies previously engaged in wrongdoing – from lack of transparency to incidental fishing (refer to Box 2) – on the five countries' economies, jobs and well-being. This is not to say that all the vessels included in the estimations are IUU vessels or that any substantial violation has been committed in the study period by any of these companies. However, this exercise offers a detailed view of the economic impacts derived from these companies' activity to build a business case for policy and enforcement reform.[10]

Despite limitations, this report fills crucial knowledge gaps about the scale, form and behaviour of the domestic and foreign fleets operating within the exclusive economic zones of Ecuador, Peru, Senegal, Ghana and the Philippines, offering a detailed view of the most prominent foreign fleets and the companies owning and operating them in these waters. The analysis examines the domestic or foreign companies owning or operating vessels in these countries' waters, ascertains which have been involved in wrongdoing, irregularities or unsustainable behaviour in the past and identifies what kind of activities they have been engaged in.

Finally, the study estimates the economic impacts derived from the activity of companies with a track record of wrongdoing, transgressions or unsustainable behaviour. Importantly, it looks at the opportunity costs in terms of GDP loss, employment loss and poverty impacts. The report also provides an open-access data repository, including deep learning algorithms and an extensive method guide (refer to annexes) to enable government agencies, specialised organisations and fishing communities or associations to replicate and scale up the data analysis to identify patterns in DWF vessels' behaviour in the EEZs of other countries or regions.

The report is structured in three main parts. Part I analyses 10 fleets (one domestic and one foreign fleet per EEZ), describing and comparing them to find commonalities and challenges between the fleets, their behaviour and their owners and operators. Part II estimates the opportunity costs in economic terms represented by companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29) based on the first analysis. Each offers a detailed methodological chapter, along with findings and conclusions. Both are brought together in the recommendations in Part III.

10 The specific method for this estimation is detailed in Chapter 7 of this report

2 Methodology: Analysing fleets in the EEZs of Ecuador, Peru, Senegal, Ghana and the Philippines

This study's methodology combines the innovative use of a massive vessel registry, a relational database, algorithms, geographic information systems (GIS) and data analysis. This methodology builds on our previous work (Daniels et al., 2016: 45; Gutierrez et al., 2018; Gutierrez et al., 2020). This chapter outlines the research questions, tools and methods and the methodological phases.

2.1 Research questions

The analysis responds to three main questions:

- **RQ1:** What is the scale, form and behaviour of the domestic and foreign fleets operating within the exclusive economic zones of Ecuador, Peru, Senegal, Ghana and the Philippines? Which are the most prominent foreign fleets in these waters?
- **RQ2:** Which are the domestic or foreign companies owning or operating vessels in these countries' waters? Which of them have been involved in any wrongdoing, irregularities or unsustainable behaviour in the past?
- **RQ3:** What estimated economic impacts could be derived from the activity of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices?

The goal is to build a business case for policy and enforcement reform. We combine fisheries expertise, data, maps and deep learning tools to answer these questions.

The research questions help structure the report. Part I addresses RQ1 and RQ2 (Chapters 2 to 5, inclusive), while Part II tackles RQ3 (Chapters 6 to 8). Part III offers recommendations derived from the joint analysis, followed by the references list and the annexes.

2.2 Methods and tools

Relational database

To build a relational database, we employed expertise in fisheries, specialised literature and the FishSpektrum Krakken® V15.0 high-granularity data registry.[11] Krakken® V15.0 is the largest registry of fishing vessels, owned by the Seattle-based Allen Institute for AI (a non-profit research institute founded by Microsoft co-founder Paul Allen). Krakken® V15.0 has been built manually since 2008, by fishing experts gathering and categorising data from public and official records. These include 48 class societies (from the American Bureau of Shipping to the Vietnam Shipping Register); 25 fishing fleet registries (from the European Community Fishing Fleet Register to Iceland's Kvótamarkaðurinn Ehf); 18 ship registries

11 'Granularity' refers to the level of detail or resolution at which data is stored and analysed. It determines the *grain* of data, which is the smallest unit of data that can be accessed, therefore affecting the level of detail in reporting, analysis and decision-making processes.

(from the Australian Maritime Safety Authority to the International Maritime Organization (IMO) Global Integrated Shipping Information System); 8 radio licensing bodies (from Brazil's Agência Nacional de Telecomunicações to the US Federal Communications Commission Universal Licensing System Database), as well as FAO's Fishing Vessel Finder, among many other public, official sources of information on fishing vessels. None of Krakken® V15.0's sources are proprietary (for example, Lloyds). The annexes include the list of original sources (consisting of 229 unique sources). The data for this study was extracted from the final update made on 31 January 2023.

Our relational database – which stores and provides access to data points related to one another – was built on Krakken® V15.0. A relational database was assembled on the relational model of data, which is equipped with the option of using SQL (structured query language) for interrogating and updating the database. This database was the basis for the data analysis in all the tables of Chapter 3 entitled 'Main findings of the fleet data analysis' in this report. Namely, the source of the tables' data was, ultimately, Krakken® V15.0. This registry has been a successful basis for previous analyses, including Daniels et al. (2016: 45), Gutierrez et al. (2018), Gutierrez et al. (2020).

Although the classification of a fish reefer as a fishing vessel can be nuanced, we included them in the study because they can participate in a fishing manoeuvre called fish trans-shipment, where a fishing vessel transfers fish onto a reefer for processing, deep-freezing and transporting (Daniels et al., 2016: 45). A fish reefer is primarily designed for transporting fish or seafood in a temperature-controlled environment to maintain their freshness and to preserve and deliver the catch, rather than for catching fish (ibid.).

Data analysis and timeframe

The database underpins the data analysis, which integrates algorithmic computing and GIS maps to answer the research questions.

To identify the domestic fleets, we requested all the vessels flagged to Ecuador, Peru, Senegal, Ghana and the Philippines from the database, supported by Krakken® V15.0. Meanwhile, to identify the foreign fleets present in the five EEZs under study, we acquired the satellite data of all vessels located in the five EEZs from 1 July 2021 to 30 June 2022, from the satellite data provider ORBCOMM. ORBCOMM is a provider of satellite data and other services designed to track, monitor and control fixed and mobile objects. ORBCOMM offers satellite-based services and caters to maritime tracking using satellite technology. All the maps in the report have been generated based on ORBCOMM AIS data.

The timeframe – 1 July 2021 to 30 June 2022 – includes the most recent data available at this project's outset. This means we used historical AIS ship tracking data to determine vessel presence and observe fishing behaviour using deep learning algorithms. We understand the situation may have changed since the satellite data was captured.

Again, the vessels' presence and identification lead to their owners or operators using Krakken® V15.0 as a source of information and the database as a tool to make queries. We combined the database and cross-referenced the data with open registries, such as the Panama Papers and the information we identified as being relevant to this investigation from the literature review. This included documentation relative to previous wrongdoing or irregularities by owners or operators of the vessels that were either part of the domestic fleets or of the foreign vessels present in any of the EEZs.

We know that flags, owners and operators have different levels of responsibility when a vessel indulges in wrongdoing. Our investigation distinguished between a) flag and b) owner/operator. We considered flags because they are relevant issues for this analysis (for example, when a domestic vessel is operated or owned by a foreign firm). However, we did not disaggregate the information to determine whether a company was the vessel's owner or operator because the investigation's goal is not to determine whose responsibility it is when a company has blacklisted vessels or is implicated in wrongdoing or involved in unsustainable practices. Of the 68,729 vessels in the database we generated for this study – containing both domestic and foreign fleets – 30,794 had the same owner and operator (or 40.80%).

Deep learning algorithms

Deep learning is now ubiquitous in data-driven research. We used convolutional neural networks (CNNs) (Li et al., 2021), commonly used for image classification, to create a classifier for fishing manoeuvres using AIS data. The strength of our CNN network lies in its ability to classify streams of AIS data points collectively rather than evaluating each data point in isolation. To classify a specific AIS data point as part of a fishing manoeuvre, it is essential to consider its context, including the information from previous and subsequent AIS data points. To train the CNN networks, fishing manoeuvres are initially labelled based on expert knowledge, allowing the algorithms to detect patterns in the location data in a supervised manner. Additionally, other manually detected manoeuvres are employed to validate the methodology.

Some devices – such as buoys or nets (refer to Box 1) – can also emit satellite AIS data; however, we did not include this data in the study because estimating its impact fell beyond the study's scope.

Geographic information systems

GIS is a computer system for capturing, storing, checking and displaying data related to positions on the Earth's surface. We used GIS software to visualise AIS data and identify fishing manoeuvres according to location and movement patterns.

2.3 Methodological phases

The methodology entailed the following steps:

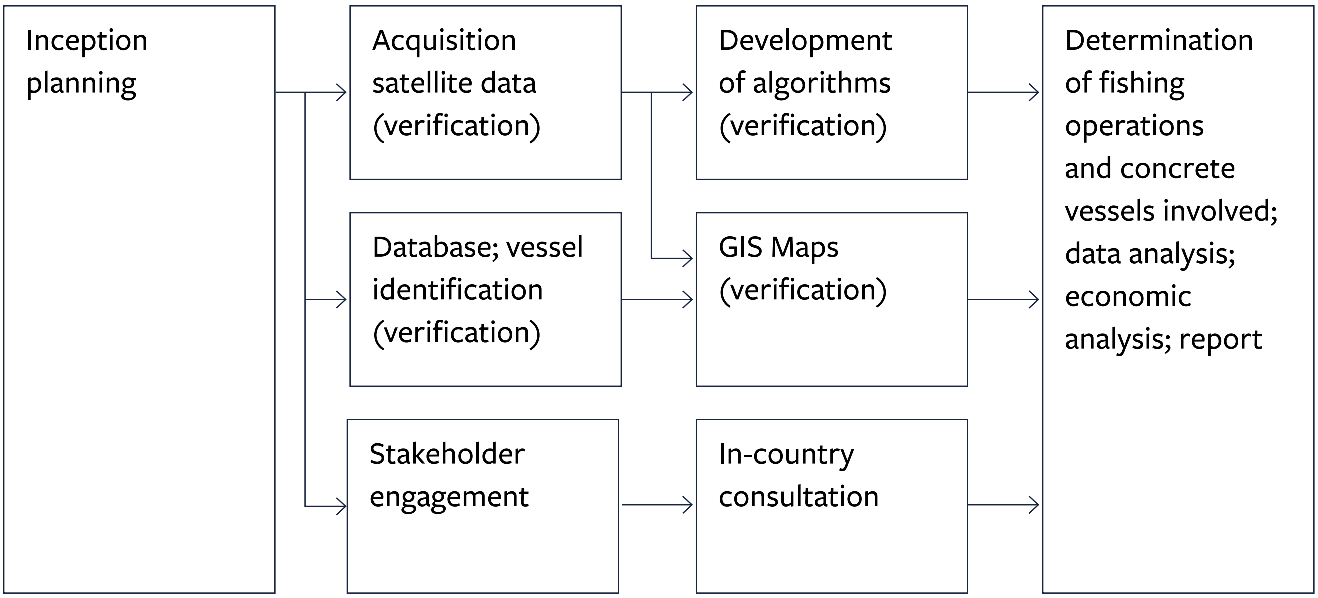
- Acquisition of tracking satellite data of all the vessels operating in the EEZs for the study period (one year) from ORBCOMM. The objective was to obtain a dataset of AIS positions filtered by EEZ and period.
- Extraction of data from the FishSpektrum Krakken® V15.0 registry on all possible DWF vessels spotted in the EEZs and all vessels flagged to the five countries under study to set up a relational database.
- Identification of the fleets and companies present in the EEZs for the period of study.
- Verification by crosschecking vessel data in the EEZs with Krakken® V15.0 to investigate unidentified vessels and remove duplication.
- Online in-country consultation workshops with stakeholders to contextualise the analysis. In-country experts, policy-makers and other stakeholders were invited to join the four two-hour online workshops to integrate their perspectives into the analysis before and

during the study. We conducted workshops with stakeholders on 30 and 31 August 2022 and 20 and 21 September 2023 and exchanged contact information with them so they could be in contact. The draft report was sent to 33 stakeholders in the five countries for feedback.

- Visualisation: Using AIS data on the vessels in our database, we visualised the positions and behaviour of fishing vessels using GIS software according to their location and movement patterns.
- Development and training of algorithms with AIS data. This included labelling AIS positions for many vessels for each type of fishing manoeuvre and evaluating the model architecture.
- Determination of fishing operations: Using the models, we determined the number, intensity and type of fishing manoeuvres in the EEZs for the study period.
- Analysis of the data combining all the sources of data (that is, the database, expertise, literature, country-level analysis and algorithmic analysis).
- Economic analysis for each country case study, which involved analysis of the economic impacts of the companies' activity in each country.

A simplified diagram to outline the main steps can be seen in Figure 1.

Figure 1 Investigation phases



Source: Elaborated by the authors

Our approach was also based on human expertise and the accuracy and completeness of the information we worked with versus reliance solely on algorithms. This approach has limitations, but we understand its advantages outshine its constraints for effective policy-making and enforcement. For instance, fish trans-shipments and squid jigging can look similar. In both cases, vessels must remain stationary despite the influence of sea currents, which AIS data can detect. The vessels involved in these manoeuvres typically stay still because fish trans-shipment involves the complex manoeuvre of transferring cargo between two boats at high sea. At the same time, squid jigging involves dropping fishing lines vertically to avoid dragging the bait. However, not every vessel can engage in trans-shipments or squid jigging because they require specific gear. Krakken® offers intelligence that helps differentiate between these manoeuvres. Combining algorithms and relying on a comprehensive database eliminates uncertainties when examining vessel characteristics, ensuring accurate manoeuvre identification.

2.4 Limitations

Three methodological limitations were connected to the deep learning models and datasets employed in this report.

Inferred fishing activity from AIS data was based on deep learning models that analyse how vessels behave and these models are less accurate than most VMSs. While AIS was designed as a collision avoidance tool and is required for vessels over a specific size by international law and some smaller vessels by national regulation, VMS is a bespoke fisheries management system regulated at the national and regional levels. Models are only as good as the data used to train them and mistakes and biases in training datasets can lead to misclassification of fishing types. We implemented rigorous data cleaning and pre-processing techniques to compensate for the gaps and noise in the AIS data. Additionally, we divided the dataset into distinct training and testing sets to prevent overfitting to the training data. This approach ensured that our models maintained generalisability and robustness when classifying fishing activities in real-world scenarios.

Even if the models are accurate, data quantity and quality can affect the results of algorithmic processes. The lack of quality data often hampers the estimation of fishing activity. This can be explained as follows: a) AIS signals have a limited range; if a vessel is operating beyond this range, its signals may not be registered; b) physical obstructions, such as other vessels in some parts of the ocean with high vessel traffic, can block AIS signals; c) weak or degraded AIS signals may not be strong enough to be reliably captured by satellites and AIS messages can interfere with one another; d) the satellite constellation we relied on (ORBCOMM) might have better coverage of certain regions than others; e) if a vessel's AIS transponder is malfunctioning, not correctly maintained, switched off intentionally or is broadcasting incorrect information, it will not transmit usable signals; f) satellite AIS systems capture AIS messages periodically; if a vessel is transmitting AIS messages at a low rate, there may be gaps in the coverage; g) the vessels in question were not required to emit AIS signals by regulation; h) some vessels broadcast AIS for only a small portion of the year; and i) the vessels exist, but were not present in any of the EEZs and, therefore, were not spotted by satellites (Windward 2014; de Souza et al., 2016; Taconet, et al., 2019).

Taconet and colleagues (2019) admit that 'AIS has some notable limitations' for monitoring fishing, as 'AIS is carried by only a small fraction of the world's roughly 2.8 million fishing vessels' and 'this fraction of vessels is not evenly distributed between regions, making it difficult to compare activity in different areas of the ocean' (ibid.: 2). Despite the frequency of these occurrences and considering that no AIS analysis will paint the whole picture, AIS data analysis has proved useful in identifying IUU, increasing transparency and offering scientific findings-based policy-making.

The deep learning algorithms utilise probabilistic statistics in various ways to model uncertainty, make predictions and enhance their learning capabilities. As the methodology indicates, we used deep learning algorithms to make sense of the satellite (big) data. Probabilistic statistics in deep learning provide a framework to understand uncertainty, make more informed decisions, handle this noisy data and improve the overall robustness and adaptability of the models so they can identify fishing manoeuvres. While digital and technological tools, along with statistical data, form the backbone of investigations like these, the crucial factor lies in the availability and representation of the data. The models employed in such investigations are trained with a wealth of global information to comprehend the intricacies of various fishing manoeuvres. However, the challenge arises when attempting to describe an entire fishing fleet. To accurately depict a fishing fleet, we need substantial data specific to that fleet. Unfortunately, in the cases analysed, the data available did not encompass a representative sample size for each fleet. As a result, extrapolating from a limited number of fishing manoeuvres to define an entire fishing fleet could lead to misleading conclusions. The limitation lies in the incomplete information available for these fleets. Without comprehensive and representative data for each fleet, relying on these algorithms to make broad generalisations becomes unreliable. Consequently, these algorithms were restricted to analysing the individual boats for which we possessed sufficient and comprehensive information. It is a matter of ensuring the data used is truly reflective and representative of the larger context, which was not true for all the vessels under scrutiny.

Regarding the data employed to describe and analyse the fisheries, we used the most recent datasets available at the time of writing. However, the Covid-19 pandemic impacted global fisheries, introducing a possible bias in the data related to DWF fleets' presence and fishing effort inside the EEZs during the period studied (from 1 July 2021 to 30 June 2022). Most of the RFMOs and regional fisheries advisory bodies (RFABs) that responded to an FAO survey expected Covid-19 to have negative consequences on the fisheries management, monitoring, control and surveillance of IUU fishing and the research (FAO, 2020b). According to this assessment (ibid.), 'RFABs reported that in capture fisheries, employment in the harvest sector will be most affected (64% of respondents)'. The impact of Covid-19 on fisheries varied across countries due to differing circumstances, policies and dependencies on the sector; however, the lockdown measures and other restrictions, the closure of borders and reduced exports and the disruption of supply chains impacted the fishing industry. As a result, this report's findings may be skewed due to the reduction of industrial fishing activity during and after Covid-19.

We selected the most prominent companies operating in the five EEZs for an in-depth examination of their wrongdoing or unsustainable practices and their impacts. This limitation means that, although we captured some of their wrongdoing, we may not have detected them all. This translates into a conservative estimation of the impacts on these five countries' economies, employment and well-being. Additionally, the different wrongdoing or irregularities captured in the report may lead to different outcomes. However, we did not aim at statistical representation but at highlighting the challenges these vulnerable EEZs face, estimating potential harms and building a case for reform.

3 Main findings of the fleet data analysis

In this chapter, we include the main findings of the fleet data analysis. Crucially, we look at the domestic and foreign fleets' scale, form and behaviour in the EEZs of Ecuador, Peru, Senegal, Ghana and the Philippines, along with the DWF foreign fleets present in these waters. This analysis forms the basis for the economic analysis of the impact of these fleets on the countries (Chapters 6 to 8).

3.1 The domestic and foreign fleets in the five EEZs: a global perspective

The sizes of the national fleets of Ecuador, Peru, Senegal, Ghana and the Philippines are not comparable; this study includes large fleets, such as the Ecuadorian and Peruvian fleets, which contain many artisanal boats, a medium-sized fleet, such as the Philippine fleet and the small national fleets of Ghana and Senegal, as well as the advanced DWF fleets of foreign origin that were spotted in these countries' EEZs in the study period.

Table 1 depicts the number of vessels connected to the five EEZs.[12] The second column shows the vessels flagged to any of the five countries under study identified in Krakken® V15.0. The third column shows the number of domestic vessels for whom we have AIS data indicating their presence in each EEZ. The fourth column includes all the foreign ships for whom we have AIS data indicating their presence in the EEZ.

Table 1 Domestic and foreign vessels per EEZ

EEZ	Total domestic vessels (flagged)	Total domestic vessels with AIS positions (flagged)	Total foreign vessels with AIS positions present in the EEZs
Ecuador	35,723	417	126
Peru	17,780	185	135
The Philippines	11,381	25	271
Ghana	1,265	34	95
Senegal	624	52	286

Source: Krakken® V15.0

As the methodological limitations show, the difference between the total vessels flagged to a national registry and those with AIS positions can be explained by numerous circumstances (Windward, 2014; de Souza et al., 2016; Taconet et al., 2019). Looking at how they behaved, we could identify the type of some of the vessels of unknown type (refer to Section 4.7.).

12 The data source for this table and the rest of the tables in this analytical section is the database supported by Krakken® V15.0, as well as the satellite data provided by ORBCOMM.

We consider the vessels with AIS positions indicating vessels' presence in the EEZs (columns three and four), although there could have been other vessels present for which we do not have AIS positions. In the case of Ecuador, the presence of a more extensive national fleet in the EEZ seems to align with a weaker foreign presence. In the Philippines, however, of about 10,000 unknown-type vessels, our database tracks Maritime Mobile Service Identity numbers (MMSIs) for only 13. Many vessels in the most extensive domestic fleets (in the Philippines) are probably artisanal or small vessels of limited capacity. These ships do not have MMSI numbers. Each AIS-equipped vessel transmits its MMSI number as part of its AIS data broadcast. We removed them from the study because we did not count on good enough AIS data to track down the vessels of unknown types. This has limited our capacity to match AIS positions with vessels that might belong to the Philippine domestic fleet. In Senegal and Ghana, a more detailed look at who owns and operates the national fleets shows that many of the companies listed as national are, rather, foreign firms. This will be discussed.

Despite the scarce AIS data, we detected fishing manoeuvres for 100 foreign vessels (from the 1,846 foreign vessels with MMSI identifiers in our database) across all EEZs. These manoeuvres include trawlers, seiners, longliners and squid jiggers. However, there are vast differences among the specific EEZs, as will be seen.

3.2 Ecuador's fleet and EEZ

Most of the vessels flagged to Ecuador are multipurpose ships (92.96%), which are dedicated to diverse seasonal activities, including non-fishing ones; the next most common type is the seiner (1.67%), typically targeting schooling pelagic fish of all sizes, followed by longliners.

The principal owners and operators of the national fleet include a couple of big companies with blacklisted vessels, implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29). Meanwhile, the foreign vessels operating in the Ecuadorian EEZ are mostly seiners (48.41%) and longliners (29.37%). Most of them are flagged to Spain (23.02%), Panama (19.84%) – a FoC –and Japan (10.32%); many of the foreign owners and operators are Colombian and Spanish. The Galapagos' rich surrounding waters attract national and foreign seiners and longliners.

A first glance at the types of vessels shows most of them are 'multipurpose'. Far behind are 'unknown', 'seiners', 'longliners' and 'fish carriers', among others.

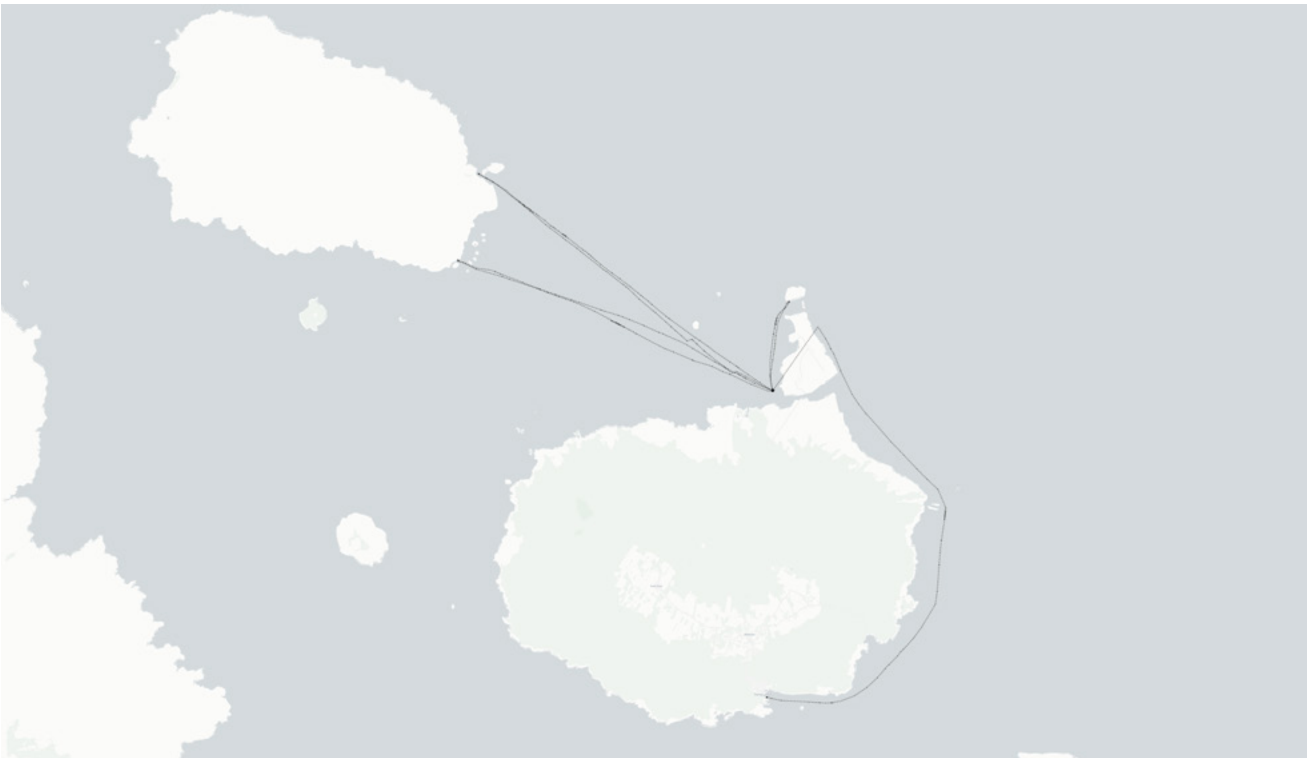
There is an over-representation of multipurpose vessels in Ecuador's national fleet. This category encompasses vessels that switch between different fishing gear throughout the season. Determining the expected behaviour of multipurpose vessels can be challenging; these vessels alternate between various fishing equipment and tactics throughout the season, making it impossible to train a model that accurately identifies their fishing manoeuvres when they occur. However, in our research on fishing manoeuvres, we utilised our pre-trained models to evaluate the performance of multipurpose vessels and compare them to the primary fishing types we have studied. In doing so, we observed behaviours that did not align with any anticipated fishing manoeuvre, resulting in sporadic false positives. Some of these multipurpose fishing boats exhibited no indication of functioning as fishing vessels throughout the study.

Table 2 Ecuadorian domestic vessels by type

Type	Total	Total %
Multipurpose	33,208	92.96
Unknown	605	1.69
Seiner	596	1.67
Longliner	444	1.24
Fish carrier	380	1.06
Shrimper	253	0.71
Pole and line vessel	111	0.31
Recreational	96	0.27
Gill netter	15	0.04
Trawler	8	0.02
Trap setter	4	0.01
Dredger	2	0.01
Squid jigger	1	0.00

Source: Elaborated by the authors based on Krakken® V15.0 data

Figure 2 A multipurpose vessel in Ecuador



Source: Elaborated by the authors based on ORBCOMM data

The vessel in Figure 2 does not behave exclusively as a fishing vessel; it goes back and forth from Puerto Villamil to Puerto Ayora, Galapagos, which does not correspond to any fishing manoeuvre. Our discussions with stakeholders confirmed that some multipurpose fishing boats change their fishing gear and engage in different economic activities, such as transporting goods and passengers.[13] These vessels are designed to be versatile; therefore, it is challenging to determine one sole activity. Thus, for fishing manoeuvre detection, we focused on four main fishing-related manoeuvres: longlining, trawling, purse seining and squid jigging (which we detected outside the EEZ).

Ecuador's marine fishing fleet is categorised into artisanal and industrial vessels. The artisanal fleet is largely made up of small-scale fishers who operate in the coastal regions. It is estimated that there are around 15,500 vessels engaged in several types of fishing (UNDP, 2023). The industrial fleet exhibits more diversity, with vessel types such as purse seiners, trawlers, longliners and gill netters. Ecuador's tuna fleet comprises around 115 large, mechanised ships (FAO, 2023). In line with these reports, without the multipurpose vessels, the most common type of fishing in the Ecuadorian fleet is seining, which typically targets schooling pelagic fish of all sizes, from small sardine to large tuna and squid. Seining involves using large nets, known as seines, to encircle schools of fish and then haul them on board a fishing vessel. The second most common type is longlining; many countries use drifting longlines to catch tuna, swordfish, sharks and other pelagic fish.

In any case, the number of seiners and longliners in Ecuador is massive, as this country has the most significant tuna fleet in the eastern Pacific region and one of the largest in the world (Collyns, 2021).

Due to a lack of access to information on many small, artisanal vessels, mainly operated by individuals, Krakken V15.0 offers data about the owner or operator on 1,453 vessels – or 4.07% of the Ecuadorian fleet. Not considering the data about the multipurpose vessels, we see that, although the percentages vary, there is a great degree of spreading in ownership and operation of the Ecuadorian fleet, as seen in Table 3.

Despite the lack of data, the list seems representative. The most prominent national flotilla in our list belongs to NIRSA (Negocios Industriales Real), one of Ecuador's largest fish exporters, which also processes and cans fish. In 2020, the company is said to have exported 29,500 tons of tuna to 32 countries, including Germany, the United Kingdom, Spain, France, Peru and Argentina (El Universo, 2021). Delipesca SA – NIRSA, the sixth most significant company on this list, is a subsidiary, making up a larger total flotilla of 32 vessels.[14]

13 We conducted two rounds of online workshops with stakeholders on 30 and 31 August 2022 and 20 and 21 September 2023 and shared with them our preliminary findings.

14 However, an official report lists only 12 tuna vessels for NIRSA and 7 tuna vessels for Delipesca (19 in total) (Instituto Público de Investigación de Acuicultura y Pesca, 2021), which shows a difference between official numbers and our list.

Table 3 Main Ecuadorian domestic vessel owners and operators (without multipurpose)[15]

Owner or operator	Total	Total %	Types
Negocios Industriales Real NIRSA SA	25	1.31	Seiner 92%, trawler 4%, gill netter 4%
Pesquera Centromar SA	13	0.68	Seiner 77%, gill netter 15%, pole and line vessel 8%
Empresa Pesquera Polar SA (RUC 09901)	9	0.47	Seiner 100%
Industria Ecuatoriana Productora Alimentos (INEPACA CA)	8	0.42	Seiner 88%, fish carrier 13%
Transmarina SA	7	0.37	Seiner 57%, longliner 43%
Delipesca SA – NIRSA	7	0.37	Seiner 100%
Pesdel SA	6	0.31	Seiner 100%
Elvayka Kyoei SA	6	0.31	Seiner 100%
Camarones del Mar Cobus SA	6	0.31	Shrimper 50%, trap setter 50%
Industrial Pesquera Junin SA (JUNSA)	5	0.26	Seiner 100%
Pesquera de Genna Fernandez PESCADEGFER CIA Co Ltda	5	0.26	Seiner 100%
Yagual Aguirre Alex Wladimir	5	0.26	Shrimper 100%
Panpesca del Ecuador	5	0.26	Shrimper 100%
Tunaexport SA	4	0.21	Seiner 100%
Globalpesca SA	4	0.21	Seiner 100%
Geopaxi SA (RUC 0992262427001)	4	0.21	Seiner 100%
Montero Estrada Edgar Isaac	4	0.21	Longliner 100%
Rivera Roche Jacinta G	4	0.21	Seiner 100%
Agrol SA	4	0.21	Longliner 75%, seiner 25%
Cevallos Mendoza Jose Temistocle	4	0.21	Seiner 100%

Source: Elaborated by the authors based on Krakken® V15.0 data

15 This table only includes the first 2020 companies by the number of vessels they control.

Box 1 Fish aggregating device residues

Fish, including tuna, cluster around floating structures; by deploying human-made structures known as fish aggregating devices (FADs), either anchored or drifting, fishers encourage fish to gather, which are then captured using purse seines, longlines or hooks, reducing the time spent searching for tuna (Pons et al., 2023). In recent decades, the number of drifting FADs in the ocean has surged, partly aided by low-cost satellite-tracking buoys that allow fishers to monitor the devices. The buoy can emit information about the number and size of fish gathered and the generation of marine litter (ibid.)

A recent report calls on UK retailers to stop selling tropical tuna caught around drifting FADs in the Indian Ocean (Rattle, 2023). One of the arguments is that juvenile fish tend to group together for safety below these floating objects, 'making it easy for purse seiners to catch them before they have had a chance to reproduce' (ibid. 5). Other endangered, threatened or protected species (such as silky sharks) also can fall victim to drifting FADs (ibid.). In some regions, the retrieval rate of drifting FADs is less than 10%, 'leaving tens of thousands of them to sink and litter the seabed or wash up on the coastlines' (ibid.: 5). Because of the low retrieval rate, ghost-fishing – when discarded fishing gear continues to fish – has also become a huge issue. Although initially the use of FADs generates a temporary increase in catches, over time the numbers drop down (Vega Granja, 2022).

These devices are employed by both domestic and foreign fleets in Ecuador (Hammond, 2021). Another report by the Earth Journalism Network indicates that FADs are being used in the Galapagos (ibid.). FADs are then dragged into the protected sea by the Humboldt Current when they are launched at the southeast of the Galapagos Marine Reserve, catching tuna and protected species such as sharks (ibid.). FADs are also causing accidents (ibid.). Coastal clean-ups in the Galapagos from 2017 have removed around 80 tons of garbage, including FAD residues (ibid.). FADs in Ecuador have begun to be managed and regulated (Nemitz, 2023).

A recent report by Bloom Association indicates that a growing number of vessels using FADs has been certified by the Marine Stewardship Council (MSC) – a not-for-profit certification organisation – as sustainable (Bloom Africa, 2023; Dasgupta, 2023). The MSC has pushed back on some of the report (*The Fishing Daily*, 2023).

Some of these companies have had issues in the past. Apart from the questionable employment of FADs (refer to Box 1),[16] a 'N.I.R.S.A. (CORPREALSA, PROSORJA, COMPAÑÍA AGRÍCOLA GANADERA, REALVEG, CALADEMAR)' is listed in the Panama Papers

16 The use of FADs is questionable, especially for pole and lining. FAD fisheries can be sustainable if managed correctly and the devices are retrieved systematically, but can also be very damaging when not controlled, as seen in Box 1.

among the firms whose members are registered in tax havens (CENAE, 2019: 2). The Panama Papers investigation itemises financial and attorney-client information for thousands of offshore entities set up mainly to avoid scrutiny and paying taxes. In 2007, NIRSA and the Spanish companies Albacora, Calvopesca and Conservas Garavilla were denounced in Spain for selling tuna that had been illegally captured in the Pacific (Greenpeace, 2007).

Meanwhile, Empresa Pesquera Polar – registered in Ecuador – was fined in a Peruvian port for having unloaded from the fishing vessel Polar 1 (Co-14443 – PM) without the presence of an inspector, in violation of Peruvian regulation (gob.pe, 2023). This firm also generated a social and environmental conflict in Salango, a small coastal village southwest of Quito (Roux, 2013). In 1980, Empresa Pesquera Polar built a fish meal industrial plant above an archaeological site on Salango beach (ibid.); this continues to be resisted by local communities (Betancourt Medranda, 2017).

This fleet also shows a degree of internationalisation, which is understood to be foreign companies owning or operating any of these companies. For instance, the second largest flotilla on the list belongs to Pesquera Centromar, which was acquired by Camanchaca (Chile) in 2006 and sold to a group of Peruvian investors led by the Galleno family (Fish Information and Services, 2012).

As is the case for the domestic fleet (except for multipurpose vessels) the most common type of foreign vessel in the Ecuadorian EEZ is the 'seiner' (61), making up almost half the entire foreign fleet, followed by 'longliner' (37), among others, as detailed in Table 4.

As for vessel ownership, Krakken V15.0 offers data about the owner or operator on 113 vessels (89.68%) of the 126 foreign vessels operating in the Ecuadorian EEZ.

Table 4 Foreign vessels in the Ecuadorian EEZ by type

Type	Total	Total %
Seiner	61	48.41
Longliner	37	29.37
Auxiliary	7	5.56
Unknown	7	5.56
Trawler	6	4.76
Squid jigger	3	2.38
Fish carrier	2	1.59
Gill netter	2	1.59
Recreational	1	0.79

Source: Elaborated by the authors based on Krakken® V15.0 data

Table 5 Main foreign vessel owners and operators in the Ecuadorian EEZ

Owner or operator	Total	Total %	Types	Address
Seatech International Inc	12	9.52	Seiner 100%	Colombia
Arrastre del Norte Pesqueros	2	1.59	Longliner 100%	Spain
Atunera Caribe SA (ATUNCASA)	2	1.59	Seiner 100%	Bolivia
Augusta Fisheries Corp (Lautaro) Co Ltd	2	1.59	Seiner 100%	Vanuatu
Chokyu Maru Gyogyo Bu Yugen Kaisha	2	1.59	Longliner 100%	Japan
Grupo Calvo – Uniocean SA	2	1.59	Seiner 100%	Spain
Overseas Tuna CO Naamloze Vennootschap	2	1.59	Seiner 100%	Curaçao
Pombo Co Ltd A	2	1.59	Gill netter 100%	Portugal
Adriatic Sea Fisheries Co Ltd	1	0.79	Seiner 100%	Cook Islands
Aitzugana SL	1	0.79	Seiner 100%	Spain
Albacora Sa (Grupo Albacora)	1	0.79	Seiner 100%	Spain
Alemar Pesqueros SL	1	0.79	Longliner 100%	Spain
America Tower I Corp	1	0.79	Seiner 100%	Belize
Antolin Perez Alonso	1	0.79	Longliner 100%	Spain
Areapesca SA	1	0.79	Longliner 100%	Spain
Armadora Cervera SL	1	0.79	Longliner 100%	Belize
Atlantex SP Z OO	1	0.79	Trawler 100%	Poland
Atlantic High Sea Fishing CO JSC	1	0.79	Trawler 100%	Lithuania
Atlantis Cruises LLC	1	0.79	Recreational 100%	USA
Atunera del Istmo SA	1	0.79	Seiner 100%	Panama

Note: This table only includes the first 2020 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

The biggest foreign company, Seatech Internacional Inc, from Colombia, controls almost 10% of the foreign vessels in this EEZ. Seatech International operates as a canned food manufacturing company, too. The company provides seafood processing, canning and wholesale distribution of tuna and other products, such as frozen, whole and pre-cooked tuna steaks. The other largest companies own only a few vessels, as detailed in Table 5, including Arrastre del Norte Pesqueros, from Spain; Atunera Caribe SA (ATUNCASA), from Venezuela; Augusta Fisheries Corp (Lautaro) Co Ltd, from Panama and Chokyu Maru Gyogyo Bu Yugen Kaisha, from Indonesia. Meanwhile, an 'Adriatic Sea Fisheries LTD' is listed in the Panama Papers as registered in The Bahamas (ICIJ, 2023). In Ecuador, Adriatic Sea Fisheries operates a seiner, Jeannine, flagged to Cook Islands, previously flagged to Kiribati (both FoCs).

Accordingly, the main flags of the foreign fleet in the Ecuadorian EEZ are Spanish, Panamanian, Japanese, Colombian and Venezuelan.

Table 6 Main flags present in the Ecuadorian EEZ

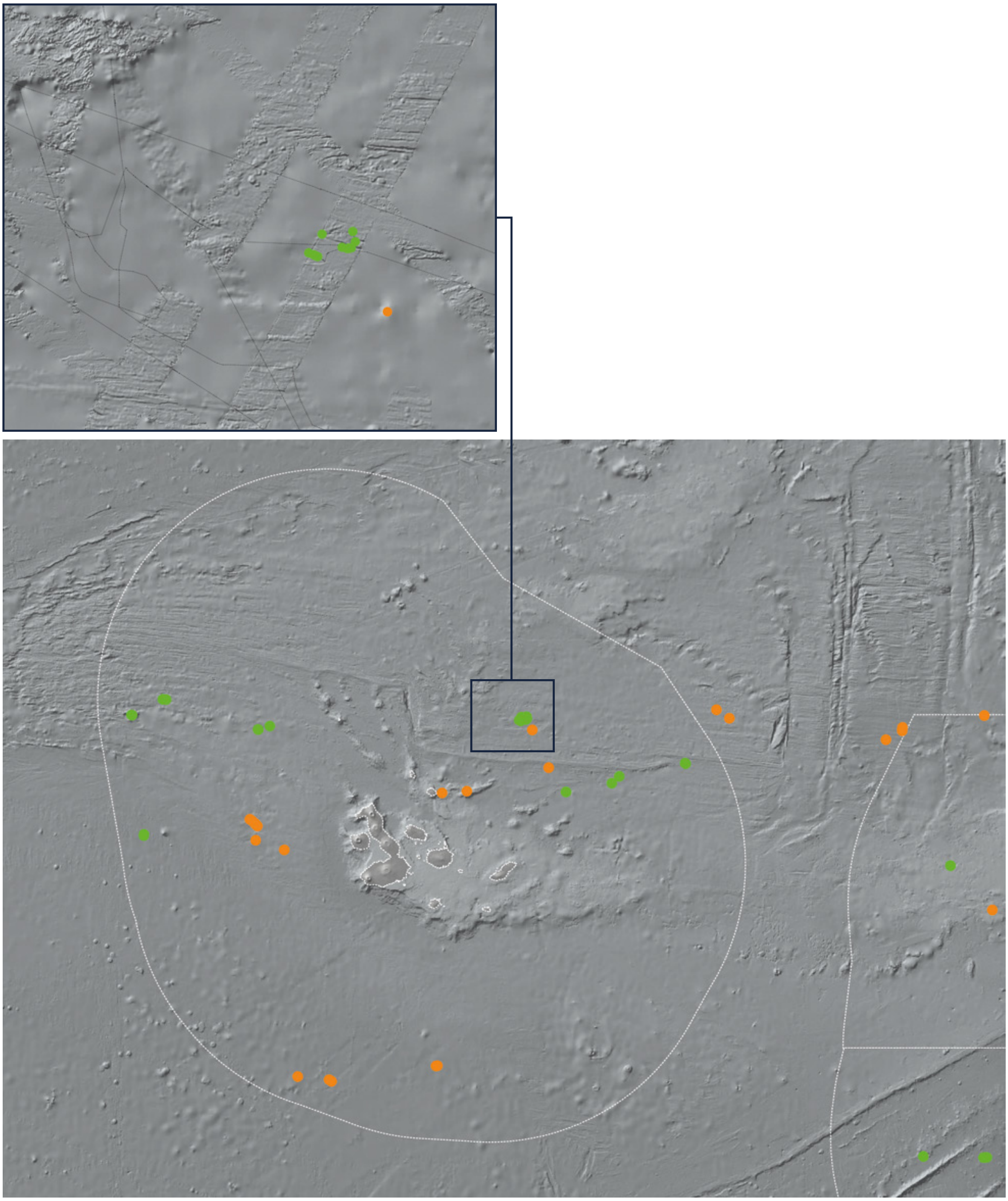
Flag	Total	Total %
Spain	29	23.02
Panama	25	19.84
Japan	13	10.32
Colombia	12	9.52
Venezuela (Bolivarian Republic of)	11	8.73
United States of America	8	6.35
Cook Islands	5	3.97
China	3	2.38
Liberia	3	2.38
Portugal	3	2.38
Curaçao	2	1.59
Mexico	2	1.59
Korea, Republic of	2	1.59

Note: The table does not include flags represented by just one vessel; therefore, percentages will not add up to 100. Source: Elaborated by the authors based on Krakken® V15.0 data

Not considering multipurpose vessels, the domestic and foreign fleets in this EEZ are dominated by seiners. Seining is mostly important for capturing tuna (yellowfin tuna and skipjack tuna). Seining is not limited to tuna; it also includes capturing other pelagic species, such as mackerel and bonito. However, several reports expose seining inside the Galapagos Marine Reserve. The Galapagos Marine Reserve is situated in the Pacific Ocean and located approximately 1,000 kilometres (620 miles) off the coast of Ecuador (about 0.5° S latitude and 90.5° W longitude). The Galapagos Marine Reserve is largely considered a 'no-take zone'. It bans almost all fishing activities within its boundaries, with limited exceptions for local artisanal fishing by licensed small-scale fishing (Moity, 2020). This designation aims to protect the area's unique and diverse marine life, including various endangered species. In 2021, apart from 115 Ecuadorian seiners, several other foreign vessels were spotted inside the marine reserve (Vega, 2021). Figure 3 shows foreign seiners' operations in the Galapagos. The green dots show positions involved in the seining manoeuvres of foreign vessels. In addition to the domestic fleet, foreign vessels also operate in Ecuadorian waters. For instance, a fleet of approximately 340 Chinese fishing vessels was observed just outside the Galapagos Islands in 2020 (Oceana, 2020). The Ecuadorian navy reported that nearly half of these vessels had intermittently switched off their satellite communications, violating the rules of the RFMO (ibid.). This illicit activity poses a significant challenge for Ecuador.

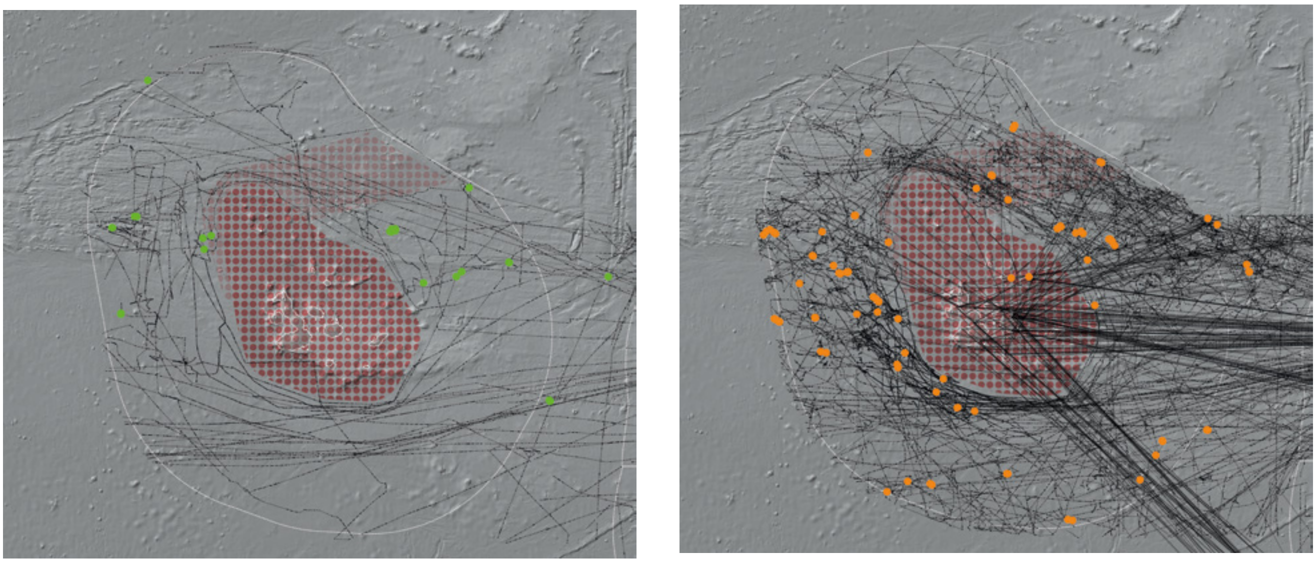
Based on the AIS database acquired for this research project and the manoeuvre detection models, we identify where and when domestic or foreign vessels were fishing. For example, Figure 3 also depicts a detailed image of a fishing manoeuvre performed in the northeastern part of the Galapagos EEZ (Ecuador) by Panamanian seiner Upar (IMO 7342304), owned by the Panamanian company Ingopesca, on 22 January 2022. Domestic seiner fishing activity is shown in orange; foreign seiner fishing activity is shown in green.

Figure 3 Foreign seiners (green) and domestic seiners (orange) in the Galapagos



Source: Elaborated by the authors based on ORBCOMM data

Figure 4 Foreign (left) and domestic (right) seining in the Galapagos

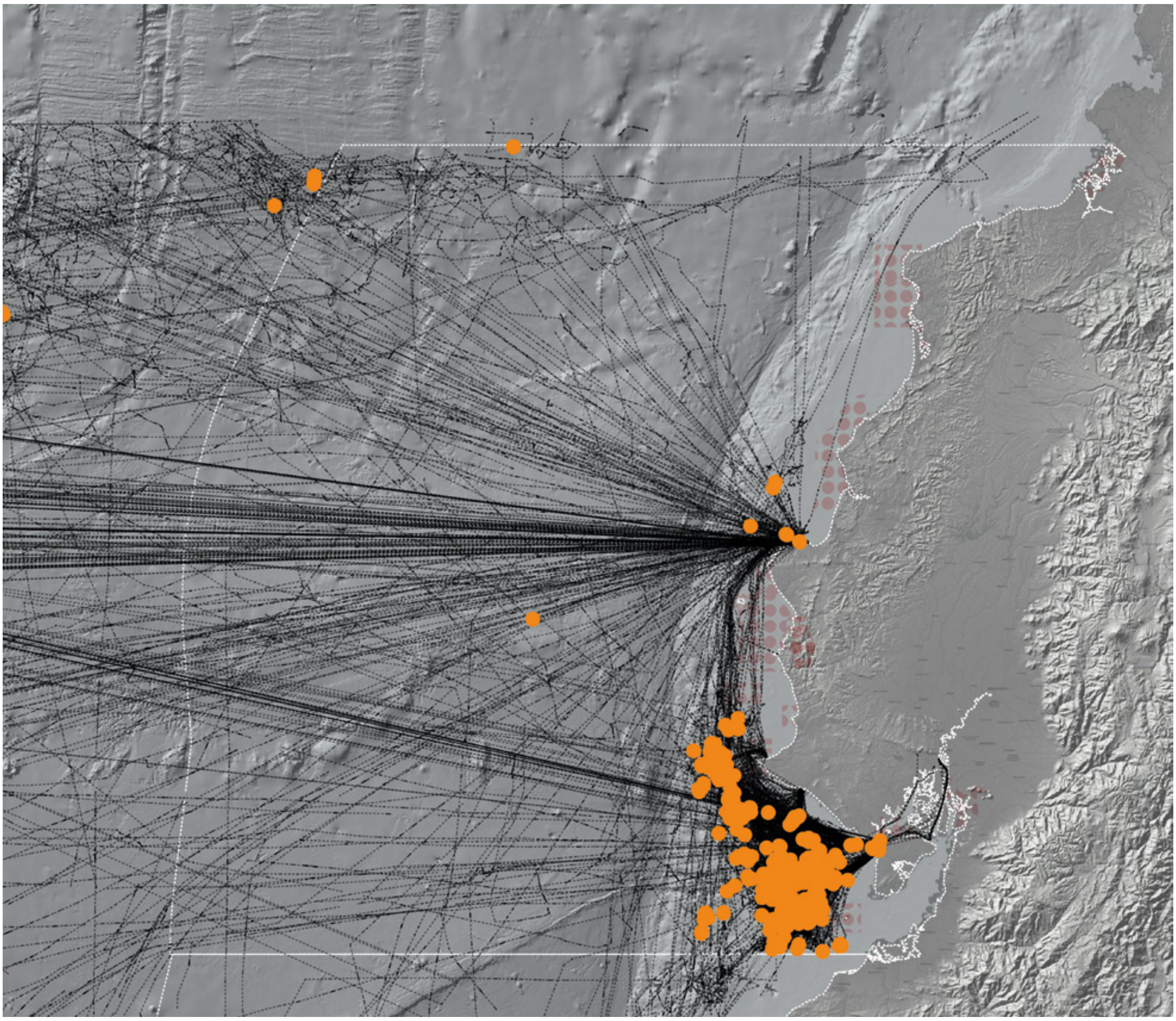


Source: Elaborated by the authors based on ORBCOMM data

Although Ecuadorian waters have long attracted foreign fishing vessels, this is not the complete story. The European Commission issued a 'yellow card' to Ecuador in 2019 based on 'serious shortcomings in the mechanisms that the country has put in place to ensure compliance with its international obligations as flag, port and market State' (European Commission, 2019a). The European Commission mentioned deficiencies in the Ecuadorian legal framework, inefficient law enforcement and deficits in the control over tuna fishing activity and the reliability of the traceability system (ibid.).

A general overview of fishing manoeuvres in the Galapagos is illustrated in Figure 4, where the left subfigure shows foreign seining manoeuvres and the right subfigure shows domestic seining manoeuvres. The red dots represent the MPAs. Foreign seiners behave much like domestic seiners around the Galapagos reserve. Figure 5 shows domestic seiners in orange. Ecuadorian seiners based in continental ports set out to fish in Galapagos, Peru and the northern corridor between the Galapagos and Ecuador. Figure 5 mainly shows seiner fishing activity in the southern part of the continental Ecuadorian EEZ, although there is also some seiner fishing activity in the northern part of the continental Ecuadorian EEZ and the corridor between the Galapagos and Ecuador.

Figure 5 Selected firms' fishing in Ecuador

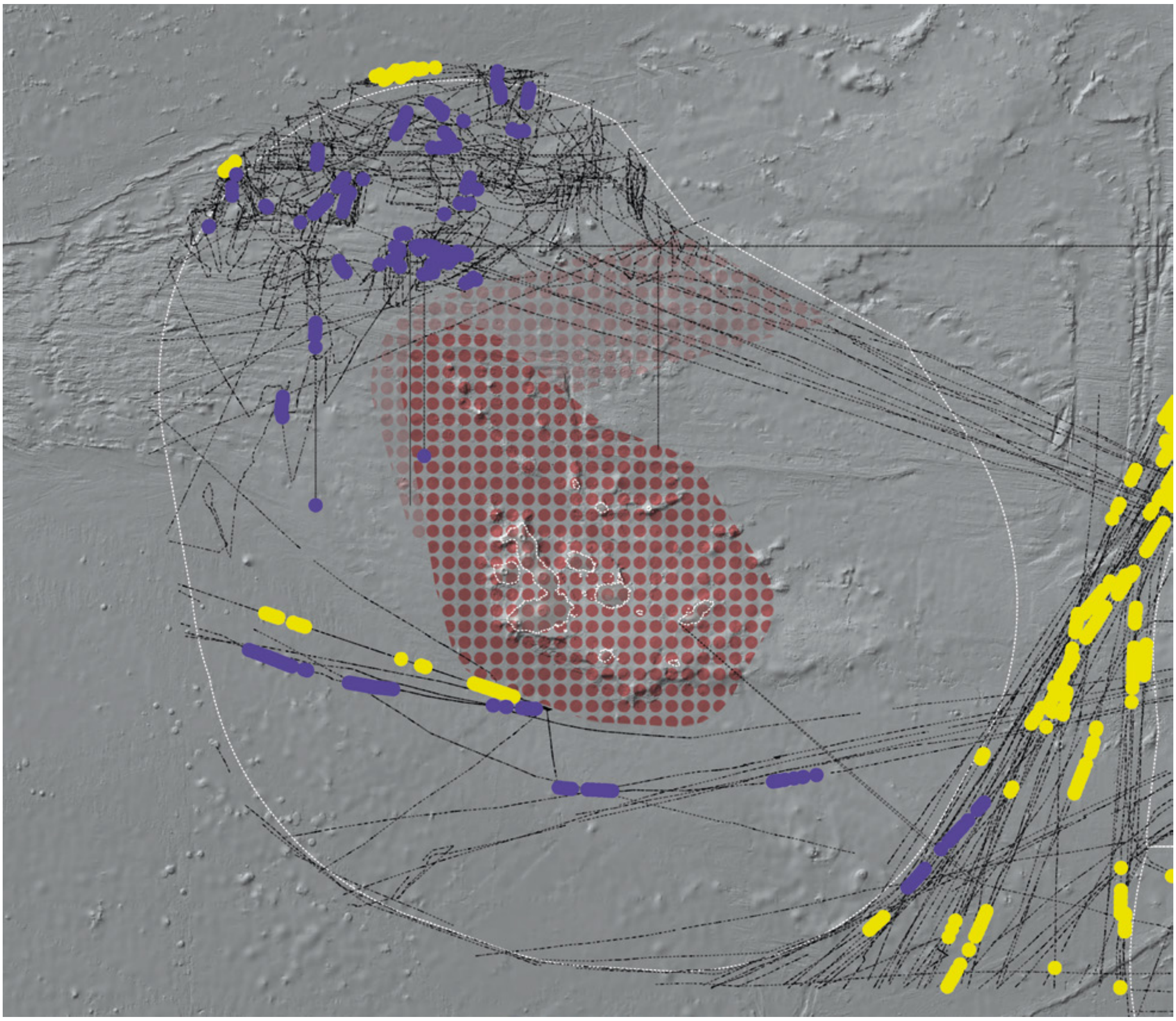


Source: Elaborated by the authors based on ORBCOMM data

Figure 6 shows longlining around the Galapagos (domestic and foreign): domestic longlining can be seen in purple, while foreign longlining is shown in yellow. The red dots represent fishing activity in the northern part of the EEZ, avoiding the marine protected area (MPA). We disregard the remaining detection in the southern half of the Galapagos EEZ and the corridor between Ecuador's EEZ as false positives.

Since 2018, 136 sizeable Ecuadorian fishing vessels have entered the Galapagos Islands' reserve (The Economist, 2020). In 2000, longline fishing was banned inside the Galapagos Marine Reserve to prevent illegal fishing of sharks and bycatch of endangered species (Moity, 2020). However, in May 2020, customs officials in Hong Kong impounded the largest illegal cargo of shark fins in the territory's history.

Figure 6 Longlining around the Galapagos (domestic and foreign)



Source: Elaborated by the authors based on ORBCOMM data

According to The Economist (2020), 'Officials found 24 tons of fins, most from endangered species such as thresher sharks, with a retail value of $1.1 million. They came from Ecuador.' Statistical and anecdotal evidence suggests the longline ban was ineffective (Castrejón and Defeo, 2023).

Nevertheless, the data in our study does not show longlining activity inside the reserve during the study period. After manually inspecting the model's fishing activity detections, we disregard them as false positives. During the workshops, the Ecuadorian stakeholders declared the situation had improved and there was some hope that the European Commission yellow card would be lifted. The Galapagos MPA is being expanded (Marine Conservation Institute, 2023); enlarging marine reserves creates an additional buffer between marine life and fishing fleets.

3.3 Peru's fleet and EEZ

Most vessels flagged to Peru are longliners (42.42%), commonly targeting swordfish, tuna, halibut and sablefish; gill netters (36.47%); and seiners (13.13%). The main owners and operators of the national fleet include companies with blacklisted vessels, implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29). As in the domestic fleet, the foreign vessels operating in the Peruvian EEZ are mostly longliners (39.26%), followed by seiners (34.07%) and squid jiggers (10.37%). However, seining activities by national and foreign vessels were the most detected fishing manoeuvres in this EEZ. Most of the foreign vessels are flagged to Spain (25.19%), Panama (14.81%) – a FoC – and China (11.11%), while many of the owners and operators are Chilean, Colombian, Chinese and Spanish. Some of these foreign companies have been involved in wrongdoing, irregularities or unsustainable behaviour.

Peru's national fleet's main fishing types are 'longliner', followed by 'gill netter' and 'seiner', among others, as seen in Table 7.

Krakken V15.0 presents data about the owner or operator of 17,311 vessels (97.37 %) of the 17,779 Peruvian vessels.

National ownership is less fragmented than in Ecuador, with Tecnológica de Alimentos SA (TASA) owning or operating a flotilla of 102 vessels dedicated to seining.

Table 7 Peruvian domestic vessels by type

Type	Total	Total %
Longliner	7,541	42.42
Gill netter	6,484	36.47
Seiner	2,334	13.13
Unknown	1,135	6.38
Trawler	243	1.37
Trap setter	21	0.12
Auxiliary	17	0.10
Whaler	5	0.03

Source: Elaborated by the authors based on Krakken® V15.0 data

As in the case of Ecuador, Peruvian firms have also experienced some issues. TASA has been investigated for catching illegal species in seining operations (incidental fishing) and incorporating them into fishmeal processing (refer to Box 2). According to industry standards, incidental fishing cannot exceed 5% of a vessel's total catch; this refers to the catch portion that was unintentionally caught but retained. Incidental catch should be distinguished from discards (accidental catch caught and then returned to the sea, mostly dead or dying) and bycatch (including all non-targeted species caught alongside the targeted species). Meanwhile, the third company on our list, Pesquera Exalmar SAA, is in a ranking published by Mongabay as owning the fishmeal processing plant with the most incidental catch landings in 2020 (Quevedo Castañeda, 2021). Of the companies in our list, TASA, Corporación Pesquera Inca, Pesquera Exalmar SAA, Pesquera Diamante SA, CFG Investments SAC, Pesquera Hayduk SA, Austral Group SAA, Pesquera Centinela SAC and Pesquera Cantabria SA appear in the investigation as companies exceeding their mackerel limitations (Quevedo Castañeda, 2021; Salazar Herrera, 2011).

Box 2 Incidental catch and fishmeal in Peru

Although in Peru it is not permitted to process species that are intended for human consumption (for example, mackerel) into fishmeal, over the years the Ministry of Production has relaxed sanctions, thus benefiting fishing companies that cross the line. In less than two years, for instance, Tecnológica de Alimentos SA (TASA), the first company in our list, processed species above the permitted limit on 425 occasions, but was only sanctioned once, according to an investigation by Mongabay, a prestigious conservation news website (Quevedo Castañeda, 2021). Mongabay reviewed the more than 27,000 landings carried out by TASA's vessels between 2016 and 2020, as well as the sanctions it received.

Every year, about 6 million tons of anchovy (Engraulis ringens) are converted into fishmeal, a product consumed by farmed animals in China, Japan, Vietnam, Germany and Taiwan, Province of China, among others. This production makes Peru the largest fishing power in Latin America and, globally, the main producer of fishmeal. However, fishing companies not only exceed the number of juvenile anchovy allowed, but also comprise illegal species captured in purse seining nets, including mackerel, hammerhead sharks, rays and manta rays (ibid.). TASA, Corporación Pesquera Inca, Pesquera Diamante SA, Pesquera Exalmar SAA, Austral Group SAA, Pesquera Hayduk SA, CFG Investments SAC, Pesquera Centinela SAC, among others in that order, were the biggest exporters of fishmeal in 2017 (Luna Amancio, 2017). The first four concentrate more than 70% of the fishmeal market (ibid.). Market concentration, opacity, meagre royalties and tax havens characterises this sector (Luna Amancio, 2017; Salazar Herrera, 2021).

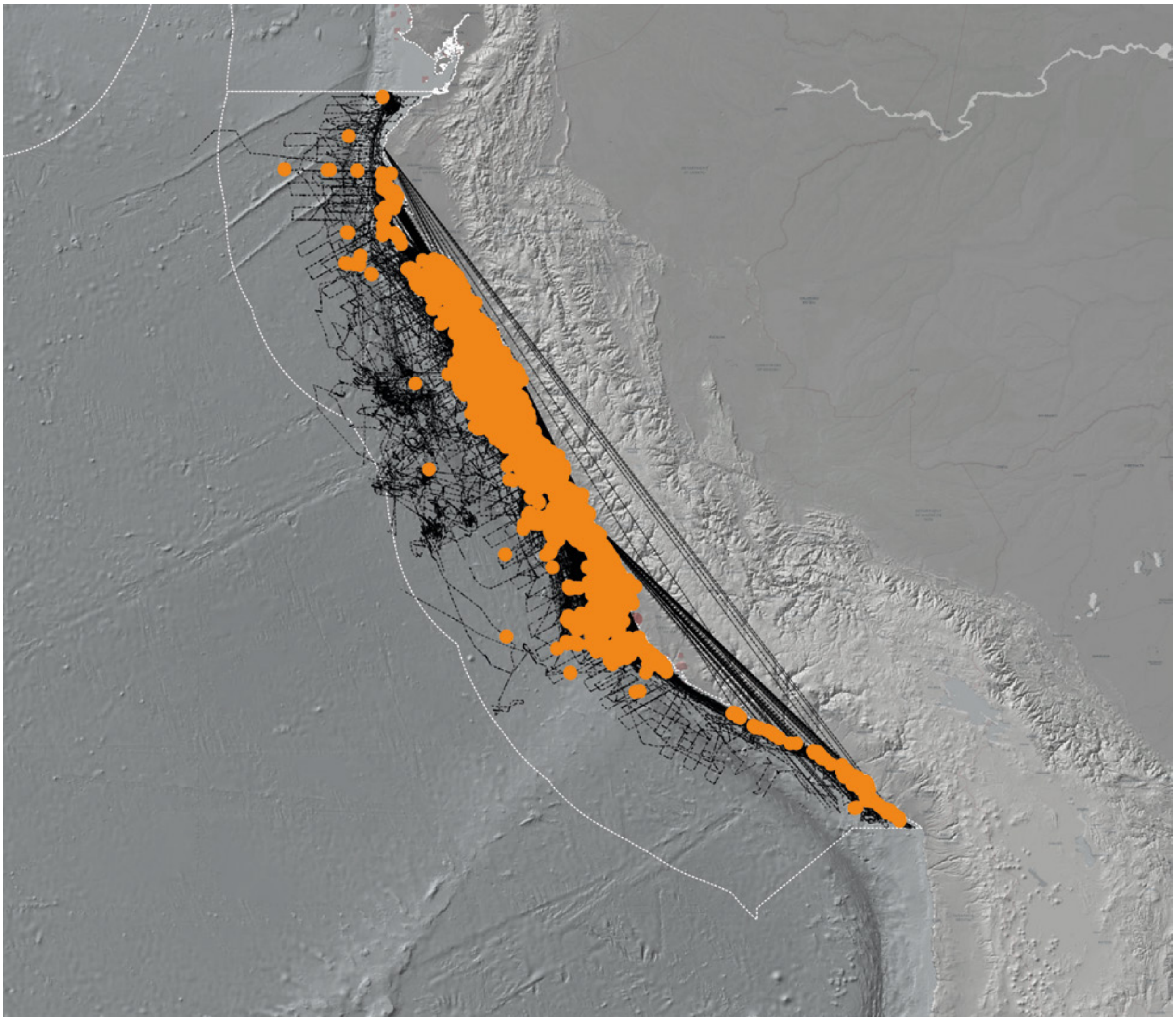
Table 8 Main Peruvian domestic vessel owners and operators

Owner or operator	Total	Total %	Types
Tecnológica de Alimentos SA (TASA) (RUC: 20137916437)	102	0.57	Seiner 100%
Corporacion Pesquera Inca SAC (SACOPEINCA) (RUC: 20224748711)	73	0.41	Trawler 1%, seiner 99%
Pesquera Exalmar SAA (RUC: 20380336384)	72	0.40	Seiner 100%
Pesquera Diamante SA (RUC: 20159473148)	55	0.31	Seiner 96%
CFG Investments SAC (RUC: 20512868046)	51	0.29	Trawler 4%, seiner 94%
Pesquera Hayduk SA (RUC: 20136165667)	44	0.25	Trawler 16%, seiner 84%
Austral Group SAA (RUC: 20338054115)	38	0.21	Trawler 3%, seiner 95%
Cristo de La Victoria SAC (RUC: 20547923953)	24	0.13	Longliner 100%
Cardenas Nunja Jose Willy (RUC: 40026209)	20	0.11	Longliner 40%, gill netter 60%
Pesquera Centinela SAC (RUC: 20278966004)	16	0.09	Seiner 88%
Loaiza Mora Lucio (RUC: 29308536)	16	0.09	Trawler 13%, gill netter 19%, longliner 50%
Pesquera Cantabria SA (RUC: 20504595863)	15	0.08	Seiner 100%
Pesca y Transporte SAC (RUC: 20525940579)	14	0.08	Longliner 100%
Inversiones CNC SAC (RUC: 20525511961)	13	0.07	Longliner 100%
Marina de Guerra del Peru (RUC: 20153408191)	13	0.07	Longliner 100%
Industrial Pesquera Santa Monica SA (RUC: 20205572229)	13	0.07	Trawler 92%, seiner 8%
RH Administraciones SA (RUC: 20108069687)	12	0.07	Seiner 58%, trawler 17%
Orosco Castro Jose Rosario (RUC: 10176194940)	12	0.07	Seiner 100%
Perupez SAC (RUC: 20502257634)	12	0.07	Longliner 67%, trap setter 33%
Sakana del Peru SA (RUC: 20293755770)	12	0.07	Trap setter 67%, longliner 33%

Note: This table only includes the first 20 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

Figure 7 shows domestic seiners in the Peruvian EEZ. Domestic seining activity is shown in orange. The figure shows intense domestic seining in the Peruvian EEZ during the study period.

Figure 7 Peruvian (domestic) seining



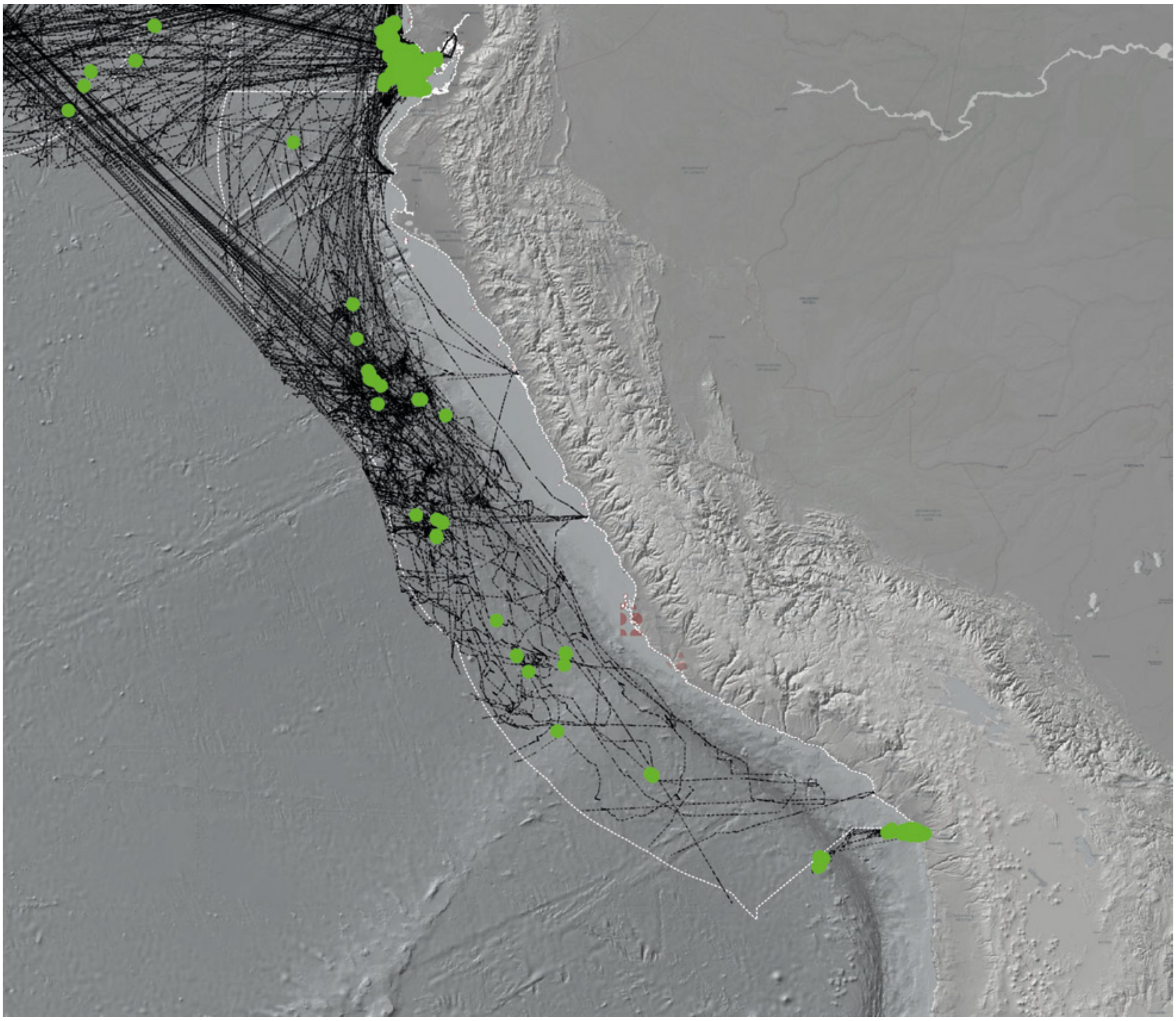
Source: Elaborated by the authors based on ORBCOMM data

Like in the national fleet, the primary type of foreign vessel operating in the Peruvian EEZ in the period studied is 'longliner' (with 53 vessels – almost 40% of the foreign fleet operating in this EEZ). Longliners commonly target swordfish, tuna, halibut and sablefish, among many other species. The other foreign vessels are mainly 'seiners' and 'squid jiggers', among others. Figure 8 shows seining activity by foreign vessels.

Krakken® V15.0 has data on the owners or operators of 125 vessels (92.59 %) of the 135 foreign vessels operating in Peruvian waters.

As in the Ecuadorian EEZ, Colombia's Seatech International Inc is the first company, controlling 11 vessels or 8.15% of the foreign fleet in this EEZ.

Figure 8 Seining activity by foreign vessels



Source: Elaborated by the authors based on ORBCOMM data

Table 9 Foreign vessels in the Peruvian EEZ by type

Type	Total	Total %
Longliner	53	39.26
Seiner	46	34.07
Squid jigger	14	10.37
Auxiliary	7	5.19
Trawler	7	5.19
Unknown	3	2.22
Gill netter	2	1.48
Fish carrier	2	1.48
Pole and line vessel	1	0.74

Source: Elaborated by the authors based on Krakken® V15.0 data

Table 10 Main Peruvian foreign vessel owners or operators

Owner or operator	Total	Total %	Types	Address
Seatech International Inc	11	8.15	Seiner 100%	Colombia
Corpesca SA	10	7.41	Seiner 100%	Chile
Kotoshiro Gyogyo Kabushiki Kaisha	3	2.22	Longliner 100%	Japan
Pingtan Marine Enterprise Ltd – Fujian Pingtan Ocean Fishery Group Co Ltd – Fuzhou Hong Long Ocean Fishing Co Ltd – 福建省平潭县远洋渔业集团有限公司 – 福州宏龙海洋水产有限公司	3	2.22	Squid jigger 100%	China
Arrastre del Norte Pesqueros	2	1.48	Longliner 100%	Spain
Chokyu Maru Gyogyo Bu Yugen Kaisha	2	1.48	Longliner 100%	Japan
Gloria Efe SA	2	1.48	Pole and line vessel 50%, longliner 50%	Panama
Grupo Calvo – UNIOCEAN SA	2	1.48	Seiner 100%	Spain
Jaldamar SL	2	1.48	Longliner 100%	Spain
Pombo Co Ltd A	2	1.48	Gill netter 100%	Portugal
Qi Dong Shun Feng Oceanic Fishery Co Ltd – 启东市顺丰远洋渔业有限公司	2	1.48	Squid jigger 100%	China
Sociedad Pesquera Camanchaca SA	2	1.48	Seiner 100%	Chile
State-Owned Assets Supervision and Administration Commission of Liaoning Provincial People's Government – 辽宁省人民政府国有资产监督管理委员会 **– Dalian Ocean Fishery Co Ltd – Liao Yu Group Corp –** 辽渔集团有限公司	2	1.48	Squid jigger 100%	China
State Council of The People's Republic of China (PRC) – China National Overseas Fishery Corp (CNFC) – Zhong Yu Global Seafood Corp – 中国水产总公司 – 中渔环球海洋食品有限责任公司	2	1.48	Squid jigger 100%	China
Alemar Pesqueros SL	1	0.74	Longliner 100%	Spain
Antolin Perez Alonso	1	0.74	Longliner 100%	Spain
Areapesca SA	1	0.74	Longliner 100%	Spain
Armadora Cervera SL	1	0.74	Longliner 100%	Spain
Atlantex SP Z OO	1	0.74	Trawler 100%	Poland
Atlantic High Sea Fishing CO JSC	1	0.74	Trawler 100%	Lithuania

Note: This table only includes the first 20 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

Box 3 Pingtan Marine Enterprise

On 28 April 2023, the Nasdaq Stock Market announced that it would delist the ordinary shares of Pingtan Marine Enterprise Ltd (C4ADS, 2023). Pingtan Marine Enterprise Ltd. (Nasdaq: PME), a China-based fishing company, has a track record of IUU fishing and other controversial activities. Nasdaq delisted Pingtan Marine Enterprise Ltd – with three squid jiggers operating in the Peruvian EEZ – for 'a documented history of global and industry transgressions' (ibid.). The companies' executives also had their US visas revoked for alleged ties to human trafficking (ibid.). A 2019 investigation showed that the company was involved in corruption, human rights abuses, IUU fishing and a political strategy to support the interests of the Chinese Communist Party (known as 'united front' activity) (ibid.).

"While this decision from Nasdaq is arguably an important step in ensuring that United States stock investors are no longer complicit in funding the illegal activities of this major Chinese fishing company, it's not a magic bullet solution. PME will likely continue to destabilize the ecosystems and sovereignty of nations around the world (including in Latin America and the Pacific Islands) with financial support from their national government." (ibid.)

In 2021, Associated Press published another report on the role of Fu Yuan Yu 7880, a tanker operated by a subsidiary of Pingtan Marine Enterprise Ltd, in a North Korean fuel smuggling operation (Goodman, 2021).

In 2022, the US Treasury Department (2022) also sanctioned the heavily subsidised, Cayman Islands-registered Pingtan Marine Enterprise Ltd, which operates around 100 fishing vessels and reefers in Ecuador and other countries. According to the sanction, its vessels had been involved in human rights abuses and were implicated in IUU fishing, including the 2017 seizure of one vessel and the arrest and imprisonment of the vessel's crew after the Ecuadorian Navy found it had illegally trans-shipped more than 6,600 shark carcasses through the waters of the reserve (US Treasury Department, 2022). Crew members reported instances of 'physical violence and forced labour' (ibid.). In addition, 'A grossly negligent response to an accident contributed to the death of a crew member after it took over two weeks to get the seriously injured crew member to see a doctor aboard another ship' (US Treasury Department, 2022).

Apart from Pingtan Marine Enterprise Ltd, the US Treasury Department also sanctioned Dalian Ocean Fishing (DOF) for human rights violations and IUU fishing (US Treasury Department, 2022). This is an extract from the official document describing the situation aboard these vessels:

> In February 2019, one of DOF's fishing vessels, Long Xing 629, went to sea with a crew of 24, operating in the Pacific Ocean until April 2020. While the Long Xing 629 was licensed to catch tuna during its voyage, it also was reportedly engaged in illegal shark finning, taking over 700kg of fins, including from endangered sharks. After 13 months without a port visit, with average workdays lasting 18 hours and living off expired food and brown desalinated seawater, five crew members had died; at-sea refuelling and trans-shipments of fish to refrigerated cargo vessels known as reefers allowed the ship to operate without interruption. The bodies of three crew members who died at sea were dumped into the ocean rather than repatriated home. When the surviving crew members returned home, they were diagnosed with malnutrition and received only a fraction of their promised pay. They have since described deceptive recruiting practices, the confiscation of identity documents, punishing work and physical abuse. Subsequent investigation found that similar abuses occurred across DOF's fleet, with widespread reports of physical assault, malnutrition, overwork, withheld pay and five more crew member deaths. Based on their contracts, crew members who left the ship would forfeit their salaries while still owing the recruiting fees they had agreed to pay out of future earnings, leading to the potential for intergenerational debt bondage. Other vessels stayed at sea for more than two years without a port visit, meaning no access to the outside world or any way to let others know of the oppressive conditions. Through all of this, DOF received almost $8 million annually in PRC [People's Republic of China] government subsidies encouraging distant-water fishing (ibid.: para. 11).

Dalian Ocean Fishery Group and Dalian Ocean Fishing share the same IMO numbers in our list (their known IMOs are 1383121, 4212374 and 4231011).

Further, despite a prohibition on the landing or trans-shipment of sharks in 2016, Peru is one of the top exporters of shark fins – about 400 tons per year worldwide – contributing close to 2% of global fin production. This is according to an Oceana report that quotes from the FAO (Oceana, 2017). In 2022, Peru issued its first shark fin trafficking conviction (Ommati, 2022). Finning is a lucrative practice that involves hunting sharks for their fins, which are considered in some countries a delicacy, while throwing the animal back into the sea, maimed and dying (Oceana, 2017). Of the 14 shark species traded in Hong Kong, more than 70% are considered at high or very high risk of extinction (ibid.).

Spain is the flag with the most common presence in the Peruvian EEZ, followed by Panama (a FoC), China and Chile, as seen in Table 11.

Despite national and foreign fleets showing a majority of longliners, most of the information on manoeuvres shows seining activity. The data does not explain this inconsistency.

Table 11 Main flags present in the Peruvian EEZ

Flag	Total	Total %
Spain	34	25.19
Panama	20	14.81
China	15	11.11
Chile	13	9.63
Japan	12	8.89
Colombia	11	8.15
Venezuela (Bolivarian Republic of)	5	3.70
Cook Islands	4	2.96
Liberia	3	2.22
Korea, Republic of	3	2.22
Portugal	3	2.22
United States of America	3	2.22
El Salvador	2	1.48

Note: The table does not include flags represented by just one vessel; therefore, percentages will not add up to 100. Source: Elaborated by the authors based on Krakken® V15.0 data

3.4 Senegal's fleet and EEZ

Most of the vessels flagged to Senegal are 'trawlers' (64.26%), followed by 'shrimpers' (9.94%). We could not initially classify 19.39% of them; however, looking at how they behave, we catalogued most of them as trawlers. The domestic fleet has a significant international presence; 5.13% of the Senegalese fleet is owned by Chinese companies (16 vessels). Most of the foreign vessels operating in this EEZ are trawlers (49.13%), longliners (17.77%) and seiners (14.63%). Most of them are flagged to China (32.06%), Spain (16.72%) and Belize (5.92%), the last two of these being FoCs. In this EEZ, foreign trawlers compete with domestic trawlers, some of which are also connected to foreign interests.

A total 117 domestic and foreign vessels in this EEZ are related to Chinese interests. Some firms that own or operate vessels in the domestic and foreign fleets have previously been blacklisted, implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29).

Most Senegalese vessels are 'trawlers', while the remainder are 'unknown' and 'shrimpers', among others, as seen in Table 12.

Table 12 Senegalese domestic vessels by type

Type	Total %	Total
Trawler	64.26	401
Unknown	19.39	121
Shrimper	9.94	62
Seiner	2.88	18
Pole and line vessel	1.76	11
Longliner	1.60	10
Trap setter	0.16	1

Source: Elaborated by the authors based on Krakken® V15.0 data

From stakeholders, we know that most of the vessels in Senegal are trawlers, while only a few tuna longliners are fishing under an EU fishing agreement. Many of the vessels of unknown type in Senegal ('unknown') are indeed trawlers, as seen in the separate analysis of all the vessels of whose type we could not initially identify (refer to Section 4.7).

Krakken V15.0 offers data about the owners or operators of 348 vessels (55.77%) of the 624 Senegalese vessels, as seen in Table 13.

Table 13 Senegalese domestic vessel owners or operators

Owner or operator	Total	Total %	Types	Address
State Council of The People's Republic of China (PRC) – China National Overseas Fishery Corp (CNFC) – Zhong Yu Global Seafood Corp – 中国水产总公司 – 中渔环球海洋食品有限责任公司	26	4.17	Trawler 100%	China
Armement Groupe Adrien Michel SA – Société de Pêche et D'armement Senegalais SA (SOPASEN)	21	3.37	Shrimper 76%, trawler 10%	Senegal
Senemer SARL	13	2.08	Trawler 100%	Senegal
Jose Marti Peix SA	12	1.92	Shrimper 67%, trawler 33%	Spain
Afropêche SARL	9	1.44	Trawler 100%	Senegal
Africaine L'atlantique	8	1.28	Trawler 88%	Senegal
Armement Delphinus SARL	8	1.28	Trawler 100%	Senegal
Paradela Armadora Eduardo Vieira SA – Grupo Vieira Mar	8	1.28	Shrimper 25%, trawler 75%	Spain
Armement Senegalais	7	1.12	Trawler 100%	Senegal
Senepesca SARL	7	1.12	Trawler 100%	Senegal
SOSAP	7	1.12	Trawler 100%	Senegal
Univers Pêche SARL – Armement FT2 SARL	7	1.12	Trawler 100%	Senegal
Berthome A	6	0.96	Trawler 83%, shrimper 17%	Senegal
Guangdong Ru Ishun Ocean Fishery Co Ltd – 广东瑞顺远洋渔业有限公司	6	0.96	Trawler 100%	China
Armement Yannick Carton	5	0.80	Trawler 60%, shrimper 40%	Senegal
Capsen SA	5	0.80	Seiner 80%, pole and line vessel 20%	Senegal
Senecrust	5	0.80	Shrimper 60%, trawler 20%	Senegal
Société Ibero Senegalaise Pour La Pêche Atlantique (SISPA)	5	0.80	Trawler 80%, shrimper 20%	Senegal
Sunumar Fishing SUARL	5	0.80	Trawler 80%, shrimper 20%	Cote d'Ivoire
Al Makaru Al ASMA	4	0.64	Null	Senegal

Note: This table only includes the first 2020 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

We have added the country of registration of the domestic companies to Table 13 to identify foreign interests. However, a company's address does not necessarily indicate where its vessels are flagged or whether it represents interests in another country, which is the case in many domestic companies registered in Senegal (and Ghana). The main domestic vessel owner in Senegal is China National Overseas Fishery Corp (CNFC), with 26 trawlers (4.17% of the national fleet) and 16 foreign longliners (5.17% of the foreign fleet operating in this EEZ, as seen later). CNFC owns the largest Chinese DWF fleet in the world, with at least 257 vessels (Gutierrez et al., 2020); it has offices in Spain, Morocco, Guinea-Bissau, India, Yemen, Saudi Arabia, Hong Kong and Australia (FIS, 2019a). Of the CNFC DWF vessels, in 2020, 192 were flagged to China, with the rest flagged to Senegal (31), Mozambique (12), Mauritania (9), unknown (7) and Belize (2), among others (Gutierrez et al., 2020). CNFC is reputedly one of the 'top 10 companies owning vessels accused of forced labour' (Daniels et al., 2023: 27). CNFC, among other Chinese DWF companies, has also been accused of under-declaring its fishing vessels' gross tonnage (GT) in Senegal, Guinea-Bissau and Guinea (Greenpeace, 2015).

Armement Groupe Adrien Michel SA – Société de Pêche et D'armement Senegalais SA (SOPASEN) (with 21 vessels) is the company with the second largest number of vessels operating in this EEZ; this is followed by Senemer SARL (with 13).

Correspondingly, the main flags operating in the Senegalese EEZ are the Chinese (32.06%) and Spanish (16.72%) flags, followed by other flags, including FoCs such as Belize (5.92%) and Panama (2.44%).

Table 14 Main flags present in the Senegalese EEZ

Flag	Total	Total %
China	92	32.06
Spain	48	16.72
Belize	17	5.92
Guinea-Bissau	15	5.23
Japan	14	4.88
Mauritania	10	3.48
Cameroon	9	3.14
Turkey	8	2.79
Panama	7	2.44
Gambia, The	6	2.09
Russian Federation	5	1.74
Curaçao	5	1.74
Taiwan, Province of China	5	1.74
Angola	4	1.39
France	4	1.39
Guinea	4	1.39
Morocco	4	1.39
Italy	3	1.05
Norway	3	1.05
Korea, Republic of	2	0.70
Comoros	2	0.70
Denmark	2	0.70
Equatorial Guinea	2	0.70
Latvia	2	0.70
Lithuania	2	0.70

Note: This table does not include flags represented by just one vessel; therefore, percentages will not add up to 100. Source: Elaborated by the authors based on Krakken® V15.0 data

As with the domestic fleet, the most common type of foreign vessel operating in this EEZ is the 'trawler' (almost 50%), followed by 'longliners', 'seiners' and others. Trawlers can target whiting, red hake, dogfish, crab, shrimp and flounder, among other species.

Krakken V15.0 offers data about the owners or operators of 235 vessels (81.88 %) of the 287 foreign vessels operating in Senegalese waters.

Table 15 Foreign vessels in the Senegalese EEZ by type

Type	Total	Total %
Trawler	141	49.13
Longliner	51	17.77
Seiner	42	14.63
Unknown	36	12.54
Fish carrier	5	1.74
Pole and line vessel	4	1.39
Squid jigger	3	1.05
Auxiliary	2	0.70
Gill netter	2	0.70
Shrimper	1	0.35
Dredger	1	0.35

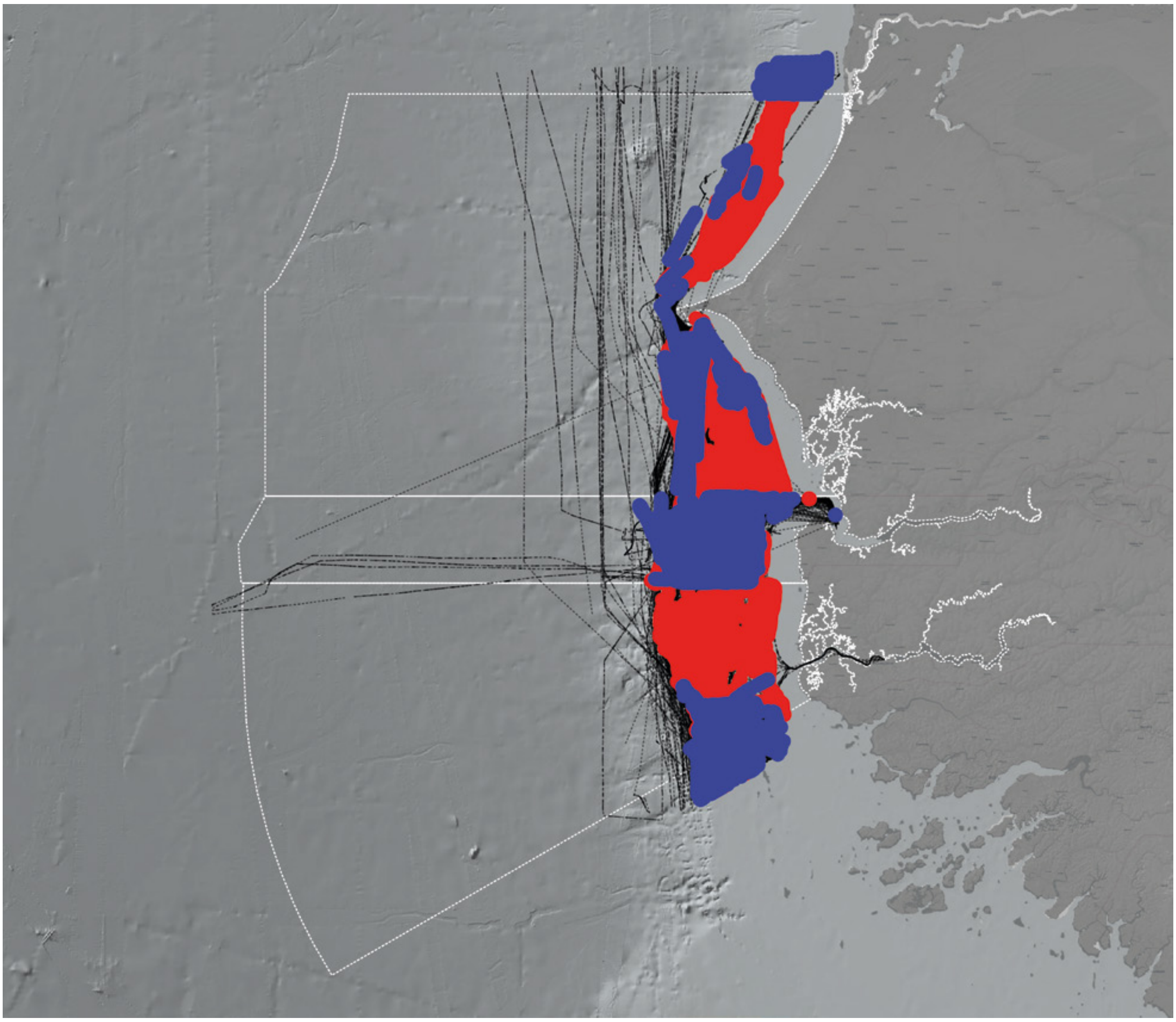
Source: Elaborated by the authors based on Krakken® V15.0 data

Table 16 Senegalese foreign vessel owners or operators

Owner or operator	Total	Total %	Types	Address
Fujian Shi Hai Fishery Co Ltd – 福建世海渔业有限公司	20	6.97	Trawler 100%	China
State Council of The People's Republic of China (PRC) – China National Overseas Fishery Corp (CNFC) – Zhong Yu Global Seafood Corp – 中国水产总公司 – 中渔环球海洋食品有限责任公司	16	5.57	Longliner 56%	China
Shenzhen Zhanshen Fishery Co Ltd	9	3.14	Unknown	China
Atuneros Congeladores y Transportes Frigorificos SA (Atunsa)	6	2.09	Seiner 100%	Spain
Changhai Zhang Zi Dao Yi Feng Aquatic Products Co Ltd – 长海县獐子岛益丰水产有限公司	6	2.09	Trawler 100%	China
Wenzhou Da Zhou Oceanic Fishery Co Ltd – 温州市大洲远洋渔业有限公司	6	2.09	Trawler 100%	China
Aly Saadi – Sonit Pêche SARL	4	1.39	Trawler 100%	Guinea
Overseas Tuna CO Naamloze Vennootschap	4	1.39	Pole and line vessel 25%, seiner 75%	Curaçao
Albacora SA (Grupo Albacora)	3	1.05	Seiner 100%	Spain
Fujian Yao Xiang Marine Fishery Co Ltd – 福建耀翔海洋渔业有限公司	3	1.05	Longliner 100%	China
Jose Marti Peix SA	3	1.05	Trawler 100%	Spain
Star Fishing	3	1.05	Trawler 67%, Seiner 33%	Guinea-Bissau
Atlantic Whale JSC – Общество С Ограниченной Ответственностью **Atlantik Veyl**	2	0.70	Trawler 100%	Russian Federation
Baltimar SA	2	0.70	Trawler 100%	Guinea-Bissau
Baltreids SIA	2	0.70	Trawler 100%	Latvia
Belromar SA	2	0.70	Trawler 100%	Guinea-Bissau
Compagnie Française du Thon Oceanique (France Thon Gie)	2	0.70	Seiner 100%	France
Dalian Hai Xin Aquatic Co Ltd	2	0.70	Null	China
Dalian Hao Hang Ocean Fishing Co Ltd – 大连晟航远洋渔业有限公司	2	0.70	Trawler 100%	China
Dalian Jin Hai Ocean Fishery Development Co Ltd – 大连金海远洋渔业开发有限公司	2	0.70	Trawler 100%	China

Note: This table only includes the first 2020 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

Figure 9 Trawling in the Senegalese EEZ



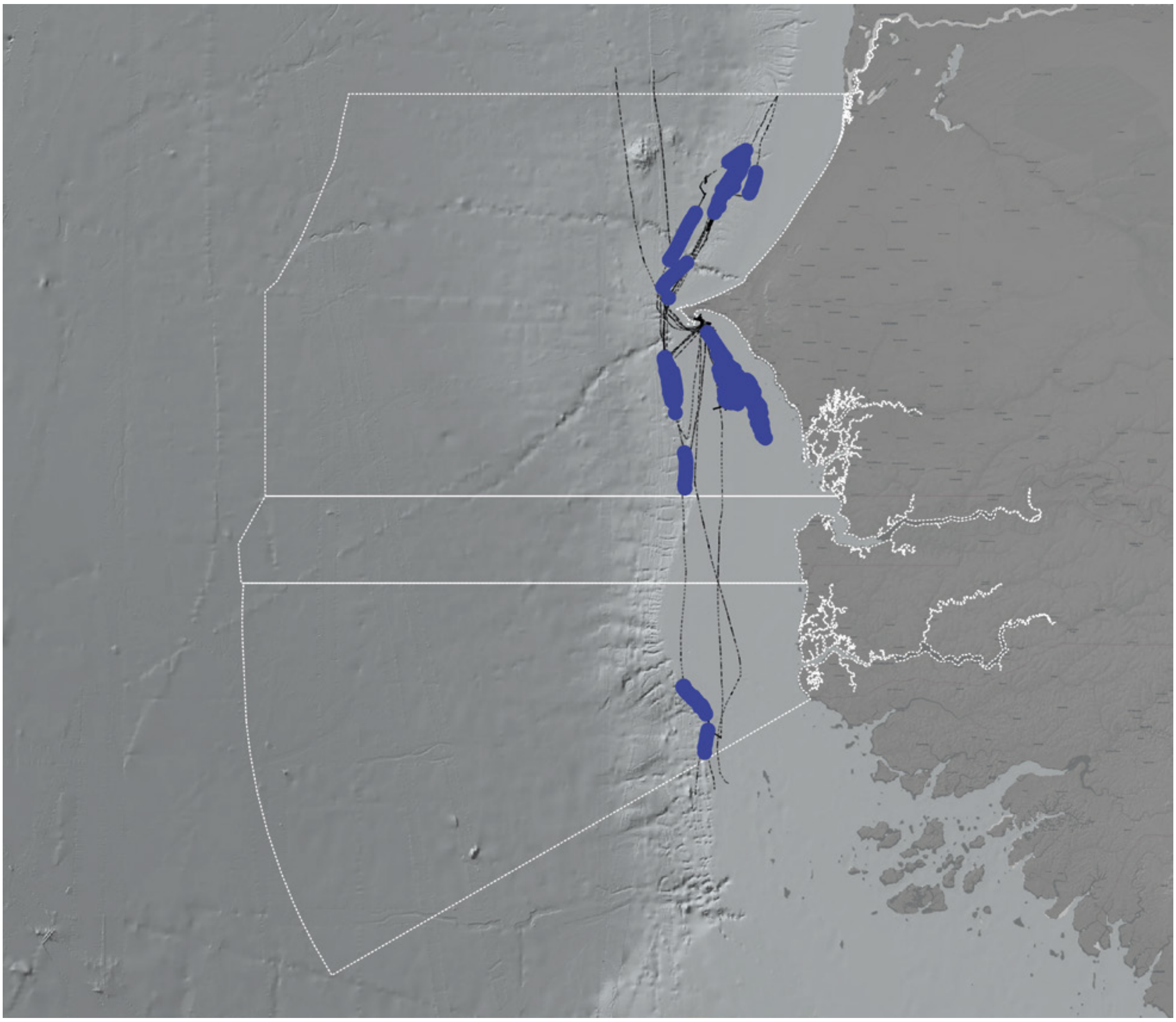
Source: Elaborated by the authors based on ORBCOMM data

What transpires from the tables and Figure 9 is that foreign trawlers compete heavily with domestic trawlers. Figure 9 shows the activity of trawlers in Senegal's EEZ. Foreign trawlers' activity is shown in blue; domestic trawlers' activity is shown in red.

Here, we would like to highlight, first, the domestic trawlers competing for fish in the northern section of the Senegalese EEZ.

Second, the foreign trawlers can be seen fishing across the southern border of the Senegalese EEZ until the N12.33° latitude, mainly coming from neighbouring The Gambia. Although not included in this report, third, an aggregation representing foreign vessels, including vessels with Mauritanian licenses (in blue), can be observed outside the Senegalese EEZ, across the northern border.

Figure 10 Two foreign trawlers in the Senegalese EEZ



Source: Elaborated by the authors based on ORBCOMM data

Senegal has a fishing agreement with Guinea-Bissau that allows Senegalese vessels to fish in Guinea-Bissau waters (Jeffang, 2023). It is important to note that there is a disputed marine area at the border of the two countries arising from overlapping maritime zone delineation.[17] To avoid conflicts, both countries have agreed to consider this area a common zone that a special bilateral agency manages; vessels of both countries can fish in this zone where Guinea-Bissau laws and regulations are applied (Intchama et al., 2018). Figure 10 shows two foreign trawlers from Spain and Comoros in the Senegalese EEZ, performing trawling fishing manoeuvres during the study period (highlighted in blue).

To illustrate foreign trawling in Senegal, we selected the Spanish trawler Villa de Marin

17 Find out more on EEZs in the annexes

(IMO 9175365), owned by Pesquerias Nores Marin SL, Spain and the Comorian trawler Moya (IMO 7424695), owned by a company based in Moroni, Comoros.

Finally, an interesting case is tuna giant Albacora, a Spanish company on the list of leading foreign companies operating in Ecuador's EEZ (11th) and that of Senegal (9th). According to a recent report, Albacora received €1.16 million ($1.18 million) annually from 2006 to 2011 in EU subsidies and €3.77 million ($3.82 million) from fisheries partnership agreements while being fined €4.1 million ($4.4 million) for illegally fishing in the United States EEZ (Daniels et al., 2022: 32; Greenpeace, 2014: 33). The Albacora seiner fleet has also been accused of switching off their transponders for long periods, contravening the International Convention for the Safety of Life at Sea (SOLAS) (Rattle and Duncan-Jones, 2022). Other companies in this report include Pingtan Marine Enterprise Ltd. (China), operating in Peru and the Philippines (refer to Box 3) and CNFC (China), operating in Peru and Senegal, which have also been involved in wrongdoing, irregularities or unsustainable behaviour, as seen earlier.

3.5 Ghana's fleet and EEZ

Most of the vessels flagged to Ghana are gill netters (59.92%), targeting pelagic fish for consumption in Ghana, Togo, Cote d'Ivoire, Benin and Nigeria, trawlers (23.95%) and pole and line vessels (10.28%). There is a significant international presence in the domestic fleet; at least 107 vessels of the Ghanaian fleet are owned by Chinese companies or connected to Chinese interests, which, together with 15 foreign vessels flagged to China, total 122. Most of the foreign vessels operating in this EEZ are seiners (45.26%), trawlers (15.79%) and longliners (13.68%). We could not initially identify the type of vessel of 16.84% of the foreign fleet, but a second analysis based on their behaviour indicated that they were trawlers, seiners or longliners. Most of the foreign vessels are flagged to China (15.79%), Spain (14.74%), Belize (12.63%), France (10.53%) and Panama (7.37%), a FoC. Some firms that own or operate vessels in the domestic and foreign fleets have been previously blacklisted, implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29).

In Ghana, most national vessels in the domestic fleet are gill netters. A gillnet is a netting wall hanging in the water column; it can target groundfish (for example, croaker, bream, grouper and hake), herring, mullet, seabass, swordfish and tuna.

Table 17 Ghanaian domestic vessels by type

Type	Total	Total %
Gill netter	758	59.92
Trawler	303	23.95
Pole and line vessel	130	10.28
Unknown	26	2.06
Seiner	26	2.06
Fish carrier	14	1.11
Squid jigger	5	0.40
Longliner	5	0.40

Source: Elaborated by the authors based on Krakken® V15.0 data

In Ghana, artisanal fishing employs gillnet drifts, which target sizeable pelagic fish for consumption in Ghana, Togo, Cote d'Ivoire, Benin and Nigeria (FIRMS, 2020).[18] This vessel type makes up almost 60% of the domestic fleet, as seen in Table 17. Gill netters can trap other marine animals, such as turtles and marine mammals (WCN, 2020), which is why they are banned or heavily regulated in some countries. For example, gill netting is regulated under the European Common Fisheries Policy, with restrictions on mesh size, fishing seasons and areas to minimise bycatch (European Commission, 2023).

In terms of vessel type, gill netters are followed by trawlers (almost 24% of the fleet), pole and line vessels (10%) and others.

Krakken V15.0 offers data about the owners or operators of 461 vessels (36.44%) of the 1,265 Ghanaian vessels.

Based on Gutierrez et al. (2020), we established there were 106 Chinese vessels in the Ghanaian domestic fleet during the study period.[19] For example, the leading owner and operator in the Ghanaian fleet is Afko Fisheries (with 20 vessels), which an investigation reveals belongs to Shandong Zhonglu Oceanic Fisheries CO, a Chinese firm (Sarpong, 2021). Afko Fisheries also has offices in Spain and South Korea; it was investigated for maltreatment of Ghanaian workers by investigative journalist Anas Aremeyaw Anas in 2003 (in Ghana Web, 2018).

Other domestic companies controlled by Chinese firms in this list include Danac Fishery (identified as Danac Fisheries) and NASAAA Co Ltd, both belonging to Dalian Mengxin (Sarpong, 2021).

An Africa–China reporting project speaks of three Chinese companies owning or operating some 15 domestic fishing firms and posing enormous challenges:

> Around 90% of Ghana's industrial fishing trawlers are owned by Chinese corporations despite foreign ownership or control being illegal, investigations by EJF have shown.[20] The lack of transparency allows these operators to set up opaque corporate structures and work through Ghanaian 'front' companies to obtain licences to fish. This means that Ghana is losing out on up to 23.7 million US dollars every year in revenue. (ibid.).

Meanwhile, in 2018, a Panofi seiner, identified as (F/V) Panofi Fore Runner, was arrested in Liberia for using FADs and fishing without a licence (refer to Box 1 for further information on FADs) (Sea Shepherd, 2018; Baird Maritime, 2018).

Additionally, the second domestic company on the list, Obourwe and Co Ltd (with 15 vessels), is connected to Chinese trawlers in another report (EJF Staff, 2018). For a complete picture of Chinese ownership across the 10 fleets operating in these EEZs, see the Conclusions (Chapter 5).

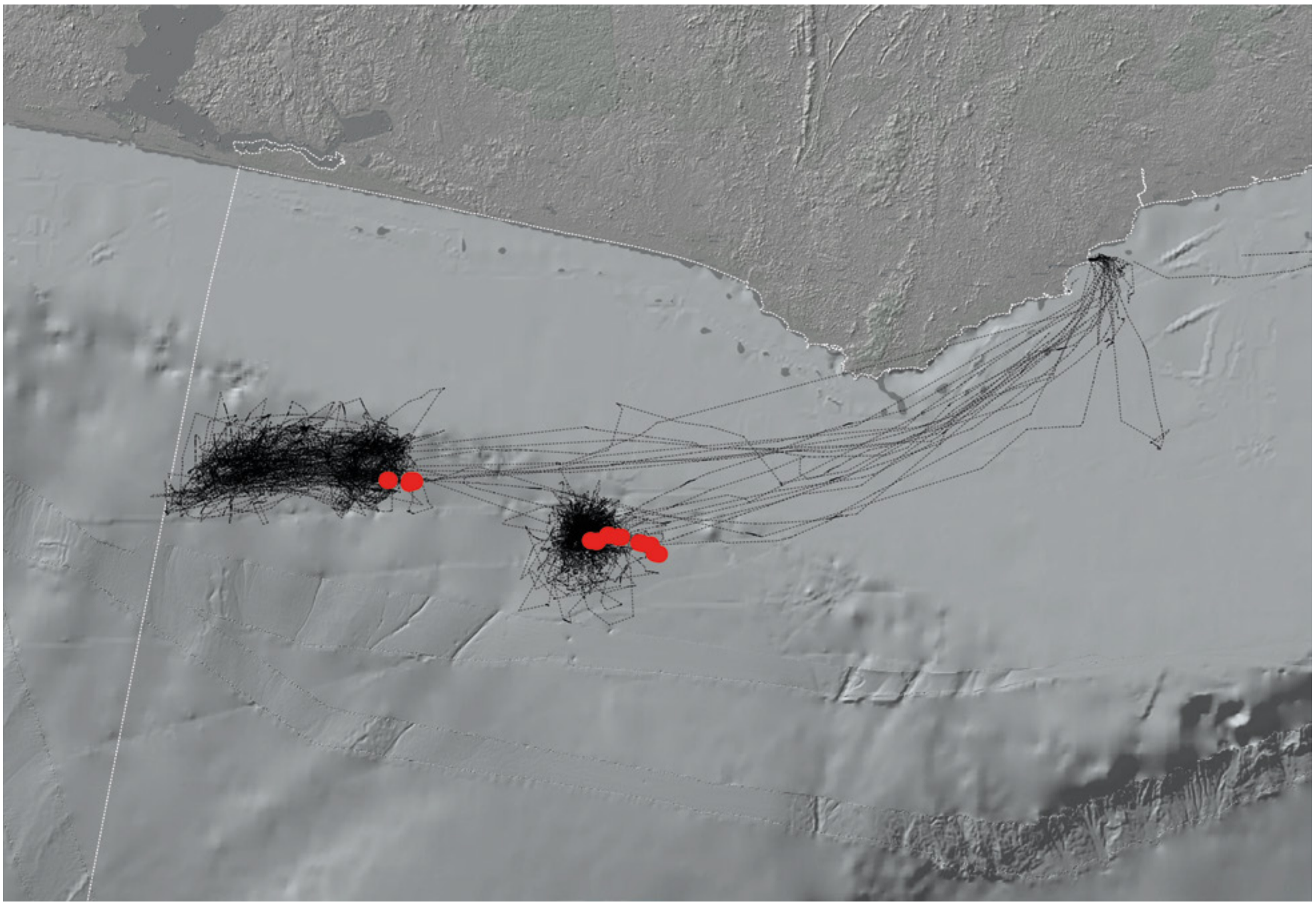
18 Gillnet drifts are potentially harmful to the environment as they can catch juvenile tuna and other species.
19 We did this for all the fleets. The conclusions gather an overview of the Chinese DWF fleet in these five EEZs during the period of study..
20 https://ejfoundation.org/news-media/chinas-hidden-fleet-illegal-practices-in-ghanas-industrial-fishery

Table 18 Ghanaian domestic vessel owners or operators

Owner or operator	Total	Total %	Types
Afko Fisheries (Ghana) Co Ltd	20	1.58	Trawler 45%, pole and line vessel 30%, seiner 10%, fish carrier 15%
Mankoadze Fisheries Co Ltd	15	1.19	Trawler 47%, pole and line vessel 47%, fish carrier 7%
Obourwe and Co Ltd	15	1.19	Trawler 100%
Kiku Fisheries Co Ltd	12	0.95	Trawler 83%, pole and line vessel 8%
Legon Fisheries Co Ltd	12	0.95	Trawler 75%, pole and line vessel 25%
Mass Fisheries Co Ltd	10	0.79	Trawler 90%, longliner 10%
Government of Ghana – Ghana State Fishing Corp	9	0.71	Trawler 100%
Cactus Enterprise Co Ltd	8	0.63	Trawler 100%
Panofi Co Ltd	8	0.63	Seiner 88%, fish carrier 13%
Toiman Fishing Co Ltd	8	0.63	Squid jigger 63%, pole and line vessel 38%
Cavalier Resources Co Ltd	7	0.55	Trawler 100%
Clear Skies Co Ltd	7	0.55	Pole and line vessel 57%, seiner 43%
Legon Trading Co Ltd	7	0.55	Trawler 100%
NASAAA Co Ltd	7	0.55	Trawler 100%
Ocean Fisheries Co Ltd	7	0.55	Trawler 43%, fish carrier 14%, pole and line vessel 43%
Bossgie Co Ltd	6	0.47	Trawler 67%, pole and line vessel 33%
Gaz Impex GH Co Ltd	6	0.47	Trawler 100%
Kaleawo Enterprises	6	0.47	Pole and line vessel 67%, gill netter 33%
Danac Fishery Co Ltd	5	0.40	Trawler 100%
Nova Complex Co Ltd	5	0.40	Gill netter 60%, trawler 20%, pole and line vessel 20%

Note: This table only includes the first 2020 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data.

Figure 11 Two Chinese (domestic) trawlers in the Ghanaian EEZ



Source: Elaborated by the authors based on ORBCOMM data

Figure 11 shows two Chinese trawlers in the Ghanaian domestic fleet trawling in the country's EEZ. In this figure, we can observe the Ghanaian trawlers OkFish 23 (IMO 9027221), owned by Legon Trading Co Ltd, C/O Legon Fisheries Co Ltd and Ankobea (IMO 9027207), owned by CG Elmina Co Ltd, trawling along the northwestern section of the Ghanaian EEZ between 27 January and 14 June 2022. Although the vessels are flagged to Ghana, the owners have been identified as connected to Chinese interests (Gutierrez et al., 2020). Ghana restricts foreign fishing vessels within its EEZ unless authorised or passing by; the legal framework governing foreign fishing activities includes the Fisheries Act of 2002 (Act 625) and subsequent amendments (Republic of Ghana, 2002).

Registration in Ghana (by foreign fleets) most likely reflects a technical compliance with laws restricting industrial and semi-industrial fishing in Ghanaian waters to Ghanaian-flagged vessels that are not owned or part-owned by foreign interests, except in the case of tuna trawling (Gutierrez et al., 2020: 21).

On the other hand, the foreign vessels operating in the Ghanaian EEZ are mainly seiners (45.26%), followed by vessels of unknown types and trawlers.

Table 19 Foreign vessels in the Ghanaian EEZ by type

Type	Total	Total %
Seiner	43	45.26
Unknown	16	16.84
Trawler	15	15.79
Longliner	13	13.68
Auxiliary	3	3.16
Gill netter	3	3.16
Squid jigger	1	1.05
Pole and line vessel	1	1.05

Source: Elaborated by the authors based on Krakken® V15.0 data

Table 20 shows the main flags operating in the Ghanaian EEZ; the most common flag is Chinese, followed by Spanish, Belizean, French and Panamanian flags. FoCs also appear on this list.

As seen in a previous report (Gutierrez et al., 2020), registration in Ghana suggests observance of laws limiting industrial and semi-industrial fishing in Ghanaian waters to Ghanaian-flagged vessels, except for tuna trawling (Republic of Ghana, 2002). Both Senegal and Ghana attract a great deal of DWF. The largest registry of Chinese vessels outside China is in Ghana, with 137 ships, mostly trawlers (Gutierrez et al., 2020). Virtually 'all the trawler agents – the people who profit from arranging the sale of licences to fish – are PMs (parliament members)' (Clover, 2020b).

Table 20 Main flags present in the Ghanaian EEZ

Flag	Total	Total %
China	15	15.79
Spain	14	14.74
Belize	12	12.63
France	10	10.53
Panama	7	7.37
Curaçao	5	5.26
El Salvador	3	3.16
Russian Federation	3	3.16
Singapore	2	2.11
Norway	2	2.11
Germany	2	2.11
Guatemala	2	2.11
Netherlands	2	2.11
Taiwan, Province of China	2	2.11
Denmark	2	2.11

Note: The table does not include flags represented by just one vessel; therefore, percentages will not add up to 100. Source: Elaborated by the authors based on Krakken® V15.0 data

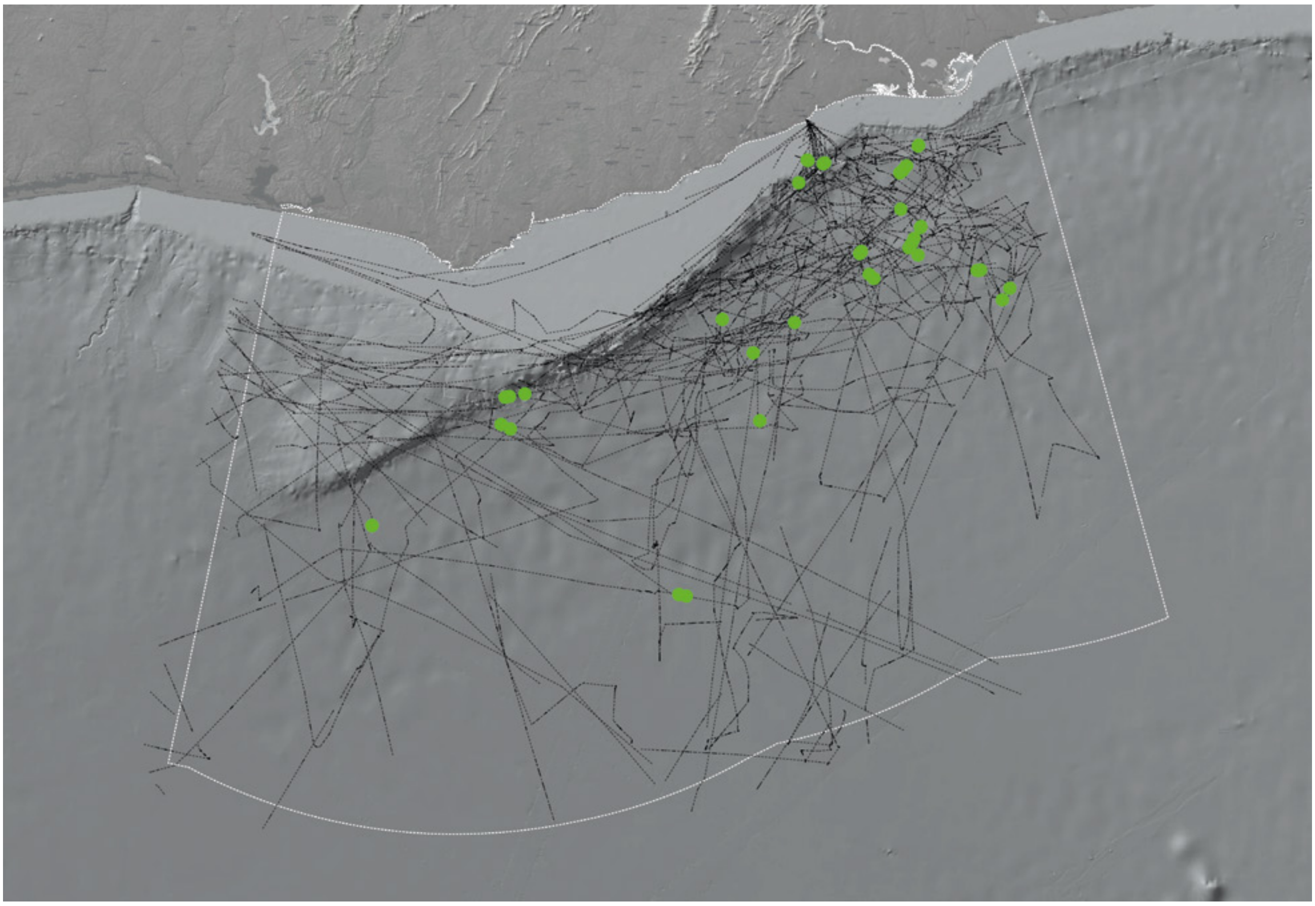
Krakken V15.0 presents data about the owners or operators of 68 vessels (71.58%) of the 95 foreign vessels operating in Ghanaian waters.

Table 21 Foreign vessel owners or operators in the Ghanaian EEZ

Owner or operator	Total	Total %	Types	Address
Compagnie Française du Thon Oceanique (France Thon Gie) – CFTO	6	6.32	Seiner 100%	France
Atuneros Congeladores y Transportes Frigorificos SA (ATUNSA)	5	5.26	Seiner 100%	Spain
Grupo Calvo – Uniocean SA	4	4.21	Seiner 100%	Spain
Armement Saupiquet SAS	3	3.16	Seiner 100%	France
Sea Breeze Ventures Co Ltd	2	2.11	Trawler 67%, seiner 33%	Belize
Integral Fishing Services Inc	2	2.11	Seiner 100%	Panama
Jealsa Rianxeira SAU	2	2.11	Seiner 100%	Spain
Pesqueria Vasco Montañesa SA (PEVASA)	2	2.11	Seiner 100%	Spain
Zhong Gha Foods Co Ltd	2	2.11	Seiner 100%	Ghana
Albacora SA (Grupo Albacora)	1	1.05	Seiner 100%	Spain
Alejandra Pesca SL	1	1.05	Longliner 100%	Spain
Antel Investments Co Ltd	1	1.05	Longliner 100%	Belize
Aquiles SA	1	1.05	Longliner 100%	Panama
Baco Seefischereibetrieb GMBH	1	1.05	Trawler 100%	Germany
Bilgin Ltd Llc / Общество С Ограниченной Ответственностью Билгин, ООО	1	1.05	Seiner 100%	Russian Federation
Cantabrica de Tunidos SAU	1	1.05	Seiner 100%	Spain
Compañia Internacional de Pescas y Derivados SA (INPESCA)	1	1.05	Seiner 100%	Spain
Dicha International Ventures Co Ltd	1	1.05	Seiner 100%	Belize
Emilio Vicente Lomba SL	1	1.05	Longliner 100%	Spain
Fancy Ocean Co Ltd	1	1.05	Seiner 100%	Belize

Notes: 1. This table only includes the first 2020 companies by the number of vessels they control. 2. CFTO, which represents two-thirds of French tropical tuna fisheries, with a total of 14 seiners and with landing bases in Abidjan (Ivory Coast) and Victoria (Seychelles), was in a process of selling its operations to Parlevliet & Van der Plas (a Dutch company) at the time of writing this report (Ouest-France, 2022). Source: Elaborated by the authors based on Krakken® V15.0 data

Figure 12 Foreign seiners in the Ghanaian EEZ



Source: Elaborated by the authors based on ORBCOMM data

As before, some foreign companies registered in Ghana are also linked to Chinese interests. For instance, despite being registered in Ghana, Zhong Gha Foods and other apparently domestic companies are Chinese (B&FT Online, 2022).

Figure 12 shows foreign seiners in the Ghanaian EEZ. Foreign seining activity is shown in green. In this figure, we can see foreign generalised seiner activity across the whole Ghanaian EEZ.

One of the most pressing problems in Ghana has been the saiko system, a traditional barter mechanism that allowed bycatch to be exchanged for farm produce. However, it became a lucrative backdoor transaction system overseen by Chinese trawlers, which would illegally transfer frozen stocks of bycatch to numerous Ghanaian canoes for sale (Clover, 2020b; Oirere, 2021). Indeed, it transformed into 'a highly organised, lucrative – and illegal– industry' (EJF Staff, 2020; Engelen, 2022). The unwanted result is that now industrial trawlers purposely target smaller fish typically reserved for artisanal fishers to sell them back to the communities (EJF Staff, 2020). As a result, saiko has severely impacted Ghana's biodiversity and livelihoods. A 2017 report found approximately 100,000 tons of illegally caught fish were landed through saiko during that year (EJF Staff, 2017). The report indicated that the estimated value of saiko fish sold at sea was between $40.6 and $50.7 million, constituting a considerable revenue loss (ibid.). Connected to this issue, Ghana was issued a first European Commission yellow card in 2013, lifted two years later and a second yellow card in 2021, which risked losing the country access to European markets. The issues highlighted by the European Commission included illegal trans-shipments at sea of 'large quantities of undersized juvenile pelagic species between industrial trawl vessels and canoes in Ghanaian waters, deficiencies in the monitoring, control and surveillance of the fleet and a legal framework that is not aligned with the relevant international obligations Ghana has signed up to' (European Commission, 2021).

At the time of writing, the country was implementing a national plan to prevent and eliminate IUU fishing and was collaborating with FAO.

3.6 The Philippines' fleet and EEZ

Initially, we could not determine the type of 85.55% of the vessels flagged to the Philippines, most of these assumed as being artisanal vessels. The rest of the vessels are 'fish carriers' (5.85%), 'auxiliary' vessels (3.94%), 'seiners' (2.20%) and 'longliners' (1.80%). The leading domestic companies are engaged in domestic and international seining, primarily catching mackerel, sardine, skipjack and tuna, as well as processing and canning. There is significant international participation in the domestic fleet, including 67 vessels linked to Chinese interests; these, together with the vessels flagged to China, total 144 vessels. Most of the foreign vessels operating in this EEZ are of an unknown type (29.52%), while the rest are longliners (29.15%), seiners (19.93%) and trawlers (11.07%). Some of the biggest foreign companies operating ships in this EEZ are Chinese; in line with this, most foreign vessels are flagged to China (25.09%), Taiwan, Province of China (21.03%), Japan (16.24%) and South Korea (7.01%). Some have been previously been blacklisted, implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29).

Most domestic vessels in the Philippines (9,737) are of an unknown type. Excluding these vessels, the most common types are 'fish carrier' (666), 'auxiliary' (448), 'seiner' (250) and 'longliner' (205).

Table 22 Philippine domestic vessels by type

Type	Total	Total %
Unknown	9,737	85.55
Fish carrier	666	5.85
Auxiliary	448	3.94
Seiner	250	2.20
Longliner	205	1.80
Trawler	62	0.54
Pole and line vessel	6	0.05
Dredger	4	0.04
Multipurpose	2	0.02
Squid jigger	1	0.01

Source: Elaborated by the authors based on Krakken® V15.0 data

We can only assume that many of the vessels of unknown type are small, artisanal vessels belonging to individuals. There are approximately 1.6 to 2 million fisherfolk in the Philippines; around 70–80% of these are considered artisanal fishers, who typically use small-scale methods for fishing (BFAR, 2022). According to the Bureau of Fisheries and Aquatic Resources (BFAR), in 2021, there were 209,196 vessels registered for 'municipal fishing', referring to traditional, artisanal, subsistence or small-scale fisheries involving the use of boats 3 GT or less (ibid.: 156).

There is a degree of opacity in this domestic fleet. To a lesser degree, the same is true for the foreign fleet operating in this EEZ, with an information gap on the type of vessels for almost 30% of the foreign fleet.[21] Meanwhile, of the 666 fish carriers, 532 are fish carrier coasters or fisheries tender vessels of small size.

Despite the high uncertainty about the types of vessels in the Philippine fleet, we have information from Krakken V15.0 on the owners or operators of 10,797 vessels (94.87 %) of the 11,381 vessels from the Philippines, as seen in Table 23.

The largest owner in the Philippines' fleet is RBL Fishing Corp (with 144 vessels), followed by Frabelle Fishing Corp (140) and Island Reef Marine Fishing and Trading Inc (107). These companies are engaged in domestic and international purse seining, primarily catching mackerel, sardine, skipjack and tuna, as well as processing and canning.

Excluding vessels of unknown type, the most common foreign vessel operating in this EEZ is the longliner (29.15%), followed by seiners (19.93%) and trawlers (11.07%).

21 We use algorithms to shed some light on the vessels of unknown type (refer to Section 4.7.).

Table 23 Philippine domestic vessel owners or operators

Owner or operator	Total	Total %	Types
RBL Fishing Corp	144	1.27	Seiner 8%, auxiliary 6%, fish carrier 2%, longliner 1%
Frabelle Fishing Corp	140	1.23	Auxiliary 25%, longliner 4%, seiner 14%, fish carrier 15%, trawler 4%
Island Reef Marine Fishing and Trading Inc	107	0.94	Longliner 3%, fish carrier 14%, seiner 2%, dredger 2%, trawler 3%, auxiliary 1%
Amadeo Fishing Corp / Eduardo O Amadeo	92	0.81	Auxiliary 20%, fish carrier 23%, seiner 7%
Rd Fishing Industry Inc – Rd Tuna Ventures Inc	76	0.67	Seiner 14%, auxiliary 22%, fish carrier 22%
Rlg Fishing Corp	73	0.64	Auxiliary 21%, fish carrier 22%, seiner 5%
San Andres Fishing Industries Inc	64	0.56	Seiner 6%, fish carrier 39%, auxiliary 17%
Nh Agro Industrial Inc	62	0.54	Seiner 10%, fish carrier 32%, auxiliary 26%
Candelario B Damalerio Fishing Enterprises (DFC) Tuna Venture Corp	62	0.54	Trawler 2%, seiner 8%, longliner 5%, fish carrier 21%, auxiliary 32%
Marchael Sea Ventures Corp / Buhisan Michael D	60	0.53	Seiner 15%, auxiliary 40%, fish carrier 27%
Citra Mina Properties Holdings Inc	60	0.53	Longliner 2%, fish carrier 3%
Trans Pacific Journey Fishing Corp – Mercidar Gfishing Corp	54	0.47	Auxiliary 28%, fish carrier 9%, seiner 35%, pole and line vessel 2%
Rge Agridev Corp	54	0.47	Null
Tuna Explorers Inc	52	0.46	Null
Zamboanga Universal Canning Inc / Universal Fishing Corp	51	0.45	Longliner 2%, auxiliary 4%, fish carrier 27%
Buena Suerte Jimenez Fishing and Trading Holding Corp	46	0.40	Longliner 4%, auxiliary 50%, fish carrier 20%, seiner 24%
Rugela Fishing Industries Inc	45	0.40	Auxiliary 13%, seiner 16%, fish carrier 29%
Royale Fishing Corp	45	0.40	Seiner 16%, trawler 2%, longliner 2%, auxiliary 33%, fish carrier 24%
Yl Fishing Corp	45	0.40	Auxiliary 9%, fish carrier 13%
Gladery Fishing Inc /Rey F Gaceta / Unicrest	44	0.39	Seiner 5%, fish carrier 5%

Note: This table only includes the first 2020 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

Table 24 Foreign vessels operating in the Philippine EEZ per type

Type	Total	Total %
Unknown	80	29.52
Longliner	79	29.15
Seiner	54	19.93
Trawler	30	11.07
Squid jigger	16	5.90
Auxiliary	6	2.21
Gill netter	2	0.74
Pole and line vessel	2	0.74
Fish carrier	2	0.74

Source: Elaborated by the authors based on Krakken® V15.0 data.

Krakken V15.0 offers data about the owners or operators of 175 vessels (64.58 %) of the 271 foreign vessels operating in Philippine waters.

According to on Krakken V15.0, 4 of the first 20 companies for which we have information on the owner or operator are Chinese companies. Pingtan Marine Enterprise Ltd – which also works in the Peruvian EEZ – has being involved in IUU fishing and other controversial activities (refer to Box 3). Poly Group Corp (PGC) – which owns and operates more than 100 vessels (Gutierrez et al., 2020) – has been questioned for lack of transparency (Gutierrez et al., 2020) and its access to African waters via secret agreements, especially in Mauritania (Transparent Sea, 2012). PGC has been described as a commercial arm of the Chinese People's Liberation Army (Welker, 1997; Bickford, 1999; Busch, 2019). Poly Technologies – a subsidiary of China Poly Group – is a defence manufacturing company connected to violations of the international arms embargo in DR Congo (Amnesty International, 2012). More recently, Poly Group has been investigated for organising 'unreported shipments of sensitive goods' to Russia defence organisations during the war in Ukraine (Garcia, 2023).

Meanwhile, a report by the Asia Maritime Transparency Initiative connects Sansha City Finance Office/Bureau with Chinese Government entities 'operating alongside law enforcement and military' in disputed waters (Poling et al., 2021).

In another case, the vessels Qiong Sansha Yu 000212 and Qiong Sansha Yu 00111 are both directly owned by SFDC (Sansha Fisheries Development Co Ltd), which is itself owned in full by the Sansha City Finance Office. Though conclusive ownership information was not found for the 45 other suspected militia vessels identified in this report registered to Sansha, most are also likely owned by SFDC, which was established in 2015 specifically for the management of Sansha militia vessels (ibid.).

Sansha City is a prefecture-level city under the island Hainan province, located at the southernmost point of China; a report by the US Naval War College says that the town was founded in 2012 'to administer the bulk of its [China's] territorial and maritime claims in the South China Sea' (Haver, 2021). Sansha City Finance Bureau established Sansha City Fisheries Development in February 2015 (ibid.).

Looking at the flags of the foreign vessels, again, most come from China (25.09%), Taiwan, Province of China (21.03%), Japan (16.24%) and South Korea (7.01%).

Table 25 Foreign vessel owners or operators in the Philippine EEZ

Owner or operator	Total	Total %	Types	Address
Usufuku Honten Kabushiki Kaisha	6	2.21	Longliner 100%	Japan
Frabelle (PNG) Co Ltd	5	1.85	Seiner 100%	Papua New Guinea
Nauru Fisheries Development Corp	5	1.85	Seiner 100%	Nauru
Fukuseki Maru Kabushiki Kaisha	4	1.48	Longliner 75%	Japan
Sansha City Finance Office – 三沙市财政局	4	1.48	Trawler 100%	China
Pingtan Marine Enterprise LTD – Fujian Pingtan Ocean Fishery Group Co Ltd – Fuzhou Hong Long Ocean Fishing Co Ltd – 福建省平潭县远洋渔业集团有限公司 – 福州宏龙海洋水产有限公司	3	1.11	Longliner 100%	China
Poly Group Corp – Poly Technologies Inc – Fuzhou Hong Dong Ocean Fishery Pelagic Fishery Co Ltd – 宏东渔业股份有限公司 – 福州宏东远洋渔业有限公司	3	1.11	Seiner 100%	China
Sayra JSC / Общество С Ограниченной Ответственностью Сайра	3	1.11	Squid jigger 67%, Trawler 33%	Russian Federation
Weng Yilan Weng Jianxin – 翁一岚 翁健心	3	1.11	Trawler 100%	China
Caroline Fisheries Corp Inc	2	0.74	Seiner 100%	Micronesia (Federated States of)
Dong Won Industries Co Ltd (동원산업 (주)**)**	2	0.74	Longliner 100%	South Korea
Fong Kuo Fisheries Co Ltd (蔡定邦**)**	2	0.74	Seiner 100%	Taiwan, Province of China
Forepost Llc / Общество С Ограниченной Ответственностью Форпост	2	0.74	Trawler 100%	Russian Federation
Fukutoku Gyogyo Kabushiki Kaisha	2	0.74	Longliner 100%	Japan
Gilontas Ocean Panama SA – Genesis Ocean SA – Tsai Lin Yu Shih	2	0.74	Longliner 100%	Panama
Great Ocean Seafood (FSM) Co Ltd	2	0.74	Seiner 100%	Micronesia (Federated States of)
Hamada Gyogyo Bu Kabushiki Kaisha	2	0.74	Longliner 100%	Japan
Haneda Suisan Yugen Kaisha	2	0.74	Longliner 100%	Japan
Jih Yu Fisheries Co Ltd (柯俊明**)**	2	0.74	Seiner 100%	Taiwan, Province of China
Kasar Fishing Corp	2	0.74	Seiner 100%	Micronesia (Federated States of)

Note: This table only includes the first 2020 companies by the number of vessels they control.
Source: Elaborated by the authors based on Krakken® V15.0 data

Table 26 Main flags in the Philippine EEZ

Flag	Total	Total %
China	68	25.09
Taiwan, Province of China	57	21.03
Japan	44	16.24
Korea, Republic of	19	7.01
Micronesia (Federated States of)	12	4.43
Nauru	10	3.69
Panama	9	3.32
Papua New Guinea	9	3.32
Russian Federation	9	3.32
Belize	5	1.85
Vanuatu	5	1.85
United States of America	3	1.11
Vietnam	3	1.11
Cook Islands	2	0.74
Solomon Islands	2	0.74
Marshall Islands	2	0.74
Netherlands	2	0.74
Denmark	2	0.74

Note: The table does not include flags represented by just one vessel; therefore, percentages will not add up to 100. Source: Elaborated by the authors based on Krakken® V15.0 data

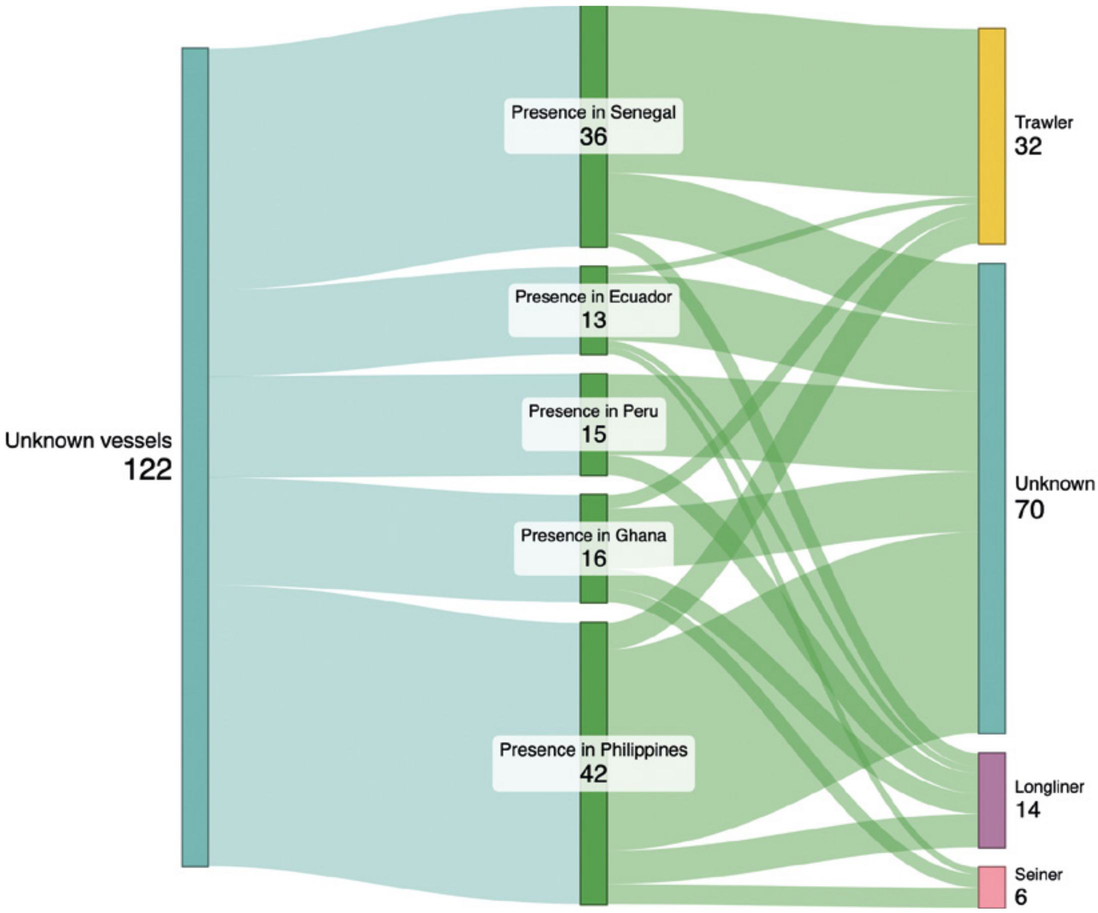
The quality of AIS data in this area is poor, so we have not been able to paint a complete picture of the foreign fleets that operate in the Philippine EEZ. However, data gathered through the Visible Infrared Imaging Radiometer Suite (VIIRS) – collecting visible and infrared images, including night lights – and analysed by the fisheries monitoring group, Karagatan Patrol, showed an increase of about 11,000 industrial-scale vessels monthly from 2012 (Enano, 2019). While it does not identify the vessels, the report indicates that most could come from China and other countries like Vietnam and Taiwan, Province of China, attributing the growth to the weakness of the Philippine Government's vessel monitoring system and the lax enforcement of laws (ibid.). Also according to this report, these foreign ships are edging toward the country's coastline in municipal waters, marginalising domestic vessels that cannot afford to go further out to sea (ibid.). Under the Fisheries Code, municipal waters are areas within 15 km of the coastline. Left unchecked and unregulated, massive-scale fishing negatively affects catches and drives artisanal fisherfolk away (Chavez, 2021).

3.7 Investigating unknown vessel types

In Figure 13, a Sankey plot illustrates how some unknown-type vessels have been categorised using algorithms. We looked at the AIS data of all the vessels whose types we did not know because Krakken® V15.0 did not have the information. The plot shows the number of initial unknown-type vessels with AIS positions, the number detected in each EEZ and how many were categorised by type. Of the 55,291 vessels of unknown type across the 10 fleets (the domestic and foreign fleets in each of the five EEZs), we have AIS positions for 122, which are distributed by flags and types, as shown in Figure 15.

Many of these vessel types remain unknown, but most of those identified were found to be trawlers. Of the vessels of unknown type in Senegal's EEZ, 12 are Chinese, 7 are Senegalese and 6 are trawlers from other nationalities. Of the vessels in the other EEZs, there are two Chinese trawlers in Ghana, one Ecuadorian trawler in Ecuador and three Chinese trawlers and one Korean trawler in the Philippines.

Figure 13 Distribution of vessels of unknown type



Note: Made with Sankeymatic

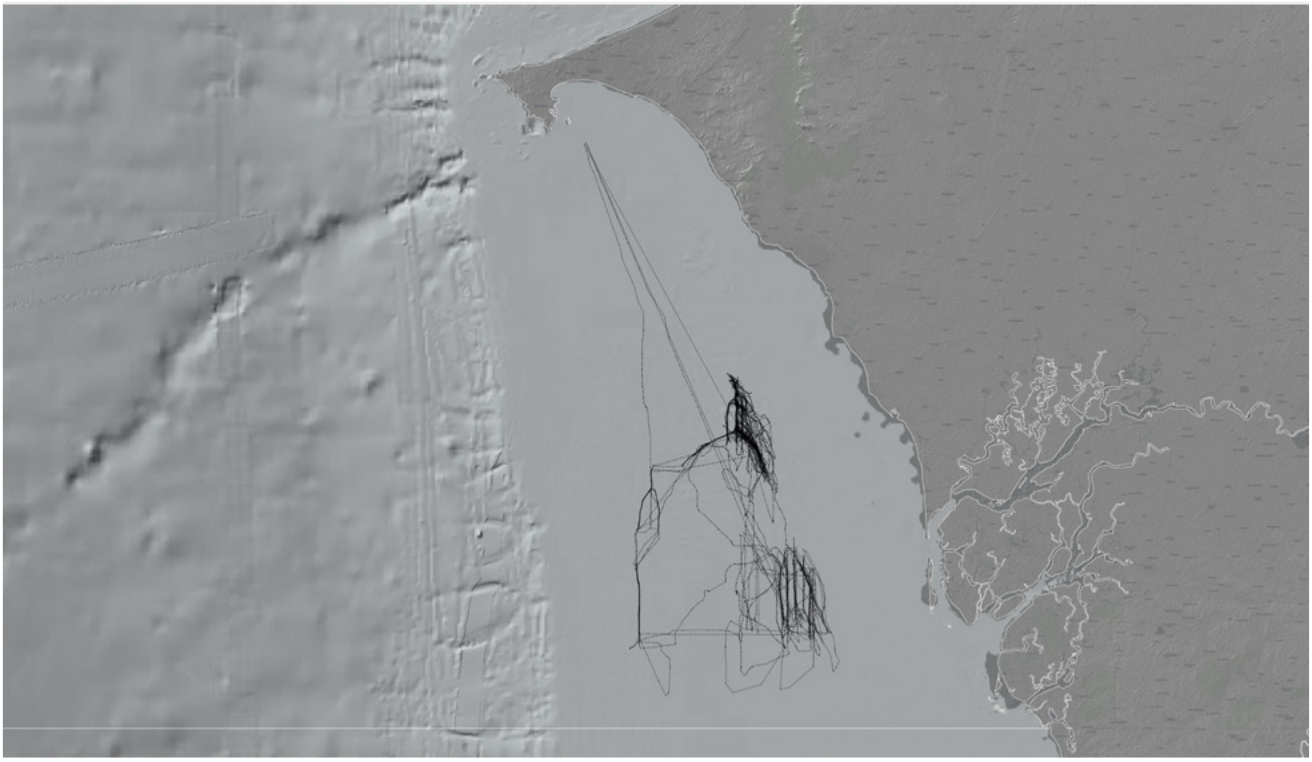
Source: Elaborated by the authors based on ORBCOMM data

The algorithms for this study were conceived with the idea of detecting fishing manoeuvres using AIS data. However, due to a lack of data and the similarities between some fishing manoeuvres and to reduce false positives, we combined the vessel's characteristics (extracted from Krakken® V15.0) with the output of the algorithms to determine if a boat was performing a fishing manoeuvre. Krakken® V15.0 is the baseline regarding boat descriptive information; nonetheless, there was no information about fishing equipment for some vessels, which could have helped determine their type.

In addition to analysing the impact of the different fleets in the EEZs, we used our algorithms to investigate fleets of unknown types.

For this, we considered the possibility of the vessels being any of the main fishing types for which we have algorithms. We analysed their AIS data and examined how many AIS datapoints were likely to be a fishing manoeuvre. Then, if the percentage of points belonging to a fishing manoeuvre was more significant than a threshold, we could assign a type to that vessel.

Figure 14 A vessel of unknown type trawling in Senegal's EEZ



Note: Made with Sankeymatic. Source: Elaborated by the authors based on ORBCOMM data

Figure 14 shows an unknown-type fishing boat performing fishing manoeuvres compatible with trawling behaviour off the coast of Senegal, as detected by our algorithms. The points depicting AIS positions drawing a straight line are unlikely to belong to a trawling fishing manoeuvre, while the rest of the points show AIS positions likely to be compatible with a trawling fishing manoeuvre.

The Philippines and Senegal have most of the unknown-type vessels. However, a significant percentage of the Senegalese vessels could be identified, while most of these vessels in the Philippines remained unknown due to lack of AIS data, except for a few seiners, longliners and trawlers. Poor AIS information or the absence of activity (for example, vessels just crossing the EEZ), among other reasons, can explain the algorithms being unable to identify types.

Nevertheless, the findings are consistent with the known vessel types of the rest of the fleets since, for example, Senegalese waters are crowded with trawlers.

3.8 The most prominent foreign fleets in these waters

Considering we have examined 10 fleets (one domestic and one foreign for each of the five EEZs), we now look at the distribution of these fleets in each EEZ according to their flags to identify the most prominent foreign fleets.
In Figure 15, we consider the domestic and foreign vessels for which we have AIS positions indicating DWF presence in each EEZs under study (refer to Table 1).

To interpret this figure correctly, some issues must be considered. First, it is essential to note that many vessels flagged to Ghana (107), the Philippines (67) and Senegal (16) belong to Chinese companies or are connected to Chinese interests (refer to Table 30). In fact, there are 192 vessels related to Chinese interests in the domestic fleets of all the countries under study, except for Peru. This means there are more Chinese vessels than the ones represented here. Second, when looking at presence denoted by AIS positions, there are some overlaps within these fleets. For example, 75 Ecuadorian vessels were detected inside the Peruvian EEZ. This means some of these 75 Ecuadorian vessels were double counted as present in the Ecuadorian EEZ and as part of the foreign fleet detected inside the Peruvian EEZ.[22] Third, for various reasons, not all vessels emit AIS signals, as explained earlier, so they were not included in this figure.

After Ecuador (with 493 vessels with AIS positions), China emerges as the second largest fleet overall (with 191 vessels), followed by Peru (189), Spain (126), Japan (with 84), Panama (68) and Taiwan, Province of China (with 64). Senegal (57), Ghana (33) and the Philippines (25) are relegated behind.

FoCs play a significant role in the foreign fleets in the five EEZs under study. Table 27 shows the FoCs in the five foreign fleets.

Table 27 Most prominent FoCs in the foreign fleets present overall

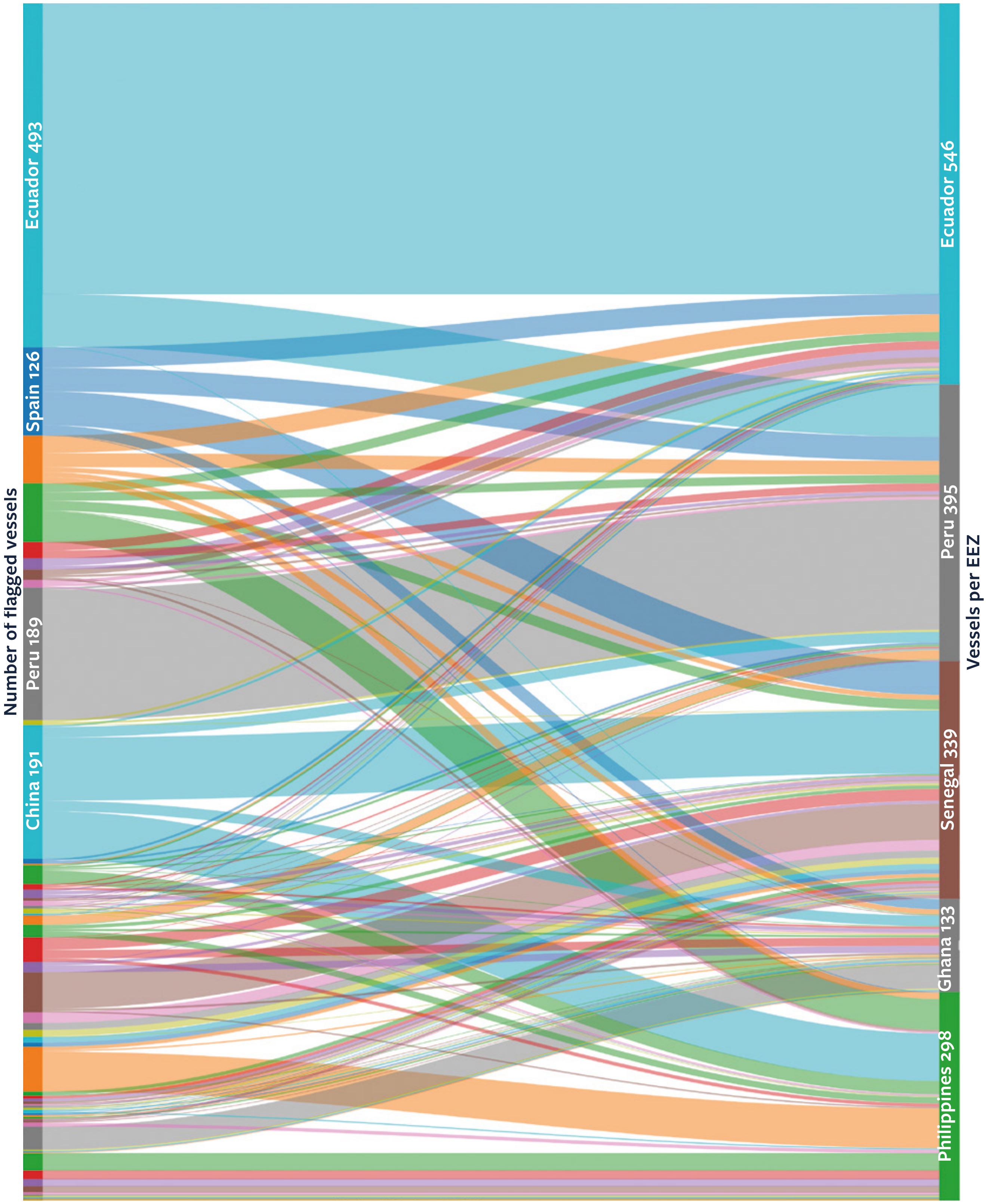
Flag of convenience	Total
Panama	68
Belize	35
Korea, Republic of	27
Cook Islands	11
Cameroon	10
Liberia	7
Vanuatu	6
Bahamas	4
Equatorial Guinea	3
Saint Vincent and the Grenadines	2
Marshall Islands	2
Comoros	2
Tanzania, United Republic of	1
Saint Kitts and Nevis	1
Palau	1
Cambodia	1
Total	181

Source: Elaborated by the authors based on Krakken® V15.0 data.

This list could instigate concerns about safety standards, environmental risks and labour conditions. Especially worrying is the presence of 10 vessels flagged to Cameroon, 6 to Vanuatu and 2 to Comoros, since these are blacklisted FoCs (Paris MOU, 2023).

22 The rest of the overlap includes three Peruvian vessels detected in the Ecuadorian EEZ; three Senegalese vessels in Ghana's EEZ; two Senegalese vessels in the Philippine EEZ; one Ecuadorian vessel in Ghana's EEZ; and one Ghanaian vessel in the Senegalese EEZ.

Figure 15 Distribution of Flags in Each EEZ



Note: Made with Sankeymatic Source: Elaborated by the authors based on Krakken® V15.0 data.

Table 28 looks at the total number of foreign vessels detected in each EEZ and how many are flags of convenience

The table shows that about one-fifth of the foreign fleets is registered with a FoC and 3% of the foreign fleets are registered with blacklisted FoCs.

Table 28 Number of FoCs in the foreign fleets

Country's EEZ	Foreign vessels	FoCs
Ecuador	126	36
Peru	135	32
Senegal	288	44
Ghana	95	24
The Philippines	271	45
Total	915	181

Source: Elaborated by the authors based on Krakken® V15.0 data

4 The presence in these EEZs of firms with blacklisted vessels previously involved in wrongdoing or implicated in diverse unsustainable practices

Permitting access to local fishing grounds and port infrastructures by vessels with a prior record of IUU fishing or wrongdoing results in a danger of backsliding (Belhabib and Le Billon, 2022). We contend it also represents a loss of opportunity for sustainable fisheries.

This chapter examines the fishing companies with vessels in the EEZs of the countries under examination that are suspected of IUU fishing, irregularities or other wrongdoing. To do this, first, we extract all the domestic and foreign vessels linked with the five EEZs that have been signalled by RFMOs, national authorities or non-governmental organisations (NGOs) (such as EJF or Greenpeace) as guilty, under suspicion of engaging in IUU fishing or sighted while behaving questionably and are registered as such in Krakken® V15.0.[23] In total, there are 72 domestic vessels and 70 foreign vessels (142 in total) on this list. Second, to this list we add the companies that own or operate vessels that, in a thorough review of the literature above, have been involved in bribery, irregular licensing practices, saiko operations, illegal trans-shipments, seining in a MPA and other transgressions. The list includes 19 companies that own or operate 657 vessels in these EEZs and the reports on which the list is based (refer to Table 29).

Without assuming that these companies' vessels were indeed involved in illegal fishing, suspicious operations or any wrongdoing during the study period, we selected those vessels owned or operated by any of these firms for which we had AIS data and observed their behaviour. The aim was to identify patterns and trends.

23 We must acknowledge that some of these allegations might not have ended in a court conviction. Collecting evidence for an IUU fishing case involves a thorough and well-documented process to ensure its admissibility in court. Some of the steps may include vessel tracking data and official onboard Inspections; inspecting logbooks, fishing permits and licences; DNA testing; crew statements and expert testimonies; and maintaining the chain of custody.

Table 29 Companies with blacklisted vessels, involved in wrongdoing or unsustainable behaviour with vessels in any of the EEZs under examination

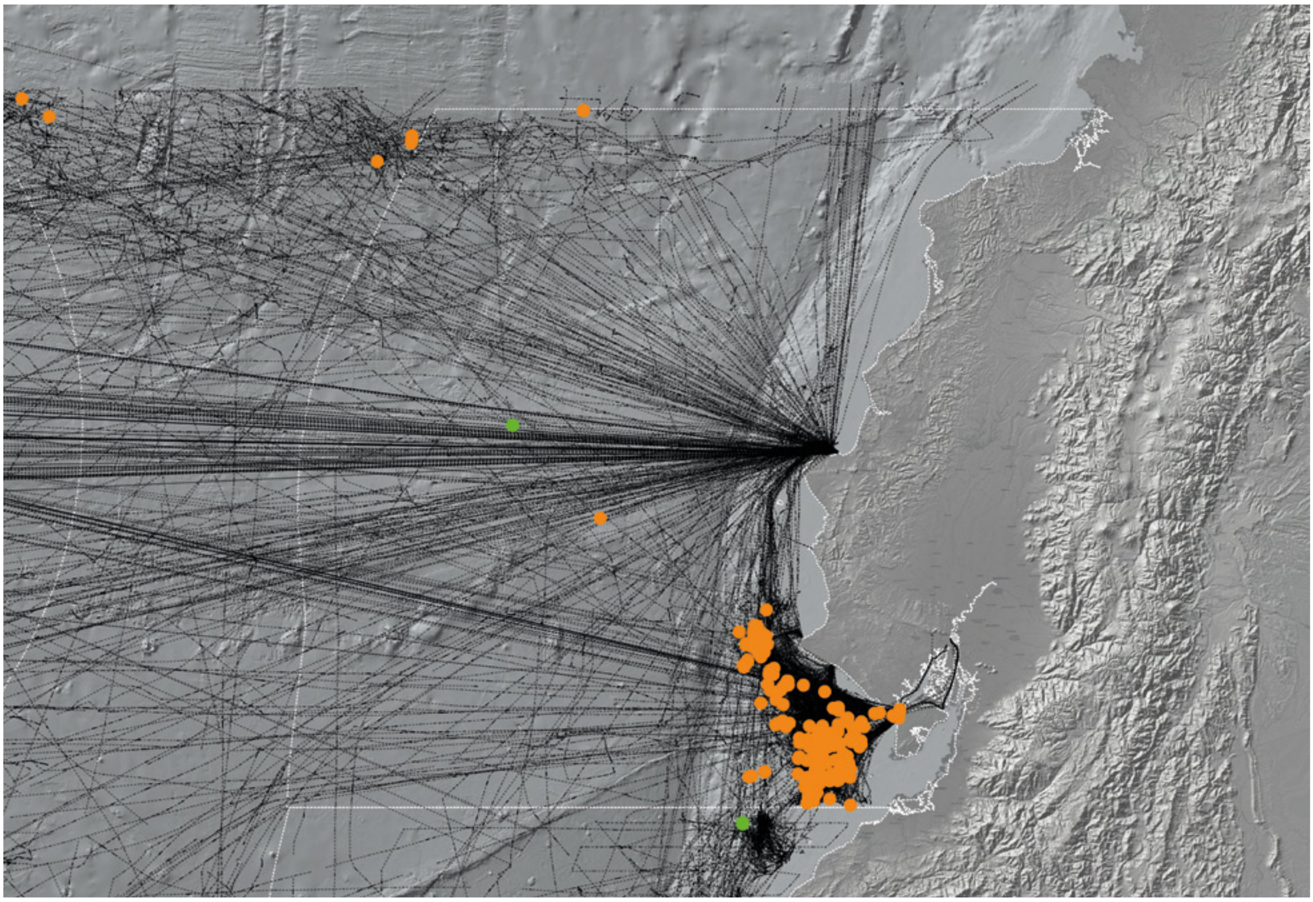
Name of the company	Total vessels	Flags	Vessel types	EEZ(s)	Issues	Sources
Tecnologica De Alimentos SA (TASA) (RUC: 20137916437)	102	Peru 100.00%	Seiner 100.00%	Peru	Discrepancies in reporting Incidental catch	Quevedo Castañeda, 2021; Luna Amancio, 2017; Salazar Herrera, 2021
Corporacion Pesquera Inca SAC (SACOPEINCA) (RUC: 20224748711)	73	Peru 100.00%	Seiner 98.63%, trawler 1.37%	Peru	Discrepancies in reporting Incidental catch	Quevedo Castañeda, 2021; Salazar Herrera, 2011
Pesquera EXALMAR SAA (RUC: 20380336384)	72	Peru 100.00%	Seiner 100.00%	Peru	Discrepancies in reporting Incidental catch	Quevedo Castañeda, 2021; Salazar Herrera, 2011
State Council of The People's Republic of China (PRC) – China National Overseas Fishery Corp (CNFC) – Zhong Yu Global Seafood Corp – 中国水产总公司 – 中渔环球海洋食品有限责任公司	58	China 55.17%, Senegal 44.83%	Longliner 32.76%, squid jigger 6.90%, trawler 46.55%, Unknown 13.79%	Peru, Senegal	Lack of transparency, Underreporting	Daniels et al., 2023; Gutierrez et al., 2020; FIS, 2019a; Greenpeace, 2015
Pesquera Diamante SA (RUC: 20159473148)	55	Peru 100.00%	Seiner 96.36%, unknown 3.64%	Peru	Discrepancies in reporting Incidental catch	Quevedo Castañeda, 2021; Salazar Herrera,
CFG Investments SAC (RUC: 20512868046)	51	Peru 100.00%	Seiner 94.12%, trawler 3.92%, unknown 1.96%	Peru	Exceeding quotas	Quevedo Castañeda, 2021; Salazar Herrera, 2011
Pesquera Hayduk SA (RUC: 20136165667)	44	Peru 100.00%	Seiner 84.09%, trawler 15.91%	Ecuador, Peru	Discrepancies in reporting Incidental catch	Quevedo Castañeda, 2021

Name of the company	Total vessels	Flags	Vessel types	EEZ(s)	Issues	Sources
Pingtan Marine Enterprise Ltd – Fujian Pingtan Ocean Fishery Group Co Ltd – Fuzhou Hong Long Ocean Fishing Co Ltd – 福建省平潭县远洋渔业集团有限公司 – 福州宏龙海洋水产有限公司	41	China 100.00%	Longliner 14.63%, squid jigger 85.37%	Peru, The Philippines	IUU fishing Human rights issues	C4ADS, 2023, 2019; US Treasury Department, 2022; Goodman, 2021
Austral Group SAA (RUC: 20338054115)	38	Peru 100.00%	Seiner 94.74%, trawler 2.63%, unknown 2.63%	Peru	Discrepancies in reporting Incidental catch	Quevedo Castañeda, 2021; Luna Amancio, 2017; Salazar Herrera, 2021
Negocios Industriales Real NIRSA SA	25	Ecuador 100.00%	Gill netter 4.00%, seiner 92.00%, trawler 4.00%	Ecuador, Peru	Listed in Panama Papers	CENAE, 2019; Greenpeace, 2007
Afko Fisheries (Ghana) Co Ltd	20	Ghana 100.00%	Fish carrier 15.00%, pole and line vessel 30.00%, seiner 10.00%, trawler 45.00%	Ghana	Lack of transparency	Sarpong, 2021; Ghana Web, 2018
Pesquera Centinela SAC (RUC: 20278966004)	16	Peru 100.00%	Seiner 87.50%, unknown 12.50%	Peru	Discrepancies in reporting, Incidental catch	Quevedo Castañeda, 2021; Salazar Herrera, 2011
Pesquera Cantabria SA (RUC: 20504595863)	15	Peru 100.00%	Seiner 100.00%	Peru	Discrepancies in reporting, Incidental catch	Quevedo Castañeda, 2021; Salazar Herrera, 2011
Corpesca SA	11	Chile 100.00%	Seiner 100.00%	Peru	Bribery	El Mostrador, 2020; CMS, 2020
Poly Group Corp – Poly Technologies Inc – Fuzhou Hong Dong Ocean Fishery Pelagic Fishery Co Ltd – 宏东渔业股份有限公司 – 福州宏东远洋渔业有限公司	11	China 27.27%, Mauritania 72.73%	Seiner 27.27%, trawler 72.73%	The Philippines	Lack of transparency	Garcia, 2023; Gutierrez et al., 2020; Busch, 2019; Amnesty International, 2012; Bickford, 1999; Welker, 1997

Name of the company	Total vessels	Flags	Vessel types	EEZ(s)	Issues	Sources
Panofi Co Ltd	8	Ghana 100.00%	Fish carrier 12.50%, Seiner 87.50%	Ghana	Fishing without license FADs	Sea Shepherd, 2018; Baird Maritime, 2018
Dalian Ocean Fishery Group – Dalian Ocean Fishing Co Ltd – Dalian Oceanic Fishing Tuna Fishing Co Ltd – 大连远洋渔业金枪鱼钓有限公司	6	China 100.00%	Longliner 100.00%	Senegal	IUU fishing, Human rights issues	US Treasury Department, 2022
State – Owned Assets Supervision and Administration Commission of Liaoning Provincial People's Government – 辽宁省人民政府国有资产监督管理委员会 **– Dalian Ocean Fishery Co Ltd – Liao Yu Group Corp –** 辽渔集团有限公司	6	China 100.00%	Squid jigger 100.00%	Peru	IUU fishing Human rights issues	US Treasury Department, 2022
Albacora SA (Grupo Albacora)	5	Panama 20.00%, Spain 80.00%	Seiner 100.00%	Ecuador, Senegal, Ghana	IUU fishing	Rattle and Duncan-Jones, 2022; Daniels et al., 2022; Greenpeace, 2007, 2014

Note: This table does not include all the companies with issues in the past; it includes a selection of the first 2020, by the number of vessels in the EEZs, from the biggest fleet to the smallest. The references on which this table is based can be found, also, in the literature review with more detail about the issues. Sources: Elaborated by the authors based on Amnesty International, 2012; Bickford, 1999; Busch, 2019; C4ADS, 2023, 2019; CENAE, 2019; CMS, 2020; Daniels et al., 2023; El Mostrador, 2020; FIS, 2019a; Garcia, 2023; Ghana Web, 2018; Greenpeace, 2015, 2014, 2007; Goodman, 2021; Gutierrez et al., 2020; Krakken® V15.0; Luna Amancio, 2017; Quevedo Castañeda, 2021; Baird Maritime, 2018; Rattle and Duncan-Jones, 2022; Salazar Herrera, 2021; Sarpong, 2021; Sea Shepherd, 2018; US Treasury Department, 2022; Welker, 1997

Figure 16 Selected firms' fishing in Ecuador



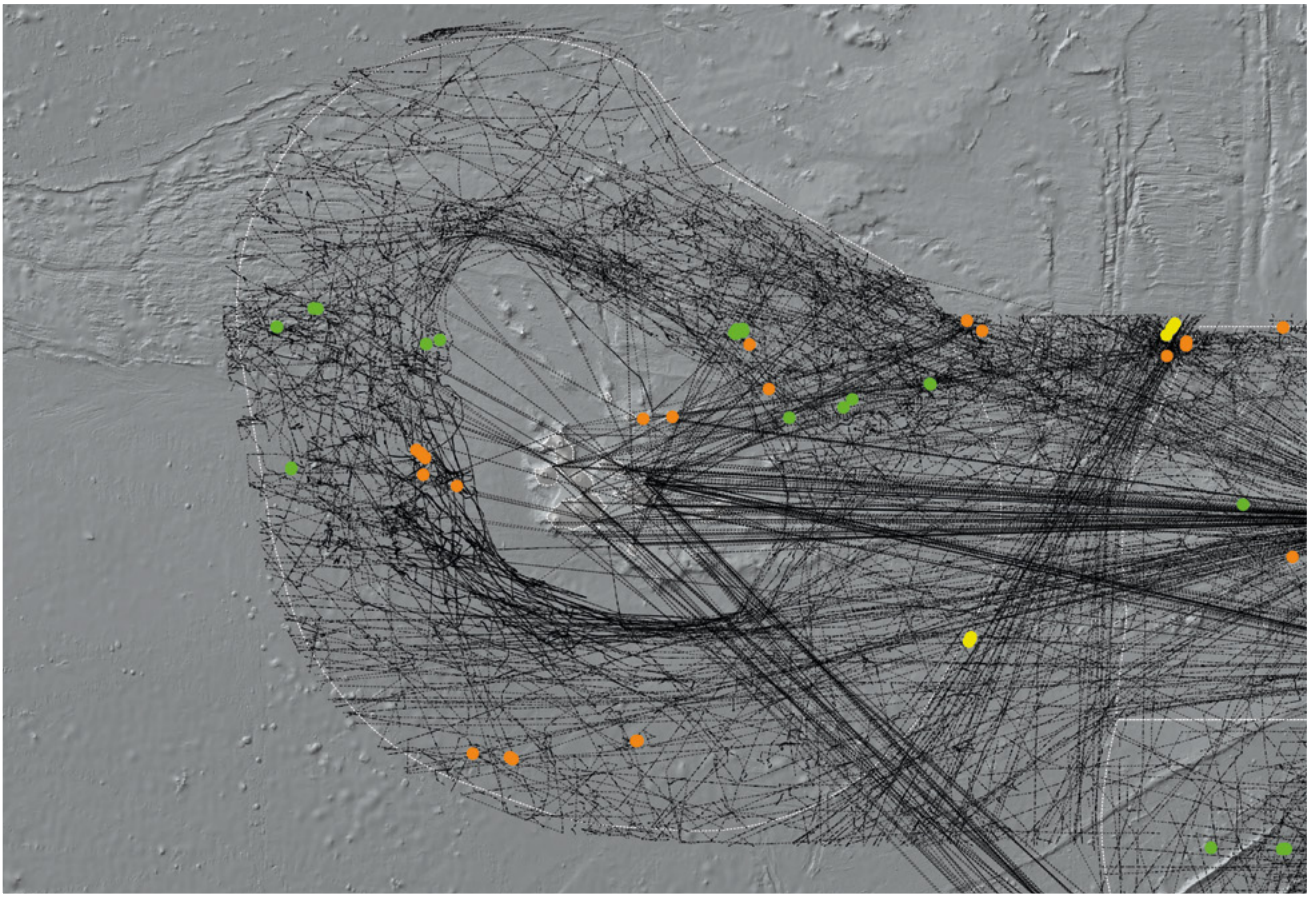
Source: Elaborated by the authors based on ORBCOMM data

Figure 16 shows a concentration of activities by these fleets south of the Ecuadorian EEZ; the sailing activity is highlighted in orange.

Figure 17 shows the activity of selected firms' vessels in the Galapagos. Domestic seiner fishing activity is shown in orange; foreign seiner fishing activity is shown in green. The longliner activity that was detected (yellow dots) was discarded as false positives.

In Peru, we looked at the activity of all vessels belonging to the companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29) and for which we had AIS positions forming clear fishing manoeuvres. Figure 18 shows the selected firms' activity in Peru. Domestic seiner fishing activity can be seen in orange; foreign seiner fishing activity is shown in green.

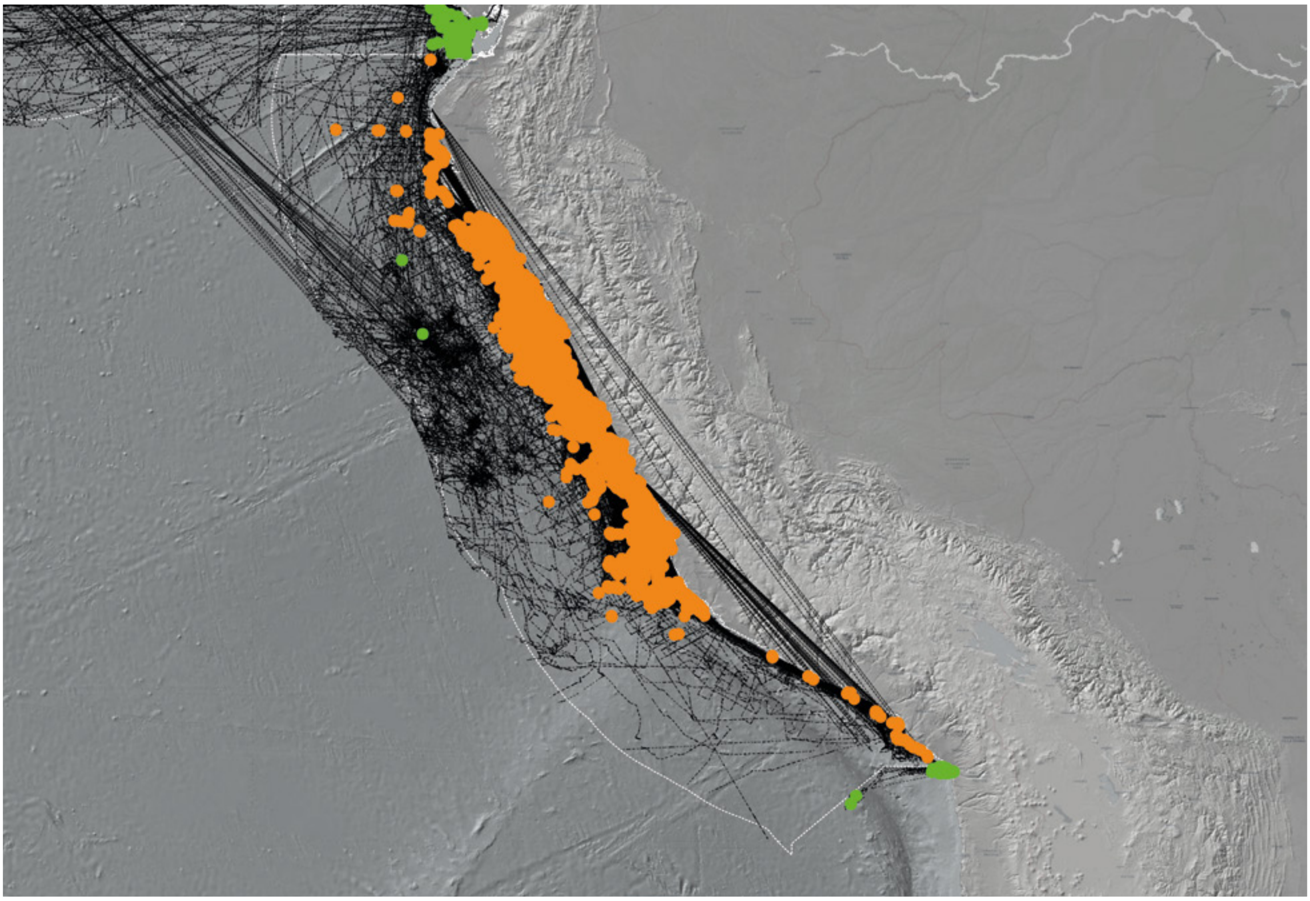
Figure 17 Selected firms' fishing in the Galapagos



Source: Elaborated by the authors based on ORBCOMM data

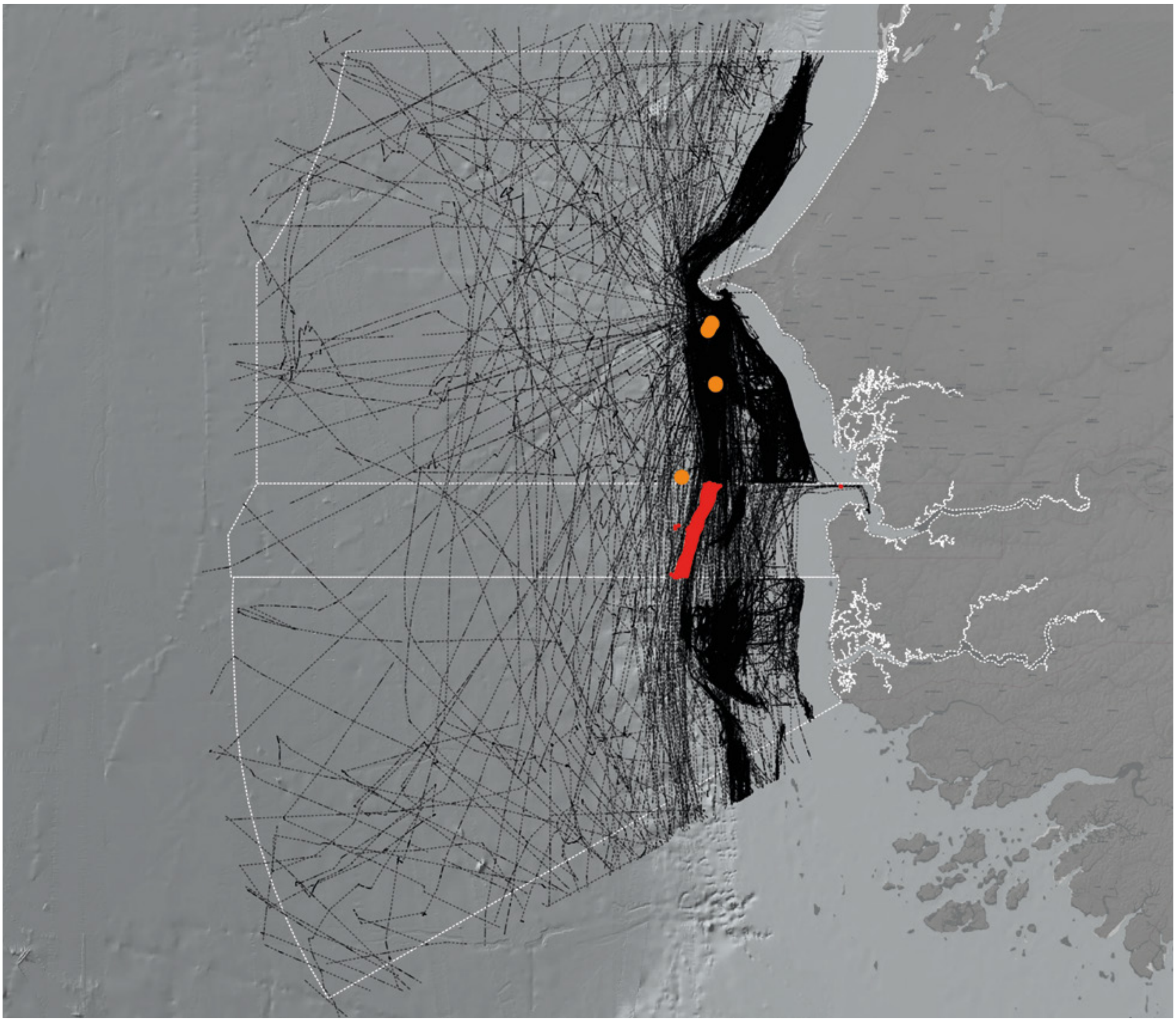
This picture coincides with general seining in this EEZ (refer to Figure 7). However, Figure 18 shows how vessels connected to the selected companies concentrate more along the two northern thirds of the coast.

Figure 18 Selected firms' fishing in Peru



Source: Elaborated by the authors based on ORBCOMM data

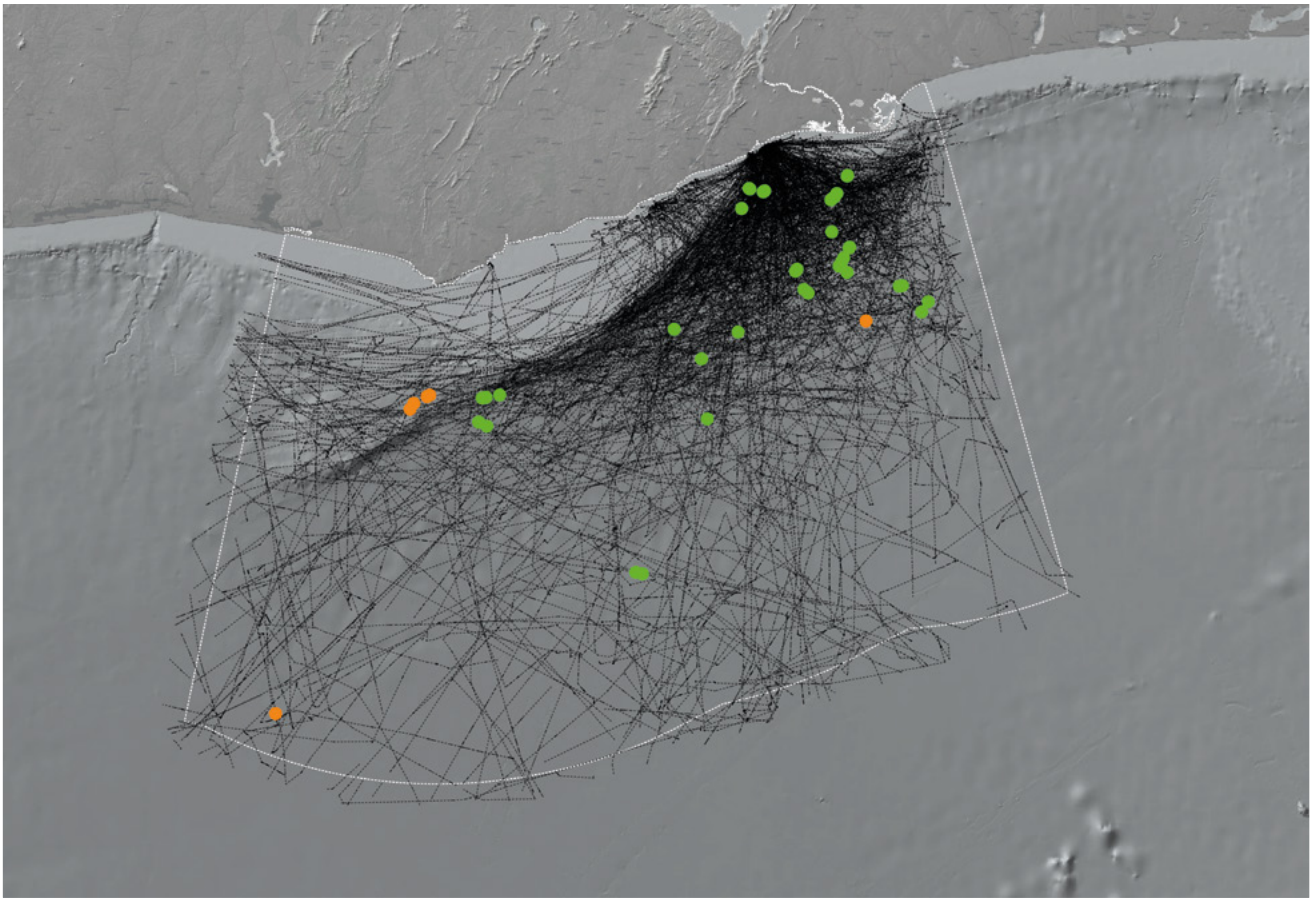
Figure 19 Selected firms' fishing in Senegal



Source: Elaborated by the authors based on ORBCOMM data

Figure 19 shows the selected firms' activity in Senegal. Here, domestic trawler fishing activity is shown in red (in The Gambia's EEZ) and domestic seiner fishing activity is shown in orange.

Figure 20 Selected firms' fishing in Ghana



Source: Elaborated by the authors based on ORBCOMM data

Figure 20 shows the activity of the selected firms in Ghana. Here, domestic seiner fishing activity is shown in orange and foreign seiner fishing is shown in green.

As can be seen, the selected companies' activity includes seining in the south of the Ecuadorian EEZ, seining in the north of Peru's EEZ, Senegalese trawling in The Gambia's EEZ, foreign trawling in the Senegalese EEZ and foreign seining in Ghana.

Considerable efforts are being made to curb IUU fishing and overfishing. Authorities in China – the largest DWF fleet in the world – have reported issuing fines amounting to about $137 million on Chinese companies for fishing illegally in international waters since 2016 (State Council Information Office, 2023). The penalties were part of an intensified push by China, the world's leading seafood exporter, to promote a more sustainable approach to DWF. In 2020, Ecuador joined the GFW platform, facilitating enhanced monitoring of the 1,200 vessels reported as making up Ecuador's industrial and small-scale fishing fleets (Global Fishing Watch, 2020). Ecuador is part of the South Pacific Regional Fisheries Management Organization (SPRFMO) and the IATTC, which will both benefit from this improved transparency. Peru has passed new fisheries legislation, including Supreme Decree No. 016-2016-PRODUCE, which determines a set of rules with which foreign vessels must comply, including that the flag state of the fishing vessel must be a member or mandatory participant of relevant regional fisheries management bodies and authorised by them when relevant. According to these rules, foreign vessels previously engaged in IUU fishing are not allowed in Peruvian waters. The regulation is mainly aimed at controlling squid jigging, which, after anchovy, is the country's second most important fishery. Peru is also a member of SPRFMO and IATTC. In 2018, Peru announced its decision to make its national vessel tracking data publicly available for the first time through GFW (Global Fishing Watch, 2018).

Despite these efforts, more needs to be done. According to the Philippine IUU Fishing Assessment Report 2021, much greater effort is still needed to incentivise the registration and licensing of domestic and foreign fishing boats, since the most prominent contributor by volume to IUU catch is fishing without registration, permits or licences. The report states, 'in areas with weak registration or licensing, there was an increase in illegal fishing, repeat offenders and related violence compared to the previous year' (BFAR, 2022). In Peru, however, Prosecutor Evelyn Lamadrid (quoted in Otoya, 2020) pointed out that one of the main challenges hindering the eradication of IUU fishing was an inability to identify foreign vessels entering the national EEZ because they did not emit AIS or 'went dark'. Similar issues have been identified in the five countries under study.

5 Conclusions of the fleet data analysis

This chapter addresses RQ1 and RQ2. Expected to reach $605.46 billion by 2029 (Fortune Business Insights, 2023), the global seafood market is a critical element in the economies of developing countries. However, this analysis exposes areas of concern about the domestic and foreign fleets operating in the selected case study countries' EEZs of Ecuador, Peru, Senegal, Ghana and the Philippines.

What is the scale, form and behaviour of the domestic and foreign fleets operating within the EEZs of Ecuador, Peru, Senegal, Ghana and the Philippines?

As seen in the 'Main findings' (Chapter 3), most vessels in Ecuador and Peru are seiners and longliners in domestic and foreign fleets. However, there is an over-representation of multipurpose vessels in the Ecuadorian fleet (92.96%) and a significant number of gill netters in the Peruvian fleet (36.47%). Longliners make up 29.37% of the foreign fleet present in the Ecuadorian EEZ and 42.42% of the domestic fleet and 39.26% of the foreign fleet in the Peruvian EEZ. By comparison, seiners make up 48.41% of the foreign fleet in Ecuador's EEZ and 34.07% in Peru's EEZ. Meanwhile, domestic and foreign trawlers are ubiquitous in the domestic and foreign fleets present in the Senegalese and Ghanaian EEZs, representing 64.26% of the domestic and 49.13% of the foreign fleet in the Senegalese EEZ and 23.95% of the domestic and 15.79% of the foreign fleet in the Ghanaian EEZ. Most domestic and foreign vessels in the Philippines are of an unknown type; the foreign fleet in the Philippine EEZ includes a significant number of longliners (29.15%) and seiners (19.93%).

These results are in line with what we have seen in the 100 clear manoeuvres identified and what is described in previous studies (for example, Castrejón and Defeo, 2023; Clover, 2016; Engelen, 2022; EJF Staff, 2020, 2018, 2021b, 2022b).

What are the most prominent foreign fleets in these waters?

Table 30 Chinese vessels in domestic and foreign fleets in the five EEZs

Countries	Domestic fleet	Foreign fleet	Totals
Ecuador	2	4	6
Peru	0	20	20
Senegal	16	101	117
Ghana	107	15	122
The Philippines	67	77	144
Total	192	217	409

Note: The numbers may not exactly match the distribution of flags, as one vessel can be flagged to Ghana but owned or operated by a Chinese company or might represent Chinese interests. To determine a Chinese connection, Gutierrez et al. (2020) examined the vessel's flag; its name and the name of its owners and operators; the vessel's registry port; the owner's or operator's addresses; and whether the vessel had been built in China, among other criteria. Source: Elaborated by the authors based on Krakken® V15.0 data.

Chinese vessels are pervasive both in domestic and foreign fleets, except in the Peruvian domestic fleet. We cross-checked the database with Gutierrez et al. (2020). Table 30 shows the Chinese fleet's distribution in the domestic and foreign fleets in each of the five EEZs. Chinese vessels can be found in 9 of the 10 fleets; the exception is the Peruvian domestic fleet.

After Ecuador (with 417 vessels with AIS positions), China emerged as the second largest fishing nation in the 5 countries under study, with 409 vessels inside domestic and foreign fleets present in any of the countries under study's EEZs. The only exception is the domestic Peruvian fleet, where we identified no Chinese vessels (refer to Table 30).

Significantly, the presence of foreign vessels in domestic fleets raises questions, as it can generate market distortions, encourage exceeding sustainable catch limits and threaten food security and livelihoods (Belhabib, 2017; Belhabib et al., 2014; Belhabib and Le Billon, 2022; Okafor-Yarwooda and Belhabib, 2020). The likelihood of offence occurrence also increases with the reflagging or domestication of foreign vessels (Belhabib and Le Billon, 2022).The operations of Chinese fishing fleets have raised concerns about potential damage to local economies and the environment in Ecuador, Peru and Argentina; these fleets could impact the commercial sustainability of tuna, squid and other species (Torrico, 2020).

Finally, FoCs are used extensively in the foreign fleets operating in the five EEZs under study. An FoC involves a state allowing registration of a foreign vessel and may be associated with low environmental and safety standards or working conditions (ITF, 2023). In some cases, the foreign company is also registered in a tax haven that is also a FoC, which can facilitate the laundering of profits from illegal fishing and concealing wealth from legal operations (Blaha, 2018). Significantly, almost one in five foreign vessels is registered with an FoC, instigating concerns about safety standards, environmental risks and labour conditions. Especially worrying are the 28 vessels flagged to blacklisted FoCs (Paris MOU, 2023).

The foreign fleet with the most significant presence of FoCs operates in Ecuador, while the foreign fleet with the fewest FoCs works in the Peruvian EEZ. Vessels that belong to local companies using FoCs are included in this estimation.

Which are the domestic or foreign companies owning or operating vessels in these countries' waters? Which of them have been involved in any wrongdoing, irregularities or unsustainable behaviour in the past? In Chapter 3, there are detailed tables including the main 20 companies in each EEZ. What is interesting is that a handful of large conglomerates – just 19 companies – owning or operating 657 vessels in these EEZs have been previously involved in wrongdoing, transgressions or unsustainable practices, including incidental fishing, lack of transparency, participation in the saiko barter system and shark finning. This signifies a missed opportunity for sustainable development and the long-term well-being of local fishing communities in Ecuador, Peru, Senegal, Ghana and the Philippines.

Despite not having performed an exhaustive investigation of all the companies emerging in our report, the analysis reveals the substantial presence in these EEZs of firms connected to a series of critical challenges in the fight against overfishing and IUU fishing.[24]

24 We examined five or six of the main foreign companies per EEZ, according to the number of vessels.

Some of the companies identified in this report have been previously linked to:

- weaknesses in fisheries management (for example, Ecuador and Ghana)
- seining in MPAs in Ecuador
- incidental fishing to feed the fishmeal market in Peru
- shark finning in Peru
- serious competition with local fishers (for example, trawling in Senegal)
- the saiko barter system in Ghana
- subsidies despite abusive behaviour
- lack of transparency in the structure of these companies
- questionable use of FADs around the Galapagos

Other concerns include use of tax havens and flags of convenience, environmental damage, harmful subsidies, human rights violations, poor labour conditions aboard fishing vessels and other issues. This does not mean the issues listed in Table 29 are comparable. Some are mere negligence, while others amount to gross violations of law or regulations. Neither do the issues listed in Table 29 indicate that domestic fleets engage in unsustainable practices or wrongdoing or that, taken case by case, these problems are unmanageable. However, the overall challenge is substantive and enduring.

6 Methodology: estimating economic impacts of firms involved in wrongdoing, irregularities or unsustainable behaviour in the case study countries

The economic impact evaluations of Part II aim to assess the potential consequences of unsustainable fishing practices by DWF fleets in five case study countries. These evaluations are structured into three chapters.

This chapter discusses various aspects of evaluating the economic impact of fishing activities by a group of firms, particularly those with blacklisted vessels or a history of wrongdoing. The analysis involves several key components, including tonnage conversion, payload calculation, price determination, economic impact estimation, GDP impacts, employment impacts and poverty impacts.

The next chapter (Chapter 7) estimates the amount and value of two identified key fish species for each country. It details the methodology used for estimating catch values, the reliability and limitations of the data and the calculation of estimates, with a breakdown by domestic or foreign fishing. The final chapter (Chapter 8) provides some higher-level economic impact estimates based on calculations within Chapters 6 and 7.

6.1 Tonnage conversion

This section begins the estimate of impacts by first introducing a tonnage conversion formula to understand net tonnage (NT) from gross tonnage (GT). It also outlines a payload calculation formula representing the quantity of fish carried. These calculations are crucial for assessing the economic output and efficiency of the fishing sector. Subsequently the price of caught fish is determined based on the average per species price. The economic impact of the fishing activities is estimated using a formula involving payload, fish price and a constant factor of 24, providing insights into the financial contribution of the fishing industry. The section then estimates GDP impacts, outlining a methodology to calculate the GDP contribution per ton of fish caught. This involves determining the total GDP contribution of the fisheries sector, dividing it by the total catch in tons and presenting the GDP contribution per ton. This allows for comparing the economic efficiency of the fisheries sector across different countries.

Employment impacts

The analysis extends to employment impacts, presenting the number of direct and indirect workers per ton of caught fish. The data is disaggregated by country, providing insights into the workforce involved in fishing and related activities.

Poverty impacts

The text explores the relationship between GDP growth and poverty reduction, using metrics such as the growth elasticity of poverty (GEP).

The methodology is applied to estimate the potential impact on poverty rates in case study countries, considering factors such as population, current poverty rates and the number of people in poverty.

Conclusion

Overall, the text systematically evaluates the multifaceted impact of fishing activities, encompassing economic, employment and poverty-related considerations. The presented formulas and methodologies offer a comprehensive approach to understanding the consequences of fishing by specific groups of companies on national economies and local communities.

To evaluate these we used the following calculation methods:

Tonnage conversion formula

The gross tonnage (GT) conversion to understand net tonnage (NT) utilises the formula:
NT = GT– (GT × 60%)

The formula assumes an average stowed (fish) factor computed as 60% (as posited by Aanes et al., 2011) of net tonnage, reflecting the portion of the vessel utilised for fish storage.

Payload calculation[25]

The payload, representing the quantity of fish carried, was calculated using the formula:
Payload = NT– (NT × 60%)

Price determination

The price of caught fish is the average per species price covered in Chapter 7, which addresses each of the EEZs.

Economic impact estimation

The estimation of the annual economic impacts attributable to the fishing activities of the group of firms was calculated using the formula:
Payload × fish price

6.2 Estimating GDP impacts

To estimate the GDP contribution per ton, the following methodology was employed:

1. The total GDP contribution of fisheries was first calculated. This was achieved by multiplying the total GDP of each country by the percentage of GDP that fisheries contribute. This gives a dollar value representing the total economic output of the fisheries sector.
2. Subsequently, this total GDP contribution of fisheries was divided by the total catch in tons. The resulting value represents the GDP contribution per ton. This estimates the economic output generated by each ton of fish caught.[26] The 'total catch' refers to the fish caught by the domestic fleet and the foreign fleet present in the EEZ.

This methodology allows for comparing the economic efficiency and productivity of the fisheries sector across different countries.

25 In the study of the economic impacts of the companies with blacklisted vessels or previously involved in wrongdoing, payloads per catch are based on Krakken V15.0 (showing domestic fleets) and ORBCOMM (showing foreign fleets) data. Table 29 uses this data to present the list of selected companies. These calculations are based on Ecuador National Chamber of Fisheries (2023); Globefish (2023); WDI (2023).

26 These calculations are based on Ecuador National Chamber of Fisheries (2023); Globefish (2023); WDI (2023).

Table 31 Fisheries contribution to GDP (2020), $ billion nominal

Country	Total catch (tons)	GDP fisheries ($ billion)	Fisheries % total GDP	Total GDP ($ billion)	GDP contribution ($) per ton
Ecuador	634,000	1.05	1.06	99.29	1,660.07
Peru	5,600,000	1.07	0.53	201.95	191.13
Ghana	393,970	0.58	0.83	70.04	1,475.64
Senegal	462,002	0.37	1.49	24.53	791.13
The Philippines	2,001,945	4.30	1.19	361.75	2,150.33

Sources: Authors' calculations based on Ecuador National Chamber of Fisheries (2023); Globefish (2023); WDI (2023)

In Ecuador, the total catch was 634,000 tons, contributing $1.05 billion to GDP. This represents 1.06% of the country's total GDP of $99.29 billion. So, the GDP contribution per ton of fish caught was $1,660.07.

Peru had a significantly larger total catch of 5.6 million tons. The fisheries sector contributed $1.07 billion to the GDP, 0.53% of $201.95 billion. So, the GDP contribution per ton of fish caught was lower than in Ecuador at $191.13.

In Ghana, the total catch was 393,970 tons. The fisheries sector contributed $0.58 billion to the GDP, representing 0.83% of the total GDP of $70.04 billion. So, the GDP contribution per ton of fish caught was higher than in both Ecuador and Peru at $1475.64.

Senegal had a total catch of 462,002 tons. The fisheries sector contributed $0.37 billion to the GDP, a significant 1.49% of the total GDP of $24.53 billion. So, the GDP contribution per ton of fish caught was $791.13.

Finally, the total catch in the Philippines was significantly larger at 2,001,945 tons. The fisheries sector contributed a substantial $4.3 billion to the GDP, representing 1.19% of the total GDP of $361.75 billion. So, the GDP contribution per ton of fish caught was the highest among these five countries at $2,150.33.

6.3 Estimating impacts in employment

We use the data in the country sections to evaluate how many workers are employed per ton of caught fish to estimate employment impacts. We have also disaggregated the data by direct and indirect employment where possible. To calculate the total, direct and indirect workers per ton, the following methodology was employed:

1. The total number of workers per ton was calculated by dividing the total number of workers by the total catch in tons. This ratio represents the number of workers catching each ton of fish.[27] The 'total catch' refers to the fish caught by the domestic fleet and the foreign fleet present in the EEZ.

27 These calculations are based on World Bank (2023b); Globefish (2023); UNDP (2023); FAO (2021);RFC (2016); Ghana Fisheries Commission (2020); Philippine Bureau of Fisheries (2021).

2. The number of direct workers per ton was calculated by dividing the number of direct workers by the total catch in tons. This estimates the number of workers directly involved in catching each ton of fish.

3. The number of indirect workers per ton was calculated by dividing the number of indirect workers by the total catch in tons. This estimates the number of workers indirectly involved (for example, those involved in processing, marketing, etc.) for each ton of fish caught.

Table 32 Fisheries contribution to employment (2020), no. of workers

Country	Total catch (tons)	Total workers (no.)	Total workers per ton (no.)	Direct workers (no.)	Indirect workers (no.)	Direct workers per ton (no.)	Indirect workers per ton (no.)
Ecuador	634,000	100,000	0.16	58,000	42,000	0.09	0.07
Peru	5,600,000	200,000	0.04	73,600	126,400	0.01	0.02
Ghana	393,970	117,000	0.30	n/a	n/a	n/a	n/a
Senegal	462,002	97,400	0.21	63,000	34,400	0.14	0.07
The Philippines	2,001,945	1,936,613	0.97	1,095,774	840,839	0.55	0.42

Sources: Authors' calculations based on World Bank (2023b); Globefish (2023), UNDP (2023), FAO (2021), SRFC (2016), Ghana Fisheries Commission (2020), Philippine Bureau of Fisheries (2021)

In Ecuador, the total catch was 634,000 tons, with 100,000 workers involved in the fisheries sector. This translates to 0.16 workers per ton of fish caught. Of these workers, 58,000 were directly engaged in fishing (0.09 per ton), while 42,000 were indirectly involved (0.07 per ton) in processing or marketing roles.

Peru had a significantly larger total catch of 5.6 million tons with 200,000 workers in the fisheries sector. This results in a lower ratio of workers per ton at 0.04. Direct workers numbered 73,600 (0.01 per ton) and indirect workers numbered 126,400 (0.02 per ton).

In Ghana, the total catch was 393,970 tons, with 117,000 workers in the fisheries sector. This gives a higher ratio of workers per ton at 0.3. However, data for direct and indirect workers was not available.

Senegal had a total catch of 462,002 tons, with a total of 97,400 workers in the fisheries sector. This translates to 0.21 workers per ton of fish caught. Of these workers, 63,000 were directly involved in fishing (0.14 per ton), while 34,400 were indirectly involved (0.07 per ton).

Finally, the total catch in the Philippines was significantly larger at 2,001,945 tons, with a substantial workforce of 1,936,613 in the fisheries sector. This results in a high ratio of nearly one worker per ton of fish caught (0.97). The number of direct workers also increased to 1,095,774 (0.55 per ton), as did the number of indirect workers at 840,839 (0.42 per ton).

Using this data, we can cross-reference the number of potential local jobs that could be impacted by the activity of domestic and foreign companies that own or operate blacklisted vessels or were involved previously in wrongdoing or unsustainable behaviour, using the estimates of catches within the case country studies.

6.4 Estimating poverty impacts

To estimate the impact of the activities of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29) on poverty, it is important to look at how activities affect GDP (refer to section 6.1) and how these GDP changes affect poverty. First, we need to examine the relationship between GDP and poverty to answer the question: how would a rise in GDP from reducing activities affect poverty nationally and within different sectors? The relationship between GDP growth and poverty reduction is complicated and can be affected by many factors. However, some efforts have been made to measure this relationship:

- GEP is a way to measure how much poverty rates change with a 1% change in income per person (Dollar and Kraay, 2002). For developing countries, GEP estimates usually range from 1.5 to 5, with an average of about 3. This means that a 1% increase in income per person is linked to a 3% decrease in poverty.
- A study by the Operationalising Pro-Poor Growth (OPPG) programme found that, on average, a 1% increase in income per person reduced poverty by 1.7% (OPPGD, 2005).
- Another study, which looked at 158 countries from 1960 to 2010, found that growth and poverty were consistently negatively related. A 10% decrease in the poverty rate was linked to an increase in GDP per person between 0.5 and 1.2% per year (Bergh and Nilsson, 2021).

These numbers help us understand how GDP growth can affect poverty rates. For example, if the estimated GDP growth from the removal of the activities of the selected group of companies is 2% and if the population stays the same, this means a 2% increase in income per person. Using a GEP of 3 (the average for developing countries) suggests that a 2% increase in income per person would lead to a 6% decrease in poverty.

The methodology outlined above, which uses the GEP and changes in GDP to estimate impacts on poverty rates, will be applied to the case study countries listed in Table 33. The table provides current population data, poverty rates and the number of people living in poverty in each country. It also calculates the number of people equivalent to a 1% poverty rate.

For instance, if we consider Ghana, a 2% increase in GDP per capita – assuming the population remains constant – would translate to a 6% decrease in the poverty rate, given a GEP of 3. This decrease in the poverty rate would equate to approximately 2.05 million people (6% of 34.12 million) being lifted out of poverty.

Table 33 Poverty rates

Country	Population (2023)	Poverty rate (%)	Number of people in poverty	People per 1% poverty rate
Ghana	34.12 million	24.2	8.26 million	341,200
Senegal	17.91 million	46.7	8.36 million	179,100
Peru	34.44 million	22.7	7.82 million	344,400
Ecuador	18.25 million	25.0	4.56 million	182,500
The Philippines	117.86 million	16.6	19.56 million	1,178,600

Source: WDI (2023)

7 Economic impacts

7.1 Economic impacts in Ecuador

Ecuador, a South American country, covers an area of 283,561 km² (CIA, 2023). It is located between 1.8312° S latitude and 78.1834° W longitude (World Bank, 2023b). The western part of the country has a coastline of approximately 2,237 km (ibid.) and an EEZ of 1,077,231 km² (FAO, 2023).

Significant rivers such as the Amazon, Marañón and Putumayo traverse the country's landscape (World Bank, 2023b), forming estuarine areas. The country's geographical location and favourable meteorological conditions enhance biological productivity in its marine waters. The upwelling areas along Ecuador's coast, particularly those associated with El Niño events in the Pacific Ocean off the coast of Ecuador, are renowned for their high biological productivity. These areas are characterised by the upward movement of nutrient-rich deep waters to the surface, which promotes the growth of phytoplankton and supports a diverse marine ecosystem (FAO, 2023).

Value and contribution to GDP in Ecuador

Ecuador's fisheries sector made a significant contribution to the country's economy. In 2015, the marine commodities supply chain, including fishers, processors, transportation and refrigeration, represented 1.5% of Ecuador's total GDP (UNDP, 2016). It has remained a significant part of the economy given the continued growth in the sector (The Fish Site, 2023) and, by 2020, represented approximately 1.06% of GDP (Globefish, 2023).

In 2023, Ecuador was one of the world's leading fish producers, with a sizable portion of its production coming from the fisheries sector (The Fish Site, 2023).

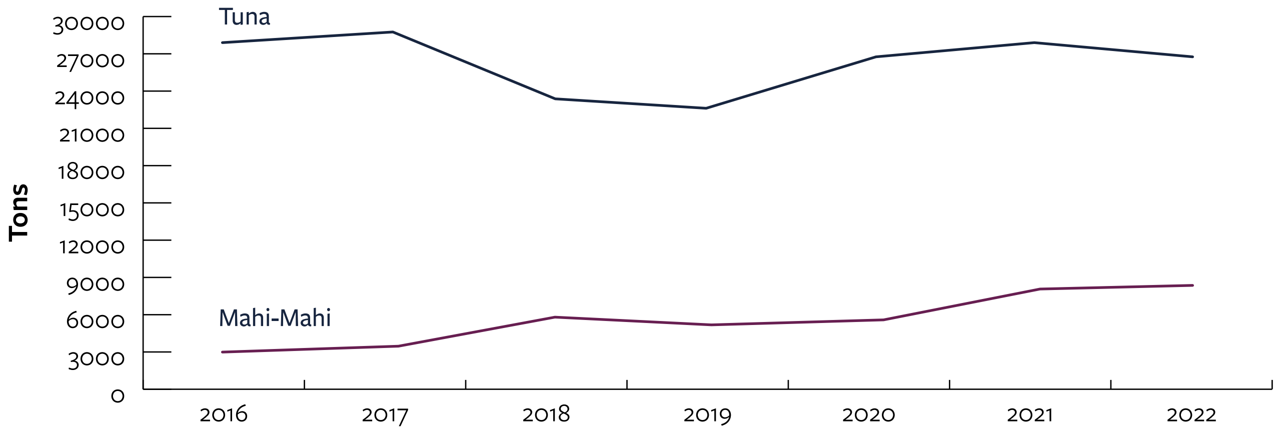
Ecuador has implemented measures to monitor and control its fishing activities. For example, Integrated Aquaculture and Fisheries System (SIAP) software allows Ecuador to monitor its fishing activity to eradicate illegal fishing digitally (FAO, 2023). This software provides authorities with detailed information about each catch, from the boat that caught the fish to its final export (ibid.).

Catch volume in Ecuador

According to Globefish (2023) data, by 2020, the total fisheries production in Ecuador was 634.4 thousand tons. As the National Chamber of Fisheries reported, between 2020 and 2023, tuna and dorado (also known as Mahi-mahi) were the primary species extracted and exported in Ecuador by DWF. This trade association represents the leading fishing companies (National Chamber of Fisheries, 2023). In the case of Mahi-mahi, catches grew between 2016 and 2022, increasing from 2,404 tons in 2016 to 6,681 tons in 2022 (ibid.).

In the case of tuna, catches have varied between 2016 and 2022. In 2018, a decrease (from 286,000 tons to 231,000 tons) lasted until 2020. In 2021, 276,000 tons of tuna were declared and in 2022, there was a downward fluctuation, with 267,000 tons (ibid.).

Figure 21 Ecuadorian tuna and Mahi-mahi catches (tons), 2016–2022



Source: Ecuador National Chamber of Fisheries (2023)

Export data and identification of key fish species in Ecuador

Dorado, a significant resource for Ecuador, showed growth in exports between 2020 and 2021. In 2020, Ecuador exported 4,546 tons of dorado, with a total value of $44 million. By 2022, the export volume had increased to 6,681 tons, with a value of $82.8 million (National Chamber of Fisheries, 2023).

Between 2020 and 2022, tuna exports went down by 30%: from 267,970 tons exported in 2020, with a value of $1.08 billion, it went to 185,507 tons in 2022, valued at $0.87 billion.

Key species fish prices in Ecuador

In 2023, the retail price range for Ecuadorian tuna was between $3.75 and $5.45 per kilogram or between $1.7 and $2.47 per pound (The Fish Site, 2023). The wholesale price range for the same year was between $2.63 and $3.82 per kilogram or between $1.19 and $1.73 per pound (ibid.).

Processors pay approximately between $1850 and $1900 per ton of frozen skipjack tuna, delivered at Ecuador's main tuna fishing docks in the city of Manta.

In the case of dorado (Mahi-mahi), prices also fluctuate according to the season. Wholesale prices per pound (whole pieces) at the dock range from $1.10 to $1.30, while the retail price of the fillet at the public sale dock fluctuates between $2.50 to $3.50.

Employment in Ecuador

Ecuador's fishing sector is a significant source of employment, with approximately 15,500 fishing vessels directly employing more than 58,000 individuals (UNDP, 2023). This makes it the Southeast Pacific Ocean's largest small-scale artisanal fishing fleet (FAO, 2023). In 2001, there were about 61,000 people employed by the Ecuador fishing industry. Up to 100,000 people could be working in the industry now (World Bank, 2023b).

Poverty in Ecuador

The fishing sector in Ecuador, particularly the artisanal and small-scale sector, plays a significant role in the country's economy. It is a major source of foreign currency, second only to mining (FAO, 2010). However, poverty is a significant issue within this sector and only 52% of fishers nationwide have completed secondary education (World Bank, 2023b). Two (2) out of every 100 employees in Ecuador are engaged in fishing. Fishers, boat owners and processors in the artisanal and small-scale sector often rely on assistance from the government, NGOs or informal agents for their operations.

A study titled 'Growing into Poverty: Reconstructing Ecuadorian Small-Scale Fishing Effort Between 1950 and 2018' suggests that most small-scale fishers live in relative poverty. These findings highlight the urgent need for effective regulations and support systems to improve the economic conditions of fishers in Ecuador. IUU fishing threatens the food and nutritional security of some 300,000 Ecuadorians engaged in fishing (FAO, 2019). The Ecuadorian Government has been taking action to clamp down on illegal fishing, as follows (Global Fishing Watch, 2023):

Publishing vessel tracking data

Ecuador shared the movements of its industrial and smaller fishing vessels with the Global Fishing Watch map, allowing authorities to monitor and identify suspicious activity.

Introducing new laws and penalties

Ecuador passed a law in 2020 that increases fines for illegal fishers and prohibits the sale of three endangered shark species.

Implementing the Port State Measures Agreement

Ecuador collaborated with the Ecuadorian Navy and other partners to enforce tighter controls on foreign-flagged vessels entering port, as part of an international treaty to curb illegal fishing.

Supporting fisheries transparency

Ecuador declared its support for fisheries transparency at the 34th Session of the Committee on Fisheries (FAO, 2021b), promoting the use of high-tech surveillance and monitoring platforms to manage its exclusive economic zone.

Estimating the potential impact on Ecuador

The previous section helps justify the two main fish species we focus our analysis on for Ecuador, namely tuna and dorado (Mahi-mahi). Given these two species, the fishing vessels used for the estimates include longliners, which target various tuna species and Mahi-mahi; and seiners, which are employed to catch pelagic fish such as tuna. We examine the potential capacity for impact of the vessels owned or operated by firms with blacklisted vessels, implicated in wrongdoing or involved in diverse unsustainable practices in the past (refer to Table 29).

Seiners comprise the bigger group for the domestic category, with 41 vessels, compared to longliners with 5. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload for seiners, is 15,498.00 tons, while for longliners, it is 212.40 tons, which could be the amount of fish or other sea resources acquired.

Table 34 Catches (tons) by selected firms in Ecuador

Domestic	Vessels	Avg. gross tonnage	Avg. net tonnage	Avg payload (tons)	Aggregated payload (tons)
Seiners	41	1,050	630.00	378.00	15,498.00
Longliners	5	118	70.80	42.48	212.40
Foreign	**Vessels**	**Avg. gross tonnage**	**Avg. net tonnage**	**Avg. payload (tons)**	**Aggregated payload (tons)**
Seiners	10	2,124	1,274.40	764.64	7,646.40
Longliners	4	633	379.80	227.88	911.52

Source: Authors' calculations; data from Table 29 ('Vessels' and 'Avg. gross tonnage')

Table 35 GDP contribution in Ecuador

Fish species	Fishing method	Domestic aggregated payload (tons)	Foreign aggregated payload (tons)
Tuna	Seiners	15,498.00	7,646.40
	Longliners	191.16	820.37
Dorado/ Mahi-mahi	Longliners	21.24	91.15

Source: Authors' calculations based on WDI (2023) and data from Table 29

Table 36 Economics of payloads per catch in Ecuador

	Domestic catch (tons)	Foreign catch (tons)	Price/ton	Domestic catch in $	Foreign catch in $	Total catch in $
Tuna	15,689.00	8,466.77	3,225.00	50,597,541.00	27,305,333.25	77,902,874.25
Mahi-mahi	21.24	91.15	2,645.00	56,179.80	241,091.75	297,271.55
Total	15,710.40	8,557.92		50,653,720.80	27,546,425.00	78,200,145.80

Source: Authors' calculations based on The Fish Site (2023); data from Table 29

Table 37 GDP contribution in Ecuador

GDP contribution ($) per ton	Total catch (tons)	Estimated total GDP	Estimated direct GDP impact	Estimated indirect impact
3,222.31	24,268.32	$78,200,145.80	$40,287,168.72	$38,011,977.08
Percentage fisheries GDP		7.45	3.84	3.62
Percentage national GDP		0.08	0.04	0.04

Source: Authors' calculations based on WDI (2023); GlobeFish (2023)

Likewise, seiners comprise the more extensive group for the foreign category, with 10 vessels, compared to longliners with 4. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload, for seiners, is 7,646.40 tons, while for longliners, it is 911.52 tons (fish or other sea resources).

Thus, foreign seiners and longliners have significantly greater average gross tonnages than their domestic counterparts, suggesting greater potential impacts.

The tonnage variance between seiners and longliners, especially in the foreign sector, highlights the substantial impact different fishing methods can have on sustainable fishing levels. Furthermore, the high tonnage of Mahi-mahi caught by foreign longliners compared to domestic longliners suggests a potential area of focus for regulatory enforcement, assuming these have been illegally caught. Table 35 summarises.

The tuna industry dominates both domestic and foreign catch in companies with blacklisted vessels, previously entangled in wrongdoing or involved in diverse unsustainable practices on each country's GDP (refer to Table 29), with 15,689 tons and 7,646.40 tons respectively, accumulating a total of $77,902,874.25 when sold (refer to Table 36). Mahi-mahi, though caught in much smaller quantities (21.24 tons domestically and 91.15 tons by foreign entities), is valued at $297,271.55.

In total, the combined value of tuna and Mahi-mahi catches in the domestic and foreign markets amounts to $78,200,145.80.

As seen in Table 37, the GDP contribution of the fisheries sector in Ecuador per ton is $3,222.31. With a total catch of 24,268.32 tons, the estimated potential impact of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices on each country's GDP (refer to Table 29) on the GDP stands at $78,200,145.80, equivalent to 0.08% of national GDP. Of this, $40,287,168.72 stems directly from fishing catch activities, while $38,011,977.08 stems from other activities along the fisheries value chain.

For every ton of fish caught, 0.20 jobs are generated (Table 38). This can be divided into 0.10 fishers and 0.10 workers involved in other related roles within the sector. With the given total catch, this translates to an estimated 4,854 total jobs that could have been potentially impacted in the fishing industry by these firms' (refer to Table 29) activity, split evenly between fishers and other workers, with each category employing 2,427 individuals.

Table 38 Jobs analysis in Ecuador

	No. of workers/ton	No. of fishers/ton	No. of others/ton
Jobs per ton	0.20	0.10	0.10
Total jobs	4,854	2,427	2,427

Source: Authors' calculations based on UNDP (2023); World Bank (2023b)

As seen in Table 39, with a population of 18.25 million and a poverty rate of 25%, approximately 4.56 million people live in poverty in Ecuador.

Table 39 Poverty analysis in Ecuador

Population (2023)	Poverty rate (%)	Number of people in poverty	People per 1% poverty rate	Estimated total GDP of catch (%)	Contribution to poverty (no. of people)
18.25 million	25	4.56 million	182,500	0.0788	14,381

Source: Authors' calculations based on WDI (2023)

Given the estimated impact of 0.08% in GDP, potentially 14,381 people could be affected by the activity of the selected companies.

In summary, the potential impact on Ecuador's GDP of the fishing activities of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29), is quantified at $78,200,145.80. When juxtaposed with Ecuador's GDP, the tally of these figures signifies a 7.45% potential impact on the fisheries sector's contribution to national level GDP and a 0.08% impact on GDP at the national level. Regarding employment, for every ton of fish these firms catch, a potential effect is observed on 0.20 jobs. This job effect is divided evenly, with 0.10 jobs for fishers and 0.10 for other related roles per ton. Aggregating these numbers reveals that 4,854 jobs might be influenced by the catch of these companies, which translates to 2,427 jobs for fishers and another 2,427 for roles related to the fisheries sector. Considering Ecuador's population and poverty rate, around 4.56 million individuals are living in poverty. So, the estimated impact on GDP due to the activity of the selected firms may potentially contribute to an additional 14,381 people living below the poverty line.

7.2 Economic impacts in Peru

Peru covers an area of 1,285,216 km². It lies between 0° and 18°S latitude and between 70° and 81°W longitude (CIA, 2021). This geographical positioning means the entire western part of the country has a coastline of approximately 2,414 km (World Bank, 2021) and an exclusive economic zone (EEZ) of 906,454 km² (FAO, 2021a). The Peruvian coast is marked by significant rivers, such as the Amazon, Purus, Jurua, Marañón and Ucayali (World Bank, 2021), contributing to the formation of estuarine areas. This geographical location is combined with meteorological conditions that are highly favourable for biological productivity in the country's marine waters. The upwelling areas along the Peruvian coast, particularly those associated with the Humboldt Current System, are renowned for their high biological productivity (FAO, 2021a). These areas are characterised by the upward movement of nutrient-rich deep waters to the surface, promoting the growth of phytoplankton and supporting a diverse marine ecosystem (FAO, 2021a).

In 2020, Peru was one of the world's top fish producers, with a total catch of 5.77 million tons, of which 98% came from fisheries and the remaining 2% from aquaculture (Globefish, 2023). The annual fisheries catch varies, with recent years seeing between 4 million and 8 million tons (FAO, 2021a). The fisheries sector significantly contributed to Peru's economy in 2020, accounting for about 0.53% of the country's GDP (Globefish, 2023). Furthermore, the export of fish and fish products brought in an estimated $2.8 billion that year. However, artisanal fisheries, which account for a significant portion of total fish production, generated substantial value (FAO, 2021a). Artisanal fisheries consistently make up most of the catch.

The marine fishing fleet of Peru is divided into artisanal and industrial vessels. The artisanal fleet predominantly comprises small-scale fishers operating in the coastal regions. Although there is no precise count of the number of artisanal vessels, around 2,500 vessels are estimated to be involved in squid fishing alone (FAO, 2020a). The industrial fleet exhibits more diversity, encompassing a variety of vessel types such as purse seiners, trawlers, longliners and gill netters (FAO, 2020a). As of 2018, more than 1,400 industrial and artisanal vessels used for fishing anchovy, hake, cod, eel, tuna, squid and Mahi-mahi had been publicly monitored (Global Fishing Watch, 2018).

In addition to the domestic fleet, foreign vessels operate in Peruvian waters. The Peruvian Association of Maritime Agents highlights the illicit fishing activities of a Chinese fleet, comprising more than 600 vessels, in Peruvian waters, specifically targeting squid (APAM, 2022). This illegal activity poses a significant challenge for Peru, with an estimated annual loss of approximately 50,000 tons of squid due to illegal fishing by these Chinese vessels, as reported by the Peruvian CALAMASUR[28] (Fish Information and Services, 2023). Experts and industry stakeholders underscore the urgency of addressing this issue. Concerning tuna, a parallel finding by Myers et al. (2022) raises concerns about the extensive Chinese fishing operations and their potential detrimental impacts on local economies and the environment in Ecuador, Peru and Argentina. The report suggests that these operations may be compromising the commercial sustainability of tuna, squid and other species. Notably, the report identifies nearly 3,000 vessels in the Chinese fleet that have significantly depleted the supply in their own coastal waters.

Peru has implemented measures to monitor and control its fishing activities. The Peruvian Government has taken several actions to combat illegal fishing, as follows:

- **Publishing vessel tracking data:** Peru has partnered with GFW to improve vessel monitoring and address illegal, unreported and unregulated fishing in Peruvian waters (Global Fishing Watch, 2023b).
- **Implementing a PRODUCE decree:** In 2018, Peru implemented a decree that mandates the use of VMS devices across domestic and foreign vessels that dock in Peruvian ports (ibid.).
- **Cracking down on illegal fishing:** The government has been working with the World Wide Fund for Nature (WWF) since 2021 to implement a pilot programme to create and strengthen fishing cooperatives, which will reduce illegal, unregulated and unreported (IUU) fishing (Aronson, 2023).
- **Implementing a catch register and developing a traceability system:** As part of the programme, fishing cooperatives are required to implement a catch register and develop a traceability system. In exchange, the members are provided with fishing licences and vessel registration (Aronson, 2023).

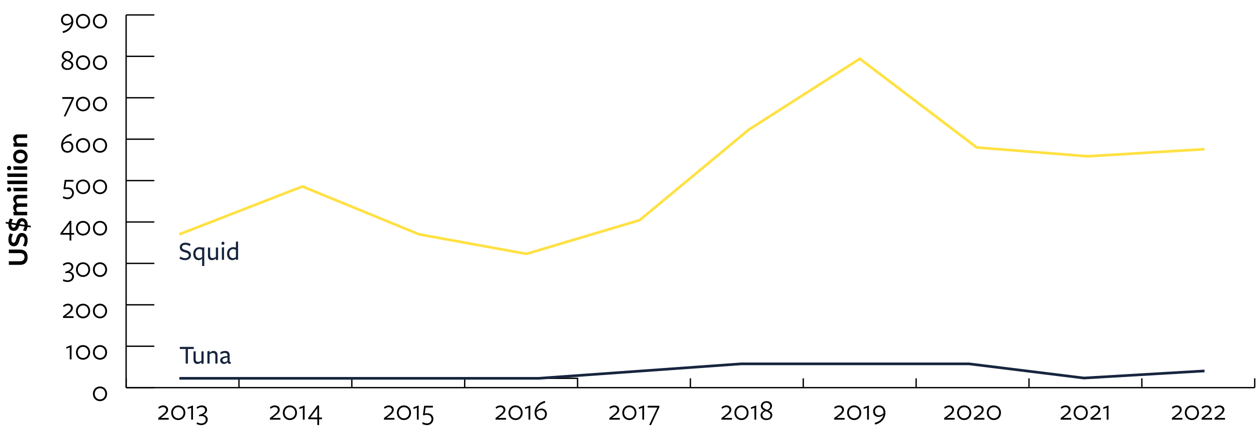
Data on the export of fish from Peru in 2020 found that the two main types of migratory species exported from the country were squid worth $597.8 million and tuna worth $46 million (Globefish, 2023). More recent data from the

28 That is, the Committee for the Sustainable Management of the Giant Squid of the South Pacific.

Government of Peru suggests that tuna and squid exports marginally declined in 2022 to $41.4 million and $582.5 million, respectively (Ministerio de la Producción, 2023).

According to a report by Oceana, squid was the most significant species in terms of frozen products, accounting for 65% of export volume and 44% in dollar value (Oceana, 2022). A total of 252,302 tons of squid were exported (ibid.). Squid fishing has become the second-biggest fishing activity in Peru in terms of catch volume and contribution to export revenues (FAO, 2021a).

Figure 22 Peruvian tuna and squid exports by value (US$ million), 2013–2022



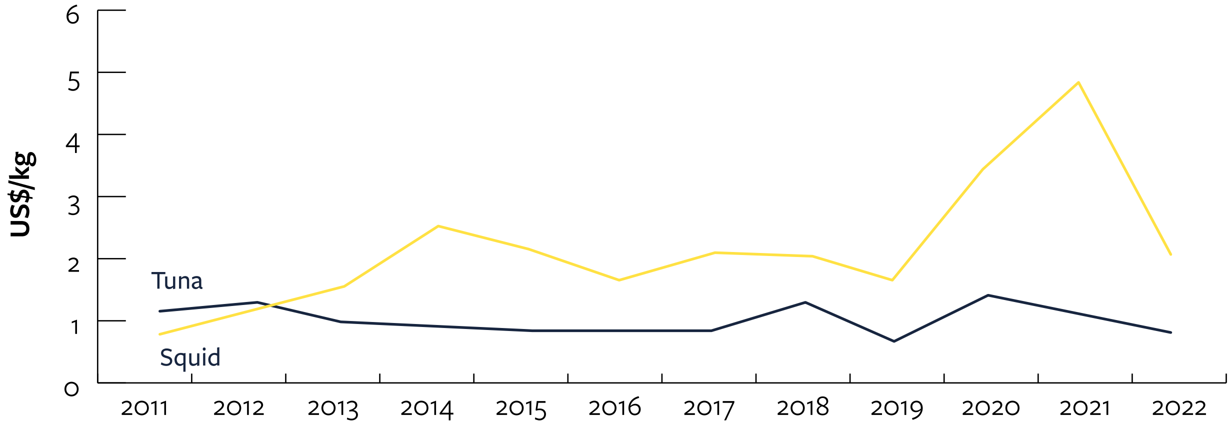
Source: Peru Ministerio de la Producción (2023)

Prices in Peru

Regarding the domestic prices of tuna and squid, official government data provided offers an insightful look into the fluctuating prices of tuna and squid from 2011 to 2022. The price of tuna peaked in 2020 at $1.41 per kilogram, while the lowest price was observed in 2019 at $0.67. Interestingly, the price of tuna in 2022 was $0.81, marking a decrease from the previous year's price of $1.05. On the other hand, squid prices followed a different trend. The highest price was recorded in 2021 at a staggering $4.84, while the lowest was in 2011 at $0.83.

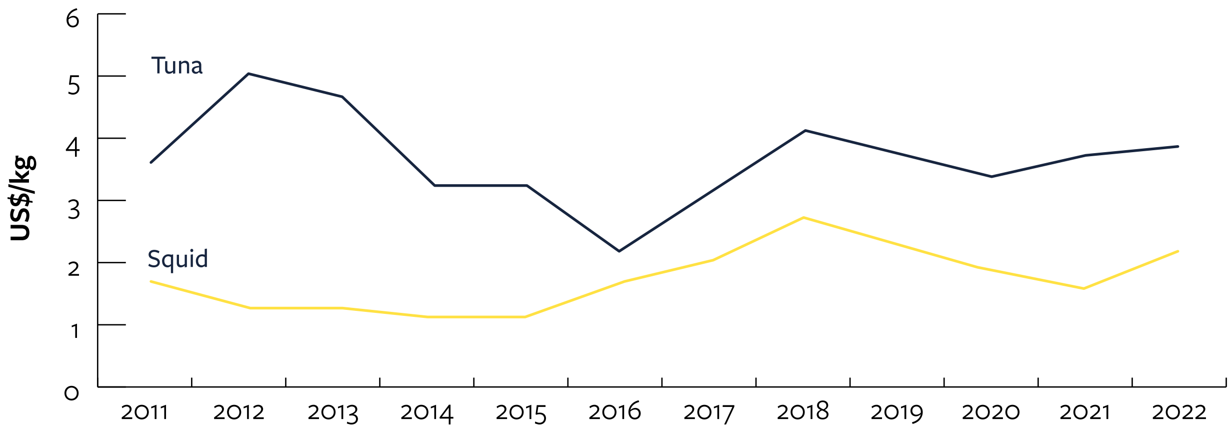
Like tuna, the price of squid in 2022 ($2.06) also decreased from its peak in the previous year (Ministerio de la Producción, 2023 (Peru)).

Figure 23 Domestic Peruvian tuna and squid prices (US$/kg), 2011–2022



Source: Peru Ministerio de la Producción (2023)

Figure 24 Peruvian tuna and squid export prices (US$/kg), 2011–2022



Source: Peru Ministerio de la Producción (2023)

For export prices, in the case of tuna, the price reached its peak in 2012 at $5.01 per kilogram, while the lowest price was observed in 2016 at $2.18. Notably, the price of tuna in 2022 was $3.84, showing an increase from the preceding year's price of $3.71. Conversely, squid prices followed a slightly different trajectory. The highest price was recorded in 2018 at $2.74, while the lowest price was seen in 2015 at $1.16. Like tuna, the price of squid in 2022 ($2.17) also increased from its previous year's price.

Employment in Peru

In terms of employment, the fisheries sector provides jobs for many people. For instance, fisheries activities producing goods for human consumption account for about 230,000 jobs, 87% of which are in the fisheries sector (FAO, 2021a). Artisanal fisheries in Peru play a twin role: first, as a key source of employment, they significantly help to mitigate poverty and second, as an important provider of protein food for the poorer population groups (ibid).

Poverty in Peru

Most small-scale fishers in Peru are currently living in poverty. The growing fishing effort is unsustainable and uneconomic, resulting in significant declines in the fleet's ratio indicators (that is, catch per unit of effort, revenue per unit of effort and fishers' incomes relative to Peru's minimum wage). Yet, fishers using the least selective fishing gear or those engaged in illegal fishing, had the most stable incomes (Béné et al., 2019). These conditions can be influenced by a variety of factors, including environmental changes such as El Niño events (Dell et al., 2014; Godfray et al., 2010), as well as social, legal and economic drivers (Béné et al., 2019).

Estimating the potential impact on Peru

The previous section helps justify the two main fish species we focus our analysis on for Peru: tuna and squid. Given these two species, the types of fishing vessels used for the estimates include longliners, used to target a variety of tuna species, among others; seiners, used to catch shoal or school pelagic fish, including tuna; and squid jiggers, specialised vessels using jigs to catch squid.

Seiners comprise the larger group within companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29), with 454 vessels for the domestic category, compared to 1 longliner. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload, is for seiners 54,425.52 tons, while for longliners it is 255.24, which could be the amount of fish or other sea resources acquired.

Likewise, seiners comprise the more extensive group for the foreign category, with 14 vessels compared to 5 longliners. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload, is for seiners 4,752.72 tons, while for longliners, it is 1,114.2. For squid jiggers, it is 4,212.00 tons, almost the same amount as that for seiners.

Thus, due to their profusion, domestic seiners have a higher average gross tonnage than their foreign counterparts. In contrast, foreign longliners, especially squid jiggers have significantly larger average GTs than their domestic counterparts, suggesting greater potential impacts.

The data shows the capacity for impact of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29). The tonnage variance between seiners and longliners highlights the substantial impact different fishing methods can have on fishing levels.

The tuna seiners' captures are substantial for domestic vessels, with a tonnage of 54,425.52. However, the longliners starkly contrast with a relatively minimal tonnage of 255.24 for tuna, indicating a lesser extent of activity of this group of vessels. Moreover, there are no recorded activities for squid jiggers, suggesting either a lack of engagement in squid fishing or better regulatory compliance in the domestic sector.

Table 40 Catches (tons) by selected firms in Peru

Domestic	Vessels	Avg. gross tonnage	Avg. net tonnage	Avg. payload (tons)	Aggregated payload (tons)
Seiners	454	333	199.80	119.88	54,425.52
Longliners	1	709	425.40	255.24	255.24
Squid jiggers	0				
Foreign	**Vessels**	**Avg. gross tonnage**	**Avg. net tonnage**	**Avg. payload (tons)**	**Aggregated payload (tons)**
Seiners	14	943	565.80	339.48	4,752.72
Longliners	5	619	371.40	222.84	1,114.20
Squid jiggers	9	1,300	780.00	468.00	4,212.00

Source: Authors' calculations; calculations and data from Table 29 ('Vessels' and 'Avg. gross tonnage')

Table 41 Summary of payloads per catch in Peru

Fish species	Fishing method	Domestic aggregated payload (tons)	Foreign aggregated payload (tons)
Tuna	Seiners	54,426.00	4,752.72
	Longliners	255.24	1,114.20
Squid	Jiggers	0	4,212.00

Source: Authors' calculations; data from Table 29

Table 42 Economics of payloads per catch in Peru

	Domestic catch (tons)	Foreign catch (tons)	Price/ton	Domestic catch in $	Foreign catch in $	Total catch in $
Tuna	54,680.76	5,866.92	3,840	209,974,118.40	22,528,972.80	232,503,091.20
Squid	0	4,212.00	2,170	0	9,140,040.00	9,140,040.00
Total	54,680.76	10,078.92	—	209,974,118.40	31,669,012.80	241,643,131.20

Source: Authors' calculations based on Ministerio de la Producción (2023); WDI (2023); data from Table 29

Table 43 GDP contribution in Peru

GDP contribution ($) per ton	Tons catch tons	Estimated total GDP	Estimated direct GDP impact	Estimated indirect impact in $
3,731.38	64,759.68	241,643,131.20	12,377,517.64	229,265,613.56
Percentage Fisheries GDP		22.58	1.16	21.43
Percentage National GDP		0.12	0.01	0.11

Source: Authors' calculations based on WDI (2023); GlobeFish (2023)

Within foreign vessels, a different scenario unfolds. The gross tonnage for tuna seiners is significantly higher (about three times bigger than the average domestic seiner). In contrast, the gross tonnage by longliners is like the domestic longliners in this group of vessels. Table 43 shows that the fishing industry contributes $3,731.38 in Peru for every ton caught. With a significant catch of 64,759.68 tons, the industry adds an estimated total of $241,643,131.20 to GDP. Of this total, the direct GDP impact is $12,377,517.64, leaving a substantial indirect contribution of $229,265,613.56. When evaluated in terms of the country's fisheries GDP, this industry accounts for 22.58%. It represents 1.16% of the total estimated GDP and 21.42% as an indirect impact. Furthermore, in the broader context of Peru's national GDP, the fishing industry's contribution stands at 0.12%, with a 0.01% direct impact and an indirect influence of 0.11%. This suggests that while the fishing industry is a significant component of fisheries GDP, the direct impact of the activity of these companies on the national GDP remains marginal; however, the indirect impacts are noteworthy.

Regarding potential estimated employment impact (Table 44), for every ton of fish caught by these companies, a total of 0.03 jobs are affected. This is broken down into 0.01 fishers and 0.02 other jobs within the fisheries value chain per ton. Given the catch, this employment distribution results in 1,943 jobs being potentially affected.

Table 44 Jobs analysis in Peru

	No. of workers per ton	No. of fishers/ton	No. of others/ton
Jobs per ton	0.03	0.01	0.02
Total jobs	1,943	648	1,295

Source: Authors' calculations based on FAO (2021)

Table 45 Poverty analysis in Peru

Population (2023)	Poverty rate (%)	Number of people in poverty	People per 1% poverty rate	Estimated total GDP of catch (%)	Contribution to poverty (no. of people)
34.44 million	22.7	7.82 million	344,400	0.1197	41,225

Source: Authors' calculations based on WDI (2023).

As seen in Table 45, given the estimated GDP impact above of 0.12%, it is projected that these companies' activities could affect an additional 41,225 individuals.

In other words, these companies' catches' potential economic contribution to the Peruvian GDP is $241,643,131.20. The combined catch from these activities signifies a 22.58% impact on the fisheries sector's GDP contribution and a 0.12% impact on national GDP. Employment-wise, every ton of fish caught has an impact on 0.04 jobs. This employment effect is spread across 0.01 jobs directly for fishers and 0.02 jobs in related sectors per ton. When aggregated, these figures mean that up to 2,590 jobs in total might be influenced by the catch, including 648 jobs for fishers and 1,295 for other related roles in the industry. Considering the estimated GDP contribution of 0.12%, the fishing activities of these companies might potentially lead to an additional 41,225 individuals living in poverty.

7.3 Economic impacts in Senegal

Located in West Africa, Senegal spans an area of 196,722 km², situated between 12° and 17°N latitude and between 11° and 18°W longitude. This geographical position provides the entire western part of the country with a lengthy coastline of approximately 700 km and an EEZ of 180,895 km². The Senegalese coast is also characterised by estuarine areas formed by the Senegal, Sine Saloum and Casamance rivers. This geographical location is combined with favourable meteorological conditions for high biological productivity in the country's marine waters, where there is a seasonal upwelling phenomenon (Bousso, 2022).

With an annual catch rate of 450,000 tons per year, for the past five years, Senegal has been the second-largest fish producer in West Africa, behind Nigeria (530,000 tons) and closely followed by Ghana (344,000 tons). The fisheries sector is a significant pillar of Senegal's economic and social development. It contributes to 3.2% of Senegal's GDP and accounted for 10.2% of Senegal's exports in 2021. It is the leading export branch with over 250 billion CFA francs (XOF) in 2021. The fisheries sector employs around 600,000 people working at different levels of the value chain (ibid.).

In 2021, Senegal's total marine fisheries landings reached 462,002 tons, valued at XOF227 billion. This represented a decline over the previous two years. Artisanal fisheries, which account for at least three-quarters of total fish production, generated XOF139 billion in 2021, corresponding to 61% of the total. Artisanal fisheries consistently make up most of Senegal's catch (ibid.).

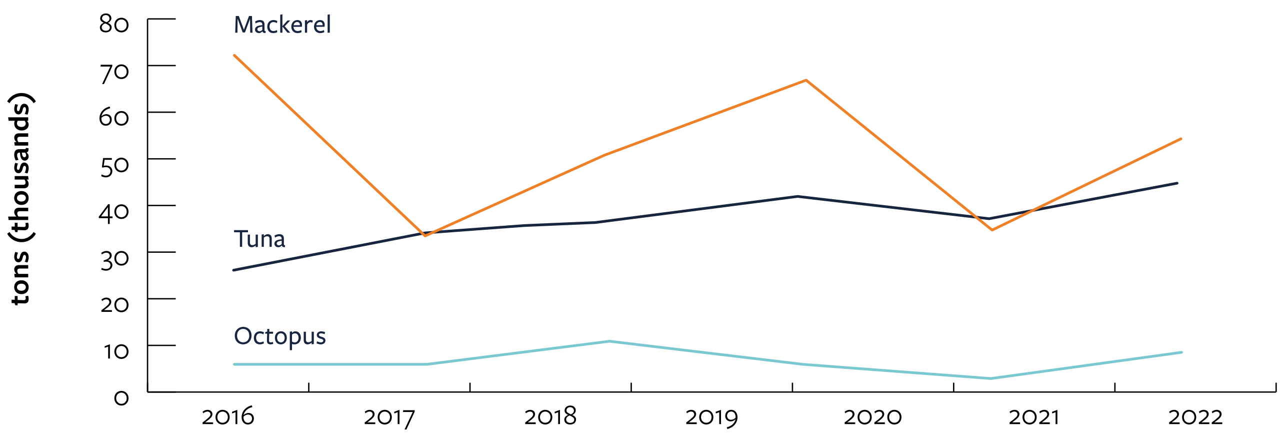
Senegal's marine fishing fleet consists of artisanal canoes and industrial vessels. In 2019, official data from the Directorate of Marine Fisheries recorded 12,864 canoes. However, it is important to note that there are thousands of unregistered canoes, with unofficial data suggesting at least 20,000 fishing canoes operating in Senegalese marine waters. About 90% of the artisanal fishing fleet is motorised and uses a variety of fishing gear depending on the target species (ibid.).

Regarding the industrial fishing fleet, the main official classification criterion is the type of license, which depends on the group of species targeted. In 2019, there were 129 industrial vessels officially operating in Senegalese marine waters. Among them, only 15% were foreign. However, several vessels have been nationalised through a joint-venture process with national operators. While most of the national industrial fishing fleet holds demersal fishing licenses, foreign vessels mainly target large pelagic fish, primarily tuna (ibid.).

According to FAO data, tuna, mackerel and octopus are the three main species targeted by DWF in Senegal. Figure 25 shows the capture production from 2016 to 2021. The production has significantly fluctuated in recent years. In 2021, mackerel comprised 50% of the production, while octopus represented 8%.

Senegal saw a significant increase in total fish exports from 2016 to 2021. The volume of fish exports increased by 46%, from 221,263 tons in 2016 to 322,283 in 2021 (Globefish, 2023). The value of these exports also saw a substantial increase of 52% during the same period. Table 46 provides a breakdown of Senegalese fish exports by species.

Figure 25 Volume of production (tons) of tuna, mackerel and octopus



Source: Peru Ministerio de la Producción (2023)

Table 46 Volume of production (tons) of tuna, mackerel and octopus in Senegal

Species	Export value ($)
Fish, other than species in HS 0303	116,536,310
Jack, horse mackerel	51,289,690
Tuna, skipjack, bonito	51,287,570
Sardine, sardinella, brisling or sprats	35,594,350
Fish, other than species in HS 0302	31,974,070
Tuna	30,401,270
Shrimp, prawn	30,377,560
Mackerel	30,203,800
Octopus	26,244,830
Squid, cuttlefish	21,660,880

Source: Globefish (2023)

Given the data above, we can identify the top two species as tuna (and its varieties), which was worth $81.7 million, as well as mackerel (and its varieties), which were worth $81.5 million in exports for 2020.

Prices in Senegal

In Senegal, the approximate retail price of tuna ranges from $3.5 to $5.5 per kilogram, whereas the wholesale price is approximately between $2.45 and $3.85 per kilogram. On the other hand, mackerel has a retail price range of $5.45 to $8.5 per kilogram, while the wholesale price is approximately between $3.82 and $5.95 per kilogram (Wamucii, 2023).

With a per capita consumption of more than 20 kg/person/year, fish products constitute at least 70% of the protein intake of animal origin in Senegal. However, over the past two decades, fishing has faced challenges such as overcapacity and overexploitation, leading to decreased fish availability. Factors such as climate change dynamics, IUU fishing, overexploitation and intense competition from external markets for pelagic species have contributed to this issue. If these challenges are not addressed, the national annual fish per capita consumption is expected to drop over the next 10 years.

Moreover, changes in the fishing sector have also affected artisanal fishing. Some artisanal fishers have switched from catching pelagic fish for the domestic market to catching demersal fish and cephalopods (octopus, squid, cuttlefish) for export. This situation highlights the need for sustainable fishing practices and effective policies to ensure food security and maintain the cultural significance of fish in Senegal.

Employment in Senegal

The fisheries sector plays a significant role in providing employment opportunities in Senegal. According to the latest government statistics, fisheries employed 97,444 people in 2019, of which it was estimated that 65% were employed directly (SRFC, 2016). However, the Illuminating Hidden Harvests (IHH) Initiative report (FAO, 2022a) estimated that the number is much higher, with 386,817 individuals engaged in fisheries, including pre – and post-harvest and subsistence fishing activities. This represents about 15% of the Senegalese active population.

Women play a crucial role in Senegal's artisanal fisheries sector. The IHH estimates that 139,549 women are actively engaged across fisheries in Senegal. Women represent approximately 50% of individuals engaged in the marine and freshwater subsistence sectors. They are primarily involved in the post-production parts of the industry, undertaking most of the processing, as well as selling and marketing of catches. IHH estimates that women represent 57% and 51%, respectively, of individuals engaged in processing and trading (FAO, 2022a).

Estimating the potential impact on Senegal

The previous section helps justify the two fish species we focus our analysis on for Senegal: tuna and mackerel. Given these two species, the types of fishing vessels used for the estimates include longliners, used to target a variety of tuna species; seiners, used to catch shoal or school pelagic fish, including tuna and mackerel; and trawlers, used primarily for mackerel fishing in Senegal.

Trawlers comprise the larger group in companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29), with 30 vessels, for the domestic category, compared to seiners and longliners. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload for trawlers, is 3,585.60 tons, with smaller payloads for seiners and longliners.

Longliners comprise the more extensive group, with 14 vessels for the foreign category, compared to seiners and trawlers. However, the aggregated payload is like that of longliners and more significant than that of trawlers.

We generally observe that foreign seiners and longliners have similar average gross tonnages to domestic trawlers in this group.

As seen in Table 49, for tuna, while the domestic catch is 428 tons, the foreign catch is significantly higher at 5,042.52 tons. At a price of 3,150 $/ton, the domestic and foreign catches of tuna are valued at $1,348,893.00 and $15,883,938.00, respectively, leading to a combined value of $17,232,831. On the other hand, the domestic catch of mackerel is notably larger at 3,911.22 tons compared to its foreign counterpart at 2,535.48 tons. Priced at 4,885 $/ton, the mackerel's domestic and foreign values stand at $19,106,309.70 and $12,385,819.80, respectively, culminating in a combined total of $31,492,129.50. When both fish types are combined, the potential impact for Senegal from these catches amounts to $48,724,960.50, with mackerel contributing a more substantial portion despite tuna's higher foreign catch volume.

Table 47 Catches (tons) by selected firms in Senegal

Domestic	Vessels	Avg. gross tonnage	Avg. net tonnage	Avg. payload (tons)	Aggregated payload (tons)
Seiners	3	603	361.80	217.08	651.24
Longliners	1	285	171.00	102.60	102.60
Trawlers	30	332	199.20	119.52	3,585.60
Foreign	**Vessels**	**Avg. gross tonnage**	**Avg. net tonnage**	**Avg. payload (tons)**	**Aggregated payload (tons)**
Seiners	6	1,729	1,037.40	622.44	3,734.64
Longliners	14	630	378.00	226.80	3,175.20
Trawlers	4	464	278.40	167.04	668.16

Source: Authors' calculations; data from Table 29 ('Vessels' and 'Avg. gross tonnage')

Table 48 Summary of payloads per catch in Senegal

Fish species	Fishing method	Domestic aggregated payload (tons)	Foreign aggregated payload (tons)
Tuna	Seiners	325.62	1,867.32
	Longliners	102.60	3,175.20
Mackerel	Seiners	325.62	1,867.32
	Trawlers	3,585.60	668.16

Source: Authors' calculations; data from Table 29

Table 49 Economics of payloads per catch in Senegal

	Domestic catch (tons)	Foreign catch (tons)	Price/ton	Domestic catch in $	Foreign catch in $	Total catch in $
Tuna	428.00	5,042.52	3,150.00	1,348,893.00	15,883,938.00	17,232,831.00
Mackerel	3,911.22	2,535.48	4,885.00	19,106,309.70	12,385,819.80	31,492,129.50
Total	4,339.44	7,578.00		20,455,202.70	28,269,757.80	48,724,960.50

Source: Authors' calculations based on Wamucii (2023); data from Table 29

When analysed in the context of GDP (Table 50), the catch impact from these companies' activity represents 13.17% of the fisheries sector GDP. On a national scale, their impact is estimated at 0.2% of national GDP, broken down to 0.05% direct impacts through fishing operations and a more substantial indirect contribution of 0.186% through other segments of the fisheries value chain.

Table 50 GDP contribution in Senegal

GDP contribution ($) per ton	Total catch tons	Estimated total GDP	Estimated direct GDP impact	Estimated indirect impact in $
4,088.54	11,917.44	48,724,960.50	9,428,270.16	39,296,690.34
Percentage fisheries GDP		13.17	2.55	10.62
Percentage national GDP		0.20	0.05	0.16

Source: Authors' calculations based on GlobeFish (2023)

In terms of employment, for every ton of catch by vessels owned or operated by companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29), there is an impact of 0.21 jobs (Table 51). This breakdown includes an impact of 0.14 fishers and 0.07 jobs in other related roles within the fisheries value chain. Given the aggregate catch data, this job potential effect equates to 2,503 positions. Specifically, the sector sees 1,668 fisher jobs and 834 jobs in other related roles.

Table 51 Jobs analysis in Senegal

	No. of workers per ton	No. of fishers/ton	No. of others/ton
Jobs per ton	0.21	0.14	0.07
Total jobs	2,503	1,668	834

Source: Authors' calculations based on SRFC (2016)

As seen in Table 52, due to the potential impact on the GDP from the fisheries sector, it is estimated that an additional 35,569.26 individuals are potentially affected.

Overall, the combined catch from the fishing activities of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29) may impact 13.17% of the fisheries sector GDP in Senegal. Nationally, the impact is estimated at 0.2% of Senegal's GDP. This encompasses a 0.05% direct contribution from fishing operations and a more substantial indirect contribution of 0.16% through the broader fisheries value chain. In employment, there is an associated 0.21 job impact for every ton of catch. This includes 0.14 roles directly for fishers and 0.07 jobs in other associated sectors within the fisheries value chain. Aggregating the data could influence up to 2,503 jobs in total – with 1,668 positions for fishers and 834 in related roles. On a societal scale, these fishing activities' potential economic ripple effects might lead to an estimated 35,569.26 additional individuals potentially falling into poverty.

Table 52 Poverty analysis in Senegal

Population (2023)	Poverty rate (%)	Number of people in poverty	People per 1% poverty rate	Estimated total GDP of catch (%)	Contribution to poverty (no. of people)
17.91 million	46.7	8.36 million	179,100	0.1986	35,569.26

Source: Authors' calculations based on WDI (2023)

7.4 Economic impacts in Ghana

Ghana's fisheries sector plays a significant role in the country's economy, contributing to employment, livelihoods, foreign exchange earnings, food security and poverty reduction. Despite the decline in its contribution to the nation's GDP from 1.5% in 2015 to 0.9% in 2019, the sector still generates approximately $1 billion in total revenue each year (Ghana Fisheries Commission, 2020). The overexploitation of fisheries resources is a concern and addressing this issue could help to sustain and potentially increase the sector's contribution to the economy.

There has been a significant increase in the volume of fish landed across all segments, particularly from 2018 to 2021. The total marine production increased by 20.5% between 2020 and 2021, from 326,867.56 tons to 393,970.01 tons. Artisanal fisheries dominate annual production, constituting more than 60% of marine production. These comprise mainly small pelagic species consumed locally, such as sardinella, anchovy, mackerel, etc. (Ghana Fisheries Commission, 2020).

The value of fish production increased from 5,264,915,898.77 ($455.9 million) new cedi (GHS) in 2020 to GHS7,373,879,913.34 ($638 million) in 2021. This shows the economic importance of the fisheries sector in Ghana (Ghana Fisheries Commission, 2020).

The fishing fleet in Ghana is categorised into three components: artisanal fishing canoes, semi-industrial vessels and industrial vessels:[29]

- **Artisanal fishing canoes:** In 2019, the artisanal fisheries sub-sector comprised 14,275 registered canoes, 90% of which were motorised. These canoes use a variety of fishing gear, including beach seines, encircling nets, hook and lines, drift gill nets and set nets (Pardie et al., 2022).
- **Semi-industrial vessels:** These vessels are made of wooden hulls with inboard engines and operate within the inshore exclusive zone and beyond. In 2019, the semi-industrial fishing fleet comprised approximately 224 boats.
- **Industrial vessels:** The industrial fishing fleet comprises two sub-groups of vessels. The first group included 76 bottom trawl vessels in 2019. The second group corresponds to the tuna vessels mainly operating in Ghana's exclusive economic zone (EEZ) and the high sea. The operational tuna vessels comprised 14 bait boats and 16 purse seiners (Ghana Fisheries Commission, 2020).

29 An artisanal fishing canoe in Ghana is a type of boat used by small-scale fishers. These canoes are often made of wood, can be up to 70-feet long and are highly vulnerable to the sea's conditions (World Bank, 2016). A significant portion of these canoes, known as Lagas canoes, are motorised and specialise in hook and line fishing. They use insulated containers and ice to preserve high-value fish (FAO, 2007).

The data from the FAO database shows that Ghana's fish exports have been on a downward trend since a peak in 2018. In 2018, 80,053 tons of fish were exported, but by 2021, this had decreased to 41,178 tons. The value of fish exports peaked in 2018 at about $227 billion but decreased to $147 million in 2021.

Regarding exports, tuna, squid and octopus are the three main species targeted by DWF in Ghana. However, the production of these species decreased from 101,994 tons in 2018 to 90,557 tons in 2021. In 2021, 96% of the production was made up of tuna, with a clear dominance of Skipjack tuna.

Tuna was also the dominant species exported over this period, representing at least 80% of the total volume of exports. The highest tuna exports were recorded in 2018, with 65,508 tons. However, squid and octopus also contribute significantly to the export value. Regarding export value, tuna, squid and octopus generated their highest value in 2018, with about $217 million. Data from the Globefish (2023) dataset shows that in 2020, tuna accounted for $68.9 million in exports, whereas squid represented $6 million in exports.

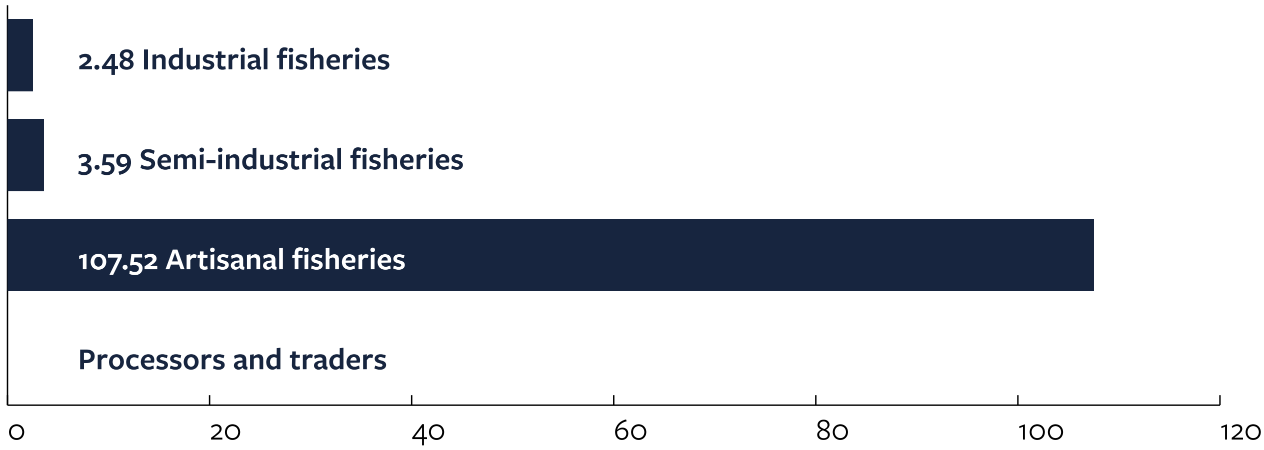
Fish products, while still the cheapest source of protein compared to meat, are becoming increasingly expensive in the Ghanaian market. Locally caught small pelagics such as sardine and mackerel cost GHS30.00 ($6) per kg, while demersal fishes such as red snapper, sea bream, croaker and cassava fish cost between GHS40 and 80 ($8–16) per kg. The price of small pelagics generally drops during the local fishing season in Ghana.

The wholesale prices per kilogram for tuna and squid were observed to vary. Tuna's prices ranged between $4.9 and $7 per kilogram. On the other hand, squid tended to be cheaper, with its price ranging between $2.1 and $4.2 per kilogram (Wamucii, 2023).

Fish is the preferred source of animal protein in Ghana and a central part of the country's cuisine. Fisheries products represent about 60% of animal protein intake and account for 22% of household food expenditures. About 75% of the total domestic production of fish is consumed locally. Per capita fish consumption over the past decade lies within a range of 20–25 kg, much higher than the average of 14 kg for West Africa (the Economic Community of West African States (ECOWAS) zone). The premium fish species in Ghana are sea bream, red snapper, croaker and cassava fish. Hotels and restaurants are the primary consumers of these species, making them increasingly unaffordable for most of the population. Various mackerel species and sardine are more accessible to the average Ghanaian. Population growth continues to drive consumption upwards. Therefore, as production from marine fisheries stagnates, domestic aquaculture and frozen imports have experienced increases to meet this demand (Ghana Fisheries Commission, 2020).

Official data indicates that the fisheries sector employs about 10% of the active workforce in Ghana. This includes fishers, processors, boat owners, boat builders, net makers and others in ancillary jobs, representing approximately 2.6 million people. This estimate encompasses the entire value chain. However, data becomes inadequate when the value chain is segregated. The marine fisheries sector directly employs about 117,000 fishers engaged in harvesting. The artisanal fisheries sector employs about 95% of these individuals (MoFA, 2021).

Figure 26 Distribution of employment in the Ghana fisheries sector (2020)



Source: MoFA (2021)

Estimating the potential impact on Ghana

The previous section helps justify the two fish species we focus our analysis on for Ghana: tuna and squid. Given these two species, the types of fishing vessels used for the estimates include longliners, used to target a variety of tuna species; seiners, used to catch shoal or school pelagic fish, including tuna (they can also be used to catch squid through night light attraction methods); and squid jiggers, specialised vessels that use jigs to catch squid.

Table 53 Catches (tons) by selected firms in Ghana

Domestic	Vessels	Avg. gross tonnage	Avg. net tonnage	Avg. payload (tons)	Aggregated payload (tons)
Seiners	17	1,163.00	697.80	418.68	7,117.56
Longliners	2	337.00	202.20	121.32	242.64
Squid jiggers	0				
Foreign	**Vessels**	**Avg. gross tonnage**	**Avg. net tonnage**	**Avg. payload (tons)**	**Aggregated payload (tons)**
Seiners	5	1,564.00	938.40	563.04	2,815.20
Longliners	1	125.00	75.00	45.00	45.00
Squid jiggers	0				

Source: Authors' calculations; data from Table 29 ('Vessels' and 'Avg. gross tonnage')

Seiners comprise the larger group within the group of companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29), with 17 vessels for the domestic category, compared to longliners. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload, for seiners is 7,117.56 tons. Likewise, seiners compose the bigger group with five vessels for the foreign category. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload, for seiners, is 2,815.20 tons. Thus, we observe that foreign seiners have significantly larger average GTs than their domestic counterparts, suggesting bigger potential impacts, with them showing an average tonnage of 563.04 per vessel.

As seen in Tables 54 and 55, tuna and squid prices were estimated using export volume and values for each species, using Globefish (2023) data. The domestic tuna catch was registered at 6,029.22 tons, while the foreign catch amounted to 2,333.76 tons. With a pricing of $5,950.00 per ton, the economic value of the domestic and foreign tuna catches was $35,873,836.87 and $13,885,857.72, respectively, accumulating to a combined total of $49,759,694.59. For squid, the domestic catch is 1,330.98 tons and the foreign catch is 526.44 tons. Priced at $3,150.00 per ton, the squid's domestic and foreign catches are valued at $4,192,598.72 and $1,658,293.56, respectively. This sums up to a combined value of $5,850,892.28. Overall, the combined economic payload from both tuna and squid catches in Ghana totals $55,610,586.86, with tuna being the more dominant contributor.

Table 54 Summary of payloads per catch in Ghana

Fish species	Fishing method	Domestic aggregated payload (tons)	Foreign aggregated payload (tons)
Tuna	Longliners (100%)	242.64	45.00
	Seiners (81.3%)	5,786.58	2,288.76
Squid	Seiners (18.7%)	1,330.98	526.44
	Squid jiggers (100%)	0	0

Source: Authors' calculations; data from Table 29

Table 55 Economics of payloads per catch in Ghana

	Domestic catch (tons)	Foreign catch (tons)	Price/ton	Domestic catch in $	Foreign catch in $	Total catch in $
Tuna	6,029.22	2,333.76	5,950.00	35,873,836.87	13,885,857.72	49,759,694.59
Squid	1,330.98	526.44	3,150.00	4,192,598.72	1,658,293.56	5,850,892.28
Total	7,360.20	2,860.20	—	40,066,435.58	15,544,151.28	55,610,586.86

Source: Authors' calculations based on WDI (2023); Wamucii (2023); data from Table 29

Table 56 GDP contribution in Ghana

GDP contribution ($) per ton	Total catch tons	Estimated total GDP	Estimated direct GDP impact	Estimated indirect impact in $
5,441.14	10,220.40	55,610,586.86	15,081,625.92	40,528,960.94
Percentage Fisheries GDP	9.59	2.60	6.99	
Percentage National GDP	0.08	0.02	0.06	

Source: Authors' calculations based on WDI (2023)

As seen in Table 56, every ton of fish caught by companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29) in Ghana results in a potential impact of $5,441.14 to the GDP. With a total catch weight of 10,220.40 tons, the estimated catch leads to a potential GDP impact of $55,610,586.86. The direct GDP impact accounts for $15,081,625.92, while the remaining $40,528,960.94 is attributed to indirect effects. When contextualised within the fisheries GDP, the catch corresponds to a potential impact of 9.57%. On the national scale, the fishing sector's impact on Ghana's GDP is 0.08%, comprising 0.02% direct impact and a more considerable indirect one of 0.06%.

In terms of jobs affected (Table 57), limited data means we are unable to disaggregate between direct and indirect jobs; however, we estimate that approximately 3,066 jobs may be influenced because of the estimated fish catch of these companies.

Table 57 Jobs analysis in Ghana

	No. of workers per ton
Jobs per ton	0.30
Total jobs	3,066

Source: Authors' calculations based on Ghana Fisheries Commission (2020)

In terms of poverty, the fish catch is estimated to cause an additional 27,091 individuals living in poverty.

Regarding employment, fishing activities by these companies could impact approximately 3,066 jobs. However, due to data constraints, it is difficult to separate these figures between direct and indirect employment impacts. Furthermore, from the point of view of potential poverty impacts, these activities might cause an additional 27,091 individuals living below the poverty line in Ghana.

Table 58 Poverty analysis in Ghana

Population (2023)	Poverty rate (%)	Number of people in poverty	People per 1% poverty rate	Estimated total GDP of catch (%)	Contribution to poverty (no. of people)
34.12 million	24.2	8.26 million	341,200	0.0794	27,091

Source: Authors' calculations based on WDI (2023)

7.5 Economic impacts in the Philippines

The Philippines possesses abundant fishery resources, occupying a central position within the Coral Triangle (SEAFDEC, 2022). It is widely recognised as the global centre of marine biodiversity, where nearly 60% of the world's known fish species and over 300 species of corals thrive (Carpenter and Springer, 2005). The country's fisheries have been a vital source of livelihoods and sustenance for its 109 million inhabitants (Philippines Statistics Authority, 2020), with over 60% residing in coastal areas (ADB, 2000). In 2020, the fishing industry contributed 1.52% to the country's GDP at current and constant 2018 prices, amounting to 273.41 billion Philippine peso (PHP) and PHP266.22 billion, respectively (BFAR, 2021). In 2020, the Philippines ranked eleventh among the top marine capture producers, contributing 2% to the world's total (FAO, 2022b).

Table 59 Volume of fisheries production per sector

Year	Total (tons)	Commercial (tons)	% to total	Municipal (tons)	% to total	Aquaculture (tons)	% to total
2021	4,248,261.39	870,038.30	20.48	1,131,907.31	26.64	2,246,315.78	52.88
2020	4,400,372.99	1,102,262.36	25.05	975,205.08	22.16	2,322,905.55	52.79
2019	4,415,002	931,451.05	21.10	1,113,271.47	25.50	2,358,333.15	53.40
2018	4,356,874.77	946,437.62	21.70	1,106,071.84	25.40	2,304,365.31	52.90
2017	4,312,089.5	948,281.45	22.00	1,126,017.30	26.10	2,237,790.75	51.90

Sources: Philippine Bureau of Fisheries (2017; 2018; 2019; 2020; 2021)

Over the five years from 2017 to 2021, the volume of production in the commercial fishing (formal) sector in the Philippines exhibited a decreasing trend, with percentages ranging from 22% in 2017 to 20.48% in 2021. On the other hand, the municipal fishing (informal) sector showed some variability, with percentages ranging from 26.1% in 2017 to 26.64% in 2021. While both sectors contributed significantly to total production, the commercial fishing sector experienced a slight decline. In contrast, the municipal fishing sector had a slightly increasing trend.

Exports from the Philippines

From 2016 to 2021, the median export volume of fish and fish products from the Philippines was around 262.88 tons. The year 2017 saw a significant surge of 85.91% compared to the previous year, peaking at 478,210 tons. However, from 2018 to 2021, there was a continuous decline in export volume, settling at 258.37 thousand tons in 2021, a decrease of 1.18% compared to 2020 (Bureau of Fisheries and Aquatic Resources, 2022).

Tuna was the leading fishery export commodity during this period, contributing 46.71% (926,581 tons) in volume and accounting for 37.15% ($2.617 billion) in value. Octopus ranked fourth in volume (68,440 tons or 3.45%) and fifth in value (around $207 million or 2.93%). Other major fishery export commodities included seaweed, grouper, crab, shrimp/prawn, squid and cuttlefish, ornamental fish, round scad and sea cucumber. These commodities collectively contributed to 73.16% of the total export volume and 76.64% of the total export value (Bureau of Fisheries and Aquatic Resources, 2022).

From 2016 to 2021, the export volume of tuna from the Philippines showed varying trends. There was a significant increase of approximately 195.86% in 2017, followed by a decline in subsequent years. The most significant decrease was in 2021, with a drop of roughly 31.22% from the previous year. The median export volume for this period was around 127,183.5 tons (Bureau of Fisheries and Aquatic Resources, 2022).

Similarly, octopus export volume varied over the years. There was a significant increase of 124.21% from 2016 to 2017, followed by a marginal increase of 2.36% from 2017 to 2018. However, there were notable decreases in the following years, with a significant decline of 44.26% from 2019 to 2020. The export volume rebounded by 63.05% from 2020 to 2021. The median octopus export volume was approximately 6,276.5 tons (Bureau of Fisheries and Aquatic Resources, 2022).

As of 2021, the major destinations for Philippine fish and fishery export products included the USA (27.06%), Japan (12.64%), China (10.57%), Netherlands (6.20%), Germany (6.17%), Spain (5.23%), the United Kingdom (3.68%), Hong Kong (3.16%), Taiwan, Province of China (2.46%) and the Republic of Korea (2.17%). All other countries accounted for a combined share of 20.64% (Bureau of Fisheries and Aquatic Resources, 2022).

From 2017 to 2021, the Philippines saw a decline in the production of oceanic tuna, with a total production of 2.58 million tons. The most significant decrease was in 2021, dropping 11.10% from the previous year. Skipjack tuna comprised about half the production, followed by frigate tuna, yellowfin tuna, eastern little tuna and bigeye tuna. Octopus production in the Philippines showed fluctuating trends over the same period. The total production reached 31,822 tons, mostly in frozen form. There was a significant increase of 32% from 2017 to 2018, but decreases followed this in the subsequent years. However, there was a substantial recovery, with an increase of approximately 111% in production from 2020 to 2021 (Bureau of Fisheries and Aquatic Resources, 2022).

Employment in the Philippines

The fishing industry offers livelihood opportunities to millions of Filipinos, with 1.9% of the Philippine population considering fishing as their primary occupation in 2021, accounting for 2,190,438 individuals (Briones, 2007). Half of these individuals are involved in the capture fishing sector, which comprises municipal, commercial and inland fisheries. The number of Filipinos engaged in the fishing industry has consistently increased, as depicted in Table 60.

Table 60 Number of fisherfolk engage per sector

Year	Capture fishing	Aquaculture	Fish vending	Gleaning	Fish processing	Others	Total
2021	1,095,774	253,825	147,038	247,164	42,524	404,113	2,190,438
2020	1,029,963	233,725	130,027	247,021	39,090	399,087	2,078,913
2019	957,551	217,198	110,851	241,138	36,129	390,892	1,953,759
2018	927,612	209,058	106,644	239,483	34,880	384,129	1,951,806
2017	876,170	199,119	98,258	236,399	32,741	373,403	1,816,090

Sources: Philippine Bureau of Fisheries (2017; 2018; 2019; 2020; 2021)

Poverty in the Philippines

Despite the vital role played by the country's fishery resources in supporting the livelihoods of fisherfolk, a considerable portion of this population still faces poverty, with many falling below the poverty line of approximately PHP12,030 per month for a family of five (Philippine Statistics Authority, 2021a). From 2006 to 2021, the poverty incidence among fisherfolk in the fishing sector exhibited a mixed pattern, as evidenced in Table 61. By 2021, the population of impoverished fisherfolk had reached 348,000.

Table 61 Poverty incidence of Philippine fisherfolk, 2006–2021 (%)

	2006	2009	2012	2015	2018	2021
National poverty	21.00	20.50	19.70	18.00	12.10	13.10
Fisherfolk	41.20	41.30	39.20	36.90	26.20	30.60

Source: Philippine Statistical Authority (2021b)

By comparison, the national poverty incidence consistently decreased from 21% in 200615 to 13.1% in 2021 (Philippine Statistics Authority, 2021b).

From 2006 to 2021, the poverty incidence among fisherfolk consistently remained more than double the national poverty incidence (BFAR, 2022). This disparity can be attributed to fisherfolk being classified as part of the informal sector, which comprises independent or small-scale producers operating outside formal economic regulations, including Philippine labour laws (Heintz, 2010). Typically, these individuals run unincorporated household enterprises, often with family members and employ seasonal workers rather than providing employment continuously (Philippine Statistics Authority, 2002). Given their status in the informal economy, fisherfolk and other sectors face high vulnerability to economic shocks, as they lack social protection coverage. The fisheries sector includes municipal fishers, gleaners and vendors engaged in trading seashells, molluscs, seaweeds, sea cucumbers and other fishery products (Bersales and Ilarina, 2019).

In 2018, the average annual income of fisherfolk in the Philippines was PHP188,488.60 ($3,381.51), slightly over half of the country's average of PHP313,000.00 ($5,615.26). The National Capital Region had the highest annual income for fisherfolk at PHP409,347.30 ($7,343.74), while the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) reported the lowest at PHP142,056 ($2,548.50). In Fisheries Management Area 5 (FMA 5) and FMA 6, both situated in the West Philippine Sea and known for DWF activities, the annual income of fisherfolk ranged between PHP194,687.95 ($3,492.72) and PhP226,412.10 ($4,061.86). In the formal fisheries sector, fishers employed in 171 establishments earned an annual PHP140,800 ($2,509), approximately 25.31% lower than their informal fisheries worker counterparts.

Estimating the potential impact on the Philippines

The previous section helps justify the two fish species we focus our analysis on for the Philippines: tuna and octopus. Given these two species, the types of fishing vessels used for the estimates include longliners, used to target a variety of tuna species; seiners, used to catch shoal or school pelagic fish, including tuna; trawlers ; and pole and liners or vessels that use lines to catch octopus.

Table 62 Catches (tons) by selected firms in the Philippines

Domestic vessels		Avg. gross tonnage	Avg. net tonnage	Avg. payload (tons)	Aggregated payload (tons)
Seiners	6	763.00	457.80	274.68	1,648.08
Longliners	9	534.00	320.40	192.24	1,730.16
Trawler	0				
Pole and Line	1	741.00	444.60	266.76	266.76
Foreign vessels		**Avg. gross tonnage**	**Avg. net tonnage**	**Avg. payload (tons)**	**Aggregated payload (tons)**
Seiners	23	1,446.00	867.60	520.56	11,972.88
Longliners	11	355.00	213.00	127.80	1,405.80
Trawler	4	464.00	278.40	167.04	688.16
Pole and Line	0				

Source: Authors' calculations; data from Table 29 ('Vessels' and 'Avg. gross tonnage')

Longliners comprise the bigger group within domestic companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29), with nine vessels for the domestic category, compared to six seiners. However, their aggregated payload, calculated by multiplying the number of vessels in each group with their average payload, is similar to that of the seiners.

Likewise, seiners comprise the more extensive group for the foreign category, with 23 vessels compared to longliners with 11. The aggregated payload, calculated by multiplying the number of vessels in each group with their average payload for seiners, is almost 10 times larger, too.

We observe that foreign seiners have significantly more average gross tonnages than their domestic counterparts, suggesting more considerable potential impacts.

Table 63 Summary of payloads per catch in the Philippines

Fish species	Fishing method	Domestic aggregated payload (tons)	Foreign aggregated payload (tons)
Tuna	Seiners	1,648.08	11,972.88
	Longliners	1,730.16	1,405.80
Octopus	Trawlers	0	668.16
	Pole and line	266.76	

Source: Authors' calculations; data from Table 29

For tuna, the domestic catch amounts to 3,378.24 tons, while the foreign catch is much larger at 13,378.68 tons (Table 63). To calculate the prices of tuna and octopus, we use the export volume and value for both species in 2021 to estimate the price per ton.

Table 64 Tuna and octopus export volumes (ton) and value ($), 2021, in the Philippines

	Tons	Value ('000 $)	Price ($) per Ton
Tuna	91,754.00	378,708.00	4,127.42
Octopus	5,980.00	27,941.00	4,672.40

Sources: Authors' calculations based on Philippines Statistical Authority (2021c); GlobeFish (2023)

As seen in Table 65, we then applied these prices to the estimated catches to evaluate the potential economic impact. The price per ton for tuna is $4,127.42, leading to an economic impact of $13,943,441 domestically and a significantly larger $58,341,545.56 from foreign catches. The total economic impact for tuna is, therefore, $113,797,143.70. In contrast, octopus has no domestic catch, but the foreign catch by companies with blacklisted vessels, previously implicated in wrongdoing or involved in diverse unsustainable practices (refer to Table 29) stands at 520.56 tons. With a higher price per ton at $4,672.408, the economic potential impact from these foreign octopus catch reaches $2,432,269, while the economic latent impact from fishing for tuna and octopus amounts to $116,229,412.40. This data underscores the significant economic bearing of fishing.

Table 65 Economics of payloads per catch in the Philippines

	Domestic catch (tons)	Foreign catch (tons)	Price/ton	Domestic catch in $	Foreign catch in $	Total catch in $
Tuna	3,378.24	13,378.68	4,127.43	13,943,442.37	55,219,538.44	69,162,980.80
Octopus	266.76	668.16	4,672.41	1,246,411.56	3,121,916.13	4,368,327.69
Total	3,645.00	14,046.84		15,189,853.92	58,341,454.56	73,531,308.49

Source: Authors' calculations based on Philippines Statistical Authority (2021c); data from Table 29

Every ton of fish caught by these firms in the Philippines has a potential impact of $4,156.23 to the GDP (refer to Table 66). With a cumulative catch weight of 17,691.84 tons, the resultant GDP impact is estimated at $73,531,308.49. Examining this further, the direct GDP impact is $38,043,261.07, whereas the indirect impact encompasses the remaining $35,488,047.42. The catch signifies a 1.71% impact when considering the fisheries GDP context. On a national scale, the fisheries sector's contribution to the Philippine GDP is 0.02%, with a direct impact of 0.01% and an indirect one of another 0.01%. From a jobs perspective (Table 67), the data showcases a trend of employment impact associated with the estimated fish catches of these companies. Specifically, every ton of fish caught has an estimated potential job impact of 0.97 positions. To break this down further, this consists of 0.55 fishers and 0.42 other jobs in the fisheries value chain. Cumulatively, the fish catch has led to an estimated job impact of 17,161, with 9,731 being fishers and 7,431 from other categories.

Table 66 GDP contribution in the Philippines

GDP contribution ($) per ton	Total catch tons	Estimated total GDP	Estimated direct GDP impact	Estimated indirect impact in $
4,156.23	17,691.84	73,531,308.49	38,043,261.07	35,488,047.42
Percentage Fisheries GDP	1.71	0.88	0.82	
Percentage National GDP	0.02	0.01	0.01	

Sources: Authors' calculations based on WDI (2023); GlobeFish (2023)

Table 67 Jobs analysis in the Philippines

	No. of workers/ton	No. of fishers/ton	No. of others/ton
Jobs per ton	0.97	0.55	0.42
Total jobs	17,161	9,731	7,431

Source: Authors' calculations based on Philippine Bureau of Fisheries (2021)

The fish catch is projected to accentuate the number of potentially impoverished individuals in the Philippines by an additional 23,926.

In sum, the fishing activities of the companies in the selected firms for tuna and octopus in the Philippines created significant socioeconomic ramifications. Every ton of fish caught relates to a possible impact of $2,150.3 from the GDP or a total value of $73,531,308.49. In the context of the fisheries GDP, this catch translates to a potential impact of 1.71% and, at a national scale, 0.02% of the Philippine GDP. Moreover, while every ton of fish caught might suggest an employment potential of 0.97 jobs, leading to around 17,161 positions overall, the broader context indicates a worrying trend. These fishing activities are estimated to potentially affect 23,926 people below the poverty line, highlighting a pressing need for sustainable and inclusive fishing practices.

Table 68 Poverty analysis in the Philippines

Population (2023)	Poverty rate (%)	Number of people in poverty	People per 1% poverty rate	Estimated total GDP of catch (%)	Contribution to poverty (no. of people)
117.86 million	16.6	19.56 million	1,178,600	0.0203	23,926

Source: Authors' calculations based on WDI (2023)

8 Conclusions: potential economic impacts

We identified a group of companies that had been engaged in wrongdoing in the past and are operating in the selected case study countries' EEZs; we then measured their fishing activities in terms of impacts on these countries' economies. Their potential impact is not negligible. It translates into 0.08% of Ecuador's national GDP, theoretically affecting 4,854 jobs and potentially causing 14,381 more people to slide into poverty due to fishing sector dynamics. These fishing activities could have affected up to 0.12% of Peru's GDP, potentially influencing 2,590 jobs and affecting 41,225 individuals. In Senegal, these firms' fishing effects might amount to 0.2% of the national GDP, potentially impacting 2,503 jobs and affecting 35,569 individuals. In Ghana, their activities might have impacted 0.08% of GDP, potentially endangering around 3,066 jobs and affecting 27,091 people. Last, these fishing activities in the Philippines amount to 0.02% of the national GDP, potentially impacting 17,161 jobs and causing an additional 23,926 people living below the poverty line. In total, 30,174 jobs could be affected and 142,192 additional people could be living below the poverty line.

In the observed Latin American countries, such activities might affect nearly 15.015% of the fisheries' GDPs, resulting in a 0.10% fluctuation in the national GDP, be associated with 0.12 jobs per ton of catch and could affect 27,803 poor people living below the poverty line.

For the West African countries, these fishing activities could impact around 11.37% of the fisheries GDPs and lead to a potential 0.14% change in the national GDP. Additionally, these activities may correspond to 0.255 jobs per ton of catch and affect 31,330 impoverished people.

Meanwhile, in the Philippines, these activities' potential repercussions could touch upon 1.71% of the fisheries GDP, leading to a slight 0.02% alteration in the national GDP, representing 0.97 jobs per ton of catch and potentially affecting 23,926 people living below the poverty line.

9 Recommendations

In this report, we analysed the DWF fleets' activity – both domestic and foreign – in five vulnerable EEZs and further evaluated the potential economic, job and well-being impacts of companies previously engaged in wrongdoing. Addressing the diverse issues in fisheries management and related activities that emerge in this report is crucial for sustainable and responsible fishing practices. This report identifies opportunities for strengthening domestic capacity for sustainable fishing and provides powerful arguments for reform. There follow 15 recommendations to tackle these challenges.

9.1 Promote good business behaviour

- Demand business transparency regarding registries, beneficial owners and operators and clarity of corporate structures, track records, licences and agreements.
- Closely monitor companies previously engaged in wrongdoing.
- Establish a ranking system, including a list of undesirable companies and penalties.

9.2 Foster international collaboration

- Cultivate alliances with organisations, governments and NGOs to share best practices, resources and information and seek funding and technical assistance from international bodies and donors to support the implementation of the system.
- Collaborate with neighbouring countries and international organisations to address shared fisheries resources and ensure the system is regionally coordinated.
- Establish a single global IUU fishing list.
- Create more MPAs; strictly enforce the ban on seining in MPAs in Ecuador and establish or expand MPAs to safeguard critical habitats and marine biodiversity. The Aichi Biodiversity Targets, adopted under the Convention on Biological Diversity, call for the protection of at least 10% of coastal and marine areas by 2020 and the Kunming/Montreal Framework calls for the protection of 30% of land and sea by 2030.
- Subsidy reform: Review and reform government subsidies to fishing companies to ensure they promote sustainability and responsible practices, while avoiding subsidies for companies that engage in abusive behaviour.
- Transparency and accountability: Create a unique global registry. Improve transparency in the structure of fishing companies through mandatory disclosure of ownership, vessel registration and catch data. Encourage independent audits of these companies. Create a registry of companies involved in wrongdoing in the past for closer monitoring. This implies eliminating the economic incentives that drive IUU fishing and overfishing, harmful subsidies and other unsustainable practices.
- Tax haven and flag of convenience control: Strengthen regulations and international cooperation to curb the use of tax havens and FoCs to evade fishing regulations and responsibilities.

9.3 Enforce and sharpen internal regulation

- Implement stricter regulations and monitoring to reduce incidental fishing for the fishmeal market in Peru and promote the sustainable use of forage fish. Make companies that take part in incidental fishing more accountable, including heftier fines and, eventually, removing operating licences.

- Enforce anti-shark finning laws and regulations in Peru, with stricter penalties for violations. Promote shark conservation through education and awareness campaigns.
- Manage and restrict trawling in Senegal and Ghana to mitigate its impact on local fishers and their livelihoods, while encouraging sustainable fishing practices. This entails strengthening the monitoring and surveillance of fishing activities, especially by large foreign DWF vessels and promoting sustainable fishing practices. Build capacity in developing countries for fisheries management, enforcement and good governance, ensuring that governments successfully control their domestic vessels and what happens in their EEZs. Put a sustainable limit to reflagging vessels that aim to take fish from the EEZ for other markets.
- Combat the saiko barter system: Crackdown on illegal saiko fishing in Ghana, increase monitoring and enforcement and promote alternative livelihoods for affected communities.
- Regulate and drastically reduce the use of FADs in Ecuador to minimise bycatch and environmental impact.

Addressing these issues requires a multifaceted approach involving government policies, international cooperation, community engagement and industry responsibility to ensure sustainable, responsible and ethical fishing practices.

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Annex: definitions of DWF, FOC, IUU fishing, presence and fishing manoeuvres

Distant-water fishing and flags of convenience

The most accepted definition of 'distant-water fishing (DWF)' covers fishing activities outside a nation's 200-mile EEZ, whether on the high seas (international waters) or in another nation's EEZ. That is, the DWF vessels of one country are those operating within the EEZs of another country or further offshore on the high seas (Oceana, 2013). Meanwhile, 'distant-water fishing nation' is a term used to describe those countries that fish outside their territorial waters and usually extend their range of action to faraway fishing grounds.

However, there is no consensus or an internationally legally binding definition of DWF. Pauly defines it in an interview with Oceana (2013):

> Distant-water fishing fleets are the fishing vessels that operate within the 200-mile Exclusive Economic Zones (EEZs) of other countries and, less often, further offshore in what is known as the high seas. The flags that these vessels fly are important here because there are countries – Belize, Liberia and Panama come to mind – that will lend them so-called 'flags of convenience' for a few bucks. According to the United Nations Convention on the Law of the Sea (UNCLOS), distant-water fleets must be offered to take the 'surplus' of fish not caught by a given country in its EEZ against a fee that is part of a negotiated 'access agreement' (ibid.)[30]

In relation to China and the European Union's DWF subsidies, Pew says DWF occurs when 'countries fish beyond their own territories', which means that 'a small number of nations end up exploiting resources in other countries' waters and on the high seas' (Pew Charitable Trusts, 2022b). DWF vessels 'stay at sea longer and catch more fish than they could normally afford to, resulting in a depletion of fish populations beyond sustainable levels' (ibid.) However, territorial waters and EEZs – distinct in nature regarding rights and duties – are not always equivalent:

> The difference between territorial sea and the EEZ is that the former confers full sovereignty over the waters, whereas the latter is merely a 'sovereign right' which refers to the coastal nation's rights below the surface of the sea. The surface waters are international waters (UNCLOS, 1982b).

The EU considers distant waters to include third countries' waters and the high seas:

30 Liberia has shed many foreign-controlled vessels in recent years to have an EC yellow card suspended.

> Countries with distant-water fishing fleets have had to enter into international agreements and other arrangements to gain access to fisheries resources in either third countries' EEZs or high seas covered by an RFMO. However, it was only in 2013 that the CFP [the EU's Common Fisheries Policy] incorporated the external dimension of fisheries as one of the pillars of the EU fisheries policy through the adoption of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy (European Parliament, 2022).

The issue of defining DWF fleets is not central to this report, since we are analysing fishing inside the five study countries' EEZs. We assume that any foreign vessel found inside one of these EEZs is to be considered DWF.

The Philippine EEZ presents a challenge, because of the presence of vessels flagged to neighbouring nations (including China, Vietnam, Taiwan– Province of China, Malaysia, Japan and Indonesia). As we have seen, the commonly accepted definition of DWF covers activities outside a nation's 200-mile EEZ, whether on the high seas or in another nation's EEZ. However, FAO defines landings from distant waters as quantities taken by vessels in all FAO major fishing areas other than those adjacent to the flag states (FAO, 1996). This definition implies that fishing taking place outside the EEZ of the flag states but within the same major fishing area is not considered distant water fishing. As our report does not break down the number of vessels by geographical regions, it is impossible to know how many vessels would be excluded from our list. Neither FAO nor the UNCLOS provides an agreed legal definition for a DWF vessel. In essence, the report excludes vessels flagged to countries operating in FAO Area 61 and FAO Area 71, both FAO areas where all adjacent nations, including the Philippines, have claims.

FoCs may be used for legitimate reasons (for example, for economic advantages, operational flexibility and to access international waters) and are legally permissible under UNLCOS ArtA. 92. However, the use of a FoC can be harmful for several reasons, such as where a vessel is taking advantage of lax norms, exceeding quotas, catching undersized fish and/or engaging in destructive fishing methods, leading to the depletion of fish stocks and ecosystem damage. Issues include the following:

Data gaps: FoC vessels often operate without proper monitoring and reporting requirements, leading to significant gaps in data on their fishing activities. This lack of transparency hinders effective fisheries management and resource conservation.

Loss of opportunity: Developing countries often suffer the most from FoC vessels, as they lose out on revenue that could be generated from their own fishing industries. These vessels do not contribute to the economies of the countries where they flag.

Labour and human rights abuses: FoC vessels are also known for poor labour conditions and human rights abuses, as they often employ low-paid, exploited and sometimes forced labour. This further contributes to the unethical and unsustainable practices within the industry.

Impact on marine ecosystems: Irresponsible fishing practices associated with FoC vessels can destroy marine habitats, bycatch non-target species and cause other environmental damage.

Weakened fisheries management: The proliferation of FoC vessels can undermine international and regional efforts to manage and conserve fisheries. It is then challenging to enforce conservation measures and protect fish stocks from overexploitation.

Difficulty in accountability: Using FoCs can make it challenging to hold operators accountable for illegal and unsustainable fishing practices, as they can easily change flags and identities to evade detection.

This is the list of FoC we have used in our report (ITF, 2023): Antigua and Barbuda, The Bahamas, Barbados, Belize, Bermuda (UK), Bolivia, Cambodia, Cameroon, Cayman Island, Comoros, Cook Islands, Cyprus, Equatorial Guinea, Faroe Islands (FAS), French International Ship Register (FIS), German International Ship Register (GIS), Georgia, Gibraltar (UK), Honduras, Jamaica, Lebanon, Liberia, Malta, Madeira, Marshall Islands (USA), Mauritius, Moldova, Mongolia, Myanmar, Netherlands Antilles, North Korea, Palau, Panama, Sao Tome and Príncipe, Sierra Leone, St Kitts and Nevis, St Vincent and the Grenadines, Sri Lanka, Tanzania (Zanzibar), Togo and Tonga.

Exclusive economic zones (EEZs)

The UNCLOS, also known as 'the Law of the Sea', is an international legal framework for all marine and maritime activities. As of June 2016, 167 countries and the EU were parties. UNCLOS defines an EEZ as follows:

The exclusive economic zone is an area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by the relevant provisions of this Convention (UNCLOS, 1982b).

An EEZ is a sea area up to 200 nautical miles from the coast, within which a state claims exclusive rights over marine resources. The National Oceanic and Atmospheric Administration (NOAA) says, 'an "exclusive economic zone" or EEZ, is an area of the ocean, generally extending 200 nautical miles (230 miles) beyond a nation's territorial sea, within which a coastal nation has jurisdiction over both living and nonliving resources" (NOAA, 2022).

It is important to note that a right of transit by foreign vessels in a coastal state's EEZ is permitted on various grounds (UNCLOS: Art. 38). In our study, the Philippine EEZ includes disputed maritime borders, taking into consideration different perspectives.

Considering the definitions of DWF and EEZs, this study's areas of interest include the EEZs of the five study countries and the surrounding waters. There were three issues that we considered as determining these areas.

- Neighbouring countries can be signatories to a treaty or be transit areas; one example is Senegal and Guinea-Bissau.

- Surrounding waters beyond the EEZ's border include adding a maximum of 0.2 degrees beyond the EEZ and simplifying the EEZ using an algorithm that reduces the complexity of its shape to reduce the computational load. The areas extend to a maximum of 0.2 degrees into other countries' EEZs or the high seas to capture vessels that might be trespassing for any given reason.
- Extra corridor areas (that is, the area between the Galapagos and Ecuador, which is of particular interest).

For example, when we look at fishing presence and activity in Senegal, we include The Gambia's EEZ since Senegalese waters surround this EEZ. A Senegalese vessel fishing in the southern region must cross The Gambia's EEZ to access the northern Senegalese region. For this reason, The Gambia and Senegal have a joint regime EEZ (marineregions.org, 2019). Another reason we expand the areas is that some potentially illegal activity typically happens on the border of EEZs. An example is a Chinese flotilla spotted on the edge of the Galapagos' MPA in 2020 (Collyns, 2020).

The areas of interest in this study include these coordinates:

- **Ecuador:** www.marineregions.org/eezdetails.php?mrgid=8431&zone=eez
- **Galapagos:** www.marineregions.org/eezdetails.php?mrgid=8403&zone=eez
- **Peru:** www.marineregions.org/eezdetails.php?mrgid=8432&zone=eez
- **Senegal:** www.marineregions.org/eezdetails.php?mrgid=8371&zone=eez
- **Ghana:** www.marineregions.org/eezdetails.php?mrgid=8400&zone=eez
- **The Philippines:** www.marineregions.org/eezdetails.php?mrgid=8322&zone=eez

The areas of study have been expanded a maximum of 0.2° in all directions to capture activity on the EEZs' borders.

Illegal, unreported and unregulated (IUU) fishing

Illegal fishing 'typically refers to fishing without a licence, fishing in a closed area, fishing with prohibited gear, fishing over a quota or fishing of prohibited species'(Marine Stewardship Council 2022). The range of offences cover fishing without permission or in violation of regulations of the flag state or host nation, misreporting or failure to report catches to relevant authorities where required to do so, fishing vessels without a flag or national registration or fishing on stocks without management measures in place. These offences can include (based on (FAO, 2019):

- Illegal fishing
  - Activity conducted in waters under a state's jurisdiction without that state's permission or in contravention of its laws and regulations.
  - Activities performed by vessels flying the flag of states that are parties to a relevant RFMO that break the conservation and management measures adopted by the RFMO or international law.
  - Any activity in violation of national laws or international obligations.

- Unreported fishing
  - Activity that has not been reported or has been misreported to the relevant national authority in contravention of national laws and regulations.
  - Activity that has not been reported or has been misreported in contravention of the reporting procedures of an RFMO.

- Unregulated fishing
  - Activity conducted by vessels without nationality or operating in an area managed by an RMFO flying the flag of a states, not a party to that RMFO.
  - It refers to fishing activities that occur in areas or for fish stocks where there are no applicable conservation or management measures. This means that such fishing activities are not subject to monitoring or control, posing a threat to marine ecosystems and sustainable fisheries.

As noted, 'overfishing' refers to the depletion of fish stocks beyond sustainable levels, leading to a decline in fish populations. Overfishing can occur because of legal fishing practices, if catch limits and regulations are not effectively enforced or if those limits are set too high.

Presence versus fishing manoeuvre

The fact that a vessel is spotted in a location ('presence') does not mean that it is fishing. Namely, presence and fishing are two concepts in tracking vessels using AIS signals. Presence tracking refers to the basic monitoring of AIS signals to determine if a vessel is within a specific area or operating in a particular region. It involves detecting and recording the AIS signals broadcast by vessels, which include information such as the vessel's identity (Maritime Mobile Service Identity or MMSI number), position, course, speed and other navigational data. Thus, presence tracking does not necessarily involve analysing a vessel's behaviour or intent; it focuses on its location and basic information. While we have included all domestic vessels identified by flags in Krakken® V15.0, we have used presence for identifying foreign vessels in the five countries, as explained in the methodology.

Meanwhile, detecting full-blown fishing manoeuvres entails a more advanced and analytical approach to AIS tracking, aiming to understand a vessel's specific activities and intentions, particularly in the context of IUU fishing. In fishing tracking, AIS data is collected, visualised, processed and analysed using machine learning and other technologies to identify behaviour patterns. This can include assessing the vessel's speed, course changes, fishing gear deployed, duration of the manoeuvre shape, distance from the coast and other relevant factors. Fishing tracking aims to detect and deter illegal fishing practices, such as unauthorised fishing in protected areas, exceeding fishing quotas or engaging in other illicit activities. Fishing tracking can involve combining AIS data with other sources of information, such as satellite imagery, to build a more comprehensive picture of a vessel's activities.

Consequently, there is an expectation to find more national vessels identified in their EEZ (for example, leaving from or arriving at their ports of reference, trans-shipping material, fuel, personal or goods, being repaired and fishing) than foreign vessels. We assume that the remote observation of a foreign vessel's presence in another country's EEZ suggests that it is engaged in DWF operations. We also expect our fishing activity detection models to produce false positives when vessels leave or call at ports and transit through high-traffic corridors, where their behaviour matches some characteristics associated with fishing manoeuvres.

Open-source repositories

- Allen Institute for AI Krakken® V15.0: https://allenai.org/data
- Algorithms employed in this analysis: https://github.com/CesarMontenegro/FishingManeuvers2023

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