A photograph of a fisherman on a boat, seen from the side, wearing a dark long-sleeved shirt. He is leaning over several large, stacked crates filled with fish. The crates are yellow and orange. The boat's deck is blue. The background shows the water.

Tracking refrigerated transshipment vessels to inform the Food and Agriculture Organization's Agreement on Port State Measures

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TRACKING REFRIGERATED TRANSSHIPMENT VESSELS TO INFORM THE FAO'S AGREEMENT ON PORT STATE MEASURES

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One Page Summary:

- Global fish stocks continue to decline and 66.9% are fished at biologically unsustainable levels.²
- Global fishing fleets of cargo-sized refrigerated vessels ‘transship’ with commercial fishing vessels at sea. Transshipment occurs when a fishing vessel transports its catch to the refrigerated transshipment vessel. Illegally caught fish can be ‘laundered’ with legal fish before entering the market.¹⁶
- Transshipment allows fishing vessels to stay at sea; sometimes for years at a time⁵ and has been linked to transnational crime and human rights violations.¹⁶
- Refrigerated transshipment vessels are usually equipped with ‘collision avoidance’ transceivers, Automatic Identification Systems (AIS), that transmit the vessel’s information.⁵²
- AIS data are non-proprietary, internationally standardized, and open source.⁶⁸ They can be used to inform and support management agencies.⁵³
- The Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (PSMA) is a binding international treaty of the United Nations’ (UN) Food and Agriculture Organization (FAO).¹³ There are 59 States and the European Union participating as of March 2019.⁴³
- PSMA addresses illegal fishing by denying port entry, and consequently markets, to foreign vessels suspected of illegal fishing activity.¹³ It requires vessel inspections and information sharing among Parties to the Agreement.¹³
- Employing novel methods, AIS data can be used to gather information and support decision-makers from the perspective of the State, an individual port, a specific vessel, or a State’s fleet of vessels.
- From 2015-2018, 784 individual refrigerated transshipment vessels made 67,308 port visits from voyages greater than 24 hours in duration; on average 67.5% were from foreign refrigerated transshipment vessels.
- PSMA participation is growing and AIS data on refrigerated transshipment vessels can strengthen PSMA leverage and address the key conditions requisite in illegal fishing and human rights violations in seafood.
- The methodology and application of AIS outlined here offers reliable and accessible information regarding port visits that has previously been difficult to obtain.¹ It can be used to encourage participation in PSMA and offers insights and transparency of refrigerated transshipment cargo vessels and the ports they visit.

“The practice of transshipment is one of the major missing links to understanding where and how illegally caught fish finds its way to the market and thus a key cause of lack of transparency in global fisheries.”

- FAO, Global Study on Transshipment, June 2018⁵

“That was the real killer of poor folks, there the real author of the catastrophe! And the sea-witch shook her rough deformed knuckles at the city, while streams of obscenities flowed from her cavernous mouth.

"And after this they'll come to the Fishmarket, the harlots, and beat you down, and beat you down! And still they'll say fish comes high, the scullions! And cheap't would be at fifty, yes, at seventy-five a pound!..."

-*The Mayflower*, Vicente Blasco Ibáñez, 1895

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Image credits:

Cover: Emi Koch

Transshipment: Alex Hafford

Illegal, Unreported, and Unregulated (IUU) fishing: Emi Koch

1. Introduction

Concern is increasing over declining fisheries and safeguarding global ocean resources. Protecting global fisheries requires numerous conservation and management approaches. Fisheries management organizations rely heavily on information regarding the use and frequency of vessels who visit the world's ports, because these are the unique points where fish enter the world's markets.

Historically, to obtain a vessel's port visit information, managers often had to write letters to port authorities, ministries, and other organizations.¹ Information is usually user-entered and exists across disparate databases. Patchworks of authorities and agencies make tracking down vessel port visits difficult. New applications using a vessel's onboard Automatic Identification System (AIS) technology, originally intended to prevent at-sea collisions, can be used to support management and enforcement policies and decisions. Managers can use AIS to obtain information about a vessel's cargo, activities, and movements.

Onboard AIS transceivers transmit a vessel's information in a format that is internationally standardized, non-proprietary, and open source. AIS data can increase seafood supply chain transparency, inform compliance with international fisheries treaties, and augment information used to fight illegal fishing and its periphery crimes.

As global fish consumption continues to rise, shipping companies have utilized the practice of transshipment. Transshipment is the at-sea transfer of goods from one vessel to another. When a commercial fishing vessel transships to a refrigerated transshipment cargo vessel, it can stay at sea much longer and continue fishing. Transshipment has been linked to transnational crime; in fisheries, transshipment enables the key conditions that foster human rights violations and unsustainable, industrialized fishing.

In response, numerous States have signed the United Nations (UN) Food and Agriculture Organization's (FAO) international treaty, the Agreement on Port State Measures, to deny ports and thereby markets, to vessels suspected of illicit activity. Because transshipment vessels are generally mandated to be equipped with AIS, the data on refrigerated transshipment vessels can be used to support the FAO's treaty in ways that have been previously unavailable.

¹ Flothmann, S., et al. (2010). Closing Loopholes: Getting Illegal Fishing Under Control. *Science*, 328(5983), 1235–1236. Retrieved from <https://science.sciencemag.org/content/328/5983/1235>

Using the AIS data of transshipment vessels and strengthening the Agreement on Port State Measures can improve fisheries conservation by applying direct pressure and focus scrutiny on the conditions that enable human rights violations.

2. Background

2.1. State of global fisheries

Wild capture fishing has remained relatively static since the late 1980s at around 80 million tons per year.² The global market for wild capture fish in 2016 was estimated at \$130 billion. Food fish consumption has increased an average of 1.5% per year per capita since 1961.³ Global marine fishery stocks continue to decline and 66.9% of fish stocks are “fished at biologically unsustainable levels” according to the FAO.⁴

2.2. Transshipment

Transshipping is an efficient means for vessels to transfer cargo and resupply at sea. In fisheries, refrigerated cargo transshipment vessels – hereafter referred to as ‘reefer’ vessels – act as at-sea depositories for commercial fishing vessels (CFV), eliminating the need to visit ports as often. Some reefers provide



at-sea processing. Types of transshipping differ by fishing area or target species to optimize economic performance. In many cases, fisheries transshipment is a perfectly legal and economical operation. However, there are transshipping operations specifically conducted for

² Food and Agriculture Organization of the United Nations. The State of World Fisheries and Aquaculture (2018). Retrieved from <http://www.fao.org/fishery/soFia/en>

³ *Ibid.*

⁴ *Ibid.*

illegal, unreported, and unregulated fishing.⁵ Transfers from CFVs to reefers can occur beyond national jurisdiction.

From 2015 through 2018, there were approximately 784 individual reefer vessels operating in global fisheries.

2.3. Maritime authority and jurisdiction

Established in the UN Convention on the Law of the Sea, a vessel's registration is tied to a State; the vessel at sea flies its State's 'flag'.⁶ A State's territorial waters generally extend from shore seaward to 12 nautical miles.⁷ States may exercise authority on any vessels within their territorial waters. Outside of a State's territorial waters, a State only has authority on vessels who fly their flag.

“There has long been a tradition that the *law of the sea* has been grounded in the notion of the *freedom of the high seas*. This freedom has, historically, three underlying principles: a ship of any nation can navigate the oceans freely; the ship's national state has exclusive dominion over the ship; and no other nation can exercise dominion over that ship. Freedom is thus the guiding principle of the law of the sea, but it is a principle strongly mediated by nationality.”¹⁰

A State retains the sovereign rights to its marine resources seaward to 200 nautical miles; the exclusive economic zone (EEZ). A State's authority differs in the EEZ compared to its territorial waters. All vessels have 'freedom of navigation' and 'innocent passage'⁸ in the EEZ, but are restricted in their economic or extractive activities.⁹ Generally, a State may exercise authority over any vessel within its territorial waters but only vessels engaged in fishing activities within its EEZ.

⁵ Food and Agriculture Organization of the United Nations. Global Study on Transshipment: Regulations, practices, monitoring and control – Advanced draft (2018). Retrieved from www.fao.org/3/CA0464EN/ca0464en.pdf

⁶ Oceans & Law of the Sea, United Nations. Convention on the Law of the Sea (1982, December 10). Retrieved from https://www.un.org/Depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm

⁷ *Ibid*, Article 3.

⁸ *Ibid*, Article 58.

⁹ *Ibid*, Article 87.

2.4. Flags of Convenience

There is a long history of shipowners flagging their vessels in States other than their own. Motivated by wartime needs or politics, the international nature of vessels, shipping, and fishing created practices of efficiency and profit. A ‘flag of convenience’ (FoC) is when the owner, control, or beneficiary of a vessel is not from the flag it flies. The term was first used by the International Transport Worker’s Federation amongst growing concern that FoCs were used to avoid safety regulations.¹⁰

FoC are issued by States that, on paper, should be responsible for the actions and regulations of their vessels but lack the capacity to do so. Some FoC States may be party to international organizations and, though there is no authoritative list, others are designated as FoCs by the International Transport Worker’s Federation because of their lax labor laws.¹¹

With growing concern about the state of global fisheries, agencies and organizations have increased regulation and conservation efforts. In response, some vessel owners have sought out FoCs to circumvent fisheries, labor, tax, or other legal maritime restrictions.¹²

2.5. Illegal, Unreported, and Unregulated (IUU) fishing

Fisheries regulations vary widely. Catch limits or gear restrictions are generally contingent on the species of fish targeted, the location of the harvest, the flag-State of the CFV, and include both domestic regulation and sometimes international agreements. Fisheries management decisions are often based on the reports and recordkeeping provided by CFVs and States. Illegal, unreported, and unregulated (IUU) fishing threatens global fish stocks, marine

¹⁰ Alderton, T. (2002). Globalisation and de-regulation in the maritime industry. *Marine Policy*, 26(1), 35–43. doi: [https://doi.org/10.1016/S0308-597X\(01\)00034-3](https://doi.org/10.1016/S0308-597X(01)00034-3)

¹¹ International Transportation Workers’ Federation. (2019). Flags of convenience. Retrieved from <https://www.itfglobal.org/en/sector/seafarers/flags-of-convenience>

¹² Miller, D., and Sumaila, U. R. (2014). Flag use behavior and IUU activity within the international fishing fleet: Refining definitions and identifying areas of concern. *Marine Policy*, 44, 204–211. doi: <http://dx.doi.org/10.1016/j.marpol.2013.08.027>

ecosystems and biodiversity, and undermines marine conservation efforts.¹³ IUU fishing also exacerbates poverty and food insecurity.¹⁴

The FAO's International Plan of Action to Prevent, Deter and Eliminate IUU Fishing, defines illegal fishing as activities in contravention to laws and regulations to which vessels or a vessel's flag-State is subject.¹⁵ This includes fishing in violation of international obligations to which a vessel's flag-State is party.

Unreported fishing involves not reporting, misreporting, or not following reporting procedures to management organizations. Unregulated fishing includes fishing activities by vessels whose flag-State is not party to a relevant fisheries management organization and when a vessel harvests in areas or for species where there is no management plan. Unregulated fishing refers to fishing by vessels that operate without a flag-State.



Globally, it is estimated that IUU fishing accounts for one-eighth to upwards of one-third of the fish caught, valued between \$10 and \$23.5 billion per year.¹⁶ In the western and central Pacific and eastern central Atlantic oceans, IUU fish is estimated at upwards of 30% of total

¹³ Food and Agriculture Organization of the United Nations. Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (2016). Retrieved from <http://www.fao.org/port-state-measures/en/>

¹⁴ *Ibid.*

¹⁵ Food and Agriculture Organization of the United Nations. International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (2001). Retrieved from <http://www.fao.org/fishery/ipoa-Iuu/en>

¹⁶ Telesetsky, A. Laundering fish in the global undercurrents: Illegal, unreported, and unregulated fishing and transnational organized crime. *Ecol. Law Q.* 41, 939–997 (2015).

catch.¹⁷ The United States estimates that 20% to 32% of the wild capture seafood by volume in its markets may be illegal or unreported.¹⁸

Multinational fishing fleets, shipping companies, reefers, ports, processors, and distributors further complicate global fisheries. Deriving ownership or accountability is often tenuous at best.

A tragic example was recently reported by a Norwegian investigative report.¹⁹ Investigators chronicled a lost Ukrainian crewmember, living in Norway, hired to crew on a Latvian crab boat. His contract was through a company in Seychelles. His paychecks came from a bank in Busan, South Korea. His vessel fished in contested waters off Norway and Russia. The vessel was owned by a Latvian shipping company listed as a kitchenware distributor. The shipping company was in turn, owned by a Lithuanian beauty product distributor, whose single investor was a Russian maritime lawyer.

The Ukrainian crewmember reported eating frozen bait because food stores were depleted and being forced to fish without safety gear. He was reported as fallen overboard near the Canary Islands while transiting to Mozambique. The vessel was supposed to be crabbing Baltic waters. Compensation, insurance, and accountability were denied to his widow and child because of the international contract.

This case study is a modern example of how convoluted and murky multinational fisheries can be. Transparency is necessary to minimize the risk of nefarious activity and close regulatory loopholes industry-wide.

2.6. Transshipment and IUU

There are many ways IUU fish enter the market. Transshipment is recognized as, “one of the major missing links to understanding where and how illegally caught fish finds its way to the market and thus a key cause of lack of transparency in global fisheries.”²⁰ A CFV involved in

¹⁷ Cabral, R. B., et al (2018). Rapid and lasting gains from solving illegal fishing. *Nature Ecology and Evolution*, 2, 650–658.

¹⁸ Pramod, G., et al (2014). Estimates of illegal and unreported fish in seafood imports to the USA. *Marine Policy*, 48, 102–113.

¹⁹ Thorenfeldt, G, et al. (2018, November 11). The Victims of the Crab War. *Dagbladet Magasinet*. Retrieved from <https://www.dagbladet.no/magasinet/krabbekrigens-ofre/70428600>

²⁰ Food and Agriculture Organization of the United Nations, *supra* note 5.

IUU fishing can stay at sea and offload its cargo and resupply with reefers. Reefers launder multiple fish catches by mixing the legally caught and IUU fish together in their holds.²¹

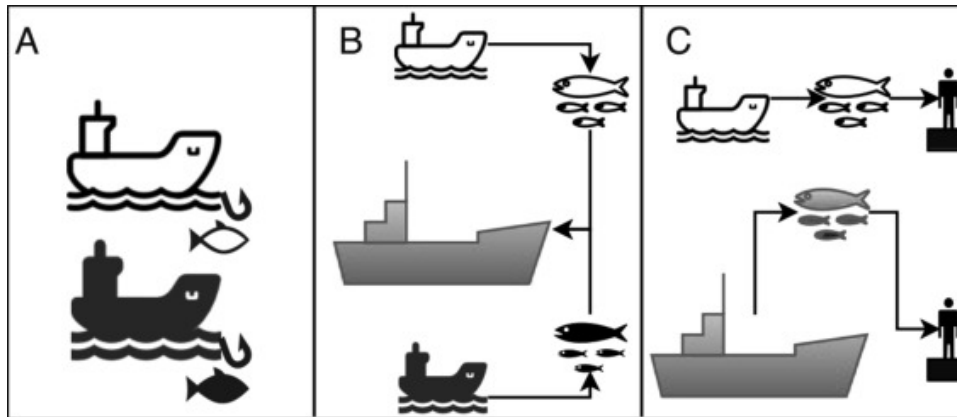


Figure 1: “A) Legal (white) vessels and illegal (gray) vessels fishing on the high seas can (B) transship their catch to a (light gray) refrigerated cargo vessel and be refueled and resupplied, allowing them to stay at sea without returning to port. Legal and illegal catch are mixed aboard the cargo vessel, which then returns to offload at port along with legal fishing vessels (C), at which point inspection agents can no longer identify whether landed fish was legally or illegally caught. Illegal vessels can thus avoid returning to port for months or years at a time, and illegal fish is laundered into the seafood supply chain.” (From Ewell, C., et al. (2017); see note 26)

In July 2004, Japanese authorities arrested a reefer flagged to Panama and owned by a Taiwanese company. The reefer made a port visit in Japan and offloaded tuna from 28 different Taiwanese CFVs. The investigation revealed all 28 CFVs had false documents about the areas they fished, vessel names, transshipment locations, and dates. Additionally, the reefer in question had two log books, one accurate and another for authorities.²²

The practice of at-sea processing of catch into boxed fillets strains transparency and recordkeeping. Identifying species or verifying the location of catch from a fillet to ascertain the legality of its harvest is difficult once it is frozen, processed, and boxed.

Reefer operations have developed to circumvent IUU enforcement and controls. They can avoid higher duties, import regulations, or visa and quota restrictions. Many IUU reefer

²¹ Telesetsky, *supra* note 16.

²² Gianni, M. and W. Simpson (2005). The Changing Nature of High Seas Fishing: how flags of convenience provide cover for illegal, unreported and unregulated fishing. Australian Department of Agriculture, Fisheries and Forestry, International Transport Workers’ Federation and WWF International.

operations are major economic drivers in vulnerable coastal communities.²³ Fisheries transshipment increases the risk of other illicit activities like human rights violations, money laundering, and human and wildlife trafficking.²⁴

Because of the potential for illicit activities associated with reefers, numerous port-States and fisheries organizations have adopted regulations regarding transshipment.²⁵ There are efforts aimed at banning transshipment completely.²⁶ For example, Indonesia has banned foreign transshipment at sea and only accepts fish from local reefers when there is an observer on board, a vessel monitoring system, and onboard closed-circuit television.²⁷

2.7. Transshipment and human rights violations – seafood slavery

Fishing is one of the most dangerous professions in the world with high injury and mortality rates; this is worsened by unsafe conditions on board CFVs.²⁸ Recent Pulitzer Prize winning reports by the Associated Press have revealed details of seafood slavery.²⁹ Seafood slavery can occur when a fishing company charters CFVs to fish in another State's EEZ. The fishing company will contact a local financial institution for funding. Once the bank agrees, the money is used to contract a local corporate entity in the country whose EEZ waters are to be fished.³⁰

²³ Food and Agriculture Organization, *supra* note 5.

²⁴ Telesetsky, *supra* note 16.

²⁵ For a detailed study of global transshipment and regulations, see Food and Agriculture Organization, *supra* note 5.

²⁶ Ewell, C., et al. (2017). Potential ecological and social benefits of a moratorium on transshipment on the high seas. *Marine Policy*, 81, 293–300. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0308597X17300623?via%3Dihub>

²⁷ Cabral, *supra* note 17.

²⁸ Human Rights at Sea (2017). Fisheries Abuses and Related Deaths at Sea in the Pacific Region. Retrieved from <https://www.humanrightsatsea.org/wp-content/uploads/2017/12/HRAS-Fisheries-Abuse-Investigative-ReportDec-2017-SECURED.pdf>

²⁹ Associated Press (2015). Seafood from Slavery: An AP investigation helps free slaves in the 21st century. Retrieved from <https://www.ap.org/explore/seafood-from-slaves/>

³⁰ A. Couper, H. Smith, B. Ciceri, (2015). Fishers and plunderers: Theft, slavery and violence at sea, Pluto Press.

One State owns the boats, funding, and provides crew. Another State agrees to the charter. To crew the vessels, the fishing company contracts a manning agency who recruits men from countries with high unemployment rates. These populations are vulnerable because of their need for work.³¹ Would-be crew sign multiple contracts – sometimes in languages they don't understand.³² Recruiters provide fake or forged visas.³³ In compensation for the recruiter finding them work, men are required to offer collateral or pay recruiters.³⁴ If they cannot pay, they enter their contract in debt.³⁵ Once at sea, things get worse.

On board the CFV they are forced to work long hours with little sleep and no medical care.³⁶ There have also been reports of physical and sexual abuse.³⁷ Passports are confiscated and if the men try to leave the CFV, they may be subject to arrest because their paperwork is forged or had been confiscated by CFV officers. If they do leave, they are forced to pay off the debt accrued by the contract.³⁸

It is estimated only 54% of fishing in areas outside of EEZs, the high seas, is profitable; that CFV fleets only profit because of subsidies and very low labor costs.³⁹ Enlistment into indentured servitude and the at-sea transfer of crews between CFVs make transparency difficult. These are some of the main underpinnings of seafood slavery.⁴⁰ As a CFV stays at sea

³¹ M. Fields (2014). *The Catch: How fishing companies reinvented slavery and plunder the oceans*, Awa Press.

³² Associated Press, *supra* note 29.

³³ *Ibid.*

³⁴ *Ibid.*

³⁵ *Ibid.*

³⁶ Both Couper and Fields, *supra* notes 30 & 31.

³⁷ *Supra*, notes 28 – 31.

³⁸ *Ibid.*

³⁹ E. Sala, et al. (2018). The economics of fishing the high seas. *Scientific Advances*. 4, 2504.

⁴⁰ Ewell, *supra* note 26.

for months and years, a fisherman's debts to the CFV for food and berth compound and abuses persist.⁴¹

The catch from these CFVs is either transshipped onto reefers or taken directly to port. The port may be within a developed State and not the State who flags or finances the CFVs. The chartered State distributes the fish to global markets, including the United States and European Union. The fishing company profits from the sales of the fish.

The transnational component of fisheries crimes consists of the following elements: the nationality of reefer and fishing crews who may move across borders undetected, a vessel's flag-State, fishing activity occurring in areas beyond State jurisdiction, and the ports where vessels land their catch.⁴² Transshipping to reefers allows these CFVs to stay at sea for years. Crewmembers subjected to these conditions have little recourse or escape until the CFV makes a port visit. Bringing transparency to reefers directly affects key conditions requisite in seafood slavery.

2.8. Port State Measures Agreement

At-sea intervention and enforcement are expensive and rare. Strategically, States exert control at their ports. The Agreement on Port State Measures To Prevent, Deter And Eliminate Illegal, Unreported And Unregulated Fishing (PSMA) from the FAO, has 59 States and one member organization (European Union) participating as of March 2019.⁴³ PSMA aims to address IUU fishing whereby Parties create binding legislation and regulations directed at foreign vessels entering their ports. By requiring such things as inspections, log books, catch traceability, and State information sharing, it creates barriers to landing IUU fish.

⁴¹ *Ibid.*

⁴² United Nations Office on Drugs and Crime (UNODC), Fisheries Crime: transnational organized criminal activities in the context of the fisheries sector (2019). Retrieved from https://www.unodc.org/documents/about-unodc/Campaigns/Fisheries/focus_sheet_PRINT.pdf

⁴³ Food and Agriculture Organization of the United Nations. Agreement on Port State Measures (PSMA) (2019). Retrieved from <http://www.fao.org/port-state-measures/en/>



Figure 2: Signatories to PSMA as of March 2019 in blue. 59 States and European Union members (28 States).

The PSMA went into force June 2016 and its implementation is, “expected to be a major advance in combatting [IUU] fishing globally.”⁴⁴ At its beginning, PSMA was approved by the FAO and open for signature from November 2009 to November 2010.⁴⁵

⁴⁴ United Nations, General Assembly, Preparatory process of the United Nations Conference to Support the Implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development: note by the Secretary-General, A/71/733 (27 February 2017). Retrieved from: undocs.org/A/71/733

⁴⁵ The Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing was approved by the FAO Conference at its Thirty-sixth Session (Rome, 18-23 November 2009) under paragraph 1 of Article XIV of the FAO Constitution, through Resolution No 12/2009 dated 22 November 2009. The Agreement was registered with the Secretariat of the United Nations on 26 January 2017 under No. I-54133.

As an FAO international treaty, States may sign, approve, ratify, accept, or may enter by accession. In general, a signatory does not give consent to be bound by PSMA rather a signature expresses willingness to continue the treaty-making process. Being a signatory allows a State to continue through the ratification, acceptance, or approval process. A State's signature, "creates an obligation to refrain, in good faith, from acts that would defeat the object and the purpose of the treaty."⁴⁶

Ratification of PSMA is an, "international act whereby a [S]tate indicates its consent to be bound to a treaty if the parties intended to show their consent by such an act."⁴⁷ Ratification allows a State the time for approval through domestic legislative requirements for implementation.

The acceptance or approval of PSMA have the same legal effect as ratification and the State consents to being bound to the treaty.⁴⁸ Acceptance and approval are used in instances where a State does not require a treaty to be ratified by heads of state. Accession allows a State to become part of PSMA once it has been enacted and signed by other States. It has the same legal obligations as ratification.⁴⁹ Accession usually occurs after the treaty has entered into force.

2.8.1.PSMA implementation

Parties to the PSMA treaty agree to publish a list of their ports.⁵⁰ Port-States create minimum standards for notification for a foreign vessel's arrival. The vessel may be denied entry by the port-State and if so, the port-State will inform the flag-State, Regional Fisheries Management Organizations, or other organizations.

If the port-State has reasonable grounds or sufficient proof a vessel has engaged in IUU fishing it will be denied entry or use of ports. A port-State may allow entry to port for inspection. Additionally, if a port-State has sufficient proof a vessel has engaged in IUU fishing it will deny port services such as refueling, resupplying, maintenance, or drydocking; exceptions being protection of life or safety.

⁴⁶ Articles 10 and 18, Vienna Convention on the Law of Treaties 1969.

⁴⁷ Articles 2 (1) (b), 14 (1) and 16, Vienna Convention on the Law of Treaties 1969.

⁴⁸ Articles 2 (1) (b) and 14 (2), Vienna Convention on the Law of Treaties 1969.

⁴⁹ Articles 2 (1) (b) and 15, Vienna Convention on the Law of Treaties 1969.

⁵⁰ Food and Agriculture Organization, *supra* note 43. Article 2.

Port-States may inspect vessels that have previously been denied entry from other Parties to PSMA or inspect vessels at the request of other Parties. Inspections cover relevant areas of the vessel, fish on board, nets and equipment, and documentation to verify compliance. If a vessel is found to have clear grounds that she has engaged in IUU fishing or fishing related activities, the port-State shall notify the flag-State and relevant organizations and deny entry or the use of the port. If a flag-State is notified that its vessel has engaged in IUU fishing it is required to fully investigate and if appropriate take enforcement actions without delay.

Selected excerpts⁴³

AGREEMENT ON PORT STATE MEASURES TO PREVENT, DETER AND ELIMINATE ILLEGAL, UNREPORTED AND UNREGULATED FISHING

Article 2: Objective – “...to prevent, deter, and eliminate IUU fishing ...thereby to ensure the long-term conservation and sustainable use of living marine resources and marine ecosystems.”

Article 3: Application – “Each Party shall, in its capacity as a port State, apply this Agreement in respect of vessels not entitled to fly its flag that are seeking entry to its ports...”

Article 6: Cooperation and exchange of information – “...Parties shall cooperate and exchange information with relevant States...”

Article 7: Designation of ports – “Each Party shall designate and publicize the ports to which vessels may request entry pursuant to this Agreement. ...Each Party shall, to the greatest extent possible, ensure that every port designated and publicized... has sufficient capacity to conduct inspections...”

Article 12: Levels and priorities for inspection – “Each Party shall inspect the number of vessels in its ports required to reach an annual level of inspections sufficient to achieve the objective of this Agreement.”

Article 23: Non-Parties to this Agreement – “Parties shall encourage non-Parties to this Agreement to become Parties thereto and/or to adopt laws and regulations and implement measures consistent with its provisions.”

Article 24: Monitoring, review and assessment – “Parties shall, within the framework of FAO and its relevant bodies ensure the regular and systematic monitoring and review of the implementation of the Agreement as well as the assessment of progress made towards achieving its objective.”

2.9. Automatic Identification System (AIS)

Automatic Identification Systems (AIS) are onboard safety transmitters and receivers used to avoid vessel collisions. AIS is utilized by port-States for maritime traffic management. The requirement for vessels to have AIS aboard varies depending on the organization or State. However, AIS is mandatory under US law for US vessels greater than 65'⁵¹ and mandated by the UN's International Maritime Organization in the Safety of Life at Sea Convention for vessels greater than 300 gross tons.⁵²

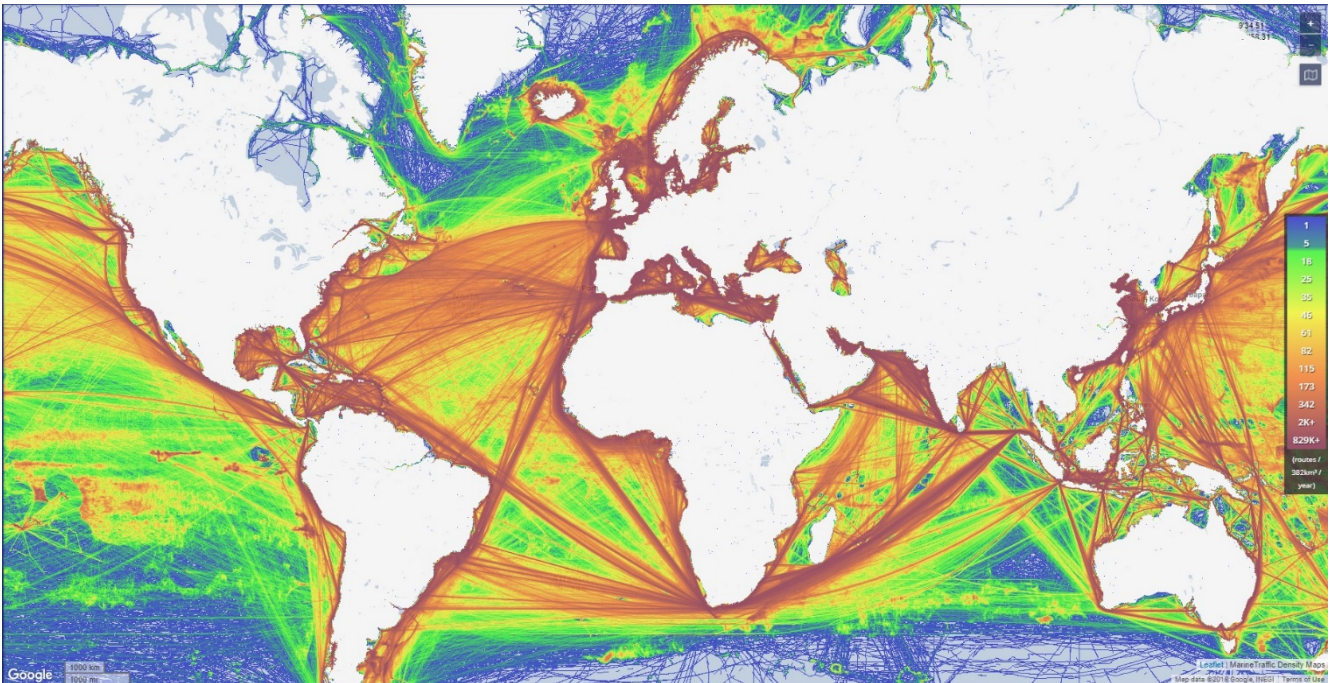


Figure 3: AIS visualization from MarineTraffic.com

AIS transmits vessel-to-vessel or between a vessel and shore. A vessel's information and position are transmitted to shoreside receivers or an array of global satellites and relayed throughout the maritime domain. AIS supports a host of maritime regulatory activities and so has led to international standardized, non-proprietary, and open-source AIS data availability. AIS data include a vessel's identity, marine mobile service identity (MMSI), call sign, location, course, and speed that agencies and States use for maritime monitoring and law enforcement.

⁵¹ 33 CFR §164.46

⁵² Safety of Life at Sea (SOLAS), Chapter V, Regulation 19.2. Carriage requirements for shipborne navigational systems and equipment.

3. AIS and its applications to PSMA

To inform PSMA, this paper focuses on reefers for several reasons. Unlike smaller CFVs, reefers are readily equipped with AIS. Reefers are a key condition in exploiting people for seafood slavery. Reefers also support industrialized fishing that can be detrimental to marine biodiversity and conservation.

3.1. PSMA Articles

AIS data applications are already being used in maritime governance, biodiversity monitoring, and fisheries management.⁵³ AIS data directly contribute to PSMA's implementation, can be useful to PSMA Parties and further the Agreement's goals by supporting three Articles.

Article 7 of PSMA states, "Each Party shall designate and publicize the ports to which vessels may request entry pursuant to this Agreement." The list of ports designated by Parties can be evaluated using AIS as outlined here. States can use AIS as a decision support tool and to spatially assess the ports being frequented by foreign vessels.

Article 12 outlines that, "Each Party shall inspect the number of vessels in its ports required to reach an annual level of inspections sufficient to achieve the object of this Agreement." States can use the number of foreign reefer port visits to allocate assets for inspections. These numbers can substantiate efforts and assistance from other Parties.

AIS provides information on the specific movements of individual vessels. This can be used to coordinate communication about vessels previously identified or associated with IUU fishing. State inspectors can more efficiently stage resources and focus strategies at the vessel, port, or fleet levels.

Article 24 of PSMA requires monitoring, review, and assessment of the implementation of PSMA. As PSMA continues to grow, vessel movements from AIS can show trends among flag-State and port-State relationships.

AIS can aid in revealing the global behavior of States and reefers. The methodology outlined here can be examined from the State perspective or the individual port perspective. It can follow one individual reefer or a flag-State's fleet of reefers across the globe. With high confidence, information on reefer port visits is now available and a State's acceptance of foreign

⁵³ Dunn D., et al. Empowering high seas governance with satellite vessel tracking data. *Fish* 2018; 19:729–739. Retrieved from <https://doi.org/10.1111/faf.12285>

reefers can be assessed. Transparency of a State’s compliance and cooperation with Parties to PSMA may be a tool and benefit to encourage participation.

4. Examples of results

A list of 784 individual reefers was created and AIS data on these reefers were compiled from 2015 through 2018. The AIS data included, among other items, a reefer’s name and flag-State. The reefer’s track line and positions were used to recreate voyages from one port to another. This created a global dataset of ‘port visits’ made by reefers from 2015 to 2018.

4.1. Reefer port visits across the globe.

In total, from 2015 to 2018, 784 individual reefers made 67,308 port visits across the globe from voyages greater than 24 hours. Of these 67.5%, or 45,722, were made by foreign reefers.

- 2015 saw 16,046 total reefer port visits with 10,784 (67%) from foreign reefers.
- 2016 saw 18,712 total reefer port visits with 12,787 (68%) from foreign reefers.
- 2017 saw 15,477 total reefer port visits with 10,466 (67%) from foreign reefers.
- 2018 saw 17,073 total reefer port visits with 11,685 (68%) from foreign reefers.

This suggests that since the majority of port visits are made by foreign reefers, PSMA can have broad application and impact. Of these foreign reefers, the number that make port visits to States who are Party to PSMA is growing as more States became Party. In 2018, 63% of reefers (7,326) made port visits in States who are Party to PSMA.



Figure 4: Port visits from foreign reefers – where the ports are either Party or not to PSMA.

The port-State and reefer’s flag is either Party to PSMA or not, creating four possible combinations of PSMA status between a port-State and a reefer. Figure 5 illustrates the increase of foreign port visits when the reefer and the port are both Parties to PSMA. The AIS data suggest that a would-be State may benefit by becoming Party to PSMA because it would open access to additional markets.

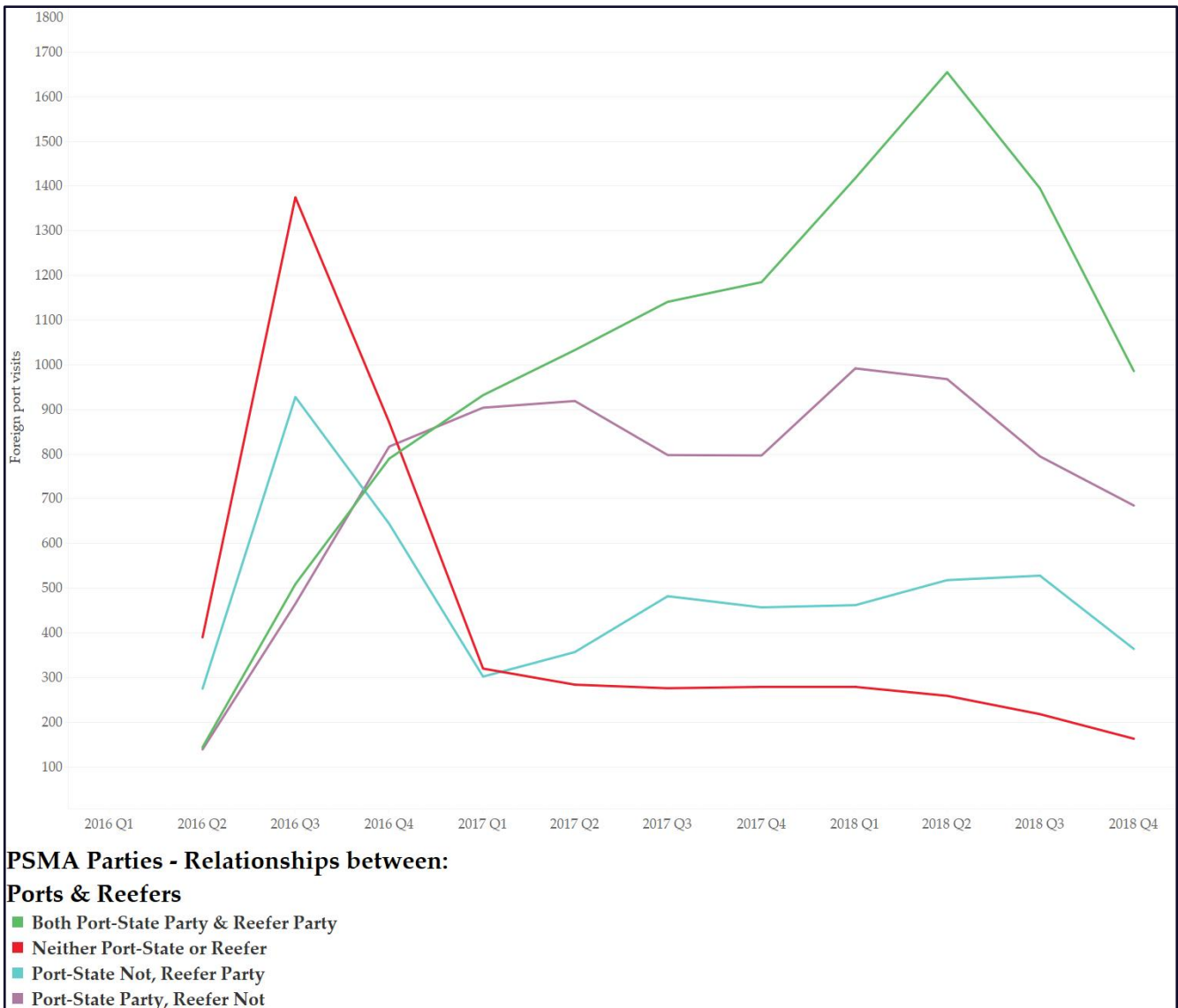


Figure 5: Relationships between port-States and foreign reefers starting when PSMA went into force, 05 June 2016 through 2018.

Once PSMA came into force on 05 June 2016, there was a large decrease in foreign reefers flagged to States that were not Party to PSMA that visited non-Party ports. There was also a large decrease in reefers flagged to Party States visiting non-Party ports. These findings are encouraging as it shows the growing impact of State participation in PSMA.

4.2. From a State perspective

AIS can be used to look at the foreign reefers a State allows to visit. For example, between 2015 and 2018 the Russian Federation had the highest amount of reefer port visits with 10,144 reefers visiting its various ports. However, of this total, only 9%, or 907 port visits, were from foreign reefers. The vast majority of reefers that visit ports in Russia are Russia's own domestic reefers.

In contrast, between 2015 and 2018, the Republic of Korea allowed 5,545 port visits from reefers. Of these, 89%, or 4,941, were foreign reefers. Using AIS, it is possible to parse out the reefers who visited the Republic of Korea. For example, 2015 saw 1,111 total reefer port visits where 86% were from foreign reefers. The foreign reefers came from 17 different flag-States comprised of 223 individual foreign reefers vessels for a total of 959 foreign reefer port visits.

4.3. From an individual port perspective

Looking at individual ports furthers transparency. Reefer AIS data revealed that location plays a role in foreign port visits. The Russian port of Vladivostok on the Pacific Ocean saw 3,853 reefer port visits between 2015 and 2018. Of those visits, only 22 were from foreign reefers. On the eastern side of the Russian Federation, the port of Primorsk on the Baltic Sea saw 261 reefer port visits and 253 were from foreign reefers.

From 2015 to 2018, the Chilean port of Quellon allowed 617 port visits from reefers. All of the reefers were domestic. Further south in Punta Arenas, Chile allowed 42 reefers to visit; all of which were foreign reefers. The impact of PSMA may be seen when looking at the flags of the reefers over Punta Arenas's timeline.

In 2015, 12 foreign reefers ported in Punta Arenas. They came from Panama, China, Cambodia, Vanuatu, Kiribati, and Belize.

PSMA went into force 05 June 2016. Chile ratified PSMA prior to this date and as PSMA went into force, Chile was a Party. In 2016, prior to PSMA coming into effect, Chile allowed reefers from Vanuatu, Kiribati, Panama, and Bahamas to the port in Punta Arenas. From June 2016 on, Chile only allowed reefers at Punta Arenas from Panama, Lithuania, and Liberia. Panama would soon become Party to PSMA on 21 November 2016, Lithuania was a Party to PSMA through the European Union, and Liberia was the only foreign flagged reefers allowed to port in Punta Arenas once PSMA came into effect for the remainder of 2016.

Both 2017 and 2018 saw 6 foreign reefers, all Panamanian flagged and in 2018 one Chinese reefer ported in Punta Arenas. The AIS data suggest that at the Chilean port of Punta Arenas, PSMA may have influenced the foreign reefers allowed in.

Overall, if Russian or Chilean agencies needed to designate ports for PSMA inspectors, AIS offers exceptional decision support data.

4.4. Following one reefer: NEW SEA REEFER, WISDOM SEA REEFER, RENOWN REEFER & HONOR

NEW SEA REEFER was registered to Honduras at 102 meters in length and 2,989 gross tons. She was active in the AIS port visit data covered in this paper until November 2015 when she changed her name. NEW SEA REEFER became WISDOM SEA REEFER. On 29 March 2017, WISDOM SEA REEFER departed Singapore and was sighted nearly a month later on 27 April 2017, transshipping with four CFVs in the Western Indian Ocean.⁵⁴ The four CFVs were reportedly engaged in unregulated fishing because they were flagged to Djibouti who is not Party to the Indian Ocean Tuna Commission (IOTC). The four CFVs transshipped 14.4 mt of species that were under the management of the IOTC.⁵⁵

WISDOM SEA REEFER still flagged to Honduras, was not Party to IOTC.⁵⁶ Honduras is listed as a FoC and not a Party to PSMA. According to WISDOM SEA REEFER's logs, the transshipment occurred off the coast of Somalia within the Somali EEZ and took four days.

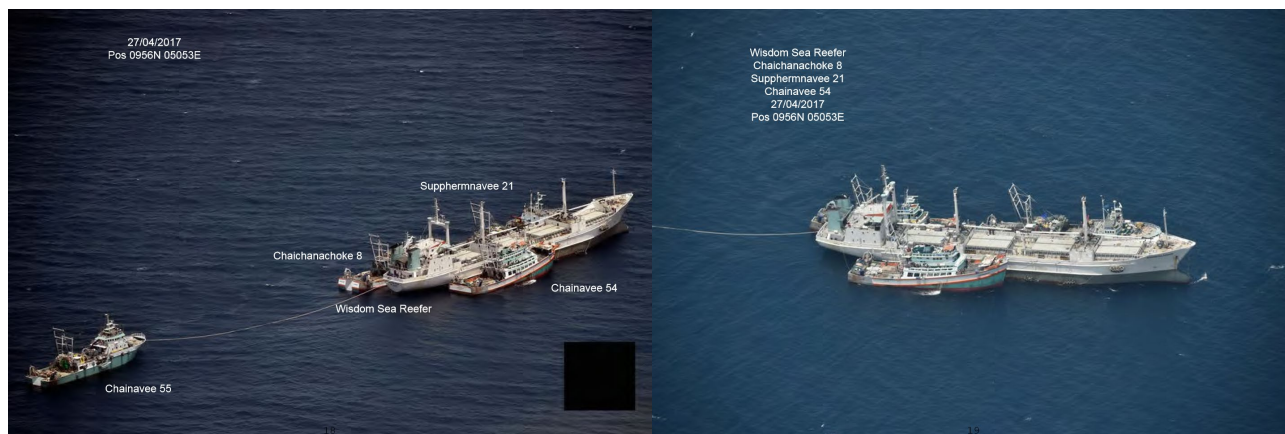


Figure 6: WISDOM SEA REEFER photographs with 4 CFVs. See Indian Ocean Tuna Commission at note 55.

⁵⁴ Indian Ocean Tuna Commission. (2018, March 19). Circular 2018-15, Draft IUU Vessel List. Retrieved from <https://www.iotc.org/documents/draft-indian-ocean-tuna-commission-iuu-vessels-list-3>

⁵⁵ Indian Ocean Tuna Commission. (2018, March 19). Dossier for proposal to include the fishing vessels, CHAICHANACHOKE 8, CHAINAVEE 54, CHAINAVEE 55 and SUPPHERMAVEE 21 into the Draft IUU Vessels List, pursuant to IOTC Resolution 17/03. Retrieved from <https://www.iotc.org/documents/draft-indian-ocean-tuna-commission-iuu-vessels-list-3>

⁵⁶ *Ibid.*

WISDOM SEA REEFER was scheduled to make a port visit in Taiwan following the alleged IUU transshipment off the Somali coast. Taiwanese officials were notified by the IOTC and the reefer's carrier company. As the Taiwanese granted port access to conduct an inspection as per their domestic regulations and PSMA, WISDOM SEA REEFER abandoned her plan to port in Taiwan. As she attempted to leave Taiwanese waters, Taiwanese officials conducted an at-sea inspection.⁵⁷

Taiwanese authorities reported WISDOM SEA REEFER had more catch aboard than her carrying capacity. Somali fishing licenses set maximum catch tonnage and the total catch for the four CFVs far exceeded their Somali permits.⁵⁸ The Captain of WISDOM SEA REEFER told the Taiwanese inspectors that he would not enter their port and would not disclose his next intended destination.⁵⁹ The Taiwanese officials believed its next port to be Bandar Abbas in Iran in August; they alerted Iran.⁶⁰

WISDOM SEA REEFER did not port in Iran. Rather, she made several port visits in Singapore. Using AIS port visit data to augment the IOTC reports, her timeline is as follows:

- 29 March, depart Singapore.
- 27 April, transship off the Somali coast.
- 16 May, arrive Singapore.
- 18 May, depart Singapore.
- 12 July, inspected by Taiwanese officials off the coast of Taiwan.
- 23 July, arrive Singapore.

⁵⁷ Indian Ocean Tuna Commission. (2017, July 24). Circular 2017-071, INFORMATION ON VESSELS ALLEGEDLY INVOLVED IN ILLEGAL AT-SEA TRANSHIPMENTS. Retrieved from <https://www.iotc.org/documents/information-vessels-allegedly-involved-illegal-sea-transshipments>

⁵⁸ *Ibid.*

⁵⁹ *Ibid.*

⁶⁰ *Ibid.*

It was reported to the IOTC that Malaysian authorities detained WISDOM SEA REEFER on 25 July 2017. On 26 September, presumably for another fishing trip, WISDOM SEA REEFER departed Singapore and returned again on 22 November. There are no more records of her after this November 2017 port visit in Singapore.

This is because on 01 December, WISDOM SEA REEFER changed her flag to Bolivia and was renamed RENOWN REEFER.⁶¹ Bolivia is land-locked, listed as a FoC, and is not Party to PSMA. As yet unconfirmed, several sources have reported that as of May 2018, RENOWN is suspected of again changing her name to HONOR and is now registered in Moldova.⁶²

The case study of WISDOM SEA REEFER follows four name changes and numerous maritime jurisdictions. Several States and fisheries organizations coordinated and communicated the behavior of WISDOM SEA REEFER after the alleged IUU transshipment was documented. WISDOM SEA REEFER has been linked to seafood slavery through operational association with reefers and CFVs with prior seafood slavery allegations.⁶³ AIS increases transparency allowing organizations and States to leverage their partners, facilitate communications, and support documentation to adjudicate IUU fishing cases.

The four CFVs involved in the transshipment sighting were previously registered to Thailand until August 2016, then registered to Djibouti. After the reported IUU fishing allegations, Djibouti deleted the four CFVs from their registry, rendering them 'stateless' in June 2017.⁵⁴

⁶¹ IOTC, Dossier, *supra* note 55.

⁶² Urbina, I. (2018, August 30). The Somali 7: Fisheries crimes exposed by open-source reporting. Retrieved from <http://safinacenter.org/2018/08/16588/>

quod vide,

Koopvaardij. (2019). News and photos about Dutch shipping. Retrieved from https://koopvaardij.blogspot.com/2018_08_23_archive.html

quod vide,

Trygg Mat Tracking. (2019). Combined IUU Vessel List. Retrieved from <https://iuu-vessels.org/Vessel/GetVessel/9504bccf-f1cc-4301-bd41-65f7819d2963>

⁶³ Urbina, I. (2015, July 25). The New York Times: The Outlaw Ocean. Retrieved from <https://www.nytimes.com/interactive/2015/07/24/world/the-outlaw-ocean.html>

5. Conclusion

PSMA is one strategy among a portfolio of others used to address IUU fishing. The analysis of AIS data suggests that the majority of global reefer port visits are from foreign reefers. Therefore, there are ample opportunities for the application of PSMA to reefers. With PSMA coming into effect in 2016, effectively knowing which ports or countries to concentrate efforts and training will lead to strengthening PSMA.

Previously, the task of cataloging and tracking the world's vessels and their port visits consisted of vast research through opaque records.⁶⁴ Records documenting fish landings, vessel port visits by flag-State, or the top ports of the world are generally disconnected.⁶⁵ The methodology used here in capturing the global behavior of reefers through AIS allows a multitude of insights into global fisheries.

These examples of application seek to promote information sharing and make readily available information that has previously been difficult to access. Transparency in addressing refrigerated fisheries transshipment cargo reefers is an important step in combating IUU fishing⁶⁶ and seafood slavery.⁶⁷

6. Methods

6.1. Global AIS data

Global Fishing Watch (GFW) provided all of the AIS data used to evaluate reefer vessels and the ports they visited.

The AIS data provided by GFW for 2015 and 2016 are from the telecommunications company Orbcomm. From 2017 and on, GFW used Orbcomm for the first half of the year and both Orbcomm and Spire for the second half. The result of using two sources of AIS data enabled GFW to have a richer dataset for the distant water fishing fleets. It is unlikely to affect the quality of AIS data regarding a reefer's port visits because when a vessel transits to a port or

⁶⁴ Flothmann, *supra* note 1.

⁶⁵ Huntington, T., et al (2015) "Fish Landings at the World's Commercial Fishing Ports" *Journal of Ocean and Coastal Economics*: Vol. 2: Iss. 1, Article 4. DOI: <https://doi.org/10.15351/2373-8456.1031>

⁶⁶ High Seas Task Force (2006). Closing the net: stopping illegal fishing on the high seas. Final Report of the Ministerially-led Task Force on IUU Fishing on the High Seas. Retrieved from <http://www.oecd.org/sd-roundtable/aboutus/stoppingillegalfishingonthehighseas.htm>

⁶⁷ United Nations, *supra* note 44.

anchorage her AIS signal is primarily detected by Very High Frequency (VHF) terrestrial receivers.⁶⁸ Additionally, AIS has been mandated on vessels over 300 gross tons on international voyages since 2008 by the International Maritime Organization and there is no reason to expect a significant change in AIS adoption on reefers starting in 2015.⁶⁹

6.2. Identification of reefer vessels

A list of reefers was supplied by GFW. Methodology for generating the list of reefer vessels is detailed in the literature.⁷⁰ Briefly, the list of reefers was derived by compiling registrations from the International Telecommunications Union and Regional Fisheries Management Organizations. Additional reefers were added after being identified using GFW's classification neural networks that were trained on AIS-based movement patterns. A detailed review was conducted by the fisheries consultancy FishSpektrum and reefers were further verified through authoritative online databases. This resulted in a list of 784 reefer vessels, including both the registration lists and movement-based classifications.

Analysis of global AIS data offers key insights into the behavior of reefers. The administrative landscape of reefers is dynamic. Often and for numerous reasons, reefer vessels change State/flag registry, vessel name, and maritime mobile service identity specific to their AIS transceiver. Therefore, this list of reefers is not intended to be authoritative.

6.3. AIS and port visits

Using the list of identified reefer vessels, the AIS data were compiled for 2015 through 2018 from GFW's database.⁷¹ The dataset consists of 99,403 individual instances of reefer port visits over four years.

⁶⁸ Carson-Jackson, J. (2012). Satellite AIS – Developing Technology or Existing Capability? *Journal of Navigation*, 65(2), 303-321. doi:10.1017/S037346331100066X

⁶⁹ IMO, (2008). International Maritime Organization, Resolution MSC.263(84) (2008), Revised Performance Standards and Functional Requirements for the Long-Range Identification and Tracking of Ships. London, United Kingdom.

⁷⁰ Kroodsma, D., et al. (July 2012) "The Global View of Transshipment: Revised Preliminary Findings." Global Fishing Watch and SkyTruth. Retrieved from <http://globalfishingwatch.org>

⁷¹ For details on the creation of this database see:

<https://globalfishingwatch.org/transshipment-success/report-first-global-view-transshipment-sea/> and <https://globalfishingwatch.org/datasets-and-code/anchorages/>

Reefer AIS data logged a ‘port visit’ when a reefer would come within specific proximities to established ports and anchorages. A ‘port visit’ required AIS data of port entry and exit with a single timestamp. A ‘port entry’ is defined when a reefer transits within three kilometers of a known anchorage or port position and slows to half a knot or below; this reasonably suggests that the vessel is mooring, anchoring, or offloading. A ‘port exit’ was when the reefer transited four kilometers from an anchorage or port position. When a reefer entered and exited a port the data log denoted a ‘port visit’ and received a time stamp. Reefer’s voyages from one port to the next were compiled in order to include voyage duration.

6.4. Identification of ports and anchorages

The anchorages and ports used are published on GFW’s website and derived from a 5-year analysis of AIS tracks where vessels anchored and ported.⁷² They are labeled using the World Port Index.⁷³ Sometimes anchorages are named by significant landmarks or nearby towns, sometimes the user-entered AIS ‘destination’ field was used, and in other instances the common name is used when there was scant information on a particular port or anchorage.

6.5. Sorting the database

Any reefer voyage between ports less than 24 hours in duration was excluded. This eliminated many reefers making more than one port visit per day or taking trips that were unlikely the result of transshipment from multiple CFVs. Many of the excluded voyages were well-boat transshipments of live fish from Scandinavian fish farms such as the Norwegian salmon farms. Additionally, reasonably assuming a reefer sails at a speed of 12 knots, she would cover 288 nautical miles per 24 hours. Given most country’s EEZ extends 200 nautical miles from shore, eliminating reefer voyages under 24 hours filtered the data for reefers outside a State’s EEZ.⁷⁴ This brought the port visits over the four years from 99,403 to 67,308.

The database contained three scenarios of reefer voyages: 1) from one port to another 2) from one port and back to that same port, and 3) entering one port but leaving from a different one.

⁷² www.globalfishingwatch.org

⁷³ Twenty-Sixth Edition of Pub 150, World Port Index. National GeoSpatial-Intelligence Agency. Retrieved from: <https://msi.nga.mil/NGAPortal/MSI.portal>

⁷⁴ Oceans & Law of the Sea, *supra* note 6.

Subsequent voyages where the starting ports were identical were excluded so as to not be double counted as port visits; for example:

Voyage 1: leave port A and arrive port B (from one port to another).

Voyage 2: leave port B and arrive port C (from one port to another).

Voyage 3: leave port C and arrive port C (from one port and back to the same port).

Voyage 4: leave port D and arrive port A (entering one port but leaving from a different).

In the above example, ports B and C (underlined) in voyages 1 and 2 were excluded.

6.6. AIS limitations

This AIS methodology revealed instances when a reefer entered one port and exited another. Navigable straits and other areas of restricted and geographically congested maritime infrastructure with numerous anchorages could return inaccurate 'port visits' in AIS. The requirement to have a reefer's speed below half a knot and excluding voyages under 24 hours should minimize these instances from the dataset.

Reefer port visits derived from this methodology were manually checked against official vessel records in Delaware Bay, Mobile AL, and Los Angeles CA to validate accuracy. In 2015 and 2017, there were 91 port visits for these three ports. When checked against the data there were no discrepancies. There were situations in which the vessel-entered data or a port name differed – 'Philadelphia' instead of 'Delaware Bay'. Instances were verified in the official records when a reefer anchored outside of a port for a period of time then transited to a mooring several kilometers away, which lead to some discrepancies. However, the overall quality check against official records suggests the methodology reasonably offers a very high confidence in the results and its accuracy.

Acknowledgements

For every aspect of this project, I am wholly indebted to my Committee. Dr. Sara McDonald, whose inspiration, patience, insight, and expertise as my Committee Chair was invaluable. Her work with the issues of seafood slavery was the inspiration for me to pursue this project. Dr. Jennifer Burney provided such a sharp vision and enthusiasm that challenged me to look at the robust complexity of the interdependent issues in fisheries socioeconomics. Dr. Travis Schramek whose direction, honesty, and reflections were extremely helpful in crafting my approach. All of the data was supplied by Global Fishing Watch. Nathan Miller and Tyler Clavelle of GFW were a great help in assisting me organize the data and sift through its applications. Lastly, to my partner and daughter who always unflinchingly supported me. When I began this, my daughter was still crawling; now she runs everywhere she can.



Global Fishing Watch



7. Appendix

Further examples of information derived from AIS dataset.

7.1. Bahamas

7.2. Chile

7.3. Ecuador

7.4. Guyana

7.5. Peru

7.6. Ghana

7.7. Top transshipment ports of the world, 2015 – 2018 combined for both domestic and foreign reefers

7.7.1. For both domestic and foreign reefers, the top five ports by total port visits by year

7.7.2. For only foreign reefers, the top five ports by total port visits by year

From 2015 – 2018:

- What foreign reefers did the State allow in?
- How many total instances of port visits, number of individual foreign reefers, and how many States comprised those foreign reefers?
- What ports did the foreign reefers visit?
- What were the names of the reefers allowed in?
- Where did the State's fleet of reefers go?
- Was the port-State or flag-State part of PSMA?

Definitions for the following figures:

- Anchorage/Port Country: The State where a reefer made a port visit.
- Best Flag: The flag of registration for a reefer.
- Ship Name Most Common: The AIS or registered name of the reefer.
- Anchorage Label: Description of anchorage or name of port visited by reefer.
- Total Foreign Port Visits Allowed: The total number of port visits made by foreign reefers.
- Number of Reefers: The number of individual reefers that made port visits.
- Number of Countries Whose Reefers Made Port Visits: The number of distinct countries whose reefers made port visits.
- Flag PSMA: Does the flag-State of the reefer participate in PSMA; Yes or Null. In some figures there will be two different colored numbers next to each other, this occurs when a State signed onto PSMA that year.

7.1. Bahamas

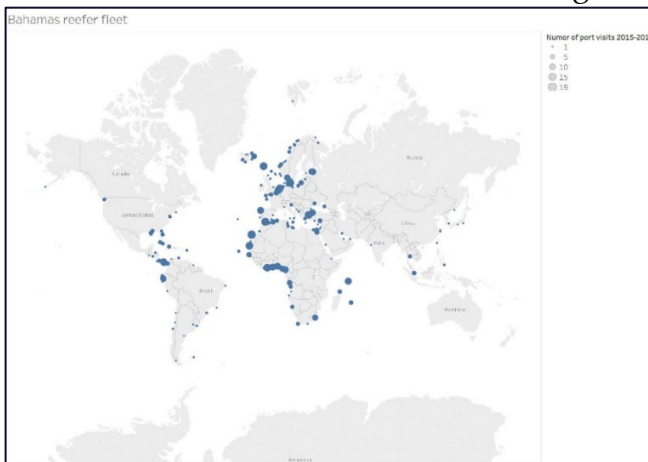
From 2015 through 2018, the Bahamas allowed 12 instances where foreign reefers made a port visit; all were flagged to Panama.

Anchorage/ Port Country	Best Flag	Shipname Most Common	Anchorage Label	Year of Anchorage Timestamp			
				2015	2016	2017	2018
Bahamas	Panama	CENTURYBRIGHT	BAHAMAS		1	1	1
			FREEPORT		1		
		IKAROS1	FREEPORT	1			
		MSCMAXINE	FREEPORT			3	4

Anchorage Country PSMA signatory

- Null
- Y

Where did the Bahamian fleet of reefers go?



fleet size				
Best Flag	2015	2016	2017	2018
Bahamas	23	21	22	21

Bahamas reefer fleet port visits

Year of Anchorage Timestamp	Country PSMA
2015	Algeria Angola Argentina Belgium Benin Brazil Bulgaria Cameroon Chile China Colombia Congo Congo, the Democratic Republic of the Costa Rica Côte d'Ivoire Cuba Curacao Denmark Ecuador Egypt Equatorial Guinea Falkland Islands (Malvinas) Faroe Islands France Gambia Germany Ghana Gibraltar Greece Honduras Iceland Indonesia Italy Libya Lithuania Madagascar Malta Mauritania Mauritius Montenegro Morocco Namibia Netherlands Netherlands Antilles Nigeria Norway Panama Peru Poland Portugal Russian Federation Senegal Seychelles Singapore Slovakia South Africa Spain Sweden Taiwan, Province of China Togo Tunisia Turkey Ukraine United Kingdom United States of America Uruguay --
2016	Algeria Angola Belgium Benin Cameroon Chile China Colombia Congo Congo, the Democratic Republic of the Costa Rica Côte d'Ivoire Cuba Curacao Denmark Ecuador Egypt Equatorial Guinea Faroe Islands Germany Ghana Gibraltar Honduras Iran, Islamic Republic of Israel Italy Japan Libya Lithuania Madagascar Malta Mauritania Mauritius Morocco Namibia Netherlands Nigeria Norway Panama Philippines Russian Federation Saudi Arabia Senegal Seychelles Singapore Slovakia South Africa Spain Sweden Thailand Tunisia Turkey Ukraine United Arab Emirates United Kingdom United States of America Angola Belgium Costa Rica Cuba Denmark France Germany Greece Iceland Indonesia Italy --
2017	Algeria Argentina Cameroon China Colombia Congo, the Democratic Republic of the Côte d'Ivoire Curacao Ecuador Egypt Faroe Islands Gibraltar India Libya Morocco Namibia Nigeria Qatar Singapore Tunisia Turkey Ukraine United Arab Emirates Western Sahara Angola Belgium Benin Bulgaria Cape Verde Chile Costa Rica Croatia Cuba Cyprus Denmark Djibouti Faroe Islands Germany Ghana Greece Iceland Indonesia Ireland Italy Korea, Republic of Latvia Lithuania Madagascar Malta Mauritania Mauritius Netherlands Norway Panama Peru Poland Russian Federation Senegal Seychelles Slovakia South Africa Spain Sweden Thailand Togo United Kingdom United States of America
2018	Algeria Cameroon Colombia Congo, the Democratic Republic of the Côte d'Ivoire Ecuador Egypt El Salvador Gibraltar Guatemala Israel Libya Morocco Netherlands Antilles Nigeria Saudi Arabia Singapore Svalbard and Jan Mayen Tunisia Turkey Ukraine Angola Belgium Benin Brazil Cape Verde Costa Rica Cuba Denmark Estonia Faroe Islands Germany Ghana Greece Guyana Iceland Indonesia Ireland Latvia Lithuania Madagascar Malta Mauritania Mauritius Montenegro Namibia Netherlands Norway Panama Poland Portugal Russian Federation Senegal Seychelles South Africa Spain Sweden Thailand Togo Turkey United Kingdom United States of America

Country PSMA

- Null
- Y

7.2. Chile

How many foreign reefers did Chile allow to make port visits?

Anchorage/Port Country	Total foreign port visits allowed				Number of reefers				Number of countries whose reefers made port visits			
	2015	2016	2017	2018	2015	2016	2017	2018	2015	2016	2017	2018
Chile	56	38	14	26	24	16	9	10	10	8	4	6

Anchorage/Port Country	Best Flag	Number of reefers				Total foreign port visits allowed			
		2015	2016	2017	2018	2015	2016	2017	2018
Chile	Bahamas	1	1	1	1	4	2		
	Belize	1				1			
	Cambodia	3				3			
	China	1	1		1	1	1		1
	Curacao	1				5			
	Kiribati	2	1			2	2		
	Liberia	3	4	1	1	11	10	3	1
	Lithuania		1			4			
	Netherlands	1				1			
	Norway		1	1	1		3	2	3
	Panama	9	6	6	5	26	12	7	18
	Ukraine				1				1
	Vanuatu	2	1		1	5	2		2



What ports did foreign reefers visit?

Anchorage/Port Country	Best Flag	Anchorage Label	Year of Anchorage Timestamp				Best Flag	Anchorage Label	Year of Anchorage Timestamp				Flag PSMA
			2015	2016	2017	2018			2015	2016	2017	2018	
Chile	Bahamas	CORONEL	1				Panama	ANTOFAGASTA	1			1	Null
		PUERTO CALDERA				1		ARICA	1				
		RADA PUNTA ARENAS		2				BAHIA DE VALPARAISO	3				
		TALCAHUANO		2				BAHIA QUINTERO (VEN..	2				
		VALPARAISO				1		BAHIA SAN VICENTE		1		1	
	Belize	RADA PUNTA ARENAS	1				CALBUCO	2					
	Cambodia	RADA PUNTA ARENAS	3				CALETA COLOSO				1		
	China	PUNTA ARENAS		1			COQUIMBO	1			2		
		RADA PUNTA ARENAS	1			1	CORONEL	2			1		
	Curacao	BAHIA DE VALPARAISO	2				MEJILLONES	1	1				
		VALPARAISO	3				PATACHE CHILE	2	1				
	Kiribati	PUNTA ARENAS		1			PTO MONTT				1		
		RADA PUNTA ARENAS	2	1			PUERTO ANGAMOS	1					
	Liberia	BAHIA DE VALPARAISO	5	4	1		PUERTO CALDERA				2		
		PUERTO CALDERA	1				PUERTO MONTT			1			
		RADA PUNTA ARENAS		3			PUNTA CHUNGO	1					
		VALPARAISO	5	3	2	1	PUNTA PATACHE	1					
	Lithuania	RADA PUNTA ARENAS		2			RADA DE ARICA	1					
		SAN VICENTE		1			RADA PUNTA ARENAS	3	7	6	6		
		TALCAHUANO		1			SAN VICENTE		1		2		
	Netherlands	COQUIMBO	1				TALCAHUANO	2	1		1		
	Norway	MEJILLONES				1	VALPARAISO	2					
		PUERTO CHANARAL				1							
		PUERTO MONTT			1		1						
		SAN VICENTE			1		1						
		TALCAHUANO			1		1						
	Ukraine	PUNTA ARENAS										1	
	Vanuatu	CABO NEGRO					2						
		PUNTA ARENAS					1					2	
		RADA PUNTA ARENAS					2	2					

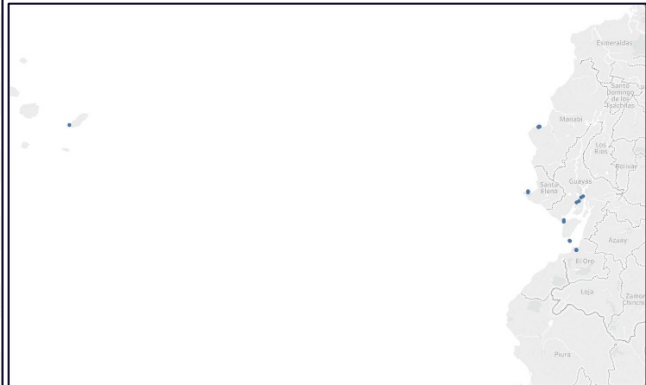
The Chilean fleet of reefers made only domestic port visits.

7.3. Ecuador

How many foreign reefers did Ecuador allow to make port visits?

Anchorage/Port Country	Total foreign port visits allowed				Number of reefers				Number of countries whose reefers made port visits			
	2015	2016	2017	2018	2015	2016	2017	2018	2015	2016	2017	2018
Ecuador	125	118	70	130	51	35	38	46	12	10	6	10

Anchorage/Port Country	Best Flag	Number of reefers				Total foreign port visits allowed			
		2015	2016	2017	2018	2015	2016	2017	2018
Ecuador	Bahamas	8	6	10	9	19	18	16	25
	Barbados	1	1			2	2		
	Belize	1	1			4	4		
	China			1				1	
	Colombia	1	1	1	1	11	14	8	17
	Curacao	2			2	4			7
	Germany	1	1			1	2		
	Kiribati	2				2			
	Korea, Republic of		2	1	3		3	1	5
	Liberia	14	11	8	11	38	49	21	34
	Netherlands	4	1		1	9	3		6
	Netherlands Ant..				1				1
	Panama	14	10	17	15	31	21	23	27
	Russian Federati..				2				3
	Saint Vincent an..	2				2			
	Spain	1	1		1	2	2		5



What ports did foreign reefers visit?

Anchorage/Port Country	Best Flag	Anchorage Label	2015 2016 2017 2018				Best Flag	Anchorage Label	2015 2016 2017 2018				
			2015	2016	2017	2018			2015	2016	2017	2018	
Ecuador	Bahamas	GUAYAQUIL	2				Korea, Republic of	MANTA		3	1	5	
		MANTA	1	1	2	3		Liberia	GUAYAQUIL	1			
		POSORJA	1	2	5	11			POSORJA	5	8	1	2
		PUERTO BOLIVAR	15	12	9	10			PUERTO BOLIVAR	29	40	20	32
		PUNTA ARENAS		1		1			PUNTA ARENAS	3	1		
						Netherlands			GUAYAQUIL	1			
	Barbados	PUERTO BOLIVAR	2	1	1				LA LIBERTAD				2
									MANTA	3			3
	Belize	BAOGANG	3	1					POSORJA	1			
		MANTA		3					PUERTO BOLIVAR	4	2		1
		POSORJA	1					PUNTA ARENAS		1			
	China	PUERTO BAQUERIZO M..			1			Netherlands Ant..	POSORJA				1
	Colombia	GUAYAQUIL				1			LA LIBERTAD	1		3	3
		MANTA	10	14	8	14		Panama	MANTA	6	8	11	9
		POSORJA	1			1			POSORJA	2	3	3	4
	PUERTO MARITIMO DE ..				1	PUERTO BOLIVAR			22	8	6	10	
					PUNTA ARENAS					1			
Curacao	GUAYAQUIL	1				Russian Federati..	LA LIBERTAD				3		
	MANTA				4		Saint Vincent an..	PUERTO BOLIVAR	2				
	POSORJA	1			1	Spain		MANTA	1	1		3	
PUERTO BOLIVAR	2			2	POSORJA		1	1		1			
Germany	POSORJA		1										
	PUERTO BOLIVAR	1	1										
Kiribati	MANTA	1											
	POSORJA	1											

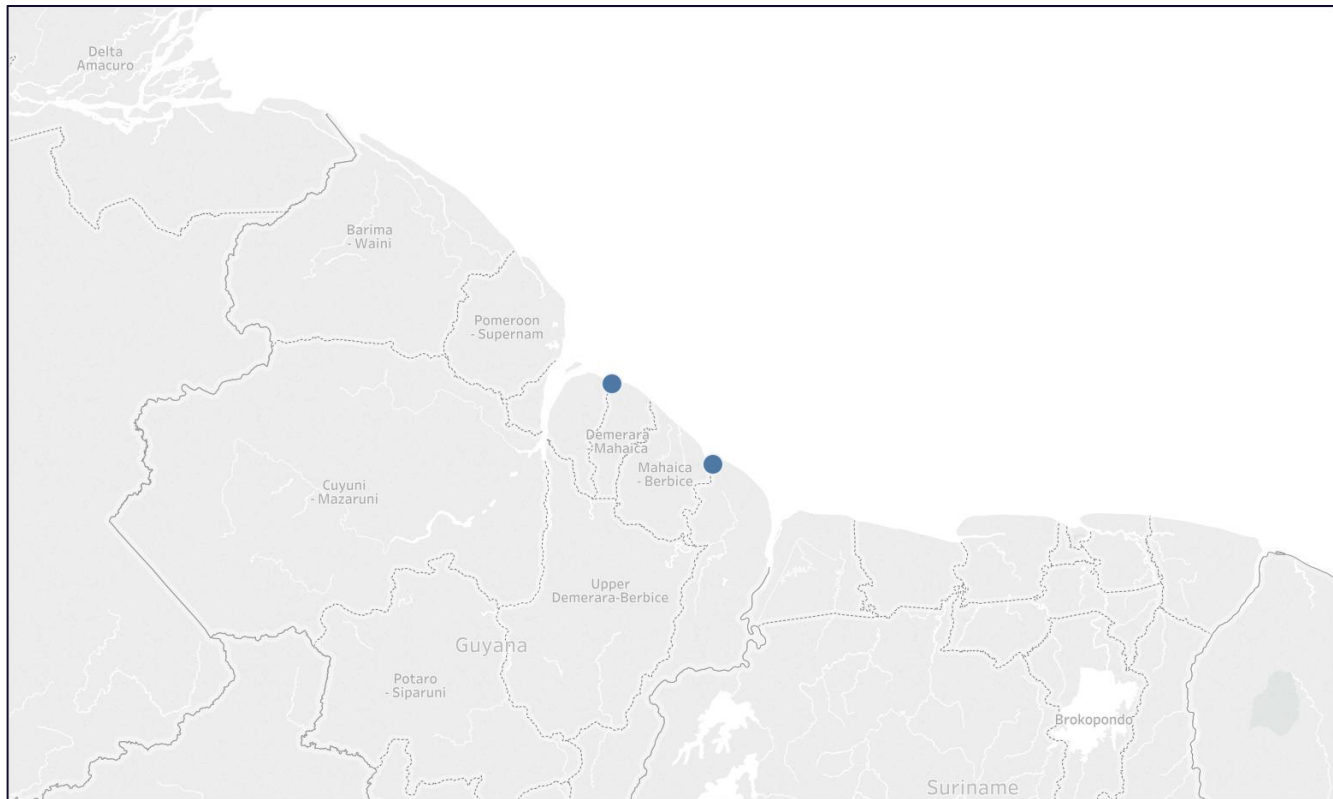
Flag PSMA
■ Null
■ Y

Ecuador does not have a reefer fleet.

7.4. Guyana

How many foreign reefers did Guyana allow in and what ports did they visit?

Anchorage/ Port Country	Best Flag	Shipname Most Common	Anchorage Label	2015	2017	2018	Flag PSMA
							■ Null
Guyana	Bahamas	GREENMAGIC	GEORGETOWN			1	■ Null ■ Y
	Panama	CENTURYBRIGHT	GEORGETOWN		1		
			NEW AMSTERDAM	1			
	Saint Vincent an..	BARANA	GEORGETOWN	1			



Guyana does not have a reefer fleet.

7.5. Peru

What foreign reefers made port visits, how many individual reefers and what were the flag-States?

Anchorage/Port Country	Total foreign port visits allowed				Number of reefers				Number of countries whose reefers made port visits			
	2015	2016	2017	2018	2015	2016	2017	2018	2015	2016	2017	2018
Peru	27	10	14	14	18	5	11	8	6	2	5	3

Anchorage/Port Country	Best Flag	Number of reefers				Total foreign port visits allowed			
		2015	2016	2017	2018	2015	2016	2017	2018
Peru	Bahamas	1		2		1		2	
	China				1				2
	Kiribati	1				1			
	Liberia	4	1	3	2	6	4	3	2
	Maldives	1				1			
	Netherlands			1				1	
	Norway			1				2	
	Panama	10	4	4	5	17	6	6	10
	Saint Vincent an..	1				1			



What ports did the foreign reefers visit and what were the names of the reefers allowed in?

Anchorage/Port Country	Best Flag	Shipname Most Common	Anchorage Label	2015	2016	2017	2018	Flag PSMA	
								Null	Y
Peru	Bahamas	GREENEGERSUND	PAITA				1		
		GREENHONDURAS	CALLAO				1		
		GREENTOLEDO	CALLAO	1					
	China	NINGTAILENG7	CALLAO						2
	Kiribati	WEILI	CALLAO		1				
	Liberia	CHILESTAR	CALLAO		1				
		FUJIBAY	CALLAO			2			
		POLARSTREAM	BAHIA DE MATARANI		1				
			CALLAO					1	
			PISCO					1	
		PRINCEOFTIDES	CALLAO		4				
		SHOTAMARU	ETEN					1	
		WATERPHOENIX	CALLAO		2				
		WEILI	CALLAO					1	
		WEISHUN	CALLAO					1	
	Maldives	BAROASAA	ETEN		1				
	Netherlands	SIERRALEYRE	PISCO					1	
	Norway	BOWARCHITECT	CALLAO					1	
			PUERTO ILO					1	
	Panama	CRYSTALREEFER	CALLAO		1				
		FRIOATLANTIC	CALLAO		1				
		FRIOHellenic	CALLAO						2
		FRIOOceanic	CALLAO					1	
		FRIOPOSEIDON	CALLAO			2		1	
		HAIFENG628	CALLAO		1				
		HAIFENG638	CALLAO		1	2			
		HAIFENG678	CALLAO						2
		HAIFENG688	CALLAO		1				
		IRISREEFER	CALLAO			1			2
		MINGHANG8	CALLAO						2
NORDICOLYMPIC		PAITA						3	
		TALARA		1	1				
PARADISEISLAND		CALLAO		6				2	
SHANGHAIREEFER	CALLAO		1						
SHINHANG6	CALLAO		2						
	CHIMBOTE						1		
WILDLOTUS	BAHIA DE MATARANI		1						
	CALLAO		1						
Saint Vincent an..	BALTICSTAR	CALLAO	1						

Peru does not have a reefer fleet.

7.6. Ghana

What foreign reefers did Ghana allow to make port visits, how many individual reefers, and what flag-States were these reefers?

Anchorage/Port Country	Total foreign port visits allowed				Number of reefers				Number of countries whose reefers made port visits			
	2015	2016	2017	2018	2015	2016	2017	2018	2015	2016	2017	2018
Ghana	152	186	136	168	68	67	48	50	16	13	15	13

Anchorage/Port Country	Best Flag	Number of reefers				Total foreign port visits allowed			
		2015	2016	2017	2018	2015	2016	2017	2018
Ghana	Bahamas	15	8	3	9	26	15	5	18
	Belize	1				4			
	China	1		1	1	3		7	18
	Comoros	4	4	4	2	6	17	12	6
	Cook Islands	1	1	1	1	3	1	3	3
	Curacao	4	4	3	1	10	10	6	4
	Cyprus	2	1	2	2	3	1	3	6
	Faroe Islands			1	1			3	4
	Germany	1	1	1		1	2	1	
	Kiribati		2	1			3	2	
	Liberia	9	10	7	10	19	21	20	29
	Lithuania	4	4	3	4	16	20	14	7
	Netherlands	1	2	2		1	7	5	
	Netherlands Ant..				1				4
	Norway	2				2			
	Panama	13	20	13	12	29	56	32	45
	Russian Federati..	2		1	1	2		9	10
Saint Kitts and N..	7	9	5	5	24	28	14	14	
Vanuatu	2	1			3	5			

The two reefers flagged to Ghana – VOLTA VICTORY and VOLTA GLORY – made port visits to Ivory Coast and domestic port visits.

7.7. Top transshipment ports of the world, 2015 – 2018 combined total port visits for both domestic and foreign reefers

1. Busan, Republic of Korea – 4,375
2. Vladivostok, Russian Federation – 3,853
3. Various anchorages, Singapore – 1,446
4. Las Palmas, Canary Islands, Spain – 1,159
5. Kaohsiung, Taiwan – 912

7.7.1. For both domestic and foreign reefers, the top five ports by total port visits by year

2015:

1. Busan, Republic of Korea – 840
2. Vladivostok, Russian Federation – 753
3. Various anchorages, Singapore – 284
4. Las Palmas, Canary Islands, Spain – 264
5. Balboa, Panama – 199

2016:

1. Busan, Republic of Korea – 1,428
2. Vladivostok, Russian Federation – 1,213
3. Various anchorages, Singapore – 464
4. Las Palmas, Canary Islands, Spain – 354
5. Kaohsiung, Taiwan – 312

2017:

1. Busan, Republic of Korea – 916
2. Vladivostok, Russian Federation – 769
3. Various anchorages, Singapore – 296
4. Anchorage off Dalian, China - 209
5. Las Palmas, Canary Islands, Spain – 354

2018:

1. Busan, Republic of Korea – 1,191
2. Vladivostok, Russian Federation – 1,118
3. Various anchorages, Singapore – 402
4. Las Palmas, Canary Islands, Spain – 336
5. Kaohsiung, Taiwan – 238

7.7.2. For only foreign reefers, the top five ports by total port visits by year

2015:

1. Busan, Republic of Korea – 762
2. Various anchorages, Singapore - 280
3. Las Palmas, Canary Islands, Spain – 262
4. Majuro, Marshall Islands – 176
5. Kaohsiung, Taiwan – 128

2016:

1. Busan, Republic of Korea – 1,312
2. Various anchorages, Singapore - 459
3. Las Palmas, Canary Islands, Spain – 348
4. Majuro, Marshall Islands – 258
5. Kaohsiung, Taiwan – 242

2017:

1. Busan, Republic of Korea – 819
2. Various anchorages, Singapore - 290
3. Las Palmas, Canary Islands, Spain – 198
4. Anchorage off Dalian, China - 192
5. Dragor, Denmark – 103

2018:

1. Busan, Republic of Korea – 1,109
2. Various anchorages, Singapore - 394
3. Las Palmas, Canary Islands, Spain – 332
4. Pohnpei, Federated States of Micronesia - 213
5. Nouadhibou, Mauritania – 200