Port State Measures Before and After Study

Technical Report · September 2023

CITATIONS
0

READS
14

9 authors, including:

Jake Lowe
MRAG Asia Pacific
15 PUBLICATIONS **61** CITATIONS
SEE PROFILE

Nathan A Miller
Global Fishing Watch
53 PUBLICATIONS **1,674** CITATIONS
SEE PROFILE

Francisco Blaha
18 PUBLICATIONS **35** CITATIONS
SEE PROFILE

Port State Measures Before and After Study

A report prepared for the *Pew Charitable Trusts*

September 2023

About MRAG Asia Pacific

MRAG Asia Pacific is an independent fisheries and aquatic resource consulting company dedicated to the sustainable use of natural resources through sound, integrated management practices and policies. We are part of the global MRAG group with sister companies in Europe, North America and the Asia Pacific.

Offices 2/29 Woodstock Rd, Toowong Qld 4066 Australia

Postal Address PO Box 732, Toowong Qld 4066 Australia

Phone +61 7 3371 1500 | **Fax** +61 7 3100 8035 | **Email** info@mragasiapacific.com.au

About this Report

This study was commissioned by the Pew Charitable Trusts. The views in the report represent those of the authors and do not necessarily represent the views of the Pew Charitable Trusts.

This report was prepared by D. Souter, J. Lowe, N. Miller, F. Blaha, N. Tellwright, S. Goldaracena, E. Aroni. C. Heinecken and J. Clark on behalf of MRAG Asia Pacific and Global Fishing Watch.

Suggested citation:

MRAG Asia Pacific (2023). Port State Measures Before and After Study. 74 p.

Acknowledgements

Studies such as this require the collection the collection of data and insights from a large number of people. Particular thanks go to staff from fisheries agencies in the case study port countries for generously providing their data, insights and time, particularly staff from Thailand's Department of Fisheries and Malcolm Block from Namibia's Ministry of Fisheries and Marine Resources. Thanks also goes to the National Geographic Pristine Seas project for generously sharing some of their data on port usage in Montevideo. Lastly, a big thanks to the staff at Pew Charitable Trusts, particularly Elaine Young for overseeing the study and Dawn Borg Costanzi for providing comments on the draft text.

CONTENTS

ACRONYMS AND ABBREVIATIONS

ANP	National Port Administration (of Uruguay)
AREP	Advanced Request to Enter Port
AVIR	Arriving Vessel Intelligence Report
CA	Competent Authority
CCAMLR	Commission for the Conservation of Antarctic Living Marine Resources
CMM	Conservation and management measure
COVID	SARS CoV-2 virus
CPUE	Catch per unit effort
DINARA	Uruguayan National Directorate for Aquatic Resources
DOF	Thailand Department of Fisheries
EEZ	Exclusive economic zone
ENSO	El Nino Southern Oscillation
EU	European Union
FAD	Fish aggregation device
FAO	UN Food and Agriculture Organisation
FFA	Forum Fisheries Agency
FFV	Foreign fishing vessel
FIQD	Thailand Fisheries Inspection and Quality Control Division
FSM	Federated States of Micronesia
GFW	Global Fishing Watch
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
IUU	Illegal, unreported and unregulated fishing
MCS	Monitoring, control and surveillance
MIFV	Marshall Islands Fishing Venture
MIMRA	Marshall Islands Marine Resources Authority
PRODUCE	Peru Ministry of Production
PSM	Port State measures
PSMA	Port State Measures Agreement
RFMO	Regional Fisheries Management Organization
RFV	WCPFC Record of Fishing Vessels
RMI	Republic of the Marshall Islands
ROP	Regional Observer Program
SADC	Southern African Development Community
SEAFO	South East Atlantic Fisheries Organisation
SPRFMO	South Pacific Regional Fisheries Management Organisation
UNCLOS	United Nations Convention on the Law of the Sea
VMS	Vessel monitoring system
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean

EXECUTIVE SUMMARY

Background and approach

Port State measures (PSMs) are an important component of the 'toolbox' of monitoring, control and surveillance (MCS) measures aimed at effectively monitoring the global trade of seafood products and preventing fish derived from illegal, unreported and unregulated (IUU) practices entering the marketplace. While PSMs have long been applied at the individual State and Regional Fisheries Management Organisation (RFMO) level, the most prominent global agreement on PSMs is the United Nations Food and Agriculture Organization's Port State Measures Agreement (PSMA), which entered into force in June 2016. Currently, there are 75 Parties (including the EU that represents 27 member States) signed up to the PSMA. The main provisions of the PSMA are based on the designation of ports for foreign vessel entry, advance notification of entry into port, risk assessment, inspections and information exchange.

As States implement the PSMA or PSMs more effectively (e.g. requirements to use only designated ports, stronger inspection regimes, etc) there is the potential to change the behaviour of fishing fleets in response to the new measures. To examine the 'real world' influence of changes in PSMA/PSM implementation, the Pew Charitable Trusts commissioned MRAG Asia Pacific, in partnership with Global Fishing Watch (GFW), to undertake a study looking at changes in foreign fishing fleet behaviour in the periods 'before' and 'after' PSMA (or PSM) implementation in a number of case study ports. The overall aim was to examine whether changes in behaviour could be detected using publicly available Automatic Identification System (AIS) data, and the extent to which any changes were influenced by PSMA/PSM implementation (as opposed to other factors influencing port usage – e.g. changes in the distribution of fishing effort, availability of local support services).

Broadly, we approached the study in three phases. The first phase focused on exploring the feasibility of using AIS data to detect and analyse changes in fishing fleet behaviour in the periods 'before' and 'after' PSMA (or PSM) implementation, as well as identifying a final list of case study ports. The second phase developed a framework of metrics to examine changes in fleet behaviour in the periods 'before' and 'after' PSM/PSMA implementation. These were broadly designed to examine (i) changes in FFV visits, (ii) changes in port usage and (iii) changes in transshipment activity. The final phase examined trends in metrics for each port and worked with local experts to examine the drivers for changes, specifically to identify if these changes were driven by PSMA/PSM implementation.

Case study port outcomes

Six case study ports were examined across five countries. The main changes experienced by each 'before' and 'after' PSM/PSMA implementation are set out below:

Majuro, Marshall Islands – The 'cut-off' date used for the Majuro case study was 2017, when the current PSM processes were first implemented. The years 2015 and 2016 were used as the 'before' period and 2018 and 2019 the 'after' period. Majuro experienced a small decline in FFV activity in the 'after' period, although this is unlikely to be related to the introduction of PSMs. FFV activity in Majuro is dominated by purse seine tuna transhipment, with levels of activity largely driven by operational and commercial factors, principally the distribution of fishing effort. Much of the change in transhipment activity (and fishing vessel/carrier port visits) can be explained by changes in the distribution of fishing effort associated with changes in the ENSO cycle. In practice, the influence of PSMs in determining the choice of port is 'swamped' by these more dominant commercial factors. The absence of any change post-PSMs is also likely to be influenced by the strong monitoring measures in place (e.g. 100% observer coverage, frequent VMS polling under the PNA Vessel Days Scheme, prohibition of at sea transhipment) and high rates of compliance evident in the purse seine fleet (MRAG Asia Pacific, 2021).

Bangkok, Thailand - The Advanced Request to Enter Port (AREP) process was implemented in early 2016 in Bangkok ports, with pre-arrival risk assessment / inspection procedures implemented throughout that year. On that basis, 2016 was used as the cut-off date, with 2014-2015 the 'before' period and 2017 to 2019 the 'after' period. The available information indicates that port usage by FFVs underwent relatively little change in the period after the implementation of the PSMA. As the world's leading tuna processing hub, port usage is

dominated by carrier vessels (mainly from the WCPO) servicing tuna processing plants in the Bangkok/Samut Sakhon areas. Very few, if any, foreign fishing vessels use the port. While AIS data was limited in the 'before' period, official port records and Thailand tuna export statistics indicate that carrier vessel visits are likely to have remained stable across the before and after periods. The apparent stability in port usage will be driven overwhelmingly by the strong and consistent demand for tuna raw material by Thai processing facilities – in short, the commercial advantages of maintaining existing supply relationships and logistics networks will substantially outweigh any 'downsides' associated with stronger port controls. The only operational change of note was an increase in average time spent at anchorage in the after period.

Chimbote/Callao, Peru - Of all the case study ports examined in this study, the Peru ports of Chimbote and Callao experienced the most substantial changes in fishing fleet behaviour following the implementation of PSMs to support implementation of the PSMA. In this case, we looked specifically at the impact of the requirement introduced in 2020 for squid jig vessels to install a VMS approved by PRODUCE and transmit six months' VMS data to Peruvian authorities prior to entry into Peruvian ports. The period 2015-2019 was used as the 'before' period and 2021-2022 the 'after' period. Prior to the introduction of the VMS requirement, Peruvian ports, and in particular Chimbote, were used for routine hull maintenance and other services. Following the introduction of the VMS requirement, Chinese jigging vessels have been almost completely absent from Chimbote, with no visits in 2021 or 2022. A similar trend was evident in Callao, with numbers of jigger visits (including those from Korea) falling sharply following 2019. An analysis of Chinese jigging vessels which previously visited Chimbote indicated that they had continued to fish in the same areas after the VMS requirement, with a small increase in visits to Chinese ports. Other vessels appear to have remained at sea for longer periods, spanning multiple fishing seasons. By contrast, the Korean jig fleet has changed fishing pattern, with vessels fishing exclusively on the Atlantic side of South America following the introduction of the VMS requirement, with no effort on the Pacific side since 2021.

Montevideo, Uruguay - 2017 was chosen as the 'cut-off' year for Montevideo port, given this was when DINARA was established as the competent authority and PSMA measures were practically and consistently applied to foreign vessels using Montevideo port. The years 2015 and 2016 were used as the 'before' period and 2018 and 2019 the 'after period'. Overall changes in fishing and carrier vessel usage of Montevideo port were broadly correlated with changes in fisheries production in the southwest Atlantic. While visits by Chinese flagged squid jiggers declined across the study period, industry sources indicated this was largely driven by a combination of lower squid catches in the SW Atlantic, increased demand for domestic squid consumption in China, an increase in the Chinese-controlled carrier fleet leading to greater capacity to transport products directly to China from fishing grounds and directives from Chinese squid companies to preferably land in China, rather than PSMA impacts. These factors also likely influenced the decline in port visits by Panamanian and Chinese flagged carrier vessels from 2017 onwards. These changes occurred despite Uruguay undertaking few inspections and not denying entry to any vessel during the study period.

Walvis Bay, Namibia - The identification of a clear 'cut-off' date for Walvis Bay is complicated by the incremental implementation of PSMs over time. Nevertheless, 2017 was chosen as the cut-off year because (a) this was when Namibia became a Party to the PSMA and (b) we understand that Namibia began monitoring 100% of all landings. The years 2014-2016 were used as the 'before' period and 2018-2021 the 'after period'. While the overall number of FFV port visits showed few strong trends across the study period, the composition of the fleet changed significantly, with visits by trawlers decreasing and tuna longliners increasing. The decline in visits by trawlers is likely driven both by the decline of foreign flagged trawlers fishing for hake and horse mackerel in the Namibian EEZ over time, as well as by Namibia's refusal to allow entry to Namibian ports by many pelagic trawlers chartered by Angola due to suspected IUU fishing (in accordance with the PSMA and the Namibian NPOA IUU) over recent years. The increase in foreign longline vessel visits to Walvis Bay during 2018-2021 is likely driven primarily by the impacts of the 'Namibianisation Policy' introduced in 2018, rather than PSMA impacts.

Analysis and main messages

For most case study ports, the introduction of PSMs has had relatively little impact on the natural dynamics of port usage

For four of the six case study ports examined here, the implementation of the PSMA (or PSMs) appeared to have relatively little impact on port usage by foreign fishing fleets during the study period. This is largely because the choice of port for foreign fishing vessels is primarily driven by commercial and other imperatives which tend to overwhelm any possible 'disadvantage' associated with stronger port controls. In other cases, the lack of a strong 'signal' in foreign fishing fleet behaviour around the time of PSMA implementation may be also partly driven by the incremental implementation of PSMs over time. Broadly, these results should provide confidence to most States considering acceding to the PSMA that the agreement can be implemented without 'scaring off' foreign fishing fleets and forgoing important economic activity associated with FFV port visits.

But, in some cases, new PSMs can have a big impact

The most notable example of a PSMA/PSM-related impact was in Peruvian ports following the VMS requirement, introduced in 2020 in response to concerns around high seas vessels switching off AIS and possibly fishing in Peru's EEZ. In this case, the introduction of the VMS requirement led to the complete abandonment of Chimbote port by the Chinese high seas squid jig fleet, as well as a significant decline in the use of Callao port by both Chinese and Korean squid jig fleets. While the extent to which the measures are linked is unknown, in the year following the VMS requirement (2021), independent analyses detected fewer Chinese squid jig vessels with AIS irregularities as well as the apparent self-enforcement of a buffer zone adjacent to the Peru and Ecuador (Galapagos) EEZs. In addition to 'positive' impacts from the VMS requirement, anecdotal evidence indicates the absence of jiggers from Chimbote has had a big impact on some local businesses (due to fewer visits, lesser demand for local services) and has resulted in many vessels remaining longer at sea, leading to concerns about increased labour rights risks.

In addition to the impacts of the VMS requirement in Peru, PSMs have influenced the composition of vessels using Walvis Bay (with the denial of entry for many Angolan-chartered pelagic trawlers in recent years), although we note in this case it is the port State denying entry rather than the fishing fleet changing behaviour in response to stronger PSMs.

There is limited evidence of a shift from PSMA designated to non-designated ports

The available evidence from the case studies indicates that there has been limited shift by foreign fishing fleets from PSMA-designated to non-designated ports (for example, to avoid stronger port controls or additional administrative burden). When changes did occur – for example, the exit of Chinese and Korean flagged squid jiggers from Peruvian ports following the introduction of the VMS requirement in 2020 – the results were mixed. Some vessels appeared to remain at sea for longer, others returned to home ports (particularly during the height of the COVID pandemic), while others called in to both PSMA and non-PSMA ports.

There was limited impact on the operational aspects of port usage – e.g. time in port, time at anchor

Broadly, time in port and wait times at anchor remained relatively constant in the periods before and after PSMA/PSM implementation for most ports (with the exception of time spent at anchorage in Bangkok). This, again, is likely largely driven by the natural operational dynamics of the port (e.g. the time taken for a carrier to fill up hasn't changed post-PSMA), and also by the considerable efforts of port States (for all of whom the economic activity associated with port usage is very important) to make the PSMA process as efficient as possible.

AIS should be complemented by other data sources and local knowledge

The emergence of publicly-available AIS data together with sophisticated analysis through 'big data' platforms in recent times has offered unprecedented insights into global fishing patterns and fleet behaviour. In this study, AIS has proven an extremely useful tool to examine the practical impacts of the PSMA. However, AIS coverage remains patchy for some fleets and areas, particularly in the earlier years of our datasets. To that end, complementing AIS data with other sources of information – e.g. publicly available port visits records, transhipment volumes – has been important to gauge the completeness of the AIS dataset as well as fill in gaps where necessary. The other essential element to ensuring best use of AIS data in studies such as this is to use local knowledge to work through the myriad of commercial and operational factors which influence fleet behaviour and may not be evident from trends in AIS data alone.

1 INTRODUCTION

Port State measures (PSMs) are an important component of the 'toolbox' of monitoring, control and surveillance (MCS) measures aimed at effectively monitoring the global trade of seafood products and preventing fish derived from illegal, unreported and unregulated (IUU) practices entering the marketplace. PSMs can take many forms, but frequently involve a requirement for fishing vessels to seek prior approval from local authorities before entering port, a process of analysing IUU and other risks associated with each vessel, and a regime of inspections and sanctions where necessary for non-compliance.

While PSMs have long been applied at the individual State and Regional Fisheries Management Organisation (RFMO) level, the most prominent global agreement on PSMs is the United Nations Food and Agriculture Organisation (FAO) Port State Measures Agreement (PSMA), which entered into force in June 2016. As of April 2023, the PSMA had been signed/ratified by 75 Parties, including the EU who represent 27 member States[1]. The main provisions of the PSMA are based on the designation of ports for foreign vessel entry, advance notification of entry into port, risk assessment, inspections and information exchange.

As States implement the PSMA or PSMs more effectively (e.g. requirements to use only designated ports, stronger inspection regimes, etc) there is the potential to change the behaviour of fishing fleets in response to the new measures. Vessels engaged in IUU activity may seek to avoid ports with stronger PSM regimes in place or increase transhipment at sea, while legal vessels may also change behaviour in response to any changes in access conditions (e.g. increased administrative 'burden', longer entry/exit clearance times, etc) or preferentially use designated ports.

To examine the 'real world' influence of changes in PSMA/PSMs implementation, the Pew Charitable Trusts commissioned MRAG Asia Pacific, in partnership with Global Fishing Watch (GFW), to undertake a study looking at changes in foreign fishing fleet behaviour in the periods 'before' and 'after' PSMA (or PSM) implementation in a number of case study ports. The overall aim was to examine whether changes in behaviour could be detected using publicly available Automatic Identification System (AIS) data, and the extent to which any changes were influenced by PSM implementation (as opposed to other factors influencing port usage – e.g. changes in the distribution of fishing effort, availability of local support services). The Terms of Reference for the study are set out at Annex 1.

This report sets out the results of the study. Following this Introduction, Section 2 sets out our approach to the analysis, including the rationale and process for the selection of case study ports, the AIS metrics chosen and the use of local experts to assist in 'disentangling' any PSM impacts from other natural port dynamics. Section 3 sets out the results for each of the six case study ports. For each port, an overview of the port is provided, together with a timeline of PSMA (or PSM) implementation, details of the 'before' and 'after' periods chosen, details of changes in fishing fleet behaviour during the 'before' and 'after' periods and an analysis of the likely drivers of any changes (or lack thereof). Finally, Section 4 analyses the main messages arising from the analysis.

2 APPROACH

Broadly, we approached the study in three phases:

[1] https://www.fao.org/port-state-measures/background/parties-psma/en/

1. Feasibility analysis;
2. Development of methodology/metrics; and
3. Analysis and reporting.

Feasibility analysis

The first phase focused on exploring the feasibility of using AIS data to detect and analyse changes in fishing fleet behaviour in the periods 'before' and 'after' PSMA (or PSM) implementation. An initial list of 10 candidate ports were selected from a list of countries nominated by Pew. Candidate ports[2] were selected based on:

- Discussions with Pew staff at the Inception Meeting held on 11th August, 2022;
- Discussions amongst the project team based on their knowledge of likely feasibility;
- Whether the port was listed as a designated port on the FAO Ports App[3]; and
- The likely availability of local experts.

Consideration was also given to the geographic spread of candidate ports, the development status of the relevant countries, the level of FFV activity in each port and the main types of fisheries/fishing vessels that accessed each port. Broadly, the intention was to arrive at a minimum of five ports for which full analysis was feasible (and insightful) covering a broad spread of geographies, development status and fishery/vessel types.

For each of the candidate ports, the project team examined a consistent set of issues including the main features of the port and the history and dynamics of port usage, key foreign fishing fleets using the port, the timeline of implementation of the PSMA (or PSMs), the availability of AIS data covering the possible 'before' and 'after' periods and the availability of local experts to assist in data interpretation. Taking into account the circumstances of each port, an overall judgement was made as to whether a before and after (B&A) analysis would be feasible, together with the most appropriate cut-off date, and 'before' and 'after' periods.

Based on the outcomes of each individual feasibility assessment, a prioritised list of ports for further analysis was developed. This process necessarily involved an element of subjectivity, but was broadly based on three key criteria:

- Whether sufficient AIS data existed to undertake robust analysis of changes in fishing vessel activity;
- Whether good information existed on the timeline of the implementation of the provisions of the PSMA/PSMs, and in particular whether a relatively clear 'cut-off' date existed to analyse activity in the period 'before' and 'after'; and
- Whether local experts knowledgeable in the dynamics of the port were available to help interpret results, and in particular, to disaggregate the impacts of PSMA/PSM implementation from other drivers (e.g. changes in fishing distribution, changes in commercial terms, etc).

Based on the outcomes of the feasibility analysis, a final list of case study ports was agreed with Pew.

Development of methodology/metrics

Following the selection of case study ports, the study team developed a framework of metrics to examine changes in fleet behaviour in the periods 'before' and 'after' PSM/PSMA implementation. These were broadly designed to examine (i) changes in FFV visits, (ii) changes in port usage and (iii) changes in transshipment activity (Table 1).

[2] The initial list of candidate ports explored included: Majuro (RMI), Bangkok (Thailand), Phuket (Thailand), Chimbote (Peru), Callao (Peru), Montevideo (Uruguay), Vigo (Spain), Las Palmas (Spain), Cape Town (South Africa) and Walvis Bay (Namibia).

[3] https://www.fao.org/fishery/port-state-measures/psmaapp/?action=qry

Table 1: Metrics for examining changes in FFV fleet behaviour 'before' and 'after' PSMA/PSM implementation.

Changes in numbers of visits
Changes in overall number of FFV visits (e.g. is there evidence of a substantial change in FFV activity in the periods B&A PSMA implementation? If so, why? If not, why not?);
Changes in number of visits by flag State (e.g. have any individual flag States disproportionately changed behaviour B&A PSMA implementation? If so, why?);
Changes in the type of vessel (e.g. trawler, longliner, purse seiner, carrier, etc) visiting the port;
Changes in target species (if known, or can be reasonably inferred).
Changes in port usage
Changes in port visit duration (e.g. has PSMA implementation meant shorter or longer stays in port for FFVs? If so, why?)
Changes in the time spent waiting to enter port (e.g. has PSMA implementation resulted in more or less waiting in areas adjacent to port as applications for entry are processed? If so, why?)
Changes in transhipment activity
For vessels appearing in the 'before' period port visit dataset for a port, but not the 'after' period, has there been a change in the frequency of at-sea encounters with carrier vessels? (i.e. have stronger port controls led these vessels to offload more at sea rather than in port?);

Additional analysis was undertaken on any particularly 'interesting' results – e.g. if a particular fleet of vessels appeared to be avoiding a port after the implementation of PSMs, where did they go?

The period 'before' and 'after' varied for each port according to several factors including:

- The quality and coverage of available AIS data (AIS data coverage of fishing fleets tends to get patchier the further back in time we go);
- The cut-off date selected (later cut-off dates – e.g. 2020 – will necessarily have fewer 'after' years);
- Complications associated with other confounding influences on FFV activity in ports (e.g. changes to port access arrangements as a result of the COVID pandemic).

For some ports (e.g. Chimbote/Callao), the analysis focused on the implementation of specific initiatives associated with the PSMA, rather than the PSMA as a whole. For example, Peru ratified the PSMA in 2017 but perhaps the most notable change in FFV behaviour occurred following the imposition of a requirement for FFVs to install an approved vessel monitoring system (VMS) and provide six months' of data to Peru authorities prior to entering port[4]. To that end, the cut-off date for Chimbote and Callao was the date the VMS requirement became operational (2020). The analysis of AIS activity focused on periods before and after this date.

Analysis and reporting

AIS data used for the analysis was extracted from the GFW dataset according to the processes set out below. These same basic processes have been used by GFW to contribute a number of independent studies, including a recently published study by Hosch et al (2023), who describe the process of identifying ports and port visits in similar terms.

Port identification

[4] This measure was introduced directly in support of PSMA implementation, and particularly to inform risk assessments of each vessel prior to entering port (Decreto Supremo 16-2020 PRODUCE).

GFW has created a global dataset of anchorages. The dataset was developed by dividing the globe into roughly equal sized grid cells (called s2 cells) approximately 0.5 km on a side. Using a global dataset of AIS vessel positions from Orbcomm and Spire from 2012 to 2021, all grid cells in which at least 20 vessels remained stationary (maximum distance travelled < 0.5 km) for at least 12 hours were identified. The mean location of all stationary events within a grid cell was recorded as an anchorage point and resulted in a global dataset of 166,514 anchorage points. Anchorages associated with quayside or harbor berths were distinguished from offshore anchorages.

Port visits

Port visits were identified using a global dataset of AIS vessel positions from Orbcomm and Spire. Port visits were initially identified at the level of an anchorage point assuming a vessel 'entered' an anchorage when an AIS position is within 3 km of an anchorage point and 'exited' with a position more than 4 km away from an anchorage point. To avoid recording vessels transiting near an anchorage (meeting the basic entry and exit criteria) as port entries, vessels are required to exhibit one of two additional events within a port visit (an anchorage stop or anchorage gap). Visit counts to anchorage points are aggregated to anchorage clusters and ultimately to ports.

To avoid inflating port visit counts with vessels that briefly exit and re-enter port, in order to be counted, the voyage prior to a port visit had to meet a set of criteria. For this study, we included port visits:

1. following voyages that were longer than **one hour** and involved a vessel travelling between **different** ports;

2. following voyages of any duration that involved a vessel exiting and subsequently re-entering the **same** port, as long as during the voyage the vessel had **an encounter event (**Miller *et al*. 2018) with another vessel, **a loitering event** (Miller *et al*. 2018) of at least 2 hours, or a **fishing event;** and

3. following voyages of any duration that involved a vessel exiting and subsequently re-entering the **same** port as long as the voyage duration was greater than 24 hours.

Identifying Foreign Vessels and Vessel Classification

Vessel identity (vessel gear class and flag State) was extracted from GFW's comprehensive database of vessel identities for over 400,000 ships that broadcast their locations each year. The database has been developed by combining information on 30 public vessel registries worldwide with the predictions of a machine learning model (Park et al, 2023).

Use of local experts

Importantly PSMs, including those implemented under the PSMA, are only one of a range of dynamic factors that influence port usage by FFVs. Other key drivers include commercial reasons (e.g. the port is home to important processing facilities), changes in the distribution of fish/fishing (e.g. ports used for transhipment/unloading will change as the distribution of fish/fishing changes), COVID-related port access restrictions and changes in political arrangements (e.g. domestication policies), amongst others.

To that end, to credibly assess the extent to which PSMs were responsible for influencing any changes in FFV activity in the 'before' and 'after' periods, the impacts of PSMs need to be disentangled from other relevant drivers. For that purpose, we worked with local experts in each port to help advise on any trends evident in AIS data and the likely underlying causes, as well as provide advice on the natural dynamics of the port. Local experts also provided advice on (and helped facilitate access to) official records of port usage where available, as well as facilitating communication with relevant local officials involved in port management/PSM delivery. Official port records provided an independent dataset against which to assess the completeness of AIS data, while local port/fisheries officials were very helpful in ground-truthing the basis for any changes in fishing fleet activity. Given the importance of having good local knowledge, ports selected for analysis were heavily

influenced by the availability of local experts. To the extent possible, important trends in FFV activity were also ground-truthed with industry contacts from relevant FFV sectors.

3 CASE STUDY PORTS

3.1 Majuro (Republic of the Marshall Islands)

3.1.1 Background

3.1.1.1 Overview of port

Majuro in the Republic of the Marshall Islands (RMI) is one of the main purse seine tuna transhipment ports in the Western and Central Pacific Ocean (Figure 1). Transhipment at sea by purse seiners is prohibited under the Western and Central Pacific Fisheries Convention, with all transhipment required to be undertaken in port. Majuro is strategically located close to fishing grounds, particularly when fishing is concentrated in the central Pacific, and offers a safe anchorage, as well as a well-developed service sector relative to nearby alternatives (regular plane flights, accommodation/ entertainment, agents, mechanical servicing, net mending facilities, etc). Tuna purse seiners and carriers are the main foreign fishing vessels visiting Majuro, with between 380 and 550 transhipments typically occurring annually in the lagoon pre-COVID (MIMRA, 2022). Majuro is also home to Pan Pacific Foods[5], which produces and exports tuna loins as well as whole round fish to global markets, as well as Pacific International Inc., which operates and net yard and container export facilities servicing purse seiners[6].

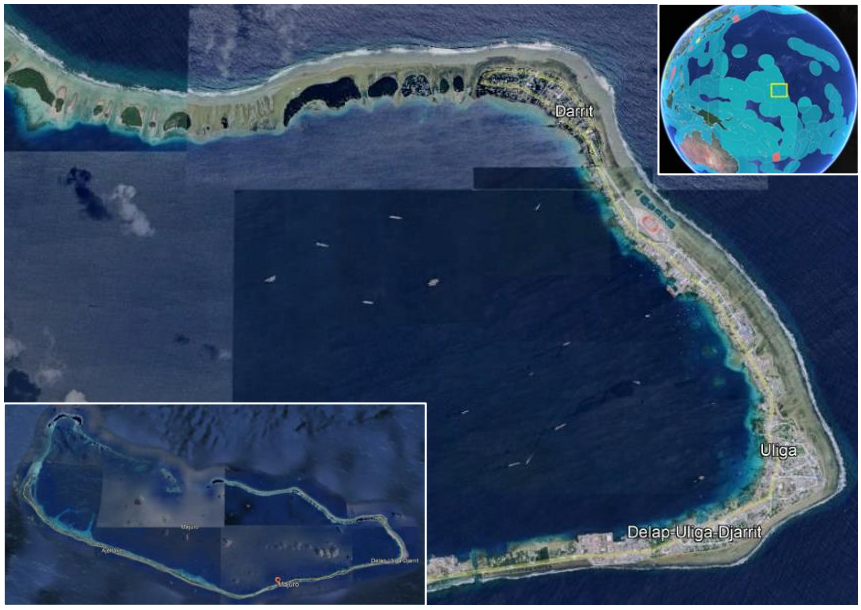


Figure 1: Aerial view of Majuro lagoon, showing vessels anchored off Majuro township (Source: Google Earth).

In addition to the purse seine activity, RMI has developed significant shore-based facilities including the Marshall Islands Fishing Venture (MIFV) longline base which processes fresh and chilled tuna. MIFV charters around 30 Chinese and Federated States of Micronesia (FSM) flagged longliners that operate almost

[5] https://www.skmic.sh.cn/en/company.html

[6] https://www.piimajuro.com/Home.html

exclusively in the RMI EEZ. The fleet unloads around 2,800 to 3,000 mt of mainly fresh, chilled tuna species, with most bound for the US, China and Canada. Frozen fish (rejects and bycatch) are shipped to Asia via transport containers and sold locally. While the vessels are foreign flagged, they are treated as domestic for PSM purposes. To that end, all longline vessels registered in WCPFC public domain data as being chartered to MIFV have been excluded from the analysis of PSM impacts below[7].

3.1.1.2 Timeline of PSM implementation

The Marshall Islands has gradually implemented PSMs as PSMA non-party. RMI was the first country in the Pacific region to pilot the FFA Port State Measure Framework, with provisions that are predominantly aligned with the PSMA, and has also expressed its intent to accede to the PSMA[8].

The Marshall Islands Marine Resources Authority (MIMRA) PSM process implemented since mid-2017 is set out in Figure 2. Broadly, MIMRA PSMs include requirements for "prior notification of port entry, use of designated ports, restrictions on port entry and port use in terms of landing/transhipment of fish, restrictions on supplies and services, documentation requirements and port inspections, as well as related measures, such as IUU vessel listing, trade-related measures and sanctions"[9].

MIMRA require the use of an agent to request port entry. Agents submit entry requests through an online application called MIMRA Web App which automatically shares relevant information with all line agencies involved. The minimum time of request for a vessel not on the WCPFC Record of Fishing Vessels (RFV) is 72 hr. These vessels are assessed on a case by cases basis, and port entry is not guaranteed. Vessels on the FFA Vessels of Good Standing List and the WCPFC RFV are required to submit requests at least 48hr prior port entry. For licensed FVs fishing in RMI waters, the minimum is 24 hrs, but 48 hrs is preferable[10].

After receiving the notification, MIMRA report that "every incoming fishing vessel (including RMI flagged) goes through a risk assessment that creates the Arriving Vessel Intelligence Report (AVIR). The intelligence analysis and risk determination allow for the identification of risks in three different categories corresponding to three steps in the analysis, including:

(i) identity – whether the vessel is who it says it is;
(ii) manoeuvring – the vessel's activity and operations and whether these were adequately reported; and
(iii) licensing – whether the vessel is allowed to be in the location it was.

The risk analysis performed by MIMRA is focused on fishing vessels, to assess the legality of the catch and on carriers' activities, not directly related to transhipments" (such as FAD deployment)[11]. The results of the risk analysis are set out in the AVIR which is provided to the boarding officers. The AVIR includes recommended boarding investigations with identified risk and other issues for verification (including log sheets, logbook, and temperature records, as relevant).

[7] Note that although both the flag State and host CCM are required to register charters with the WCPFC, only flag State submitted information is public domain.

[8] FFA's Tuna Pacific; Fisheries news and view, Micronesian leaders unite to combat IUU fishing by 2023, 2019. Available at: https://www.tunapacific.org/2019/03/19/micronesian-leaders-unite-to-combat-iuu-fishing-by-2023/.

[9] http://www.rmimimra.com/index.php/about-us/oceanic-industrial-affairs/port-entry

[10] http://www.rmimimra.com/index.php/about-us/oceanic-industrial-affairs/port-entry

[11] http://www.rmimimra.com/index.php/about-us/oceanic-industrial-affairs/port-entry

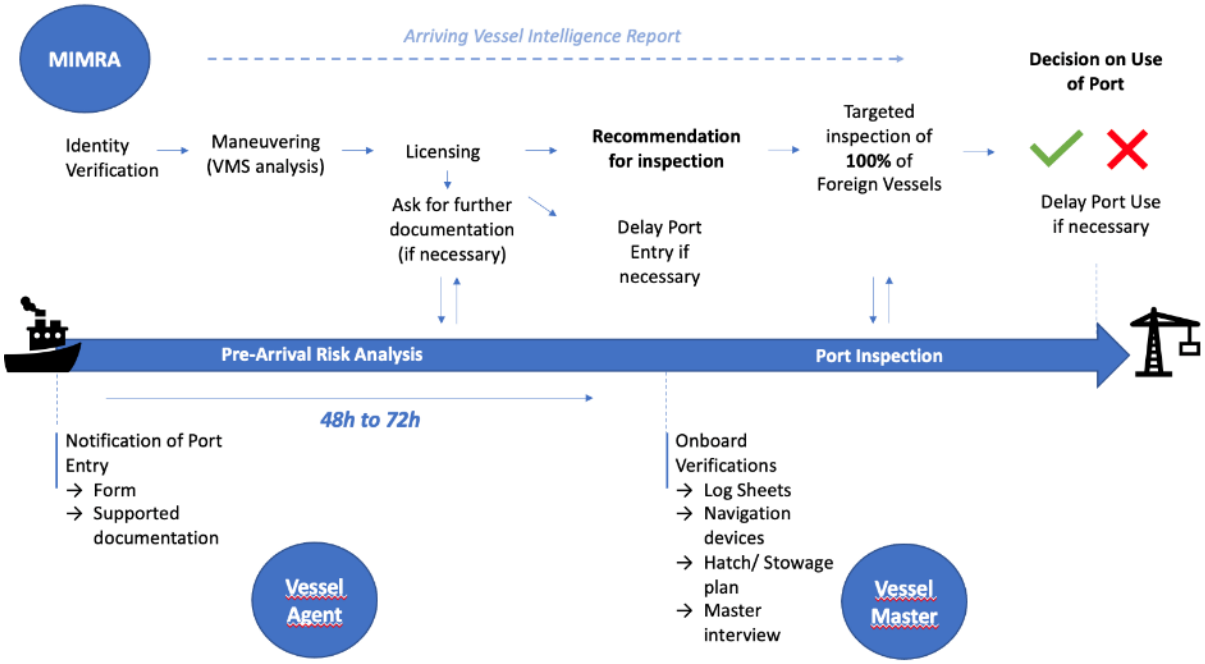


Figure 2: Majuro Port State Measures process.

MIMRA inspect 100% of incoming FFVs and carriers, as well as RMI-flagged purse seiners. Locally-based domestically chartered longliners fishing exclusively in RMI's EEZ are the only exemption and are targeted at 25% of port entries for unloading.

Port use (transhipment, landing, resupplying, etc.) requires formal authorisation by the MIMRA officer and is only provided if all risks identified in the AVIR have been adequately addressed. Port use will be delayed when information regarding a vessel's activities is not forthcoming or when the master and/or operator gives no clear explanation. MIMRA report that "where non-compliance is identified, port use is not granted and the boarding officers oversee seizing evidence, including master/captain vessel's documents, fishing gears and the vessel"[12].

The rule applied in the RMI is that no fish can leave the vessel before it is cleared – accordingly, there is a strong economic incentive for vessels to cooperate with MIMRA's risk analysis and investigation as port entry or port use will be delayed until receipt of the necessary information, which can result in significant costs for vessel operators.

3.1.1.3 Cut-off date

The choice of cut-off date and years for the 'before' and 'after' analysis is complicated for Majuro given PSM measures were deliberately implemented in a way that allowed industry and local processes to adjust (e.g. minor offences were let go, with checks for the detected offence becoming the norm thereafter).

Nevertheless, we have used 2017 as the cut-off year here given this was the period when the new PSM process described above began to take practical effect. The years 2015 and 2016 have been used as the 'before' period and 2018 and 2019 the 'after' period. The 'after' period did not extend into 2020 given that very significant changes to port access rules were implemented to minimise COVID risks.

[12] http://www.rmimimra.com/index.php/about-us/oceanic-industrial-affairs/port-entry

3.1.2 Before and after analysis

3.1.2.1 Changes in number of visits

Total number of visits

Figure 3 shows the total number of port visits by vessel type for years spanning the 'before' and 'after' periods as detected by AIS data. Broadly, fishing vessel visits increased from 2015 to 2016 before declining slightly in 2017/18 and levelling off in 2019. With the exclusion of the registered locally-chartered Chinese and FSM flagged longliners from the data, foreign fishing vessel visits are dominated by the tuna purse seine fleet (Figure 4). A smaller number of visits by longliners is also recorded, although it is possible many of these are also locally-chartered vessels for which charter arrangements are not reflected in WCPFC public domain data.

Anecdotal advice indicates that Majuro receives very few visits by longliners other than those chartered to MIFV, with only very occasional visits for crew medical emergencies and the like. Very few vessels of other types call into Majuro, other than very isolated visits by Japanese tuna pole and line vessels. These vessels don't tranship or unload in Majuro, preferring instead to return to Japan to unload or tranship at sea.

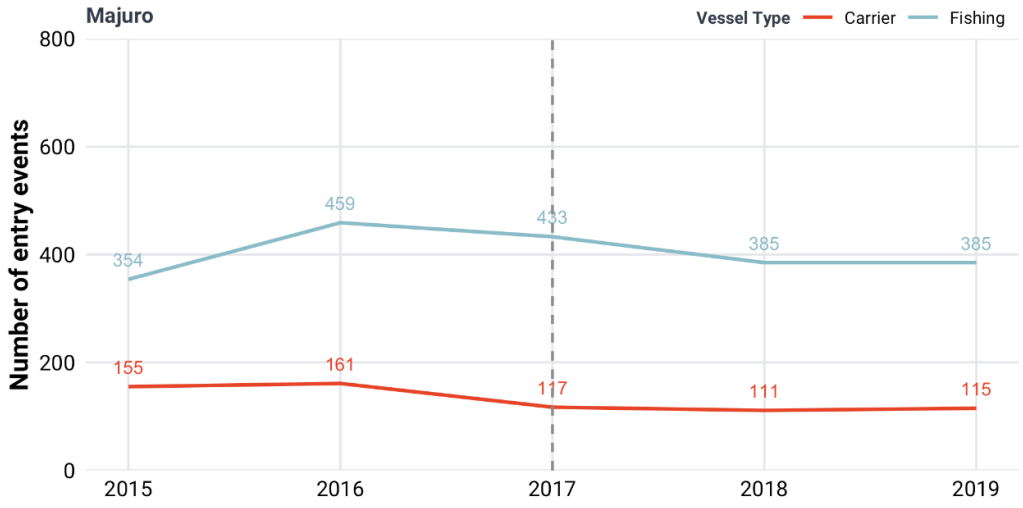


Figure 3: Total number of foreign fishing vessel and carrier vessel port visits to Majuro detected by AIS, 2015-2019.

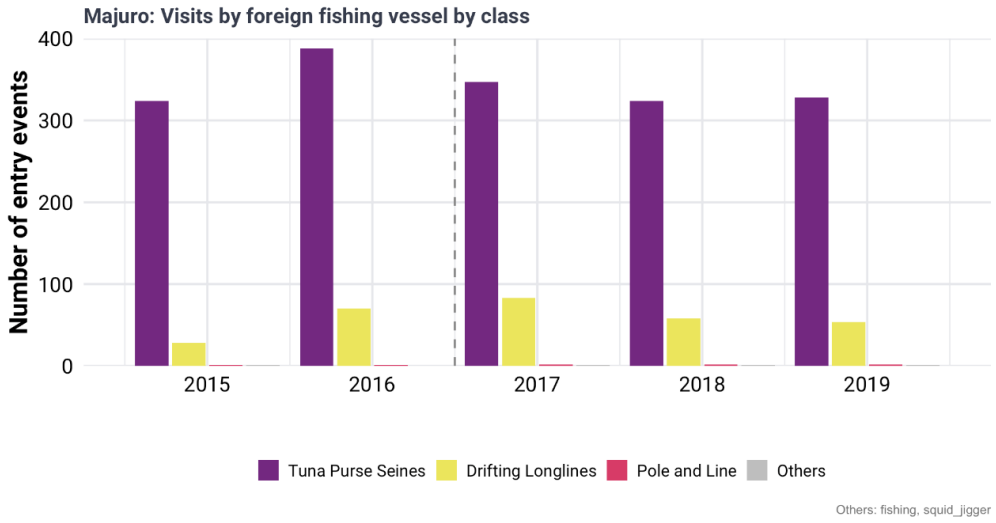


Figure 4: Number of foreign fishing vessel visits to Majuro by vessel type as detected by AIS, 2015 to 2019.

Trends in the AIS data are broadly consistent with publicly available information on vessel activity in the port. Majuro is one of few ports internationally for which good information on port usage by the main fishing fleets is provided by local authorities. For the purse seine fleet, information on the number of transhipments (by flag State) and transhipment volumes are reported each year in the MIMRA Annual Reports[13]. While the number of transhipments may not line up exactly with the number of visits (e.g. there may be a small number of vessels which come in for maintenance or crew emergencies without transhipping, or land all catch at one of the local processing/container facilities), it will be a very close proxy. Assuming one transhipment per visit, our analysis indicates that AIS detected between 81% and 95% of foreign purse seine visits between 2016 and 2019, so AIS trends are likely to be reasonable (Figure 5).

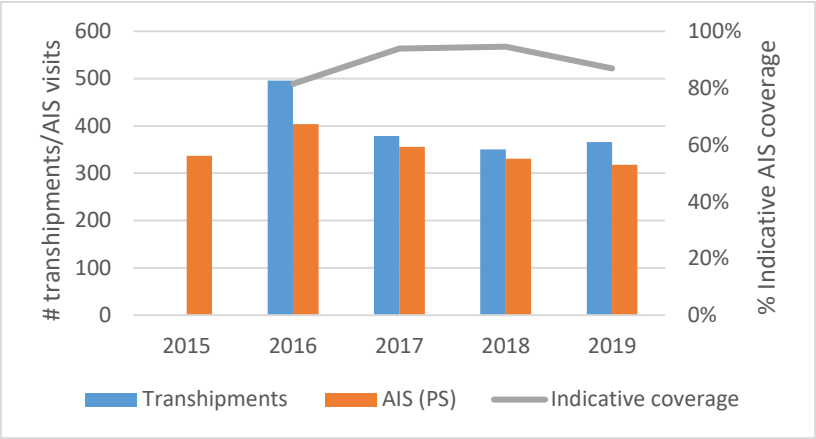


Figure 5: Number of reported transhipments versus the number of purse seine vessel visits to Majuro detected by AIS, 2015-2019.

Carrier vessel visits detected by AIS declined in the cut-off year (2017) and remained stable at lower levels thereafter. While official statistics on carrier vessel visits to Majuro are not published, the number of visits detected in the AIS data over the study period is broadly consistent with trends in official records of transhipment activity (MIMRA, 2022; Figure 6). This indicates that the AIS dataset is likely to include most actual visits. The proportionally higher transhipment volume to carrier visits in later years is likely to be driven by higher average transhipment volumes (MIMRA, 2022).

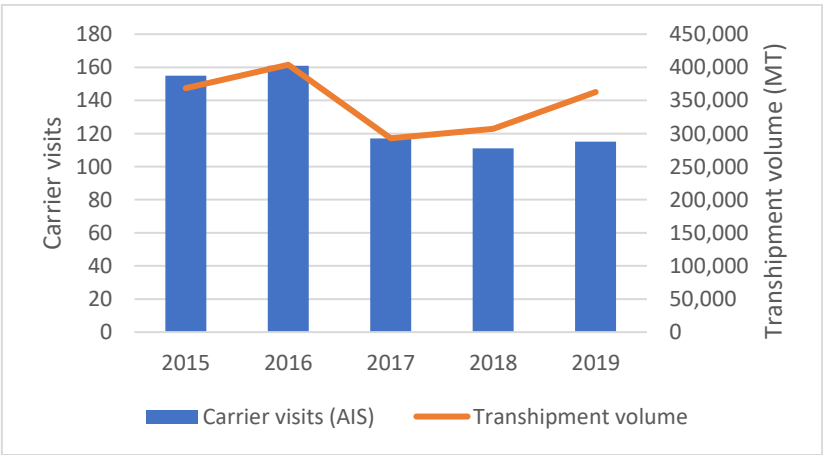


Figure 6: Number of AIS-detected carrier visits to Majuro versus reported transhipment volume, 2015-2019. (Transhipment data source: MIMRA, 2022)

[13] http://www.rmimimra.com/index.php/resources

While both purse seine and carrier vessel visits declined in 2017 and remained at lower levels thereafter, the introduction of stronger PSMs in 2017 is likely to have had very limited, if any, practical influence over these outcomes. In practice, the choice of transhipment location is driven by a mix of commercial and operational drivers that can be broadly categorised into four types (Blaha, 2019)[14]:

1. Proximity to fishing grounds

The proximity of transhipment port to the current fishing ground is a dominant driver of transhipment location, given it is in the interests of the purse seiner to limit the 'downtime' involved in steaming/unloading. To that end, tuna trading companies coordinate closely with fishing companies to place carriers in locations close to current fishing grounds. While the specific needs arising from the fishing trip (see below) may influence location, all other things being equal, purse seiners and carriers will coordinate transhipment in the nearest convenient port.

When tuna stocks move east towards the central Pacific (particularly in Nauru, Kiribati, eastern PNG, and the high seas in between Kiribati's EEZs), the options for transhipment port are Funafuti (few services), Tarawa (quite exposed anchorage and minimal services) or Majuro with all the advantages (see below).

2. Specific needs arising from the fishing trip

Access to services: Purse seiners and carriers are complex vessels with an incredible amount of machinery and technology that needs parts and maintenance. While most repairs are done on board, if land-based services are needed the preference is to use ports such as Majuro which has good availability of spare parts and capable technicians ready to support a rapid turnaround. In the worst-case scenario, complex electronics can be sent for repair in Honolulu, 4 hrs away by frequent flights.

Helicopter base: While the role of helicopters onboard is in something of a transition (with the emergence of drones and much of the purse seine fish caught on FADs with sonar buoys), they are still an important element of the industry. Majuro has an airport five minutes flight from any purse seiner in the harbour and a local base for Hansen, one of the key helicopter service providers worldwide.

Health facilities on shore: While the evacuation of a critically injured crew member is governed by maritime and crew welfare rules, in non "life or death" situations, most purse seine Masters will have no qualms in steaming 24 or 48hs or more to get the crew to the port offering the better facilities. Majuro has a well-run modern hospital supported by Taiwanese doctors and technology without costs for the injured crew.

Flight frequency and connections: frequent international air travel connections for key personnel and observers is an advantage. Majuro has flights to Honolulu 5 days a week and, pre-COVID, had connections via Nauru to Brisbane (Australia) and Nadi (Fiji)

3. Master of the vessel

Safety of anchorage: the vessel's safety is ultimately the responsibility of the Master of both purse seiner and carriers. As transhipment occurs on the carrier's anchor, a good ground for anchoring is essential. Carriers often have two purse seiners transhipping simultaneously (one on port and one on starboard), all reliant on the carrier's anchor. Given that anchor dragging is a consequence of wind and swell exposure, the more protected the anchorage area the better. Majuro lagoon is very protected, with excellent soft sand anchorage grounds and very limited swell. Entry to the lagoon is also through a deep, well-marked channel without shifting sandbanks or exposed coral heads.

[14] http://www.franciscoblaha.info/blog/2019/12/9/factors-contributing-to-the-choice-of-port-for-transhipment-by-purse-seiners

Town access*:* having easy access to a wharf positioned near the main facilities in town needed by crew also influences a Master's choice. Majuro downtown can be reached in 10 — 15 minutes from anchorage, with supermarkets, entertainment, phone cards (for crew to communicate with family), pharmacy, etc. all nearby.

Big wharf access for net repairs: There are two big wharves to load or unload heavy gear, and one of them has a net repair shed with a Net Master based there.

Quality of the agents: Agents play a key role in the tuna transhipment world, operating between vessel owners, captains, traders, carriers, and the relevant Government agencies. Majuro has various agents capable of coordinating local services and providing translation.

Regulatory reliability: Having all line agencies (immigration, biosecurity, customs, etc.) lined up on vessel arrival (no time wasting) is an important element in the transhipment equation. Note that Majuro has a competitive advantage over other ports as it is a 7-day operation, managed by an inter-agency web-based programme.

The reputation of the fisheries observers: In many cases, vessels receive onboard observers that are nationals of the port State where they are transhipping. Repeated bad experiences with observers (drunkenness, violence, etc.) and/or repeated good experiences with observers from a certain nationality are known to influence the Master's preference for certain ports.

4. Vessel manager

Costs: Fees associated with anchorage, berthing, pilot, line agencies, transhipment volumes and agents are important considerations for vessels managers. Majuro's port costs are very competitive for the region.

Relationship with carriers: The choice of transhipment port can be influenced by existing contractual arrangements with the carrier but also cargo space trading in between operators. Carrier operators may offer space to a "rival" if that allows the carrier to be full and head towards the processing country, particularly when there is low stock in the canneries. Majuro has a permanently based representative of FCF, as well as frequent visits by Trimarine agents, to facilitate cargo space availability.

While each of the above factors influence transhipment location, and many of them make Majuro an attractive transhipment choice, the dominant driver of actual transhipment activity is proximity to fishing grounds (all other things being equal, vessels won't steam to the other side of the WCPO to offload at a port with better facilities; they will tranship at the closest convenient port). On that basis, much of the change in port activity across the study period can be explained by changes in the distribution of fishing effort (Figure 7). 2015 and the first half of 2016 were strong El Nino periods, with most of the catch and effort focused on the eastern side of the WCPO (Williams and Ruaia, 2022). This led to higher transhipment activity and port visits to Majuro, which is conveniently located in the central WCPO.

In 2017 and 2018, the El Nino Southern Oscillation (ENSO) was mainly in La Nina or neutral territory, leading to a higher proportion of fishing effort in the west of the WCPO. This led to a reduction in transhipment activity/port visits in Majuro (Figure 3; Figure 6), and likely higher transhipment activity in western ports such as Rabaul, PNG and Pohnpei, FSM.

In 2019, the ENSO returned to strong El Nino territory with effort shifting east and a consequent upswing in transhipment activity in Majuro. As noted above, vessel visits didn't increase proportionally to transhipment activity because there was a higher average volume per transhipment (MIMRA, 2022).

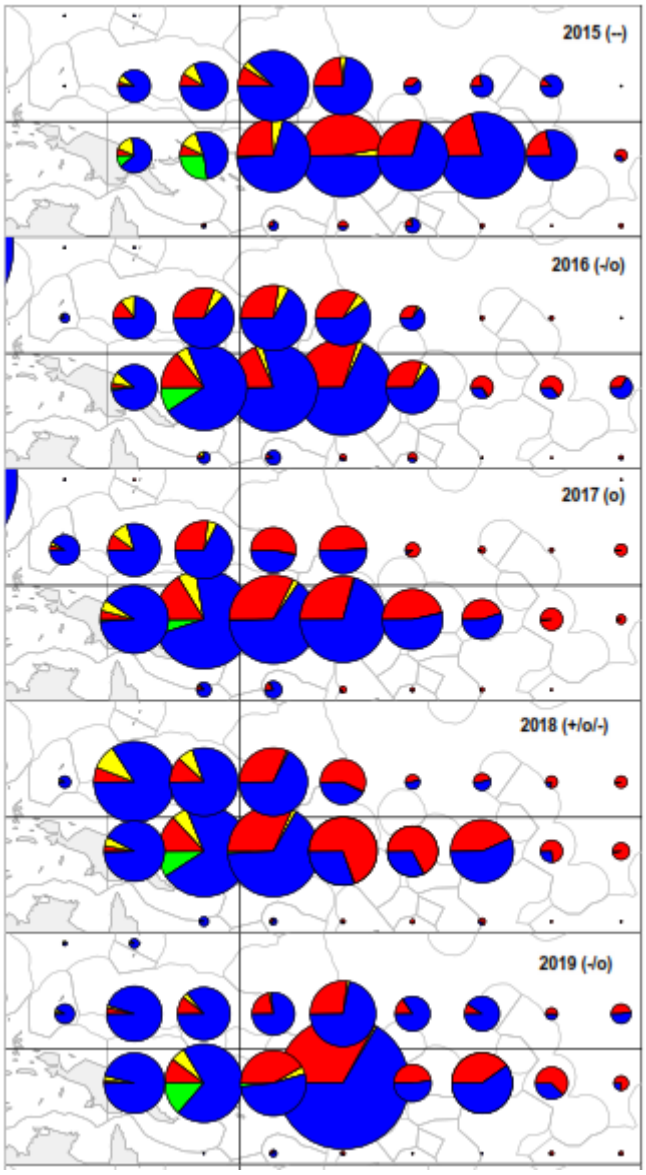


Figure 7: Distribution of purse seine fishing effort, 2015 to 2019, by set type (blue=free school; red=drifting FAD; green =anchored FAD; yellow=log set). (Source: Williams and Ruaia, 2022)

Changes by flag state

Fishing vessels

Figure 8 shows changes in the number of fishing vessel port visits by flag State during the study period. The Taiwanese purse seine fleet had the largest number of entries, with the pattern of visits broadly consistent with the overall pattern of purse seine visits. Chinese-flagged vessels were the next main users of the port, although these figures will likely include some locally chartered longliners. The number of visits by Chinese vessels dropped off in the 'after' period, although this may be more to do with better public registration of vessel charters (and therefore exclusion from our dataset) than actual changes in vessel behaviour following the introduction of PSMs. Visits by FSM-flagged vessels increased over the study period. This is likely driven by (a) re-flagging of purse seine vessels to FSM to secure access to favourable fishing access arrangements under the Federated States of Micronesia Arrangement (FSMA) and (b) increased visits by locally chartered FSM flagged longliners for which charters are not recorded in public domain WCPFC data (and hence not excluded from our dataset). The pattern of visits by other flag States remained relatively stable between before and after periods, indicating limited flag State specific impact from the implementation of PSMs.

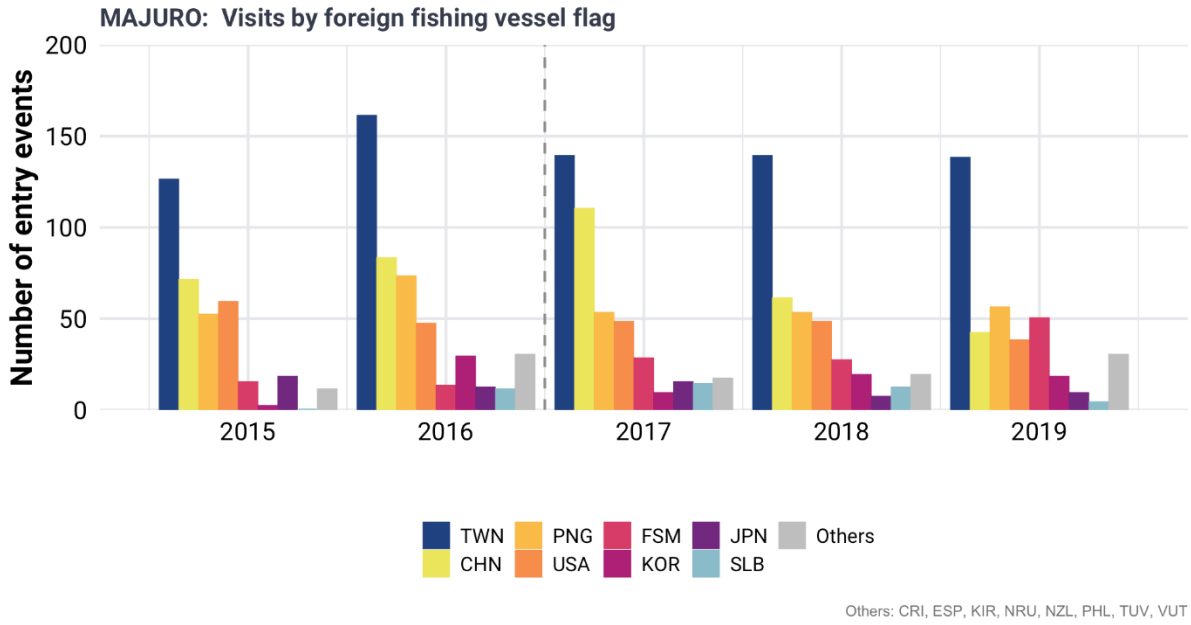


Figure 8: Number of foreign fishing vessel port visits by flag, 2015-2019.

Carrier vessels

A number of trends in carrier visits by flag State are evident, although these are likely to be unrelated to the introduction of PSMs. The number and proportion of visits by vessels flagged to Kiribati, Korea and Vanuatu declined over time, while the proportion of visits by Panama flagged vessels increased (Figure 9). These trends appear to be consistent with reflagging activity amongst the carrier fleet. For example, only 2 carrier vessels currently listed on the WCPFC RFV[15] are flagged to Kiribati, while 9 vessels are listed as having previously been flagged to Kiribati (7 of which have reflagged to Panama). Similarly, only 5 carriers on the RFV are currently flagged to Vanuatu, while 22 vessels were previously flagged to Vanuatu (including 16 which have reflagged to Panama). While the dates of reflagging are not reported, it highlights a general trend over the study period towards reflagging carriers away from Pacific Island States towards States such as Panama.

Reflagging trends are driven by a range of factors including relative tax arrangements and compliance costs between States, transparency around company ownership, capacity to meet local crewing requirements, RFMO membership and whether the flag State has authorisation to access the EU market and a Competent Authority (CA) (MRAG Asia Pacific, 2019).

The outlier in that trend are the Korean vessels, for whom the number of visits declined over time and the changes are unlikely to be a result of reflagging[16]. In the case of the Korean carriers, it is likely that the decline in visits to Majuro was influenced by a strengthening of commercial relationships between Korean companies and countries such as Kiribati and Tuvalu (with whom Korean companies are involved in a number of joint venture arrangements). Together with a preference of Korean fleets to fish in the east of the WCPO, this is likely to have led to an increasing preference to tranship in ports such as Tarawa (Kiribati) and Funafuti (Tuvalu). In the context of the current study, it is unlikely that the introduction of PSMs in Majuro contributed in any significant way to this trend.

[15] https://vessels.wcpfc.int/browse-rfv, as at April 27, 2023

[16] As at April 27 2023, there were 29 Korean carriers listed on the RFV, but only 3 with a previous flag of Korea. Of the 29 Korean flagged carriers, 6 reflagged to Korea during the 2015-2019 period. Of the 3 vessels with a previous flag of Korea, only 1 reflagged away from Korea during the study period.

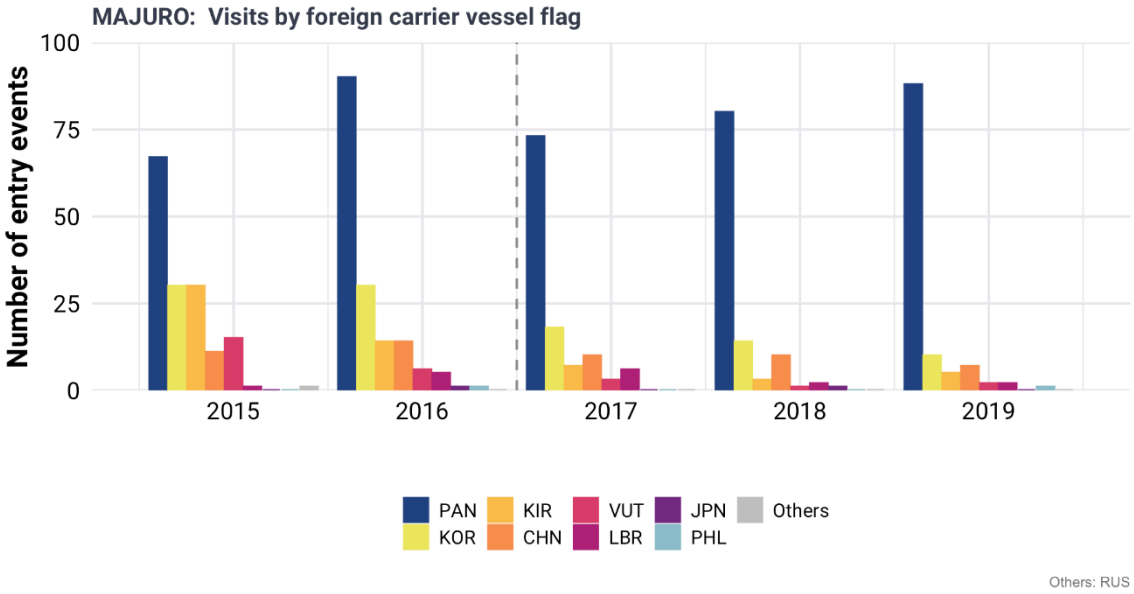


Figure 9: Number of carrier vessel visits to Majuro by flag State 2015-2019, based on AIS data.

3.1.2.2 Changes in port usage

Time in port

The median duration of foreign carrier visits to Majuro declined very slightly between the before and after periods, with purse seine vessel visits duration remaining stable (Figure 10; Figure 11; Figure 12). One possible explanation for the slightly shorter carrier visits in the after period is the increase in average transhipment volume during this period (allowing vessels to fill up and depart quicker) (Table 2; MIMRA, 2022). For purse seiners, the very stable median visit duration indicates very limited practical impact on the timing and efficiency of port access from the introduction of PSMs.

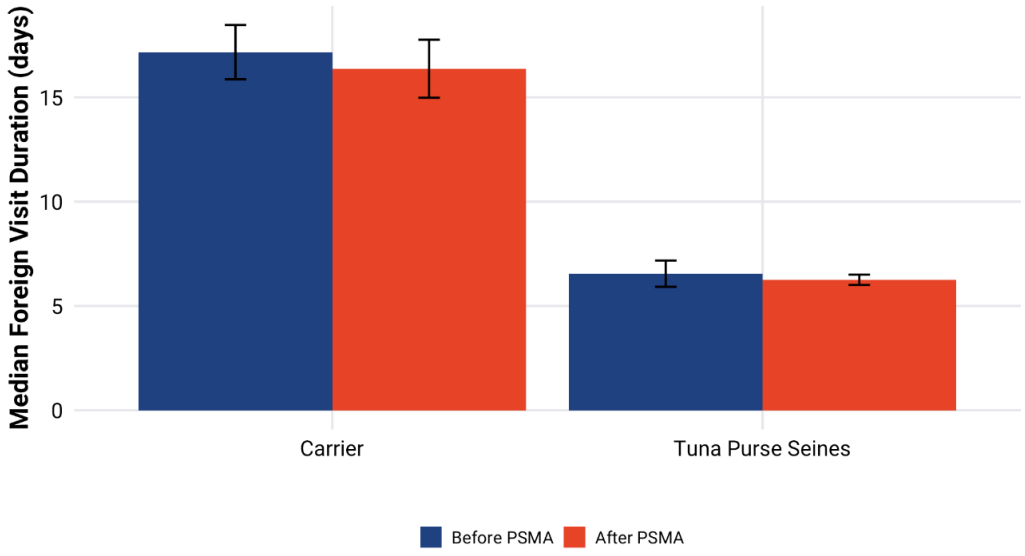


Figure 10: Median port visit duration by vessel type in before (blue) and after (red) periods.

Table 2: Purse seine tuna transhipment number and volume in Majuro, 2014-2021. (Source: MIMRA, 2022)

Tuna transshipment Majuro 2014-21

Year	Number	Metric Tons	*Average
2014	382	158,065	414
2015	504	368,323	731
2016	551	403,809	733
2017	424	292,754	690
2018	403	307,164	762
2019	449	362,454	807
2020	175	118,743	679
2021	297	221,609**	746

*Average metric tonnage per transshipment. ** Provisional tonnage estimate.

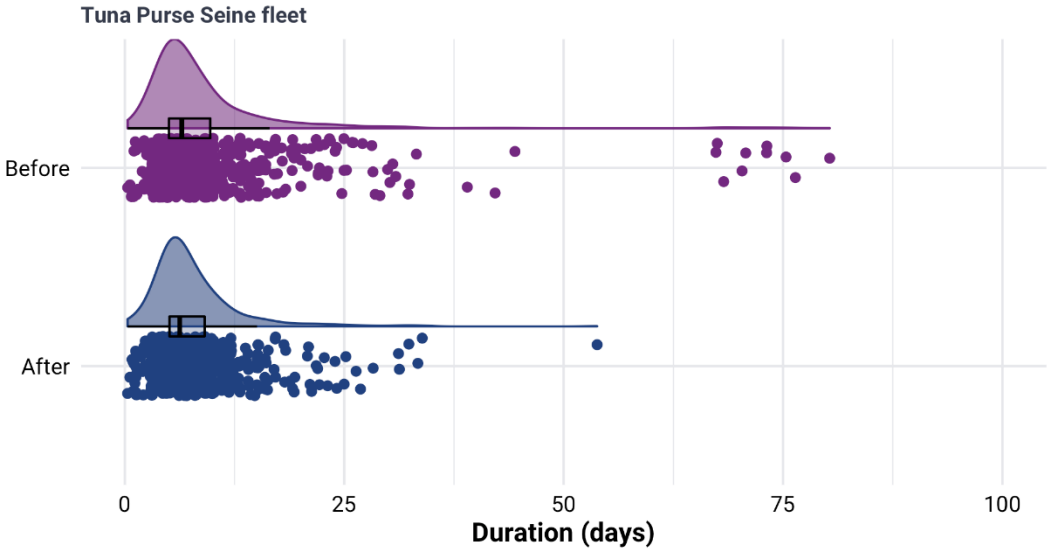


Figure 11: Port visit duration for foreign purse seine vessels in Majuro during the before (purple) and after (blue) periods. Individual data points represent individual port visits; horizontal lines in boxplots indicate the median visit duration and the probability distribution is shown by shaded bands.

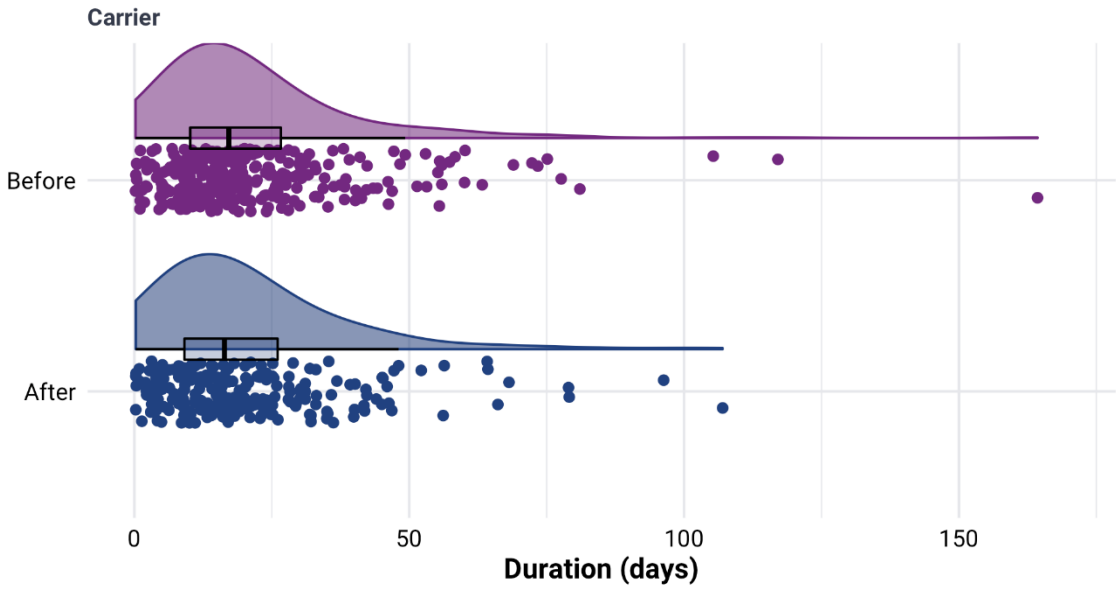


Figure 12: Port visit duration for foreign carrier vessels in Majuro during the before (purple) and after (blue) periods. Individual data points represent individual port visits; horizontal lines in boxplots indicate the median visit duration and the probability distribution is shown by shaded bands.

3.1.3 Summary of changes

Majuro experienced a small decline in FFV activity in the after period, although this is unlikely to be related to the introduction of PSMs. FFV activity in Majuro is dominated by purse seine tuna transhipment, with levels of activity largely driven by operational and commercial factors, principally the distribution of fishing effort. Much of the change in transhipment activity (and fishing vessel/carrier port visits) can be explained by changes in the distribution of fishing effort associated with changes in the ENSO cycle. There were relatively few changes in visits by individual flag States following the introduction of PSMs. Visits by Korean carrier vessels declined over time, although this was likely related to an increasing preference to tranship in Kiribati and Tuvalu ports given the strengthening commercial relationships between Korean companies and these countries throughout the study period. The absence of any change post-PSMs is also likely to be influenced by the strong monitoring measures in place (e.g. 100% observer coverage, frequent VMS polling under the PNA Vessel Days Scheme, prohibition of at sea transhipment) and high rates of compliance evident in the purse seine fleet (MRAG Asia Pacific, 2021).

3.2 Bangkok (Thailand)

3.2.1 Background

3.2.1.1 Overview of port

The Kingdom of Thailand (Thailand) has two separate coastlines in the Andaman Sea (western coastline) and the Gulf of Thailand (eastern coastline). These areas provide distinct entrances to the Indian Ocean and Pacific Ocean respectively, making Thailand well-positioned to import, process and export fish due to proximity to these productive fishing grounds. As such, Thailand is a major tuna processing state, absorbing 20-25% of the global commercial tuna harvest[17]. Thailand is also the world's third largest exporter of seafood, responsible for around 8% of global exports[18].

Thailand receives a large proportion of tuna (primarily skipjack) by fish carriers entering from the WCPO. Smaller quantities of tuna are landed directly by longliners from the Indian Ocean. Almost a third of fish reportedly enter Thailand from foreign-flagged fishing vessels (FFVs)[19]. Accordingly, the PSMA is one of the most important measures in place to prevent IUU fish from coming into Thailand.

Thailand separates ports for use by domestic Thai-flagged vessels from FFVs (PSMA ports). There are 26 designated PSMA ports authorised for FFV entry[20]. These are further subdivided into ports for *international* FFV (not from neighbouring countries) (19 ports), and ports for *neighbouring country* FFV (Myanmar, Cambodia, Malaysia and Indonesia) (7 ports). The locations of the neighbouring FFV ports are strategically located near the boundaries with neighbouring countries, as shown in Figure 13, whereas the international FFV ports are more centrally located in Bangkok/Samut Prakan, Samut Sakhon, Phuket and Songkhla provinces.

[17] G. Hosch, B. Soule, M. Schofield, T. Thomas, C. Kilgour, Any port in a Storm: Vessel Activity and the Risk of IUU-Caught Fish Passing through the World's Most Important Fishing Ports, Journal of Ocean and Coastal Economics (2019) Available at: https://cbe.miis.edu/cgi/viewcontent.cgi?article=1097&context=joce

[18] Department of Fisheries. Available at: https://www4.fisheries.go.th/dof_en/view_message/232

[19] The Pew Charitable Trusts and OceanMind webinar: How Effective Port State Measures Implementation Can Reduce Illegal Fishing in the Seafood Supply Chain on 20 April 2021. Available at: https://www.youtube.com/watch?v=WyTX9qww2YI

[20] Designated Ports App (fao.org)

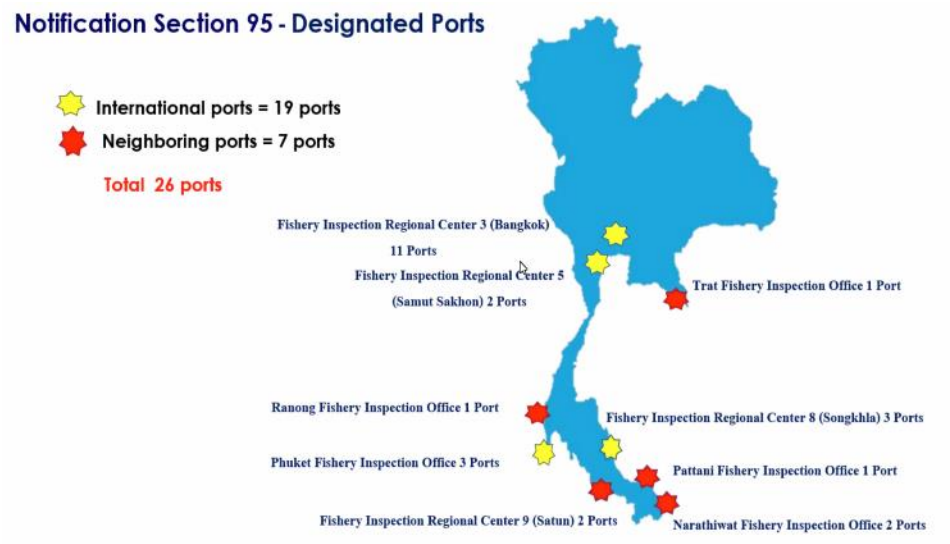


Figure 13: Map of PSMA designated ports in Thailand. Image Credit Thailand Department of Fisheries[21].

There are 11 PSMA ports along the Chao Phraya river that can be considered under the umbrella of 'Bangkok port'. These span the Bangkok metropolitan area and Samut Prakan Province, shown in Figure 14. All 11 ports are privately owned, with a range of services either at these ports, or nearby, including maintenance, dry docking, refuelling and crew changes.

Figure 14: Map of the 11 PSMA designated ports in Bangkok along the Chao Phraya River.

[21] Presentations on PSM implementation available at: http://www.seafdec.or.th/psm/psm-inspector-2021/presentations/DOF-TH_1_Implementation_PSM_Thailand_Jitpisut.pdf

The main vessels using Bangkok port are fish carriers, primarily arriving from the WCPO and delivering tuna to the Bangkok/Samut Sakhon processing facilities. While small numbers of FFVs visit Phuket on the Andaman Sea side and large numbers (between 7,000 — 8,000) of small FFVs from neighbouring countries visit Thailand's 'neighbouring' ports (mainly Ranong and Trat), official records for port visits to Bangkok show no international FFVs visiting from October 2015 to September 2020[22]. On that basis, our analysis of the PSMA impacts focused on the carrier sector.

3.2.1.2 Timeline of PSM implementation

Thailand has proactively implemented the PSMA, making it part of their national agenda in 'the fight against IUU fishing'. This was in part due to pressure from a 'yellow card' issued to Thailand under the EU's IUU regulation April 2015. As a result, Thailand has implemented robust control measures on FFV arrivals, which include extensive pre-arrival analyses and risk assessments, and 100% onboard inspection rates which go beyond PSMA requirements. The yellow card was lifted in January 2019, however Thailand has maintained these controls, albeit COVID-related restrictions impacted the ability of port inspectors to conduct inspections for periods during the pandemic.

Key dates in the implementation of PSMs were:

- Oct 2014 - Thailand joined the PSMA on a voluntary basis and started a pilot project on PSM implementation at Phuket Port.
- Nov 2015 - Thailand issued the Royal Ordinance on Fisheries B.E. 2558.
- May 2016 - Accedes to the PSMA.
- May 2017 - Started the electronic PSM system in Thailand, for electronic reporting of port entry requests.
- Jun 2017 - Thailand issued the Royal Ordinance on Fisheries B.E. 2560 (revised) – this established the current legal framework including prohibiting IUU vessels, requiring advance notice of entry to port, landing and import controls and exceptions for neighbouring countries.
- Jun 2018 - Thailand launched the electronic traceability system for all imported fish[23].

The practical implementation of the PSMA in Thailand follows 3 steps [24] [25]:

1) Before port entry

The vessel agent is required to submit an Advanced Request to Enter Port (AREP) via the Thai online and electronic 'PPS' system. For FFV from non-neighbouring countries, this is required to be submitted 72 hours before entry into the Kingdom of Thailand.

The DOF is responsible for reviewing information on the AREP and the associated documents. DOF complete a pre-arrival risk assessment and analysis using AIS tracking information to compare reported activities with observed activities for both carrier and donor fishing vessel activities. Following review and collection of additional information where necessary, DOF may (i) allow port entry and offloading, (ii) allow port entry with onboard inspection or (iii) deny port entry. The decision is made on the Notification Report which is sent back

[22] https://www4.fisheries.go.th/local/index.php/main/view_qr_group/200/1786/
[23] The electronic traceability system won second place at the 2019 STOP IUU FISHING AWARDS hosted by the 6th Global Fisheries Enforcement Training Workshop (GFETW).
[24] Presentations on PSM implementation available at: http://www.seafdec.or.th/psm/psm-inspector-2021/presentations/DOF-TH_1_Implementation_PSM_Thailand_Jitpisut.pdf
[25] Presentations on PSM implementation available at: http://www.seafdec.or.th/psm/psm-inspector-2021/presentations/DOF-TH_2_Implementation_PSM_Thailand_Jaruwan.pdf

to the vessel agent and other relevant agencies 24 hours prior to entry request date. The vessel agent then confirms with DOF and the Customs Department the date and time of port entry for inspection onboard.

2) Vessel inspection at port

Fisheries Inspection Officers complete onboard inspections to review any risks identified for the vessel requesting port entry during the pre-arrival risk assessment. Inspections usually involve interviewing the Master, reviewing navigation/fishing logbook and logsheets and hatch temperature logbooks, as well as checking original documents. Upon completion of the onboard inspection, a Port Inspection Report (PIR) form is completed to either authorise or delay/deny offload.

3) Offloading monitoring

The DOF and Customs Department are responsible for ensuring the legal offloading of catch. Before offloading commences, both Fisheries Inspection Officers and Customs Officers review the hatches onboard the vessels and cross check the stowage plan with the reported weight of catch from each donor fishing vessel. Trucks arrive at the port, are weighed upon entry and exit of the port, and provided with individual seals. Catch is loaded directly onto the trucks, sealed, weighed and then transported to nearby cold storage or processing facilities. The Fisheries Inspection and Quality Control Division (FIQD) are responsible for reviewing the truck upon arrival at the cold storage or processing facility, which involves ensuring the seal is intact before cutting the seal, and monitoring the unloading to record the actual weight and species, which is reported on the Import Movement Document (IMD).

3.2.1.3 Cut-off date

The AREP reporting process was implemented in early 2016 in Bangkok ports, and pre-arrival risk assessment / inspection procedures were implemented throughout the year. Therefore, 2016 was used as the cut-off date, with the years 2014 and 2015 selected as the 'before' period and 2017 to 2019 the 'after' period. The main challenge in the analysis is that, as a relatively early implementer of PSMA measures, Thailand's 'before' years span a period where AIS transmission was increasing, but not yet widespread, across the carrier vessel fleet. To that end, other data sources (e.g. official port records, customs trade data) have been used to supplement AIS information on fleet behaviour.

3.2.1 Before and after analysis

3.2.1.1 Changes in number of visits

AIS data shows an increase in the number of port visits through the 'before' period, peaking at 147 in the cut-off year (2016) and stabilising at between 140-144 visits per year in the 'after' period (Figure 15). In practice, the increase in port entries over the 2014-2016 period is almost certainly an artefact of increasing AIS coverage across carrier vessels rather than actual increase in the number of port visits. Official statistics on port entries by FFVs are published only as far back as October 2015, however Bangkok consistently received between 7-18 carrier visits per month in the October 2015 to December 2019 period[26]. Customs statistics on skipjack tuna exports – likely a reasonable proxy for processing, and therefore carrier vessel activity – also indicate stable export volumes across the 2012-2019 period (Figure 16). Our analysis indicates that AIS datasets include between 90-98% of officially reported carrier visits in the 2016-2019 period (Figure 17), but likely a lower (but unquantified) proportion prior to 2016. Therefore, the carrier vessel port entries on AIS for 2014 and 2015 displayed in Figure 15 show a much lower number than the true number of vessel port entries.

[26] https://www4.fisheries.go.th/local/index.php/main/view_qr_group/200/1786/

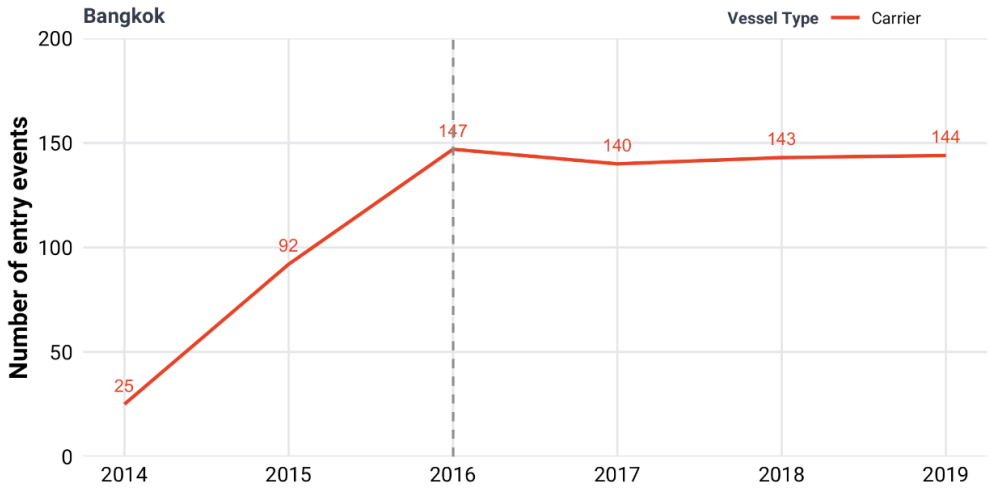


Figure 15: Total number of carrier vessel port entries to Bangkok, 2014-2019, based on AIS data.

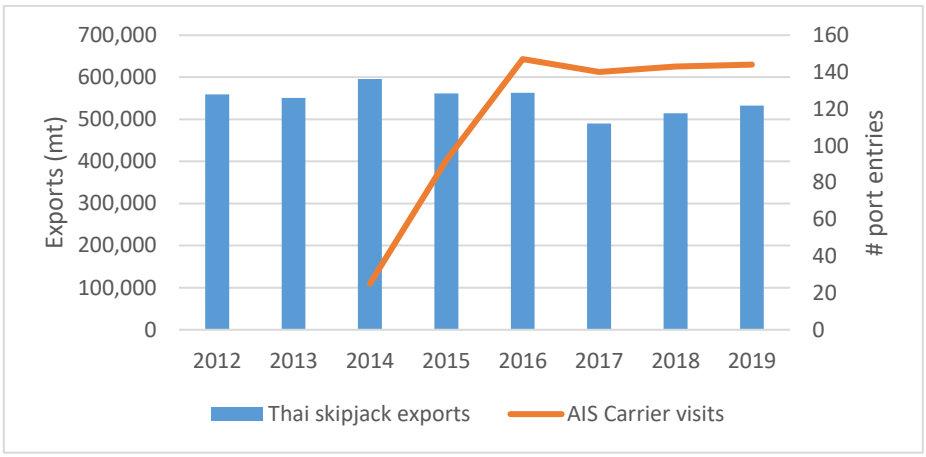


Figure 16: Thailand skipjack tuna exports (2012-2019) versus carrier visits detected through AIS (2014-2019). (Data source: Thailand Customs Statistics; Global Fishing Watch)

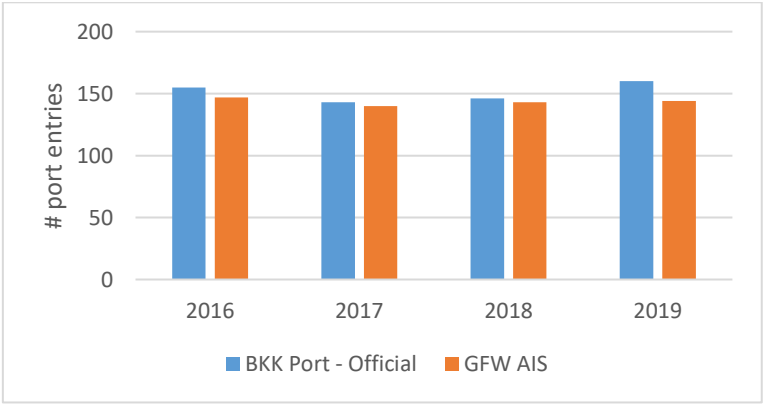


Figure 17: Comparison of official Bangkok port entry visits by carriers published by DOF versus port entries detected by AIS. (Data source: Thailand Department of Fisheries[27]; Global Fishing Watch)

[27] https://www4.fisheries.go.th/local/index.php/main/view_qr_group/200/1786/

The reason for the relative stability in carrier vessel visits after PSMA implementation (and likely before) is the presence of major tuna processing facilities in Bangkok/Samut Sakhon. From a commercial point of view, the convenience and efficiency benefits of being able to offload fish close to processing facilities through well-established land-based logistics networks and within longstanding commercial relationships are likely to substantially outweigh any 'disadvantages' associated with stronger port controls. Put simply, carriers continue to come to Bangkok because 'it's where the processing plants are'. While alternative ports exist in the region (and elsewhere) to service tuna processing facilities (e.g. Ho Chi Minh, Vietnam; Manta, Ecuador), demand from Thailand's major tuna processors is strong and consistent, thus any 'downsides' of PSMA impacts would need to be substantial to overwhelm the commercial advantages of continuing supply. To that end, the absence of any real impact on the number of carrier visits to Bangkok post the implementation of the PSMA is not surprising.

Changes by flag state

Notwithstanding the increase in carrier visits detected through AIS across the 'before' period, the composition of visits by flag State has remained relatively stable over time (Figure 18). Panamanian flagged carriers dominate visit numbers, followed by Korean flagged vessels. This is broadly consistent with the general composition of larger carrier vessels authorised on the WCPFC RFV during that time period (MRAG Asia Pacific, 2019)[28].

While there is some change in the composition of flag States using Bangkok ports before and after PSMA implementation – e.g. a small reduction in Kiribati and Vanuatu flagged carriers; and increase in Bahamas and Chinese flagged carriers – this is likely to be reflective of the natural dynamics of carrier reflagging (e.g. MRAG Asia Pacific, 2019) and/or increased AIS coverage across some fleets, rather than any fleet-wide change in behaviour.

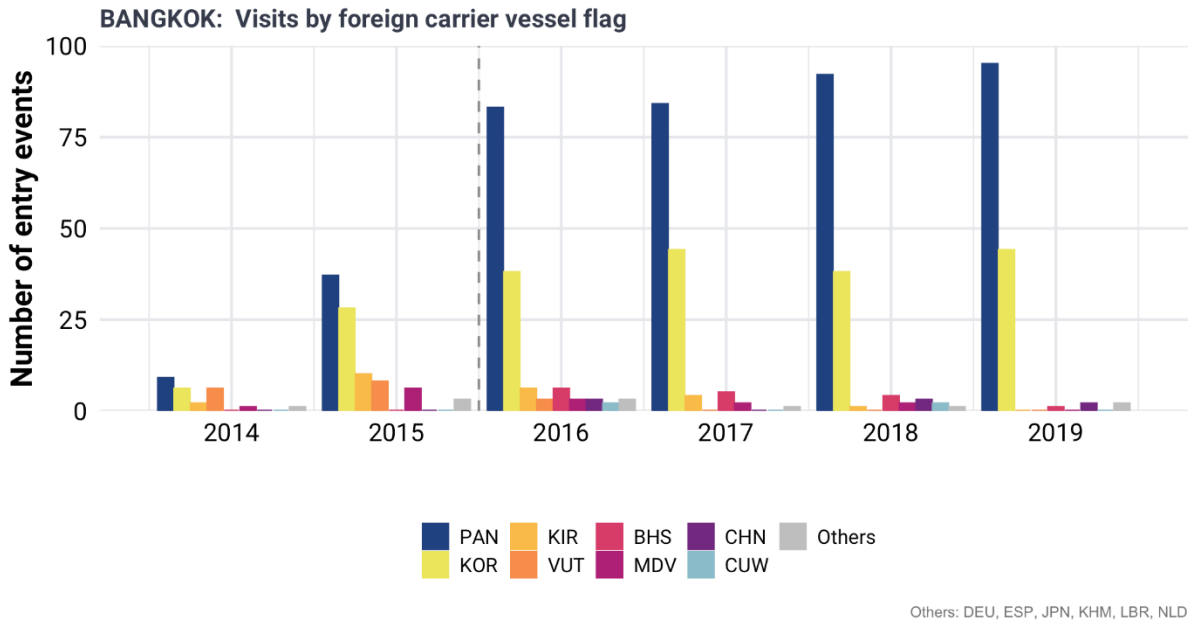


Figure 18: Number of carrier vessel visits to Bangkok by flag State, 2014-2019, based on AIS data.

[28] The Philippines and Japan had larger fleets of carrier vessels on the WCPFC RFV than Korea, although these tended to be smaller vessels likely servicing domestic fleets/ports.

3.2.1.2 Changes in port usage

Time in port

AIS records indicate that the time spent in port by carriers reduced slightly following the implementation of the PSMA, with the median carrier visit duration reducing from 2.96 (± 1.73) days in the 'before' period to 1.75 (± 0.55) in the 'after' period (Figure 19; Figure 20).

There are a range of factors outside of PSMs that can influence visit duration (and/or visit duration detected by AIS) including:

- the quantity of fish to unload – this is the key factor influencing duration, with unloading typically taking 1-2 days;
- more frequent AIS transmissions/AIS receivers due to more satellites/antennas and better AIS technology. For example, AIS data in earlier years may have more gaps, so this could extend the port in time because the analysis might record the vessel leaving later than it actually did; and
- the extent to which vessels also undertake maintenance and other factors that may result in longer stays.

Nevertheless, there are also a range of PSM related factors that could have plausibly contributed to faster turnaround times. These include:

- requiring carriers to wait outside of port for entry approval, meaning that all stakeholders have more time to prepare for unloading once the vessel is in port (e.g. port inspectors (fisheries/customs/immigration) all have time to plan for their inspections);
- more staff/more efficient processes (after 2015 DOF hired a number of staff to assist with inspections and developed SOPs/manuals so inspections may be more efficient; better inter-departmental cooperation, procedures, technology may also increase efficiency; e-PSM system after 2018 may have contributed to faster requests and responses for port entry and departures);
- the logistics of unloading may be better prepared because of the wait times to port arrivals (e.g. trucks are ready to transport fish to processing plants – although this is perhaps less likely given the longstanding logistics networks in place for the sector).

Anecdotal advice from DOF indicates the main determinant of unload times and time at port will be the unload volume. Data on unload volumes pre- and post-PSMA is not available, so DOF cautioned against drawing any strong conclusions about the impact of PSMs on port visit duration. DOF noted that rigorous inspections of carrier vessels were not undertaken prior to PSMA implementation, so this process itself will presumably have increased, rather than decreased, time in port.

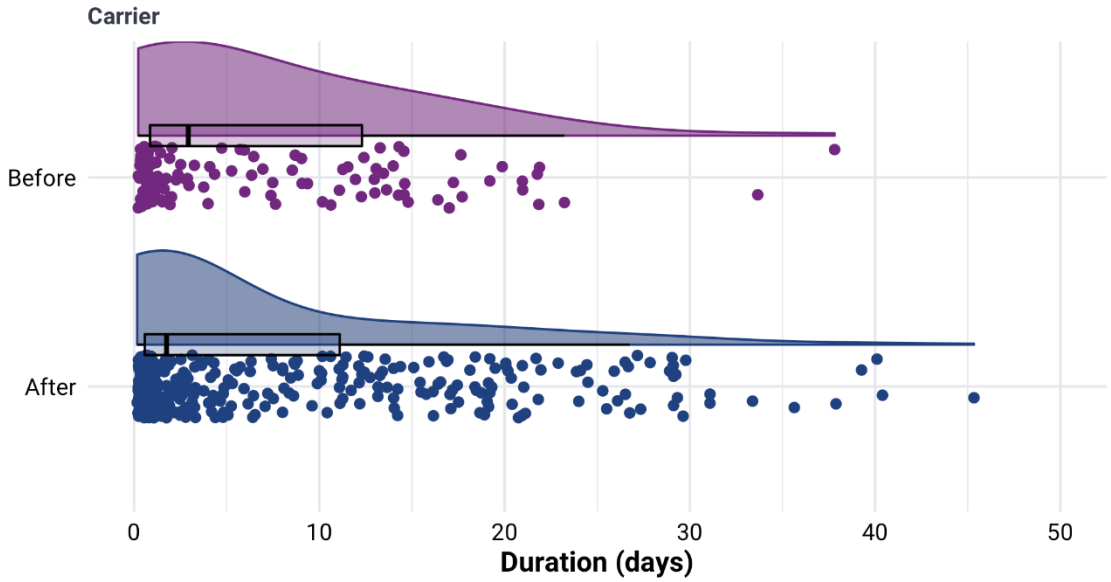


Figure 19: Raincloud plots of the duration of carrier vessel visits to Bangkok in the 'before' (purple) and 'after (blue)' periods. Individual data points represent individual port visits; horizontal lines in boxplots indicate the median visit duration and the probability distribution is shown by shaded bands. Note one visit of around 140 days during the before period was excluded from the analysis.

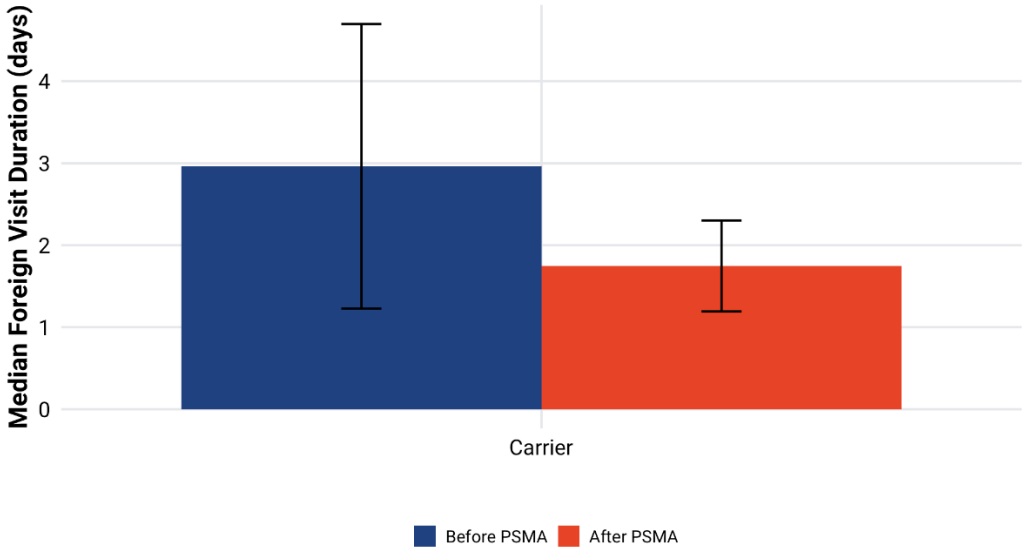


Figure 20: Median carrier vessel visit duration during the before (blue) and after (red) periods. Whisker bars represent one standard error.

Time spent at anchorage

Thailand requires 72 hours prior notification for port arrival (and entrance into the Territorial Sea). Entry into the port is not allowed until issuance of the Notification Report, so carriers tend to anchor just outside of the Territorial Sea in the upper Gulf of Thailand until they receive port entry authorisation.

AIS data indicates that wait times at anchorage have increased following the PSMA, with median wait times increasing from around 4 hours to 14 hours (notwithstanding high variability in wait times in the before period) (Figure 21). This appears generally consistent with the change under the PSMA to require approval prior to port entry.

As part of the process of assessing port entry requests, DoF conduct a risk assessment on the carrier vessel and all donor fishing vessels. This risk assessment includes an analysis into all donor fishing vessel activities, including requesting supporting information from the flag State which can take many days. The investigation into the donor fishing vessels is likely an important contributor to the increased anchorage times.

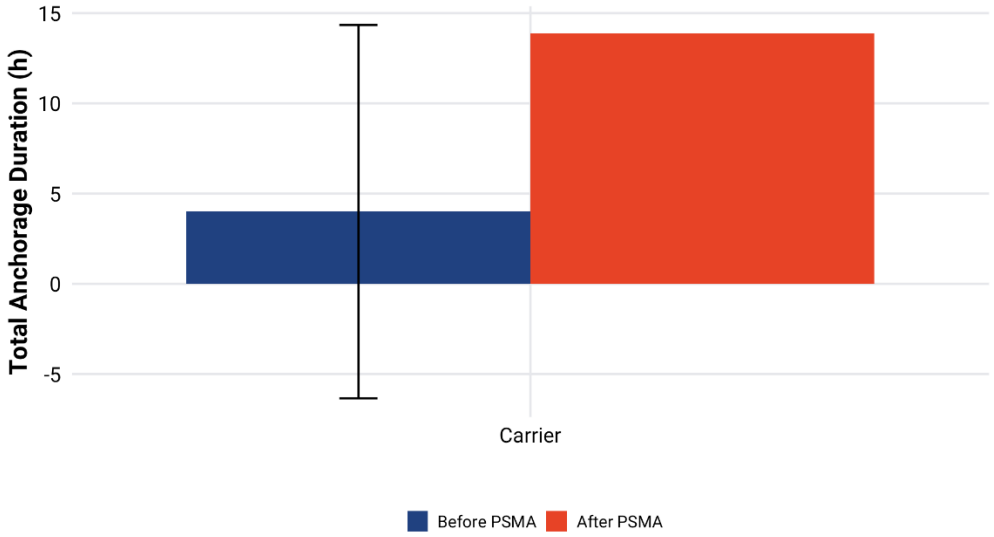


Figure 21: Median wait time (hours) at anchorage in periods before (blue) and after (red) PSMA implementation.

3.2.1 Summary of changes

The available information indicates that port usage by FFVs underwent relatively little change in the period after the implementation of the PSMA. As the world's leading tuna processing hub, port usage is dominated by carrier vessels (mainly from the WCPO) servicing tuna processing plants in the Bangkok/Samut Sakhon areas. Very few, if any, FFVs use the port. While AIS data is limited in the 'before' period, official port records and Thailand tuna export statistics indicate that carrier vessel visits are likely to have remained stable across the before and after periods. No substantial changes were evident in the composition of flag States of carriers visiting Bangkok. Port visits tended to be slightly shorter in the period after the PSMA, with time spent at anchorage longer. The apparent stability in port usage will be driven overwhelmingly by the strong and consistent demand for tuna raw material by Thai processing facilities – in short, the commercial advantages of maintaining existing supply relationships and logistics networks will substantially outweigh any 'downsides' associated with stronger port controls. This is particularly the case given IUU activity in the WCPO purse seine tuna fishery is estimated to be low (MRAG Asia Pacific, 2021) and there is no reason to avoid designated ports under the PSMA.

3.3 Chimbote, Callao (Peru)

3.3.1 Background

3.3.1.1 Overview of ports

Callao is the main seaport of Peru, located in the western suburbs of Lima (Figure 22). Consistent with its status as Peru's main seaport, Callao offers a full range of commercial support services.

Chimbote port is located in the state of Ancash, around 365km north of Lima. Chimbote is the largest centre for anchoveta processing in Peru, strategically located adjacent to some of the main fishing grounds.

Chimbote port has historically had significant exports of fish oil and fish meal, although volumes have declined in recent years with much of this now exported through Callao[29].

Figure 22: Aerial view of Chimbote and Callao ports (Google Earth)

The main foreign fishing fleets visiting Peruvian ports in recent years have been Chinese and Korean squid jiggers calling into Chimbote and Callao, Spanish and Japanese tuna longliners calling into Callao and tuna purse seiners from Latin America and the US calling into Paita and Callao.

The foreign jig fleet targeting jumbo squid in the high seas waters of the SPRFMO Convention area has increased rapidly from 50 vessels in 2007 to 575 vessels in 2020[30]. Originally, vessels from this fleet using Peruvian ports visited Callao for crew changes and to complete necessary documents (e.g. change of ownership). However, in 2017 the bulk of logistical operations shifted to Chimbote largely because the fleet found new fishing grounds around Ecuador's Galapagos EEZ[31]. Chimbote was preferred both because of its proximity to the new fishing grounds, its wide bay which allows entry to deep draft vessels and also due to the presence of SIMA, a company that offers hull maintenance services. We also understand that Chimbote is considered less crowded than Callao, which is preferable for logistics including changing crew and refuelling.

[29] Ministerio de Transportes y Comunicaciones (2021) PLAN MAESTRO DEL NUEVO TERMINAL PORTUARIO DE CHIMBOTE. (https://cdn.www.gob.pe/uploads/document/file/2866782/PLAN%20MAESTRO%20-%20NUEVO%20TERMINAL%20PORTUARIO%20DE%20CHIMBOTE.pdf.pdf)

[30] https://www.sprfmo.int/assets/Meetings/SC/10th-SC-2022/SC10-SQ01_rev2-Squid-information-held-by-the-Secretariat.pdf

[31] https://globalfishingwatch.org/map/?latitude=-15.74839647604037&longitude=-83.24706166276286&zoom=3.107145371885443&start=2012-01-01T00%3A00%3A00.000Z&end=2017-01-01T00%3A00%3A00.000Z&dvIn[0][id]=fishing-ais&dvIn[0][cfg][filters][geartype][0]=squid_jigger&dvIn[1][id]=context-layer-graticules&dvIn[1][cfg][vis]=false&dvIn[2][id]=context-layer-eez&dvIn[2][cfg][vis]=true&dvIn[3][id]=vms-with-norway&dvIn[3][cfg][vis]=false&timebarVisualisation=heatmap

Conversely, the foreign tuna longline fleet, mainly flagged to Spain and Japan, use Callao to offload bycatch (e.g. sharks) as well as limited logistics. This fleet prefers Callao port due to the relative proximity to their fishing grounds.

3.3.1.2 Timeline of PSM implementation

Key dates for PSM implementation include:

- **November 22, 2009**: Peru, along with other countries, approved the text of the PSMA at the 36th Conference of the United Nations Organization for Food and Agriculture.
- **March 3, 2010:** Peru signs the PSMA.
- **May 5, 2016**: The bill for the approval and ratification of the PSMA is sent to Congress.
- **July 22, 2016**: The Decreto Supremo Nº016-2016-PRODUCE[32] establishes the first measures to authorize operations in Peruvian ports and shipyards of foreign-flagged vessels that carry out fishing activities for highly migratory, straddling, or transboundary hydrobiological resources on the high seas. The supreme decree establishes that foreign-flagged fishing vessels must provide the information of vessel tracking data for the period from the last departure to the arrival at the national port. The vessel tracking data comes from the VMS system in their home country and can be shared using a hard copy printout. PRODUCE implemented this measure using Peru's General Fishing Law.
- **June 23, 2017**: The bill of the PSMA is sent to the Congress of the Republic for approval.
- **September 6, 2017**: The PSMA is ratified by the Congress of the Republic through Supreme Decree No. 040-2017-RE[33].
- **October 27, 2017**: The PSMA officially enters into force in Peru and is ready for implementation by the Ministry of Production (PRODUCE).
- **August 26, 2020**: The Decreto Supremo Nº016-2020-PRODUCE[34] modifies a number of articles from the previous supreme decree. In addition to requiring that FFVs operating outside Peruvian waters and seeking to enter Peru ports are authorised under relevant RFMOs, the measure requires that foreign-flagged vessels fishing for certain highly migratory, straddling species on the high seas have VMS approved by PRODUCE and to transmit their positions to the control centre for the six months prior to entering port. While a short initial transitional period was granted, the new supreme decree came into effect from December 31, 2020. The only exception is for 'forced arrivals' including medical emergencies and engine failures.

  Importantly, the decree applied the new VMS requirement to 'recursos hidrobiológicos altamente migratorios, transzonales o transfronterizos en alta mar'. Under Peruvian law, this concept applies to species such as jack mackerel and squid, and not to other highly migratory species such as tuna. The new requirement was driven by long-standing concerns that high seas squid jiggers in particular were switching off AIS and fishing illegally inside Peru's EEZ (e.g. Aroni, 2018; Welch et al, 2022).

3.3.1.3 Cut-off date

Although Peru ratified the PSMA in 2017, the most 'impactful' measure introduced to assist in PSMA implementation was the requirement for foreign squid jigging vessels to operate an approved VMS from 2020. To that end, 2020 has been used as the cut-off date for the analysis, with 2015-2019 used as the before period

[32] https://busquedas.elperuano.pe/dispositivo/NL/1408438-6

[33] https://busquedas.elperuano.pe/dispositivo/NL/1562695-6

[34] https://cdn.www.gob.pe/uploads/document/file/1277508/D.%20S.%20N%C2%BA%20016-2020-PRODUCE.pdf?v=1599077884

and 2021-2022 the after period. Given the measure applied to fishing vessels only and not carriers, we have focused the analysis on the fishing fleet.

An inevitable complication of using 2020 as the cut-off year is the potentially confounding impact of COVID-related port restrictions and broader impacts on seafood trade implemented around the same time[35]. To that end, advice has been sought from local experts, Government officials and industry contacts to disentangle PSMA-related impacts from other drivers.

3.3.2 Before and after analysis

3.3.2.1 Changes in number of visits

Total number of visits

Chimbote

Figure 23 sets out trends in FFV and carrier vessel visits to Chimbote port over the study period. The number of FFV port visits grew steadily throughout the 'before' period, peaking at 149 visits in 2019, before declining sharply to only 12 in 2020. Very few carrier vessels visit the port.

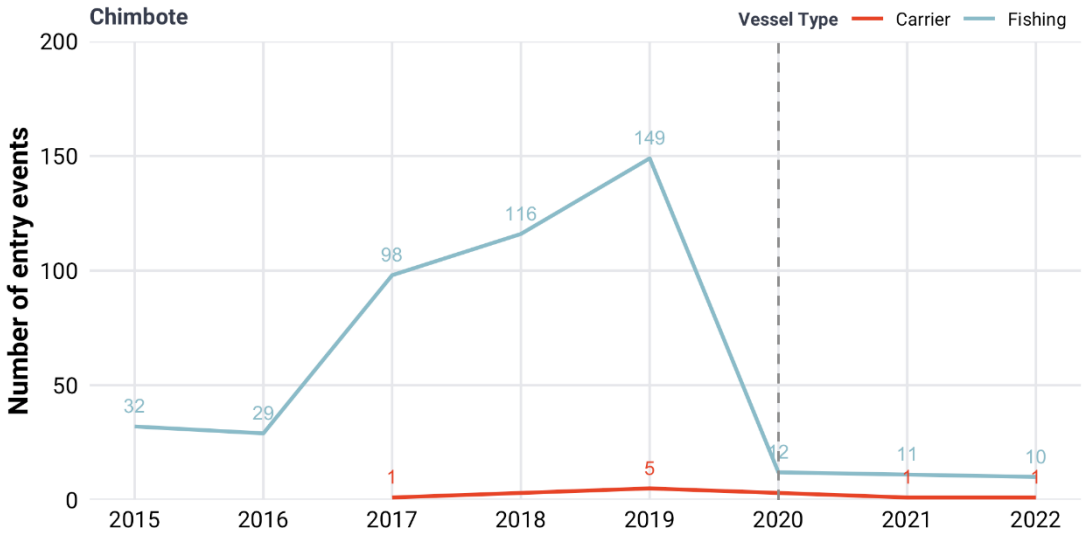


Figure 23: Total number of FFV and carrier vessel visits to Chimbote, 2015 - 2022.

An analysis of changes in activity by vessel type indicates that essentially all changes have been driven by changes in the squid jig fleet (Figure 24). As discussed above, Chimbote became a favoured port for Chinese squid jiggers to undertake routine hull maintenance and other logistical services from around 2017. With the introduction of the VMS requirement in 2020, together with COVID-related port restrictions, numbers of visits fell sharply to 4 in 2020. Despite the progressive relaxation of COVID-related port restrictions from mid-2020, no squid jiggers visited the port in 2021 or 2022.

[35] On March 16, 2020, the Peruvian government declared a stay-at-home order and also closed the borders (land, sea, air) in response to the COVID-19 pandemic.

Small numbers of purse seiners, tuna purse seiners and longliners – to whom the VMS requirement does not apply - continued to visit Chimbote after 2020.

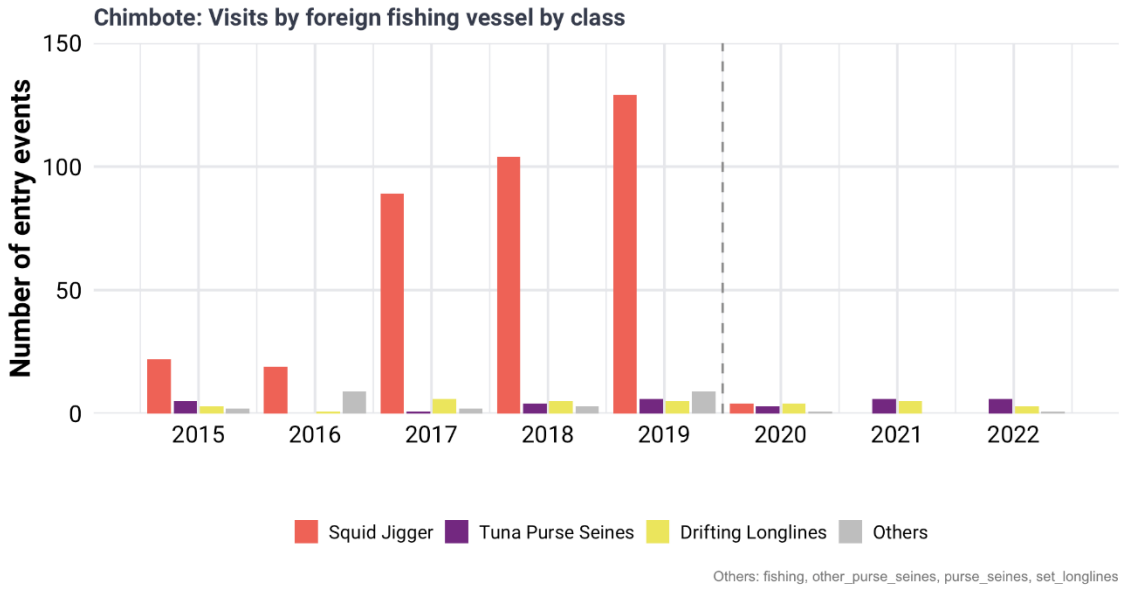


Figure 24: Total number of FFV visits to Chimbote port by gear type, 2015 - 2022.

Advice from Chinese industry sources indicated that Chinese fishery authorities viewed the imposition of the VMS requirement as inconsistent with the management of fishing vessels on the high seas. As a result, they opposed the measures, and since 2020 Chinese jiggers have entered Peruvian ports only in case of emergency. They advised that the imposition of the VMS requirement was the primary driver of the change in port visits, with COVID-related restrictions having little lasting influence.

BOX 1: WHERE HAVE THE CHINESE SQUID JIGGERS GONE?

Given the substantial decline in Chinese squid jig vessels to Peruvian ports following the introduction of the VMS requirement, this begs the question: where have they all gone?

The Chinese jig fleet operating in the SE Pacific tend to fish in an annual cycle, with effort focused on the Illex squid fishery in the SW Atlantic off Argentina in the first half of the year before transiting across to the SE Pacific in the second half of the year to fish jumbo squid (Figure 25). Prior to the VMS requirement, many jig vessels would call into Peruvian ports (particularly Chimbote) to undertake routine hull maintenance as part of this annual cycle.

With the introduction of the VMS requirement, advice from Chinese industry sources indicated that many Chinese vessels chose to return to China for hull maintenance/refit, while others remain at sea for multiple fishing seasons without visiting port.

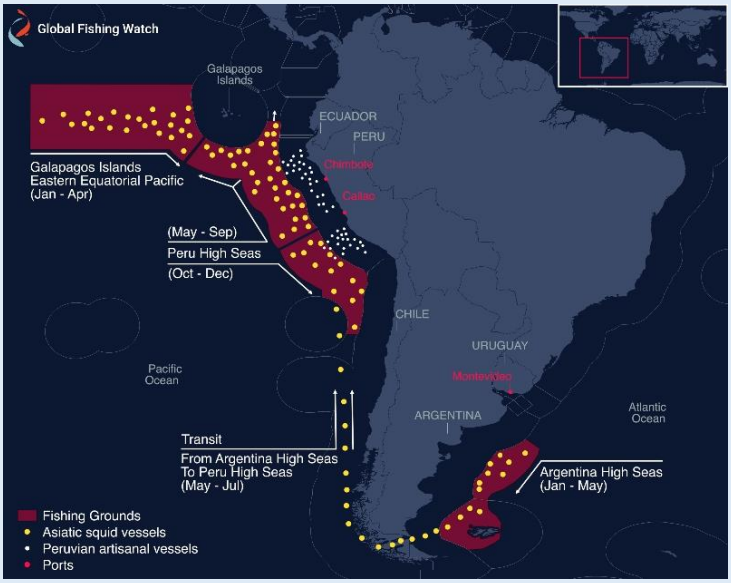


Figure 25: Seasonal fishing patterns and areas for squid in the SW Atlantic/SW Pacific (Source: Global Fishing Watch)

This is consistent with the available AIS information. Figure 27 shows the location of fishing effort for Chinese squid jig vessels that visited Chimbote at some point during the 2015-2019 period. Broadly, it shows that vessels continue to fish in roughly the same locations after 2020 (i.e. they had not shifted effort to different regions – e.g. NW Indian Ocean, NW Pacific).

Figure 26 shows port visits by Chinese squid jig vessels that called into Chimbote at least once during 2015-2019. In the period after the VMS requirement was introduced in 2020, there is no clear pattern to port visits, other than a minor rise in visits to Ningbo and Zhoushan, China. Note that visits to Punta Arenas, Chile, are likely to be anchoring during transit between ocean basins rather than use of the port. Similarly, visits to Telok Ramunia, Malaysia, are likely to be transit through the Strait of Malacca. To that end, the available information indicates Chinese jigging vessels have either chosen to remain at sea for longer periods or returned to Chinese ports for refit. China has not yet signed the PSMA and domestic vessels are not subject to formal PSMA measures in any event[36]. One possible consequence of remaining at sea for longer periods, is the increased risk of labour rights violations, which have been previously tied to trip duration (e.g. McDonald et al, 2021). Some Peruvian analysts have begun to explore the implications for labour rights resulting from the VMS requirement.[37]

Figure 26: Annual distribution of fishing effort by Chinese squid jig vessels that visited Chimbote prior to the introduction of the VMS requirement, but not after, 2015-2022.

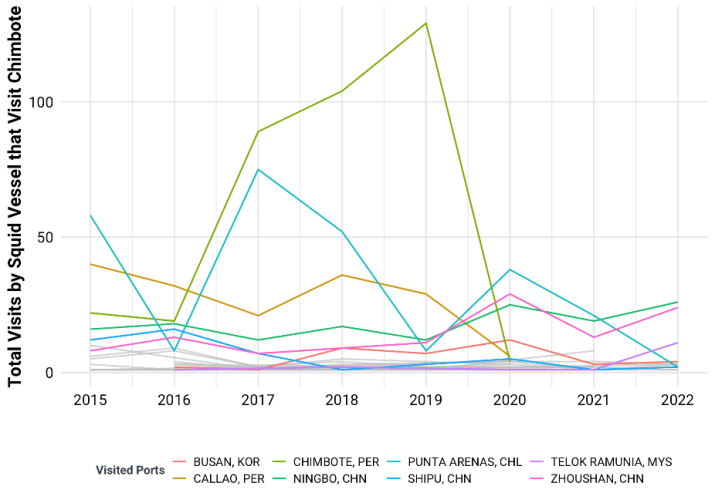


Figure 27: Port visits by Chinese squid jigging vessels who called into Chimbote during the 'before' period, 2015 to 2022.

[36] We note that China is also yet to provide designated ports for the purposes of SPRFMO CMM 07-2022, however this measure does not apply to domestic vessels and China has advised that it does not expect foreign fishing vessels landing SPRFMO managed species to use their ports (https://www.sprfmo.int/assets/Meetings/03-CTC/8th-CTC-2021/meeting-documents/CTC8-Doc09-Port-Inspection-Implementation-Report.pdf)

[37] https://artis0nal.wixsite.com/my-site/en/post/dire-labor-conditions-in-the-squid-fishery

Callao

The pattern of FFV visits is similar in Callao, with an increase in visits across the 'before' period, peaking in 2018/19, before declining sharply in 2020 and remaining at lower levels thereafter (Figure 28). The increase prior to 2020 was driven largely by squid jiggers and to a lesser extent longliners and tuna purse seiners (Figure 29). The decline in port visits after 2020 is driven almost entirely by a reduction in squid jiggers, with relatively consistent visits from longliners and tuna purse seiners. Given the VMS requirement does not apply to these latter vessel classes, this is perhaps not surprising.

While some visits from jiggers were recorded in 2021 and 2022, anecdotal evidence suggests that these were likely to be 'forced arrivals'. We understand the number of requests for port entry as a result of crew emergencies has increased since the VMS requirement was introduced. Nevertheless, Chinese industry sources advised that a Chinese company is operating a medical vessel in the vicinity of the main fishing ground, meaning that vessels may be able to receive medical attention without calling into port in future.

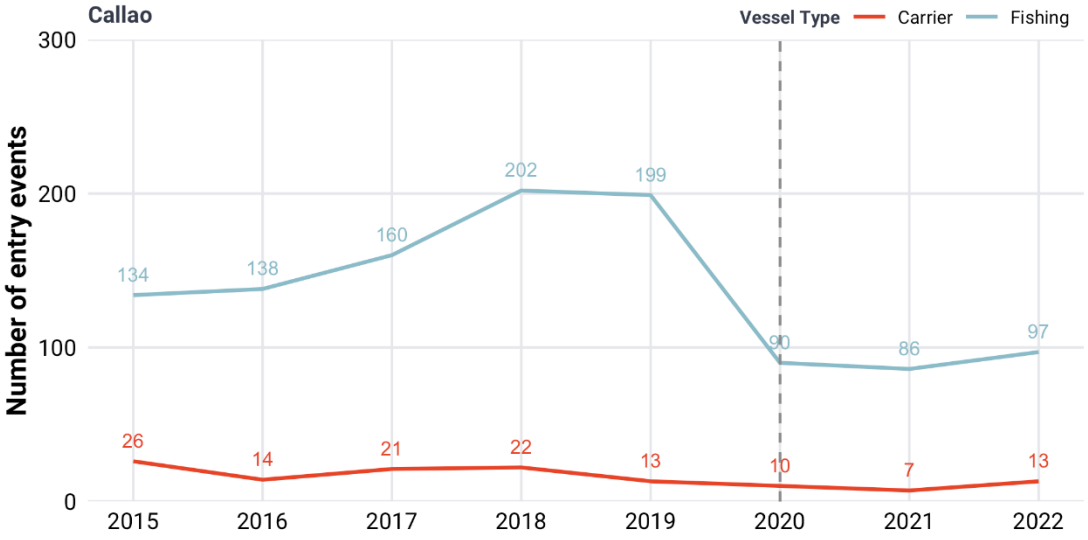


Figure 28: Total number of FFV and carrier vessel visits to Callao, 2015 - 2022.

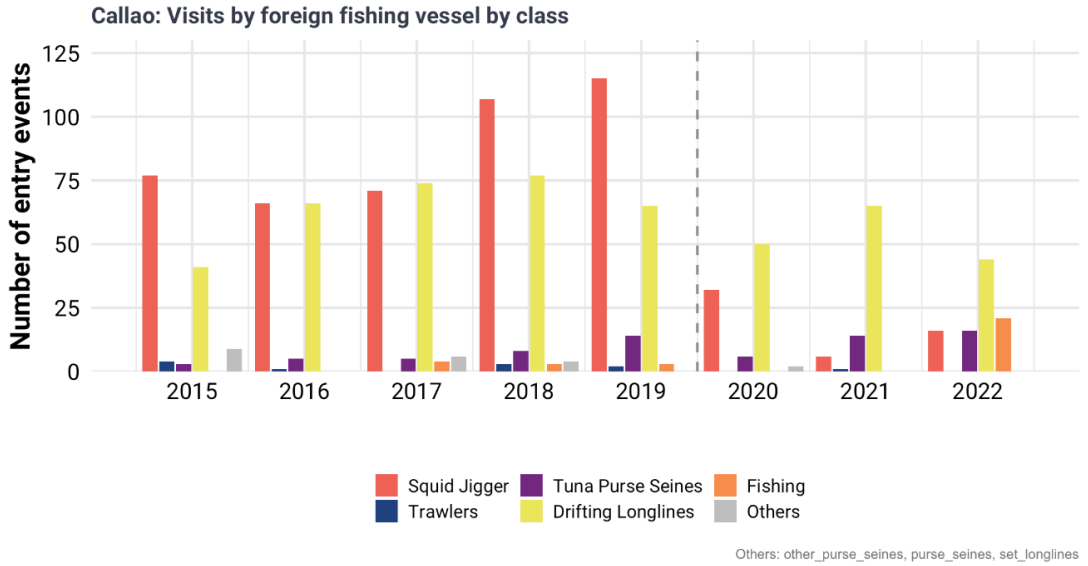


Figure 29: Total number of FFV visits to Chimbote port by gear type, 2015-2022.

Changes by flag state

Chimbote

Changes in fishing vessel activity in Chimbote by flag State are consistent with the trends described above for vessel type. The main change was the exit of the Chinese squid jig fleet from 2020 onwards following the introduction of the VMS requirement (Figure 30). Other fleets have used the port in modest numbers, with changes in years likely unrelated to PSMs.

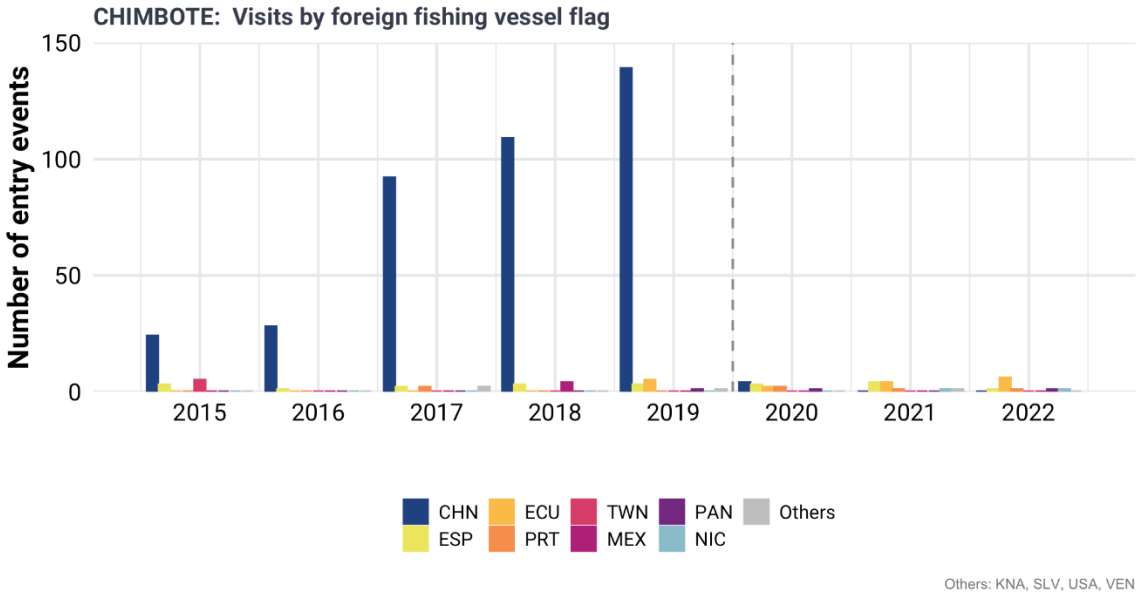


Figure 30: Number of FFV visits to Chimbote by flag State, 2015-2022.

Callao

Changes in the flag State composition of fishing vessels visiting Callao are also broadly consistent with the trends discussed above by vessel type (Figure 31). Visits by Chinese vessels declined in 2020, although the decline was less pronounced than in Chimbote. It is likely many of the visits after 2020 are 'forced arrivals'. The other notable change is the decline in the Korean fleet which had 32 entries in 2018 and 27 in 2019, but only 2 visits in 2020, 1 in 2021 and none in 2022. These vessels were high seas squid jiggers who showed the same response to the VMS requirement as the Chinese jigging fleet (Box 2).

Visits by Spanish and Japanese longliners account for the next highest number of visits after Chinese jigging vessels and are relatively consistent through the before and after periods. Notably, these vessels were not subject to the VMS requirement. Other changes are relatively modest and likely unrelated to the VMS requirement.

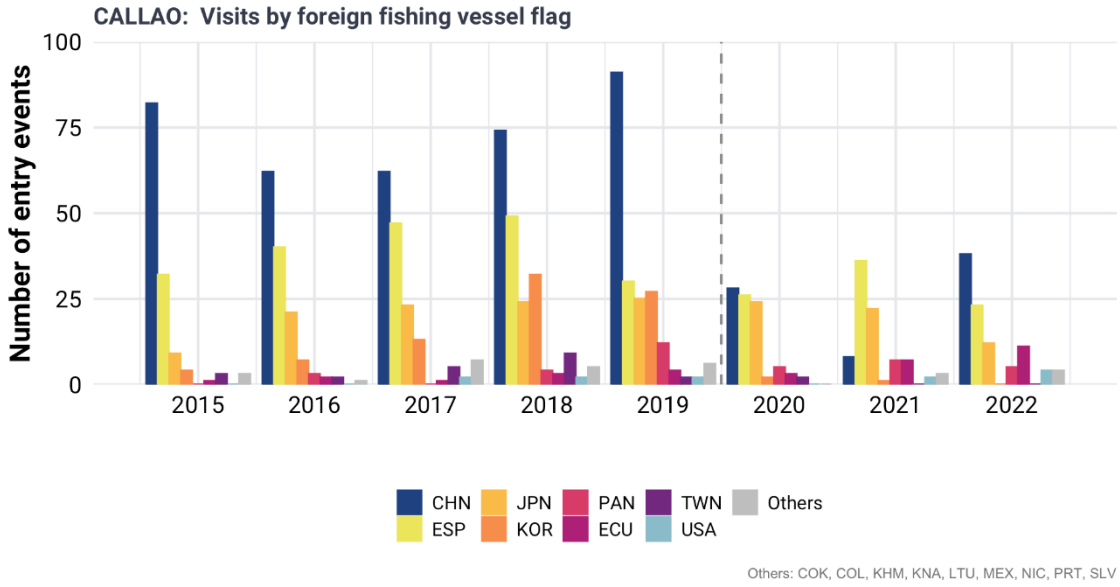


Figure 31: Number of FFV visits to Callao by flag State, 2015-2022.

BOX 2: WHERE DID THE KOREAN SQUID JIGGERS GO FROM CALLAO?

While the Korean squid jigging fleet operating in the eastern Pacific prior to the VMS requirement in 2020 was relatively small (around 15 active vessels in 2019; NIFS, 2022), the fleet regularly used Callao port for reprovisioning, documentation (e.g. updating SPRFMO authorization, registering change of ownership) and crew changes with up to 29 visits annually. Since the introduction of the VMS requirement, the fleet has effectively vacated the port, with only one visit in 2021/2022. Anecdotal information indicates the fleet has decided not to fish in the eastern Pacific, preferring instead to remain in the Atlantic. This is consistent with both official reports indicating no Korean squid fishing effort in the SPRFMO Convention Area in 2021 (NIFS, 2022), as well as AIS data showing the fleet operating exclusively in the SW Atlantic in 2021/2022 (Figure 32).

For those Korean squid jiggers that visited Callao during the 'before' period (2018-2019), AIS data indicate higher usage of Busan (Korea - perhaps influenced by COVID restrictions) and Berkeley Sound (Falkland Islands) in 2020. Since 2021, visits to Busan have fallen sharply, with port visits dominated by ports in the SW Atlantic region (Berkely Sound, Falkland Is; Stanley, Falkland Is; Montevideo, Uruguay) (Figure 33). In the context of the PSMA, Montevideo is a designated port, although the Falklands Islands ports are not. We understand Falkland Islands ports are used for reprovisioning rather than landing, with average time in port <1 day.

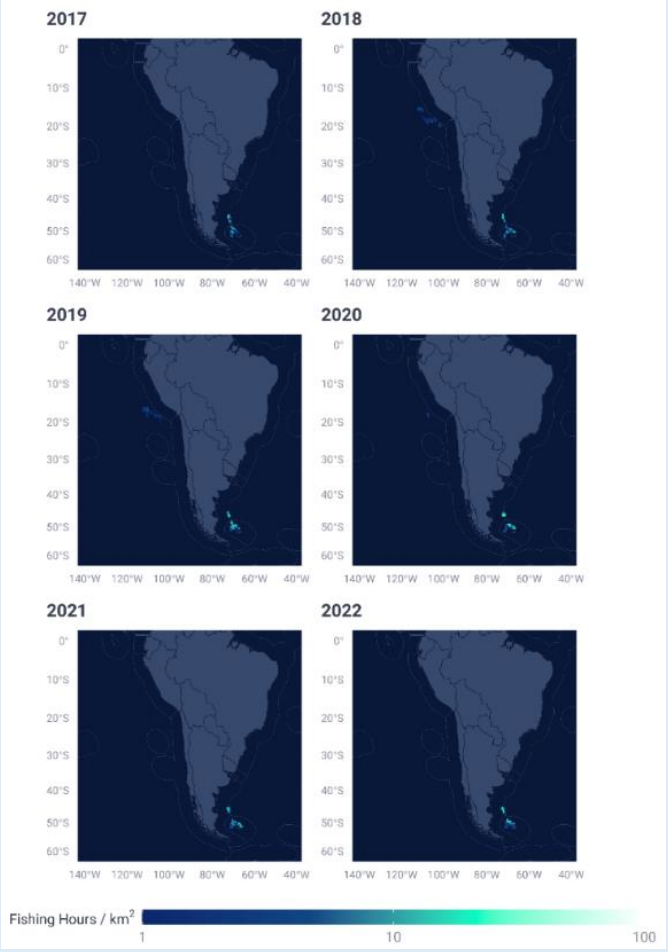


Figure 32: Annual spatial distribution of Korean squid jig fleet fishing effort, 2017-2022.

Advice from Korean industry sources indicate that the introduction of the VMS requirement was an important factor in the change of fishing pattern, although not the only one. Lower catch rates and profitability in the SE Pacific also likely contributed to the return to the Falkland Islands and SW Atlantic, which have historically been the main fishing grounds for the Korean jigger fleet (KOFA[38] pers com).

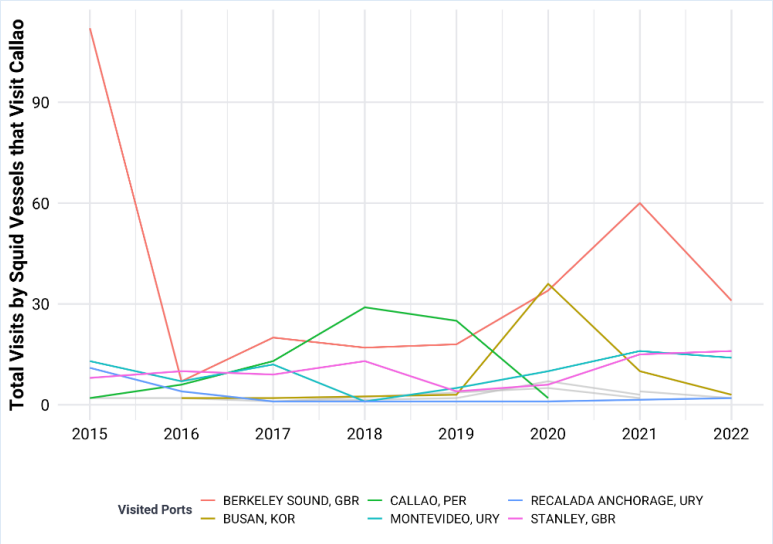


Figure 33: Port visits across the years 2015 – 2022 by Korean squid jig vessels who used Callao in the 'before' period (2018-2019).

3.3.2.2 Changes in port usage

Time in port

Chimbote

Given the complete disappearance of the Chinese jigging fleet from Chimbote port following the introduction of the VMS requirement, comparisons of time in port during the before and after periods are not 'apples vs apples' (in that the composition of FFVs using the port has changed). Nevertheless, they are useful to highlight potential impacts on local service businesses. Prior to the VMS requirement, AIS data indicates that Chimbote received up to 129 visits annually from squid jiggers, with each vessel remaining in port for around two weeks on average (Figure 34). Anecdotal information indicates that, in addition to hull maintenance, both the fishing company and crew used services offered by local businesses (e.g. accommodation, restaurants, entertainment) providing a boost to the local economy. Following the VMS requirement, the duration of FFV visits declined substantially from 13 days to around 6 (mainly from the tuna fleet) (Figure 35). To that end, the loss of the jigger revenue represents a loss for local businesses. In that context, we understand there is tension at the local level between artisanal fishers who are strongly supportive of the VMS requirement and local businesses who've lost business.

[38] Korea Overseas Fisheries Association.

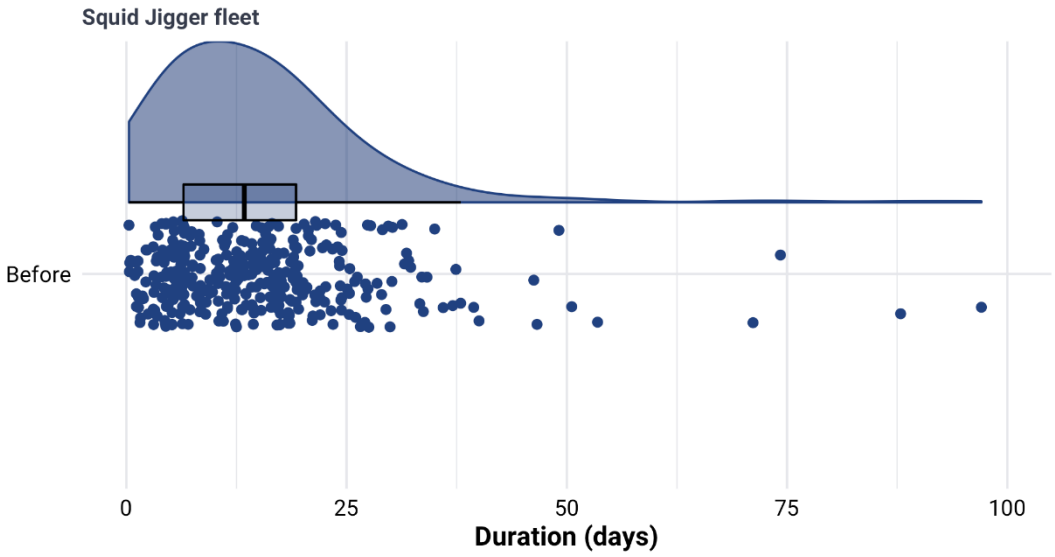


Figure 34: Duration in port for each squid jigger visit to Chimbote, 2015-2019. Individual data points represent individual port visits; horizontal lines in boxplots indicate the median visit duration and the probability distribution is shown by shaded bands.

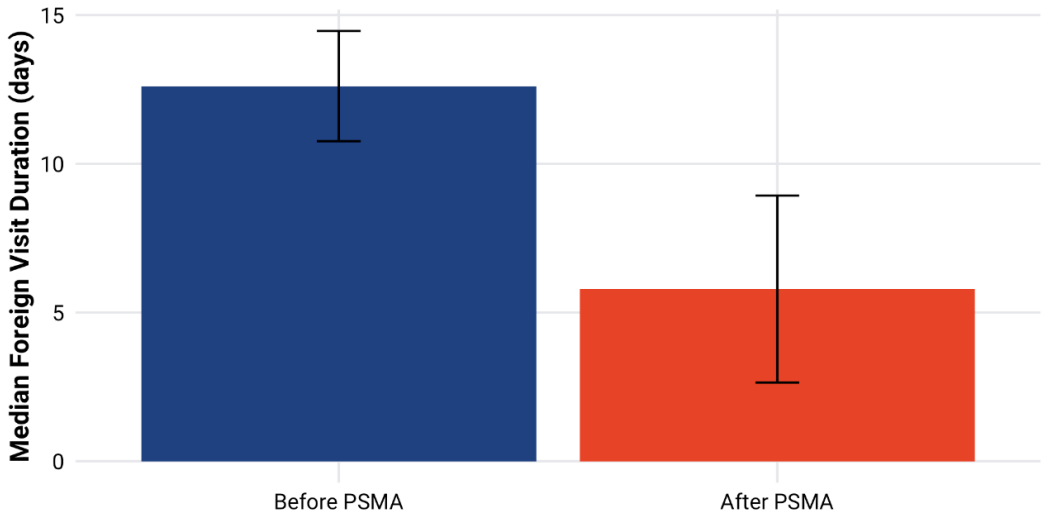


Figure 35: Change in median duration of foreign fishing vessels visits to Chimbote port before (2015-2019; blue) and after (2021-2022; red) the introduction of the VMS requirement.

Callao

The impact of the VMS requirement on time in port in Callao was far less pronounced, with limited change in the before and after periods (Figure 36). This is mainly because vessels do not typically use the port for hull maintenance, which takes around two weeks on average. Instead, vessels use Callao port for refuelling, crew change and unloading in the case of the tuna longline fleet, which require less time. To that end, the disappearance of the jig fleet had proportionally less impact than in Chimbote.

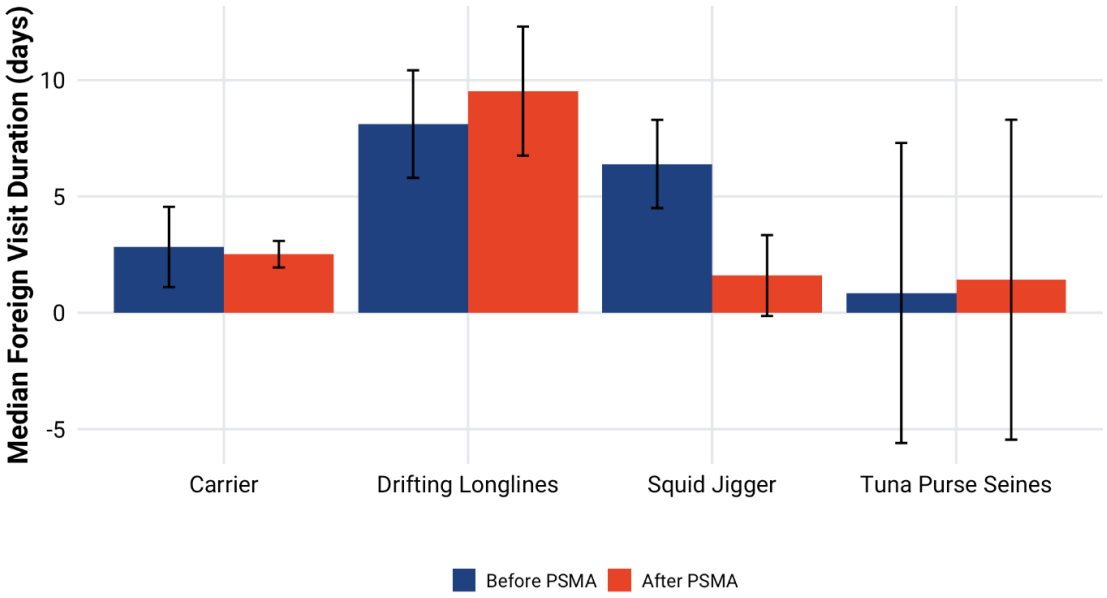


Figure 36: Change in median duration of foreign fishing vessels visits to Callao port before (2015-2019; blue) and after (2021-2022; red) the introduction of the VMS requirement.

3.3.2.3 Changes in transhipment activity

One of the possible consequences of stronger port controls associated with the PSMA is a higher rate of transhipment at sea by vessels in fisheries for which transhipment at sea is commercially feasible (including high seas squid fisheries). To examine any changes in transhipment frequency, we looked at the rate of encounters[39] detected by AIS for squid jig vessels which visited Chimbote/Callao prior to the VMS requirement but not after (i.e. did the non-use of Chimbote/Callao port mean these vessels were transhipping more at sea?).

Chimbote

Figure 37 shows the average number of encounters per vessel per year detected by AIS for squid jig vessels which visited Chimbote in the before period but not after (in Chimbote's case, all squid jiggers in the dataset). The rate of encounters per vessel increased during the after period, although the drivers are unknown and likely to be unrelated to PSMs. Chinese jiggers visited Chimbote for hull maintenance rather than to offload catch, so the introduction of the VMS requirement should have little influence over the frequency of transhipment at sea (i.e. vessels were not shifting from onshore unloading to at sea transhipment). While the actual reason for the increase in encounter rate is not known, it is more likely to be driven by changes in fishery dynamics. For example, based on data submitted to SPRFMO[40], the CPUE of Chinese jig vessels increased in 2021 (compared to the 2015-2019 average) potentially leading to a higher frequency of transhipments. The CPUE for 2022 was not available at the time of writing.

[39] Defined as an event where a fishing vessel and a neighbouring vessel are continuously within 500 meters from one another for >2hr and traveling at <2kt, while at least 10km from a coastal anchorage (see for example Miller et al, 2018). Loitering events were not examined because there is a higher risk of picking up fishing activity.

[40] https://www.sprfmo.int/assets/Meetings/SC/10th-SC-2022/SC10-SQ01_rev2-Squid-information-held-by-the-Secretariat.pdf; nominal CPUE calculated based on total weight of catch divided by total number of fishing days. Data for 2022 was not available at the time of writing.

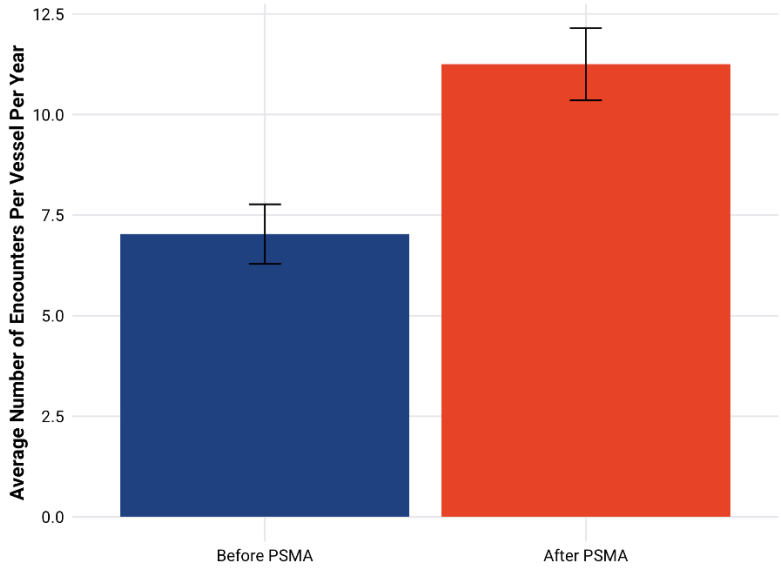


Figure 37: Change in the average annual rate of at sea encounters detected by AIS before (blue) and after (red) the implementation of the VMS requirement in 2020 for Chinese squid jiggers that that visited Chimbote in the 'before' period.

Callao

For Chinese squid jiggers which visited Callao in the before period but not after, a similar trend was evident – the average rate of encounters per vessel per year rose by roughly the same degree as Chimbote (Figure 38). Similar to Chimbote, it is most likely that the trends are driven by changes in fishery dynamics (e.g. CPUE), although it is also plausible that because Callao was primarily used for logistics purposes (e.g. reprovisioning, crew change) jiggers required more encounters with carriers to service these functions.

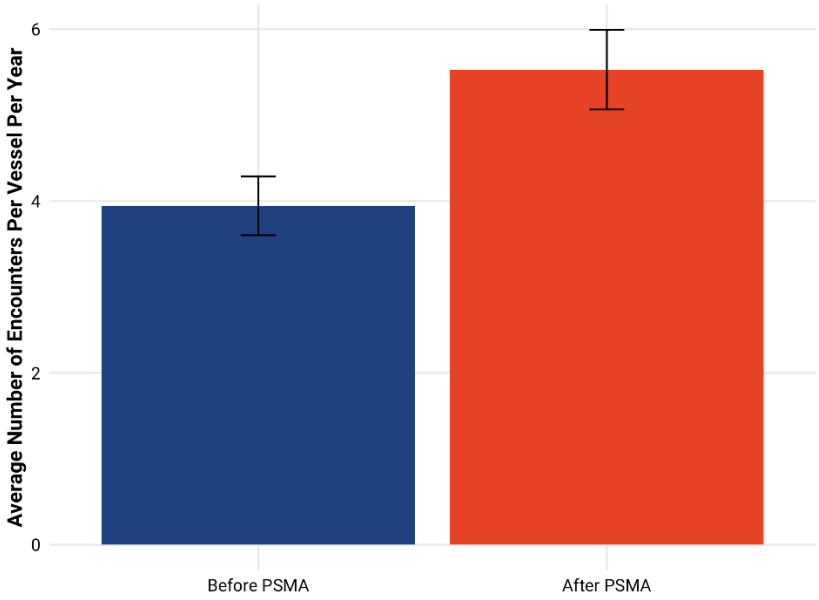


Figure 38: Change in the average annual rate of at sea encounters detected by AIS before (blue) and after (red) the implementation of the VMS requirement in 2020 for Chinese squid jiggers that visited Callao in the 'before' period.

3.3.3 Summary of changes

Of all the case study ports examined in this study, the Peruvian ports of Chimbote and Callao experienced the most substantial changes in fishing fleet behaviour following the implementation of PSMs to support implementation of the PSMA. In this case, we looked specifically at the impact of the requirement introduced in 2020 for squid jig vessels to install a VMS approved by PRODUCE and transmit six months' VMS data to Peruvian authorities prior to entry into Peruvian ports. The introduction of the new VMS requirement was in response to concerns of illegal fishing by high seas jigging vessels in the Peru EEZ. Prior to the introduction of the VMS requirement, Peruvian ports, and in particular Chimbote, were used for routine hull maintenance and other services. Following the introduction of the VMS requirement, Chinese jigging vessels have been almost completely absent from Chimbote, with no visits in 2021 or 2022. A similar trend was evident in Callao, with numbers of jigger visits (including those from Korea) falling sharply following 2019. An analysis of Chinese jigging vessels which previously visited Chimbote indicated that they had continued to fish in the same areas after the VMS requirement, with a small increase in visits to Chinese ports. Other vessels may have chosen to remain at sea for longer periods. By contrast, the Korean jig fleet has changed fishing pattern, with vessels fishing exclusively on the Atlantic side of South America following the introduction of the VMS requirement, with no effort on the Pacific side since 2021. The rate of encounters at sea by Chinese squid jiggers no longer visiting Peruvian ports increased during the after period, although this is more likely driven by fishery dynamics (e.g. changes in CPUE) than PSMs.

3.4 Montevideo, Uruguay

3.4.1 Background

3.4.1.1 Overview of port

Montevideo is a major port in South America, geographically positioned at the intersection of key maritime routes. It provides a range of services, including dry docking and specialised repairs (Figure 39), and is free of import tariffs for foreign catch landed and containerised, or loaded into a bonded coldstore. In addition, there is no requirement for fishing vessels to be licenced within the Uruguayan EEZ to use the Montevideo port, which further facilitates the use of Montevideo as a base and distribution centre for distant water fleets that operate on the high seas of the Southwest Atlantic (FAO Fishing Area 41). Fishing in this section of the Atlantic is not regulated by any Regional Fisheries Management Organization (RFMO) nor provisions agreed in UN Convention on the Law of the Sea (UNCLOS) and the UN Agreement (e.g., there is no agreement on straddling stocks).

Since 2016, Montevideo has received approximately 300 visits by foreign fishing vessels and approximately 20 carrier vessels per year[41]. The primary foreign fishing vessels which use Montevideo port are Spanish flagged trawlers targeting hake, ling and toothfish on the high seas of the Southwest Atlantic, while most carrier vessels are flagged to Panama. According to local experts, the number of Montevideo port visits by fishing and carrier vessels was not affected by the COVID pandemic.

[41] Note that these numbers vary from Hosch et al (2017). The records here have been cross-referenced against official port records, with non-fishing vessels excluded.

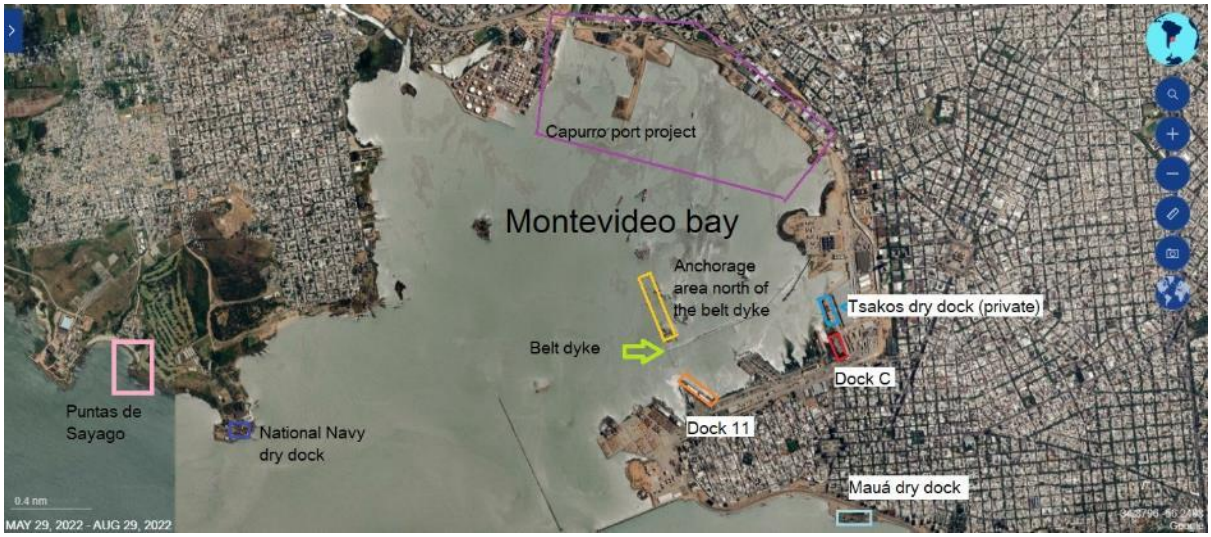


Figure 39: Port of Montevideo. Note that the Tsakos dry dock collapsed in December 2022.

The analysis of PSMA impacts on Montevideo port use is complicated by the fact that, until 2020, foreign vessels used the anchorage, waiting and service areas located outside the port, in the Rio de Plata (Figure 40), for various services not related to the movement of catches (e.g., for repairs, crew changes, refuelling, provisioning) without being subject to PSMA measures. While these areas are in waters of common use with Argentina[42], they are administered by Uruguay due to their proximity to the Uruguayan coastline (albeit both countries can use them freely). In order to unload and transship, fishing and fishing support vessels must enter the port of Montevideo, where they became subject to provisions of the PSMA.

Figure 40: Map of service/waiting areas in the Rio de Planta.

[42]This delimitation was established by the Treaty of the Río de la Plata and its Maritime Front, and the zones created by the Administrative Commission of the Río de la Plata.

In 2020, an extension in the interpretation of Law 13.637 by the Naval Prefecture of the Port of Montevideo established that *"arrival at port is understood as both the entry of a ship or vessel to the port facilities, as well as any operation with said port, carried out by a ship or vessel that is in waters under national jurisdiction".* Thereafter, FFVs and carrier vessels using anchoring, waiting and service areas, and receiving services from Montevideo, were subject to PSMA measures and immigration, customs and other laws of the country. This aligned the actions of the Uruguayan National Directorate for Aquatic Resources (DINARA) and the Naval Prefecture with the PSMA as, *"the term 'port' encompasses all offshore terminals and other facilities for landing, transshipment, packaging, processing, refuelling or replenishment".*

Our analysis focuses only on port use before and after implementation of the PSMA requirements in 2017.

3.4.1.2 Timeline of PSM implementation in Montevideo Port

Uruguay signed the PSMA in 2009 and that same year began voluntarily implementing the PSMA basic documentation requirements on vessels that required EU health certification for the export of their catch. We understand that this involvement of DINARA in catch certification resulted in vessels flagged to Togo, Gabon and the Ivory Coast to stop using Uruguayan ports in 2010. However, it was not until November 30, 2012 that Law No. 19.017 approved the provisions of the PSMA into Uruguayan law. In 2013, Uruguay was one of the first countries to ratify the PSMA and the PSMA entered into force in 2016.

While there were some issues evident during PSMA implementation in 2016, as reflected in data discrepancies between the National Port Administration (ANP) and DINARA (Box 3), the underreporting of foreign arrivals and unloadings (incl. transhipments) to and by DINARA reduced during 2017 and 2018 following better coordination because of decree No. 94.017, of April 3, 2017. This decree established DINARA as the competent authority to apply the PSMA and required all foreign fishing and carrier vessels seeking to enter Montevideo to request prior authorization from DINARA and pay a fee[43]. The decree also designated Montevideo as the only port which foreign fishing vessels may enter, required foreign vessels entering the port to have a representative agent in Uruguay, and created the Coordinating Commission for the Prevention of Illegal Fishing. Once prior authorisation by foreign vessels is sought, DINARA then informs the ANP and the Naval Prefecture whether vessels are approved to use the port.

As per Law No. 19.017, the application for port entry must be accompanied by the fishing license/s and/or permit/s of the vessel, a signed declaration from the vessel master confirming no catch on board is IUU (including location information by FAO area and subarea), a declaration of possessing vessel monitoring system (VMS) or certificate indicating that the vessel is monitored by the flag authority, a crew list (indicating name, surname, nationality, and identity document of each individual) and a cargo manifest with details of the species to be unloaded by common name and scientific name.

Moreover, foreign fishing vessels may be subject to inspection by DINARA, who may examine the vessel in its entirety, including the seafood on board, fishing gear, equipment, and any document regardless of format, provided that it is relevant to verify compliance with conservation and management measures (where they exist).

[43] In the case of carriers that receive transshipments on the high seas and request entry to Montevideo port, the fee must be paid by each donor fishing vessel, the carrier being exempt from paying their fee.

BOX 3: DISCREPANCIES IN VESSEL ENTRY RECORDS, MONTEVIDEO

In 2016, DINARA did not record the entry of 11% of foreign fishing vessels to the port/ anchorage areas (31 of 279 arrivals). A third of those arrivals not registered by DINARA were Chinese flagged fishing vessels (n=11), mainly jiggers. The most significant discrepancy in 2016, however, was that DINARA recorded just over half of the landings and just under half of the volumes landed than the ANP. That year there were 198 unloads according to ANP, but DINARA only confirmed 113 unloadings (Figure 41). Thus, for the Port Administration, foreign ships would have unloaded ≈86,000t in 2016, but DINARA recorded only ≈38,000t. Spanish trawlers accounted for the majority of landings and inconsistencies, with ANP data indicating ≈48,000t was landed while DINARA registered only ≈22,000t. The highest proportion of landings not accounted for by DINARA however, was that of Korean longliners, because they had no information on the location and timing of landing, despite records indicating that the target species was Toothfish and CCAMLR port state CMMs require inspection and reporting. These irregularities were progressively addressed towards the middle of 2017 and in 2018 (Figure 42).

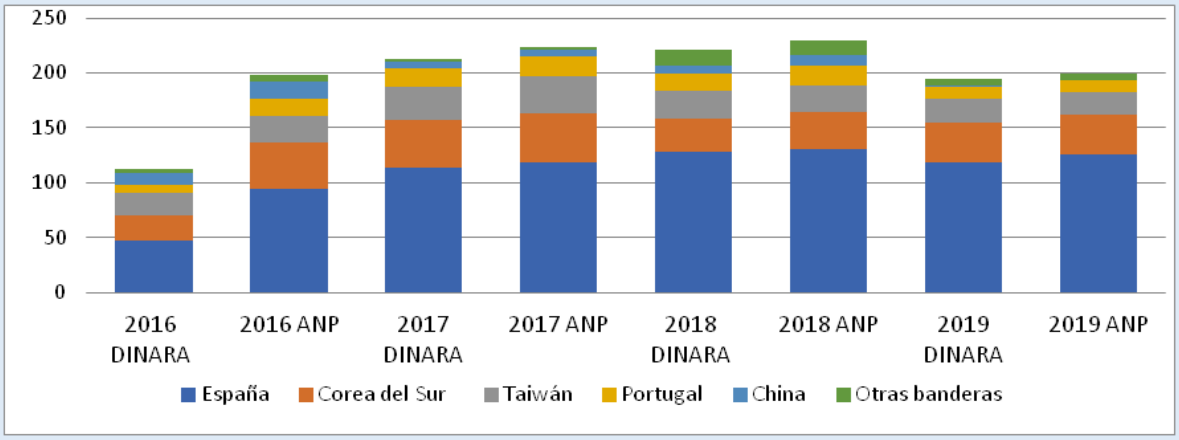


Figure 41: Number of registered arrivals of foreign fishing vessels to unload in Montevideo by nationality, according to data source (ANP and DINARA). (Source: National Geographic Pristine Seas).

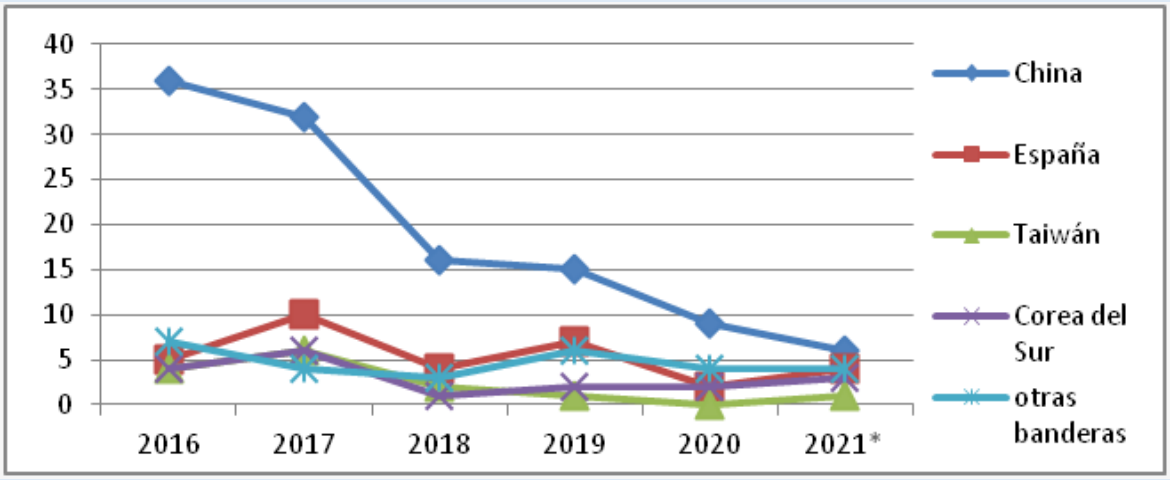


Figure 42: Number of arrivals of foreign fishing vessels in port/anchorage areas not registered by DINARA, 2016-2021. (Source: National Geographic Pristine Seas)

3.4.1.3 Cut-off date

2017 was chosen as the cut-off year for Montevideo port, given this was when DINARA was established as the competent authority (Decree 323.017), PSMA implementation discrepancies were largely resolved (discussed above; Box 3), and PSMA measures were practically and consistently applied to foreign vessels using Montevideo port. The years 2015 and 2016 have been used as the 'before' period and 2018 and 2019 the 'after period'.

3.4.2 Before and after analysis

3.4.2.1 Changes in number of visits

Total number of visits

The number of entry events by fishing and carrier vessels spanning the 'before' and 'after' periods are shown in Figure 43. Three data sources are shown: (i) port entry events detected by AIS, (ii) foreign vessel visits reported by the ANP, and (iii) the author's' best estimates of port entries by foreign vessels subject to PSMA measures. The authors' best estimates are considered the most reliable dataset, given that AIS underestimates port entries when compared to official data (Figure 43), and because ANP port visit data is based on the number of requests for port services. This slightly overestimates port entries for PSMA purposes in cases where vessels remain in port between fishing seasons and request services at the beginning of the following season, or where a vessel changes its name in port then requests port-services. The authors' best estimates were constructed by cross referencing vessel information recorded in ANP manifests of arrival with that registered with the International Maritime Organization Global Integrated Shipping Information System and Equasis Quality Shipping Information System (for ships that no longer exist), then removing instances where vessel movement within port was recorded as multiple entry events.

There are several possible reasons AIS underestimates the number of vessel entries to port:

- Vessels visiting Montevideo may not operate with AIS or don't operate with AIS while entering or exiting the port;
- Vessels may have a poor-quality AIS device and thus are seen infrequently and their visit to Montevideo was missed; or
- Missing visits are by vessels that use AIS, but these vessels aren't classified as 'fishing vessels' or 'carrier vessels' by GFW.

To provide the most accurate picture of PSMA impacts on vessel activity, we have largely based our analysis on official data from ANP and the authors' best estimates. Nevertheless, we have compared these data to AIS estimates where appropriate to show the issues associated with this AIS data for Montevideo and to emphasise the importance of ground truthing AIS estimates with official data from port administrations.

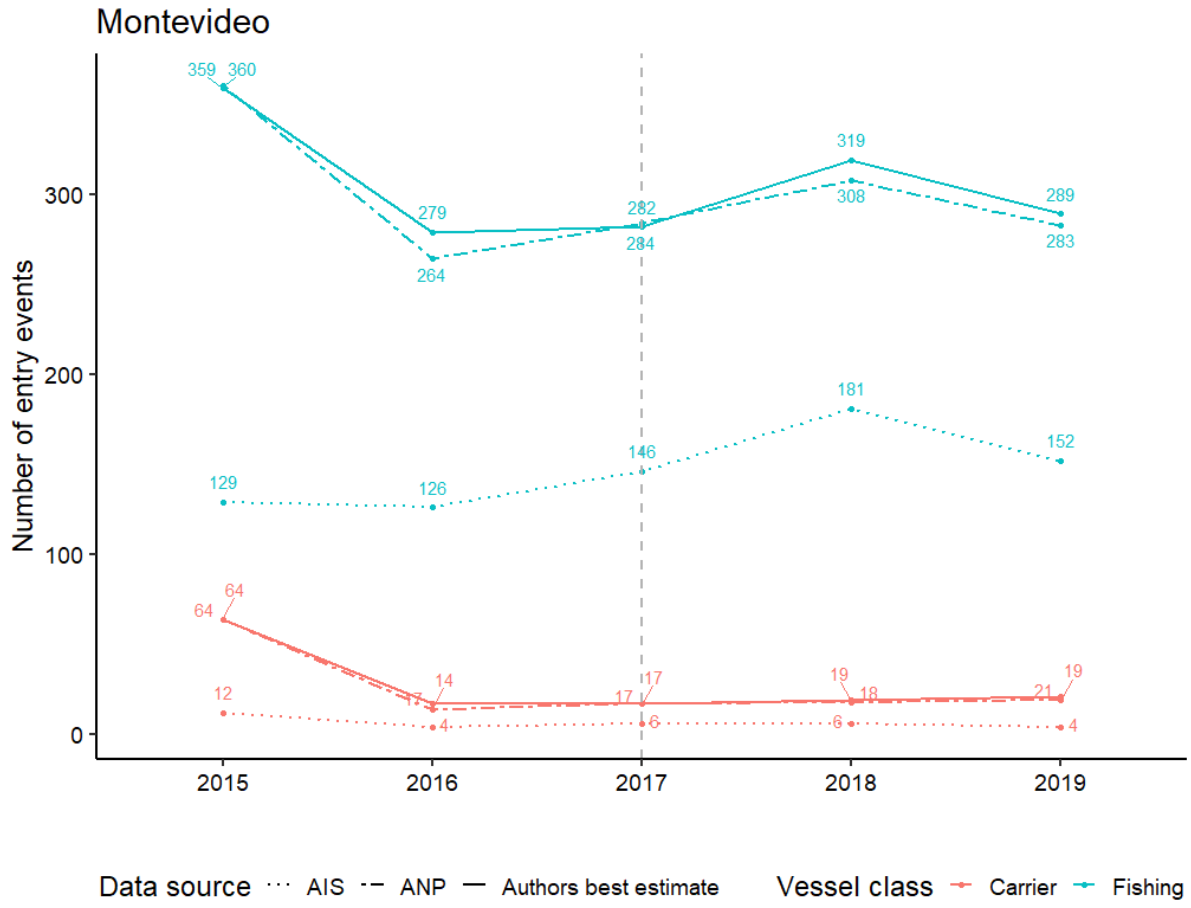


Figure 43: Total number of foreign fishing and carrier vessel port visits to Montevideo detected by AIS (dotted lines), reported by ANP (dashed lines) and according to the author's best estimates (solid lines), 2015-2019. The vertical dashed line at 2017 represents the practical implementation of PSMA measures (i.e., the cut-off between 'before' and 'after' periods). ANP and author's best estimate are considered the most reliable data sources.

Broadly, the number of fishing vessel visits to Montevideo were variable among years and showed no clear response to the practical implementation of PSMA measures from 2017 onwards. Rather, the largest signal in ANP data was the substantial decline in the number of foreign fishing vessel visits to Montevideo between 2015 and 2016. A substantial decline in the number of port entries by carrier vessels was also evident between 2015 and 2016 according to data from the ANP, with no clear response to the practical implementation of PSMA measures evident thereafter (2017-2019; Figure 43).

While the PSMA entered into force globally in 2016, it is not clear that this had any significant impact on foreign fishing vessel usage of Montevideo port. Rather, trends in port usage appear to be better explained by trends in fishing activity, with the gross number of fishing vessel visits to Montevideo correlating broadly with trends in fisheries production from the Southwest Atlantic region over the study period (Figure 44). Additional confirmation would come from linking changes in production by species to vessel type (e.g. declines in squid catch to declines in jigger visits), although limitations in AIS coverage make this difficult.

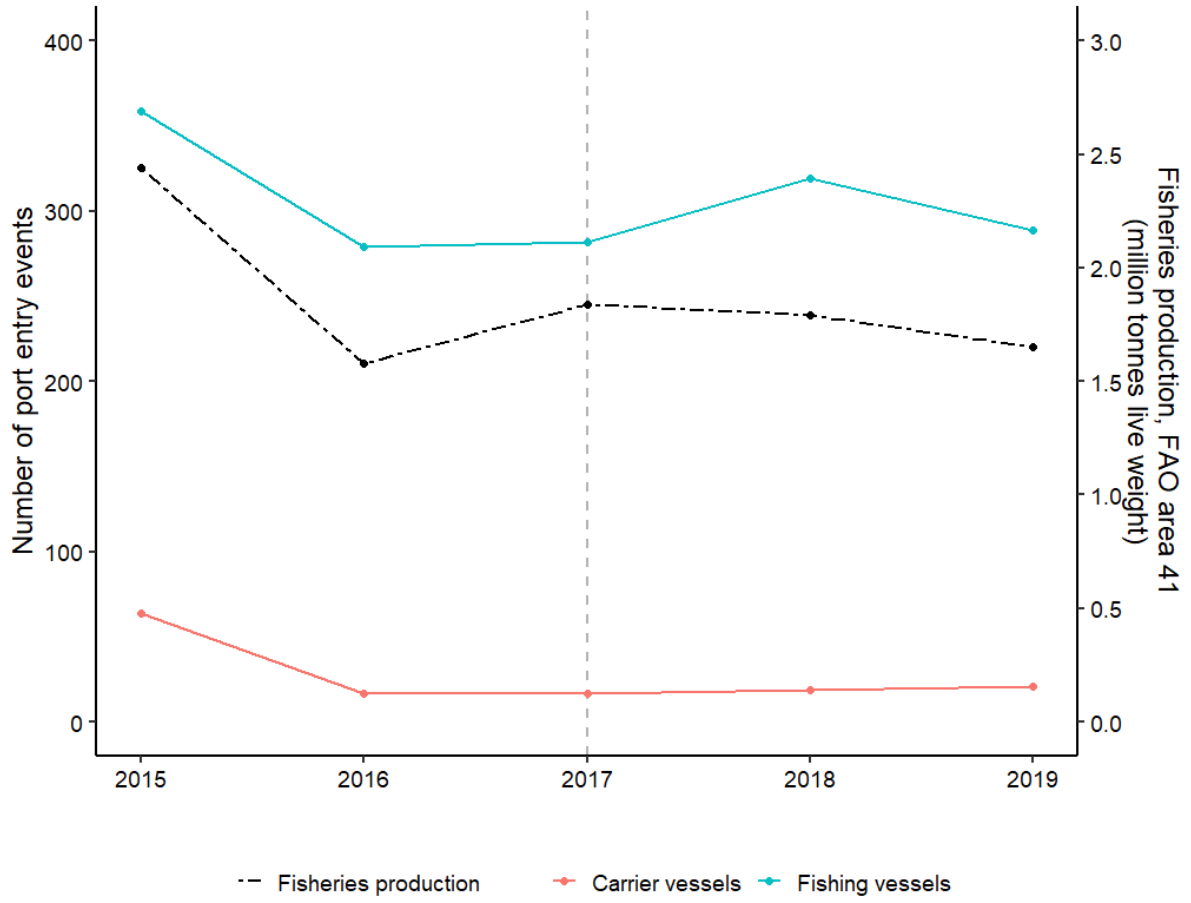


Figure 44: Number of foreign fishing and carrier vessel entry events to Montevideo vs. fisheries production from FAO area 41, 2015-2019. Number of port entry events are the authors' best estimates. Fisheries production data were sourced from FAO (2020, 2022).

The number of carrier vessel visits to Montevideo are also thought to partly result from lower volumes of transhipped catch in FAO area 41 post-2016, particularly squid, with DINARA data indicating that 310,580t of catch was unloaded from carriers in 2015 while only 42,831 – 48,798t of catch was offloaded annually between 2016 and 2018[44]. This represented a proportional decline from ~13% to ~3% of total FAO area 41 catch unloaded by carrier vessels in Montevideo from 2015 to 2016-2019.

Changes by gear type

The available AIS information indicates that the decline in fishing vessel port visits between 2015 and 2016 was primarily due to a decline in the number squid jiggers and trawlers entering Montevideo (Figure 45). The number of AIS-detected port entry events by squid jiggers then continued to decline throughout the analysed period, while entry events by trawl and longline vessels increased following the practical implementation of PSMA measures in 2017 (Figure 45). While visits by gear type are not reported by ANP, these AIS trends

[44] Source: DINARA presentation at the Second Meeting of the Parties to the FAO Agreement on Port State Measures of 2009 (Santiago, Chile, June 3-6, 2019).

broadly correlate with entry events by flag in the ANP dataset (discussed in detail below), understanding that Chinese flagged vessels are primarily squid jiggers and the Spanish fleet comprises primarily trawlers.

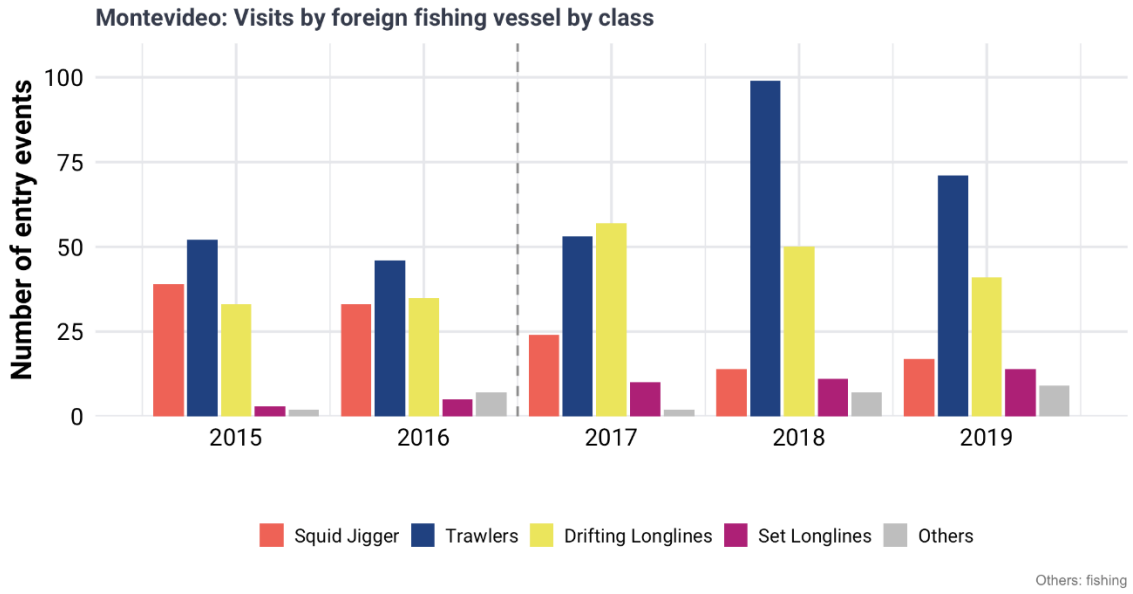


Figure 45: Changes in the number of foreign fishing vessel visits by gear type according to AIS, 2015-2019.

Changes by flag state

Fishing vessels

Data from ANP suggests that the decline in port visits to Montevideo between 2015 and 2016 occurred primarily due to a decline in visits by Chinese and Spanish flagged vessels (Table 4). While the number of port visits by Spanish flagged vessels then increased in 2017 and remained relatively high post-PSMA implementation, the number of visits by Chinese vessels declined further from 2017-2019 according to all three data sources (Table 4; Figure 47). Additional data made available through the National Geographic Pristine Seas project indicated that Chinese squid jigging vessels were mainly responsible for this decline, with the number of Chinese trawl vessel visits remaining relatively stable 2016-2019 (Table 3).

Table 3: Number of arrivals of Chinese flagged trawlers and squid jigging vessels to Montevideo, 2016-2019, and reason for entry. (Source: National Geographic Pristine Seas)

China - Trawlers	2016	2017	2018	2019
Arrivals	23	16	25	24
Landing catch	10	4	6	1
Other reason	13	12	19	23
China - Squid Jiggers	**2016**	**2017**	**2018**	**2019**
Arrivals	45	17	10	7
Landing catch	6	2	7	0
Other reason	39	15	3	7

While it cannot be ruled out that the perception of more stringent controls due to PSMA implementation played some role, the declining number of visits by Chinese flagged squid jiggers was not solely related to the PSMA. Rather, advice from Chinese industry sources indicates that, due to the decline in squid catches in SW Atlantic, from 2016 onwards many Chinese companies opted to transport squid back to China using their own fishing boats or via transhipment, resulting in fewer unloads in Uruguay. This is consistent with AIS information (Figure 46), data from National Geographic Pristine Seas (Table 3), as well as advice provided by sources linked

to the Uruguay administration which indicated that distant water fishing fleets altered their behaviour post-2016 to only enter Montevideo at the end of the fishing season rather than throughout the year as they had done previously. In addition, Chinese industry sources attributed changes in Chinese squid vessel dynamics to an increase in the number of carriers constructed/controlled by Chinese companies (predominantly flagged to Panama and China) and increased demand for squid for local consumption in China 2015-2019[45]. Over this period, we also understand that some Chinese squid companies began discouraging unnecessary foreign port use, preferring that their vessels returned to China to offload catch and undertake major repairs where practical due to concerns around crew members absconding while onshore and therefore inconveniencing the vessel operationally.

Changes in fishing vessel use of Montevideo occurred despite few PSMA inspections being performed in practise. According to data from DINARA, one inspection was carried out on a jigger in 2018 and eight inspections were carried out on jiggers in 2019.

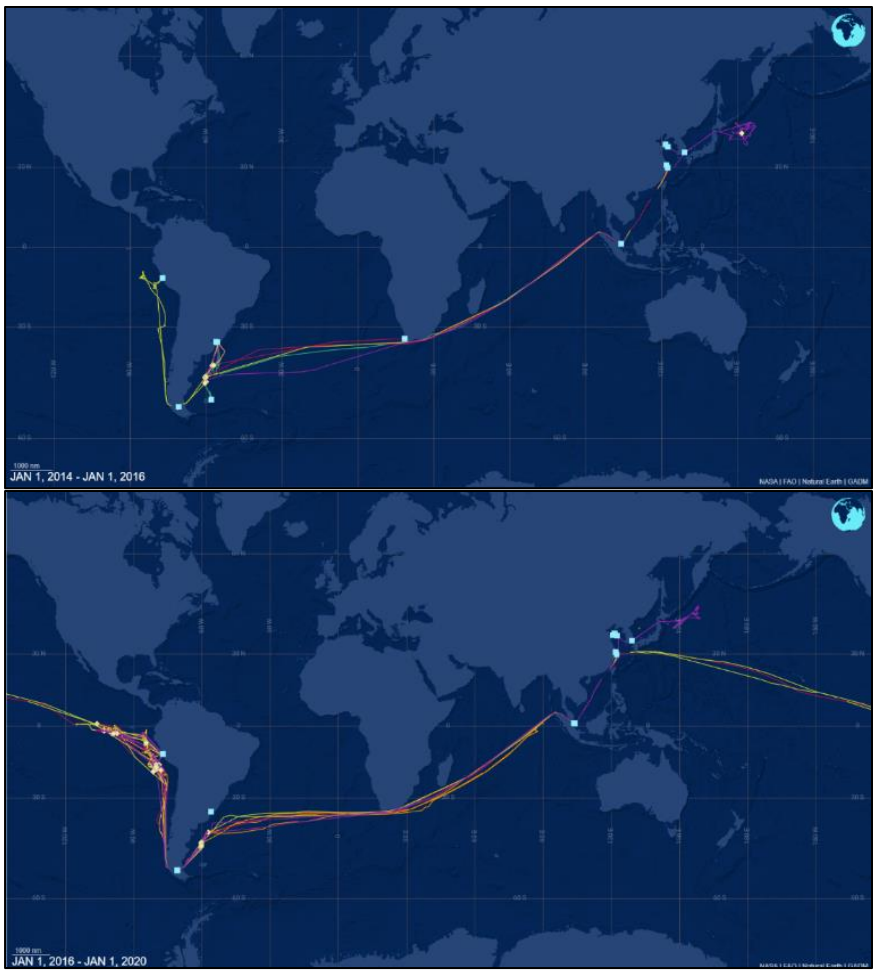


Figure 46: Example of changes in Chinese squid vessel dynamics before (above) and after (below) 2016. Tracks of the same six Chinese flagged squid jigging vessels are shown in both maps. Note the lack of visits to Montevideo and increased circumnavigation from Atlantic to eastern Pacific and China post-2016.

45 While squid consumption data for China are not available, the industry-advised increase in demand for squid 2015-2019 is supported by statistics on squid landings from China's Fishery Statistical Yearbook (BFMARA 2016,2017,2018,2019,2020), plus imports and minus squid exports based on data sourced from the China Customs Statistics Platform (The General Administration of Customs of PRC, 2015-2023). Using this approximation method, estimated annual domestic consumption of squid increased from 575,841t in 2016 to 728,111t in 2019.

Vessels flagged to Spain and the Falkland Islands[46] were primarily responsible for the increase in port visits in the 'after' period (Table 4; Figure 47). These fleets are comprised mainly of trawlers. It is not clear what drove changes in vessel dynamics post-2017. The sovereignty of the Falkland Islands/Malvinas is contested; they are recognised as an overseas territory of the United Kingdom but are also claimed by Argentina. In 2011, MERCOSUR countries (incl. Uruguay) agreed not to allow Falkland Island flagged vessels to enter their ports, in support of Argentina's claim to sovereignty over the territory of the Falkland Islands/Malvinas. As a result, all Falkland Islands vessels operated under the British flag when entering Montevideo (see ANP vs. author's best estimates; Table 4). There is some potential that increased arrivals of Falkland Island flagged vessels post-2017 occurred as a result of relaxed diplomatic relations, following the 2018 shared research dialog between Argentina and the Falkland Islands on straddling stocks (albeit later suspended in 2020). Alternatively, the simultaneous increase in Spanish vessel use of Montevideo may suggest that these fleets simply require ports to land their catch. Unlike Chinese squid jigging vessels which often tranship their catch and are more 'flexible' in terms of port use (recognising that carrier vessels provide FVs some services at time of transhipment and that many ports across the annual Chinese squid vessel footprint offer ancillary services), trawlers must unload in port (usually Montevideo or Berkeley Sound, Falkland Islands).

Table 4: Number of foreign fishing vessel visits to Montevideo port according to AIS, ANP and the authors' best estimates (BE), 2015-2019.

	2015			2016			2017			2018			2019		
Vessel flag	AIS	ANP	BE	AIS	ANP	BE	AIS	ANP	BE	AIS	ANP	BE	AIS	ANP	BE
China	25	118	109	29	66	68	16	46	33	17	36	35	12	27	31
Spain	60	127	127	48	99	99	61	122	122	94	145	145	70	133	134
Korea	24	61	59	22	52	51	27	56	53	23	44	44	31	50	54
Portugal	11	11	11	15	15	15	16	19	19	17	22	18	11	14	12
Falkland Is.	3	0	14	4	0	14	4	0	13	9	0	25	6	0	19
Taiwan	3	10	21	7	12	25	21	25	38	12	16	27	16	24	25
Norway	0	6	6	0	1	1	0	0	0	2	7	4	2	0	1
S. Helena	2	2	2	0	1	1	1	1	1	2	4	4	1	2	2
Belize	0	0	0	0	0	0	0	0	0	3	11	15	2	6	8
Argentina	0	3	3	0	2	2	0	0	0	1	0	0	0	0	0
Chile	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2
Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gr. Britain	1	14	0	0	12	0	0	11	0	1	20	0	0	20	0
Japan	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Kiribati	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Russia	0	3	2	1	2	2	0	0	0	0	0	0	0	0	0
Ukraine	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0
Vanuatu	0	1	1	0	0	0	0	1	0	0	0	0	1	3	1
Senegal	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Tanzania	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
Panama	0	2	2	0	0	0	0	1	1	0	0	0	0	0	0
Palau	0	0	0	0	1	0	0	1	0	0	1	0	0	2	0
Total	**129**	**360**	**359**	**126**	**264**	**279**	**146**	**284**	**282**	**181**	**308**	**319**	**152**	**283**	**289**

[46] The Falkland Island operates as a 'Category 2' ship registry under the umbrella of the UK and has authority to flag fishing vessels (https://www.redensigngroup.org/member-registers/category-2/falkland-islands/). Under UNCLOS and under international law, all ships registered within the Crown Dependencies and UK Overseas Territories, including the Falkland Islands, are British Ships, although some obligations including the power to deal with all IMO flag-state matters may be devolved to individual registries. We note that many of the Falkland Islands flagged trawlers are actually Spanish owned and crewed.

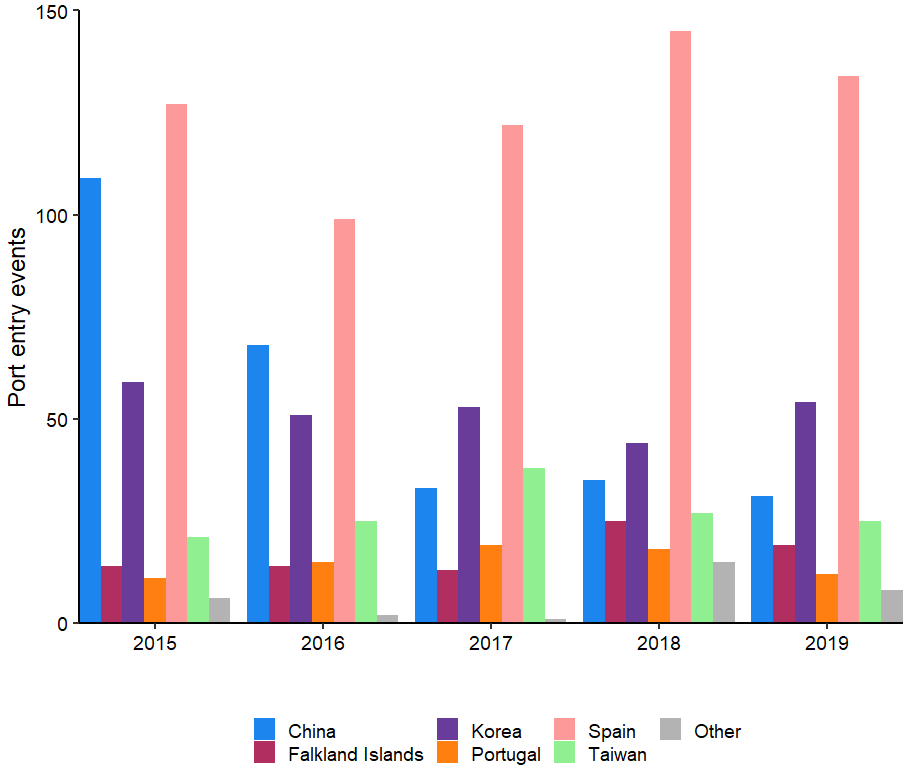


Figure 47: Authors' best estimates of foreign fishing vessel visits to Montevideo port for the major flag states driving overall trends, before (2015-2016) and after (2017-2019) PSMA implementation.

Carrier vessels

The substantial decline in number of visits to Montevideo by carriers between 2015 and 2016 is primarily a result of a decline in visits by Panamanian, Taiwanese, Chinese and Liberian flagged vessels (Table 5).

While there was little overall change in the total number of port visits by carriers between 'before' and 'after' periods (discussed above; Figure 43), carrier dynamics post-PSMA implementation in 2017 changed considerably. Visits to Montevideo by carriers flagged to Panama declined between 'before' and 'after' periods, while the number of visits by carriers flagged to Vanuatu increased post-2017, according to AIS and official data from the ANP (Figure 48; Table 5). Both AIS and official ANP data also indicate that there were several carriers flagged to Kiribati, Moldova, and Taiwan that used Montevideo prior to 2017, but not after.

Chinese industry sources indicated that many of the Panamanian flagged carriers that use Montevideo are Chinese built and owned. As discussed above, a combination of lower squid catches in SW Atlantic, increased transport of catches back to Chinese ports by Chinese FVs, increased demand for squid for domestic consumption in China, increased number of carriers constructed/controlled by Chinese companies, and directives from Chinese squid companies to preferably land in China all likely contributed to the decline in Montevideo visits by Panamanian and Chinese flagged carriers. While we cannot rule out that PSMA implementation (or the perception of stronger controls) also played some role, it is notable that changes in carrier dynamics occurred largely in the absence of PSMA inspections; DINARA inspected no carriers in 2018 and only one carrier vessel in 2019.

The increase in Vanuatu flagged carriers post-2017 was driven by a single vessel, the reefer *La Manche*, belonging to Norwegian company Aker Biomarine. This vessel transhipps in CCAMLR waters with Norwegian vessels and unloads krill meal in Montevideo, according to ANP data.

It is unclear what drove the carriers flagged to Taiwan to stop using Montevideo post-2015. The three carriers flagged to Kiribati which used Montevideo prior to 2017 were subsequently reflagged to Liberia and Panama,

and the Moldovan flagged vessel which used Montevideo in 2015 and 2016 did so only to disembark deceased crew members.

Table 5: Number of foreign carrier vessel visits to Montevideo port according to AIS, ANP and the authors' best estimates, 2015-2019.

	2015			2016			2017			2018			2019		
Vessel flag	AIS	ANP	BE	AIS	ANP	BE	AIS	ANP	BE	AIS	ANP	BE	AIS	ANP	BE
Panama	4	26	28	0	3	6	3	10	9	2	5	6	0	4	6[47]
China	1	3	0	0	0	1	0	0	0	0	0	1	0	0	0
Vanuatu	0	7	7	2	6	6	1	6	8	4	11	10	4	9	11
Bahamas	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Taiwan	2	9	12	0	0	0	0	0	0	0	0	0	0	0	0
Kiribati	1	7	7	1	3	3	0	0	0	0	0	0	0	1	0
Liberia	2	3	3	0	1	0	2	1	1	0	0	0	0	2	1[48]
Moldova	2	4	4	1	1	1	0	0	0	0	0	0	0	0	0
Russia	0	1	0	0	0	0	0	0	0	0	1	1	0	1	2
Belize	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0
Total	**12**	**64**	**64**	**4**	**14**	**17**	**6**	**17**	**17**	**6**	**18**	**19**	**4**	**19**	**21**

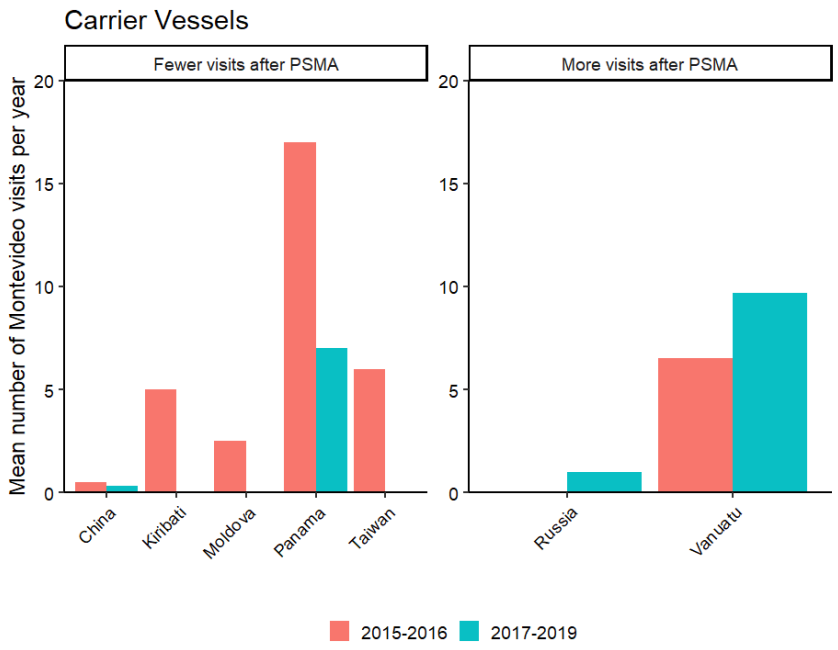


Figure 48: Authors' best estimates of mean number of foreign carrier vessel visits per year to Montevideo port for the major flag States driving overall trends, before (red) and after (blue) PSMA implementation.

3.4.2.2 Changes in port usage

Time in port

47 One vessel simultaneously flagged to Germany according to IMO GISIS. Flag of entry is unclear.

48 Vessel simultaneously flagged to Panama according to IMO GISIS. Flag of entry is unclear.

AIS records indicate that the median time squid jiggers spent in Montevideo port was longer after PSMA implementation than before (Figure 49). Nevertheless, it difficult to robustly assess PSMA-related impacts because port-visit duration trends are confounded by vessels that remain in-port between seasons (Figure 49) and it remains unclear whether AIS data are representative of actual trends, given the underestimation of port entries evident when compared to data from official sources (i.e., ANP). No significant changes were evident in median foreign visit duration of other gear types according to AIS.

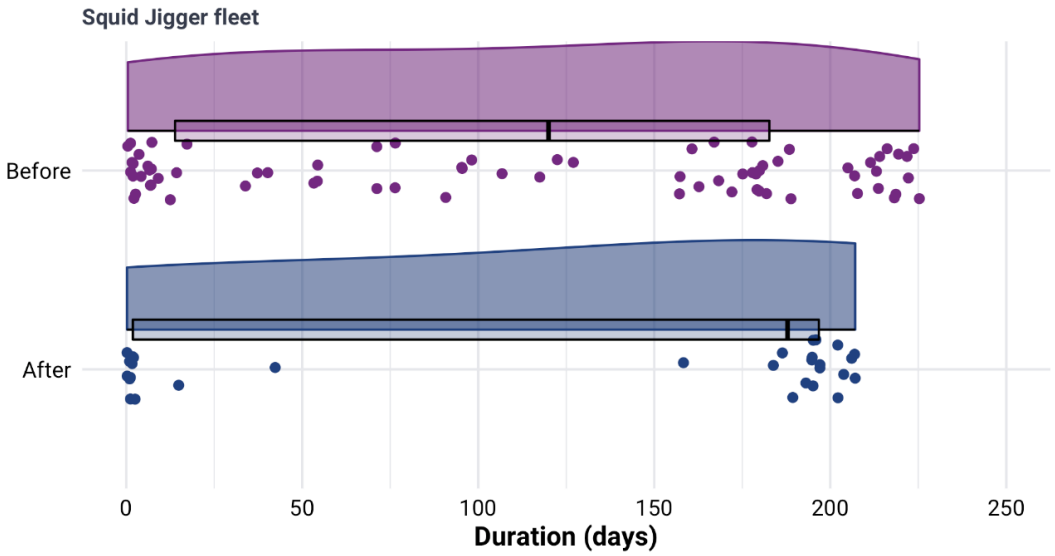


Figure 49: Median foreign visit duration of squid jigging vessels, before (purple) and after (blue) PSMA implementation in 2017. Individual data points represent individual port visits; horizontal lines in boxplots indicate the median visit duration and the probability distribution is shown by shaded bands.

Time spent at anchorage prior to entering Montevideo was highly variable between before and after periods, with no clear trend evident for any gear type (Figure 50).

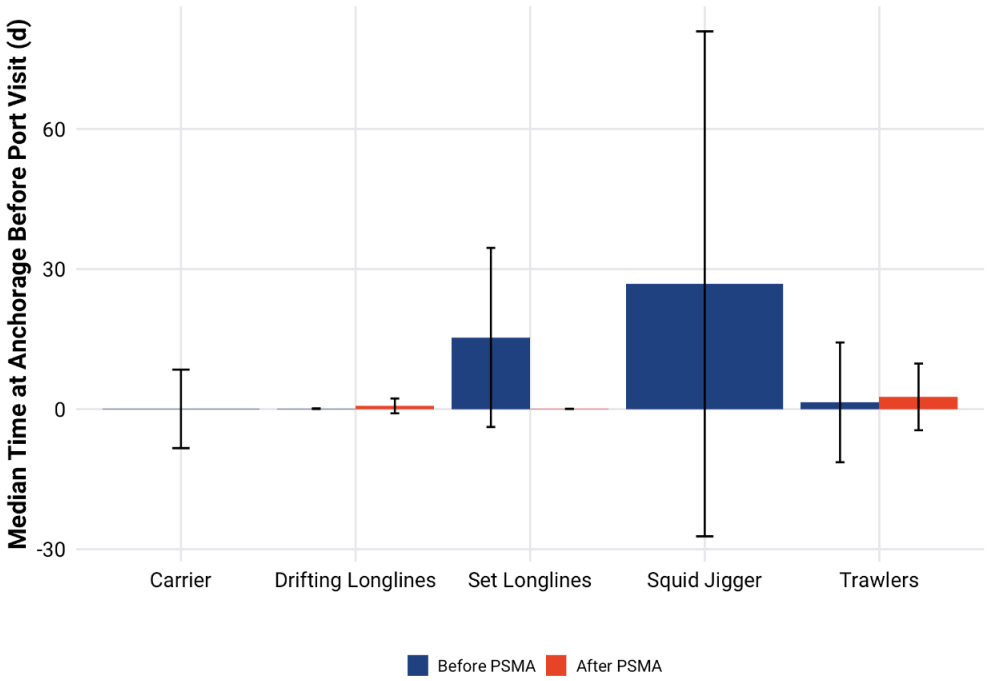


Figure 50: Median time spent at anchorage prior to visiting Montevideo port, before (blue) and after (red) PSMA implementation in 2017.

3.4.3 Summary of changes

While changes in vessel dynamics were evident during the study period, these appear to be better explained by factors other than PSMA implementation. Overall, changes in fishing and carrier vessel usage of Montevideo port were broadly correlated with changes in fisheries production in the southwest Atlantic. While visits by Chinese flagged squid jiggers declined across the study period, industry sources indicated this was largely driven by a combination of lower squid catches in the SW Atlantic, increased demand for domestic squid consumption in China combined with an increase in the Chinese-controlled carrier fleet leading to greater capacity to transport products directly to China from fishing grounds, and directives from Chinese squid companies to preferably land in China, rather than PSMA impacts. It may have also been influenced by the emergence of Chimbote (Peru) as an important alternative port for hull maintenance for Chinese squid vessels working the 'squid route' from 2017 onwards. These factors also likely influenced the decline in port visits by Panamanian and Chinese flagged carrier vessels from 2017 onwards. While visits by Falkland Islands and Spanish flagged fishing vessels increased slightly in the 'after' period, the reasons are not known. These changes occurred despite Uruguay undertaking few inspections and not denying entry to any vessel during the study period. Across fishing gears, there was no discernible effect of PSMA implementation on port visit duration or time spent at anchorage before entering Montevideo port.

3.5 Walvis Bay, Namibia

3.5.1 Background

3.5.1.1 Overview of port

Walvis Bay is a deep-water harbour located approximately halfway down the Namibian coast, on the west coast of Africa. It is geographically positioned near key international shipping routes and acts as an important hub for Atlantic fleets, being one of two primary ports utilised by fishing vessels in Namibia (the other being Luderitz). Walvis Bay receives around 3,000 vessels annually and handles approximately 5 million tonnes of cargo (Smit, 2023). In addition to handling imports, exports and transhipments of various commodities, the port offers a range of facilities and services, including ship repair services, lifting facilities of up to 2,000 tonnes and three floating docks with a combined lifting capacity of 29,500 tonnes.

The port is operated by the Namibian Port Authority (Namport) and is well situated to serve Southern Africa's landlocked countries. Currently, the road and rail facilities are being upgraded to make Walvis Bay the 'gateway port' for the Southern African Development Community (SADC) region.

Walvis Bay port comprises three main sections (the South Port, the Fishing Harbour and the North Port). There are 11 commercial berths, a tanker jetty and a dedicated passenger berth for cruise and passenger ships (Figure 51).

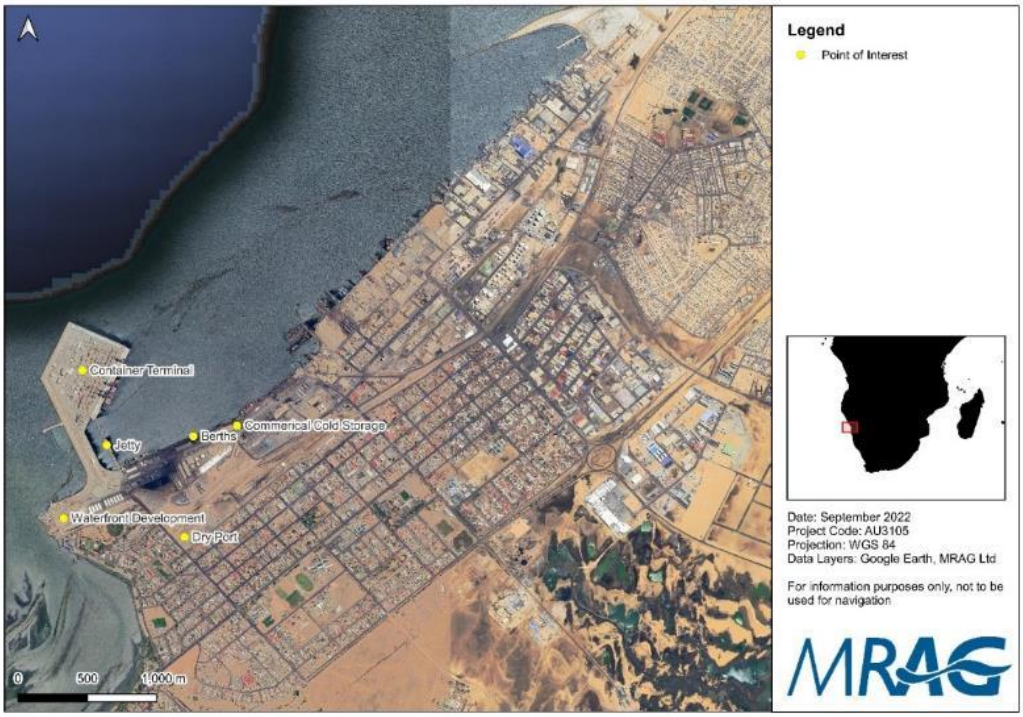


Figure 51: Map of Walvis Bay port showing key points of interest (yellow dots).

3.5.1.2 Timeline of PSM implementation

Port -State measures have been incrementally implemented over a long period in Namibia, mainly through the application of RFMO measures (e.g., International Convention for the Conservation of Atlantic Tunas [ICCAT], the South East Atlantic Fisheries Organisation [SEAFO]) and other regional agreements (e.g., the Abuja MoU, SADC).

On 22 October 1999, the MoU for Port State Control for the West and Central African region (the Abuja MoU) was signed covering 22 African counties in the south east Atlantic region, from Mauritania to South Africa (including Namibia). Its remit was to establish a system of harmonised port State control inspection procedures. While it was primarily developed to improve safety, the MoU also allowed for increased cooperation, better training and increased automation of data collection and sharing. The PSM requirements for vessels are set out in the Marine Resources Act (Act no. 27 of 2000).

In 2012, ICCAT introduced Recommendation 12-07 outlining the minimum standards recommended for port inspections (subsequently replaced by Recommendation 18-09) and developed a port inspection expert group to assist with implementation. For Namibia, the expert group noted that in 2018:

- 100% of foreign-flagged fishing/support vessels carrying ICCAT managed species entering its ports had been inspected;
- 73 inspectors had been assigned to the two (2) ICCAT designated ports;
- all inspection reports of vessels carrying tuna had been submitted to ICCAT; and
- inspectors had been trained in 14/14 training modules identified in a self-assessment[49].

[49] https://www.iccat.int/Documents/BienRep/REP_EN_18-19_I-1.pdf (pages 367-375)

SEAFO conservation measures for port inspection have been progressively adopted over time[50]. An initial Conservation Measure 02/05 On Interim Port State Measures was adopted in 2005, with members obliged to maintain an effective system of port State control and share information with other parties, amongst other things. This was subsequently revised in 2007 (Conservation Measure 09/07 to Amend and Consolidate Conservation Measure 02/05 Relating to Interim Port State Measures) to include new obligations around designation of ports, prior notice of port entry and a prohibition of landings from fishing activities that contravene any element of the SEAFO conservation and management measures. In 2011, SEAFO adopted Conservation Measure 21/11 on port State control which mirrored many of the requirements of the PSMA (designation of ports, advance request for port entry, requirements around approval or denial of port entry, inspections, etc). At its 10th Annual Meeting in 2013, SEAFO repealed Conservation Measure 21/11 on port State control and incorporated its requirements in an agreed System of Observation, Inspection, Compliance and Enforcement which entered into force in December 2017[51].

In addition to the bodies above, Namibia is also a contracting party to Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and a party to the SADC, both of which have independently developed several measures to encourage cooperation on MCS and PSMs.

Namibia became a Party to the PSMA through accession on 17 August 2017. Nevertheless, the PSMA was yet to be domestically legislated at the time of writing and the main PSMs in place were those associated with RFMO agreements (discussed above). While the ports of Luderitz and Walvis Bay were designated under the ICCAT and SEAFO agreements discussed above, including the provision of direct PSM inspector contacts, no Namibian ports have been publicly designated under the PSMA[52]. Namibia has not submitted any public reports on PSMA implementation or performance to the FAO.

3.5.1.3 Cut-off date

The identification of a clear cut-off date for Walvis Bay is complicated by the incremental implementation of PSMs over time. Nevertheless, 2017 was chosen as the cut-off year because this was when Namibia became a Party to the PSMA. The years 2014-2016 have been used as the 'before' period and 2018-2021 the 'after period'.

3.5.2 Before and after analysis

3.5.2.1 Changes in number of visits

Figure 52 shows the total number of port visits by vessel type for years spanning the 'before' and 'after' periods, as detected by AIS. Port entries by fishing vessels were variable through time with no clear impact on total number of port entries from PSMA implementation in 2017. Official records of FFV visits to Walvis Bay are not publicly available, so the extent to which the AIS data reflects actual patterns of activity is not clear.

Port visits by carrier vessels generally rose through the 2014 to 2018 period, but from 2019 there was a noticeable decline (Figure 52). This may be related to changes in transhipment activity in ICCAT area. Both the ICCAT Regional Observer Program (ROP) and GFW analysis documented a ~21% decline in transhipment activity in 2019 compared to 2018 (GFW, 2021a) and we understand that the number of ICCAT ROP transhipments declined further 2019-2021 (J. Clark, pers comm.). The reason for the decline is not known but similar levels of reduced transshipment activity in the Indian Ocean Tuna Commission (IOTC) and Inter-American Tropical Tuna Commission (IATTC) areas between 2018 and 2019 also occurred (GFW, 2021a), while

[50] http://www.seafo.org/Documents/Conservation-Measures

[51] http://www.seafo.org/Documents/SEAFO-System

[52] e.g. https://www.fao.org/fishery/port-state-measures/psmaapp/?locale=en&action=qry

reported transhipment activity also declined in the WCPFC area from 2019 to 2021[53]. Impacts in 2020 and 2021 may be at least partly due to COVID-related dynamics, although it is also possible the trends reflect stronger inspection and information requirements that were imposed on carrier vessels, following concerns about IUU fishing and transhipment events in Angolan waters over this period.

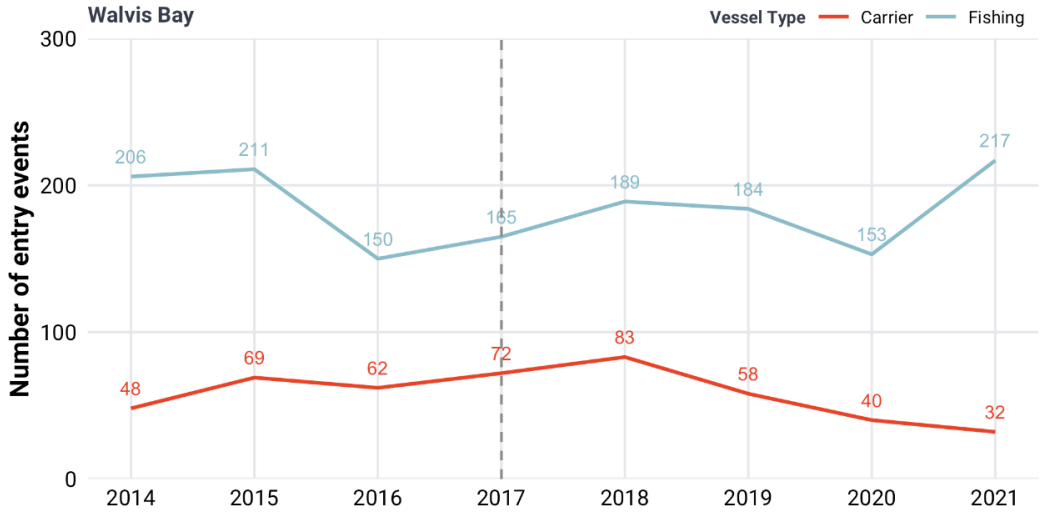


Figure 52: Total number of fishing vessel and carrier port visits to Walvis Bay detected by AIS, 2014-2021.

While the total number of fishing vessel visits to Walvis Bay showed no clear trend, substantial changes in fishing vessel dynamics by gear type were evident during the analysed period. The number of port visits by trawlers declined while the number of longline (drifting and set) vessel visits to Walvis Bay increased post-2017 (Figure 53).

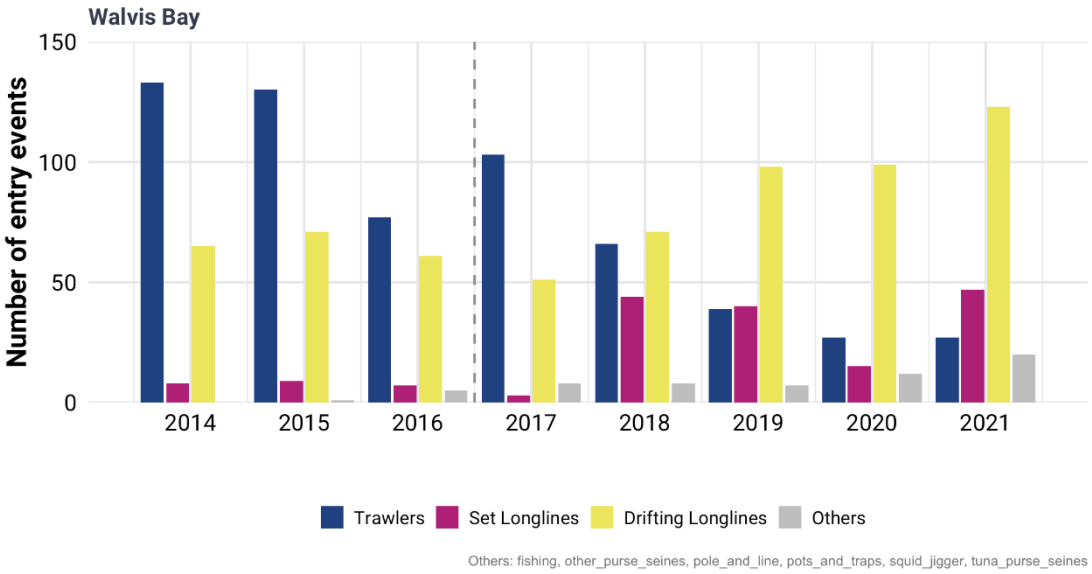


Figure 53: Changes in the number of foreign fishing vessel visits by gear type, 2014-2021.

[53] https://meetings.wcpfc.int/index.php/node/17379

The dynamics behind these changes may be complex, but are likely influenced by a new rights allocation process initiated in Namibia in 2018 (see Government Notice No 92 and 93 issued on 24 May 2018[54]). This notice effectively invited all Namibians, regardless of experience in fishing, to apply for a fishing right. Many new rights holders chartered foreign vessels to operate which may help explain the increase in foreign longline vessel visits to Walvis Bay from 2018 to 2021. Furthermore, it is possible that existing rights holders assisted new rights holders without vessels to catch quota on their behalf during this period. We understand that approximately 80% of all pelagic longline vessels are currently chartered to Namibian rights holders and the majority fish for ICCAT managed species. All foreign chartered vessels underwent strict background checks (including ownership, share structures, IUU records) before being issued a fishing license. Foreign vessels chartered by Namibian rights holders are also required to have VMS installed, carry fisheries observers, and are subject to the same PSMA measures as foreign vessels operated by non-Namibians.

A combination of factors likely accounts for the decline in the number of trawler visits to Walvis Bay across 2014-2021 (Figure 53). Firstly, the Namibian Ministry of Fisheries and Marine Resources (MFMR) advised that there were a number of Spanish flagged trawlers fishing for hake in the Namibian EEZ and several mid-water trawlers flagged to Baltic States which targeted horse mackerel in the Namibian EEZ, however numbers of both vessels declined through time. We understand that no foreign chartered vessels targeting hake or horse mackerel are operating in the Namibian EEZ at present. Secondly, we understand that over recent years around eight pelagic trawlers chartered to Angola have been refused entry to the Namibian EEZ, as well as Walvis Bay and Luderitz ports, due to suspected IUU fishing (MFMR pers. comm). Prior to their refusal, these vessels generally visited Walvis Bay once or twice a year for annual dry docking/ maintenance/ repairs and are now thought to be using South African ports (MFMR pers. comm). Financial losses to the local economy which occur due to the refusal of foreign vessels suspected of IUU range between 5 million and 15 million NAD (or ≈268,000 – 803,000 USD[55]) per vessel, depending on vessel size (MFMR pers. comm). Accordingly, decisions to deny entry are carefully considered and denial is regarded as an action of last resort (MFMR pers. comm).

In the context of the current project, the changes in visits by both longline and trawl fleets appear broadly unrelated to the implementation of the PSMA in 2017. Nevertheless, in the case of the Angolan chartered trawlers, the capacity to deny entry to ports based on suspected IUU may have influenced the number of visits in recent years. Importantly, in this case, it is the port State denying vessel entry rather than the fishing vessel operator choosing to avoid a port with strong PSMA controls.

For trawl vessels which visited Walvis Bay prior to 2017, but not after, an analysis of fishing effort patterns indicates the vessels have moved to other regions. In 2018, much of the effort was directed in the south west Atlantic near the Falkland Islands, while in 2019 effort shifted to waters off Guinea Bissau in West Africa. In 2020, effort was largely concentrated off Angola and Guinea Bissau, with some effort also off Mauritania. In 2021, effort was divided between Angola and the south west Atlantic, while in 2022 effort was fully concentrated in the south west Atlantic.

Nevertheless, it also appears to be the case that overall levels of effort amongst these vessels declined with several vessels no longer active in AIS data in later years (which could be explained by a number of things, including that they've been decommissioned). This is also consistent with port visit activity, with numbers of visits declining substantially after 2015 (Figure 54).

[54] https://mfmr.gov.na/downloads/-/document_library/DWqND60MzhTr/view_file/418000?_com_liferay_document_library_web_portlet_DLPortlet_INSTANCE_DWqND60MzhTr_redirect=https%3A%2F%2Fmfmr.gov.na%2Fdownloads%2F-%2Fdocument_library%2FDWqND60MzhTr%2Fview%2F417987%3F_com_liferay_document_library_web_portlet_DLPortlet_INSTANCE_DWqND60MzhTr_redirect%3Dhttps%253A%252F%252Fmfmr.gov.na%252Fdownloads%253Fp_p_id%253Dcom_liferay_document_library_web_portlet_DLPortlet_INSTANCE_DWqND60MzhTr%2526p_p_lifecycle%253D0%2526p_p_state%253Dnormal%2526p_p_mode%253Dview

[55] Rounded to the nearest 1000 USD, assuming a 0.05356 exchange rate.

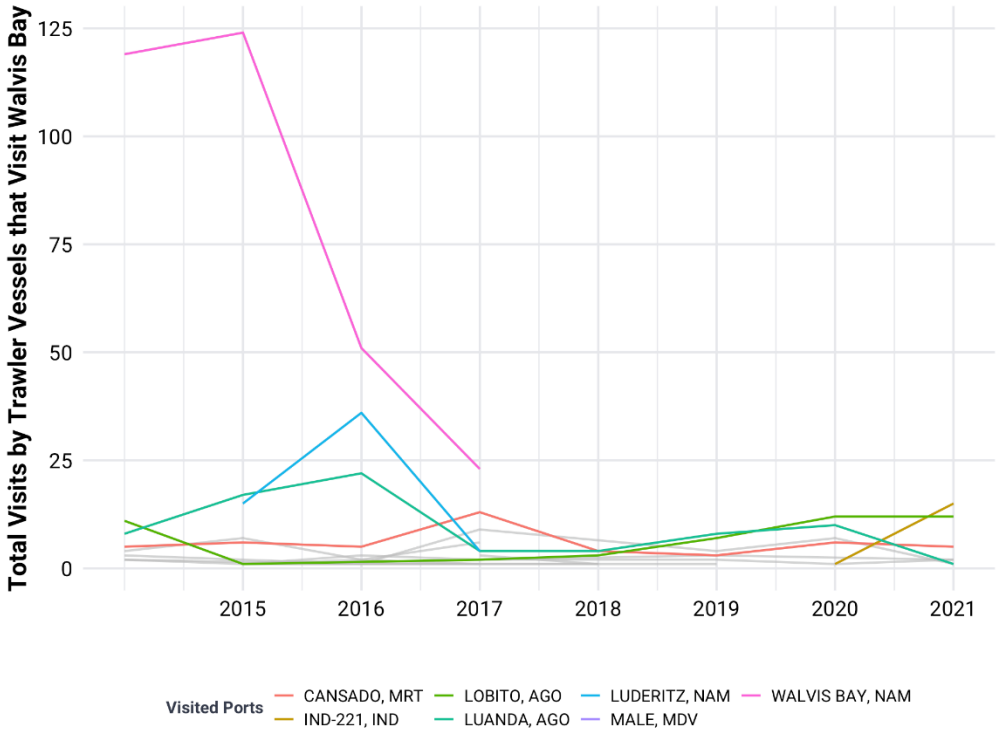


Figure 54: Change in port visit activity by trawl vessels visiting Walvis Bay (as detected by AIS) before the introduction of the PSMA in 2017 and after.

Changes by flag state

Fishing vessels

Figure 55 shows changes in the number of fishing vessel port visits by flag State during the study period. The largest increases post-2017 by number were the Panamanian, Spanish and Vanuatu flagged vessels, while visits by vessels flagged to Saint Vincent and the Grenadines declined most substantially. Rather than the PSMA, local experts suggested that Spanish flagged vessels continue to use Walvis Bay because many of the companies have a base in Namibia, the port is favourably positioned in relation to the Atlantic, it offers fast and efficient service delivery, and there is a general absence of corruption. Reasons for the uptick in entry events by Panamanian flagged vessels in 2018, 2019 and 2021 are unclear (Figure 55). It is notable that the relatively strong trends evident in vessel use of Walvis Bay according to fishing gear are not evident in flag state dynamics. This is likely driven by trends in individual fishery dynamics (e.g. decline in trawl activity) as well as the impacts of the 'Namibianisation Policy' (i.e. chartering of foreign vessels by new Namibian rights holders).

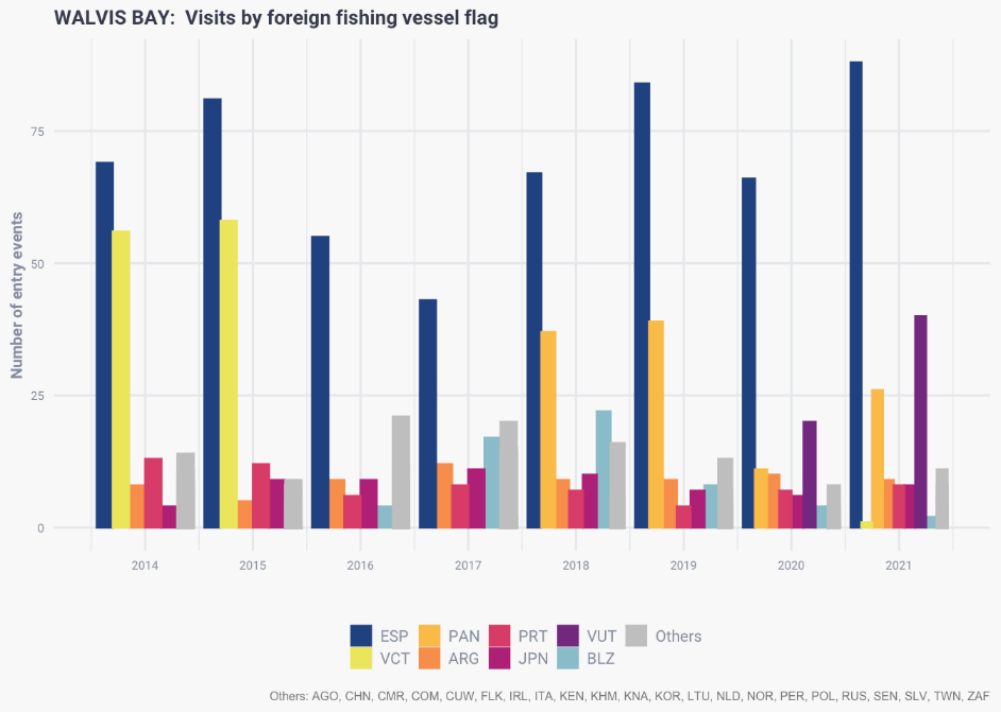


Figure 55: Number of foreign fishing vessel port visits to Walvis Bay by flag, 2014-2021.

Carrier vessels

Figure 56 shows changes in the number of carrier vessel port visits by flag State during the study period according to AIS. The noticeable decline in carrier visits after 2018 (discussed above) was primarily due to fewer visits by carriers flagged to Liberia and Panama, and to a lesser extent Saint Kitts and Nevis, Cook Islands (included in 'others') and Comoros. Conversely, visits by Bahamas flagged vessels increased from 2016-2019 to levels similar to 2014/15. While the decline in the overall number of carrier visits 2018-2021 are likely related to low ICCAT transhipment activity (discussed above), the drivers of particular flag State dynamics are unclear. Re-flagging is relatively common amongst carrier vessels, with the choice of flag State driven by a range of factors including differences in tax regimes, compliance costs, transparency and the flag State having the capacity to authorise the vessel to supply products to the EU market (MRAG Asia Pacific, 2020). In the context of the current study, it is unlikely changes in visits by flag State were influenced by Namibia's implementation of the PSMA.

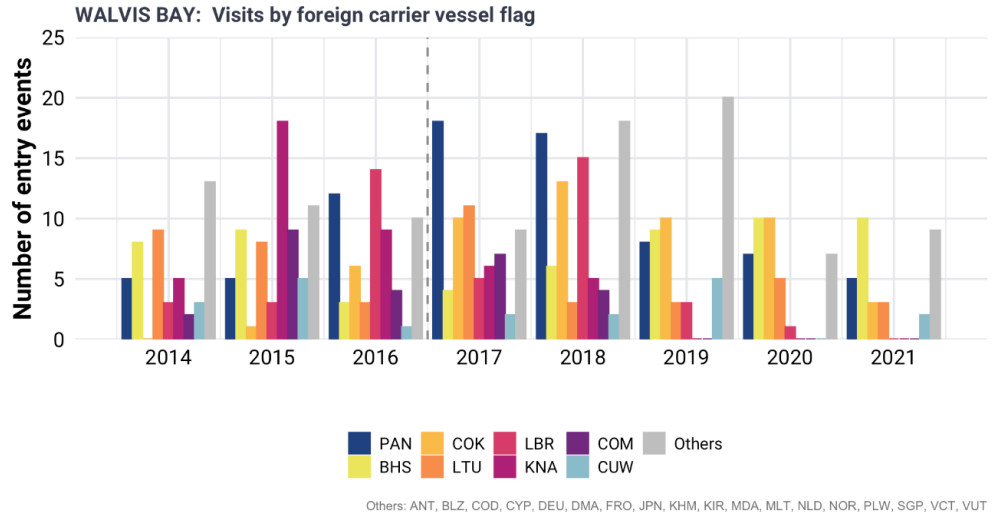


Figure 56: Number of foreign carrier vessel port visits to Walvis Bay by flag, 2014-2021.

3.5.2.2 Changes in port usage

Time in port

Trends in the duration of port visits pre- and post-PSMA implementation varied amongst fishing vessels types, although this appeared to be largely independent of PSMs (Figure 57). The drifting longline fleet experienced very little change, with median visits duration remaining around 5 days in both periods. Median visit duration declined slightly for the set longline fleet (2.5 to 2.1 days), although there were relatively few visits prior to 2017. Amongst the trawl fleet, median visit duration rose (3.3 to 4.5 days), influenced by the smaller number of visits post-2017 and the smaller number of relatively fast turnarounds (<7 days). Visit duration by carriers also rose (5.8 to 8.3 days), again influenced by a higher proportion of longer visits. Advice from MFMR indicated that the nature of the hake, horse mackerel and tuna longline fleets stayed relatively constant through the study period and PSM processes were unlikely to have influenced port visits duration to any significant degree with inspections done on arrival within a few hours. They also noted it is possible that COVID-related issues may have impacted port visit duration later in the time series.

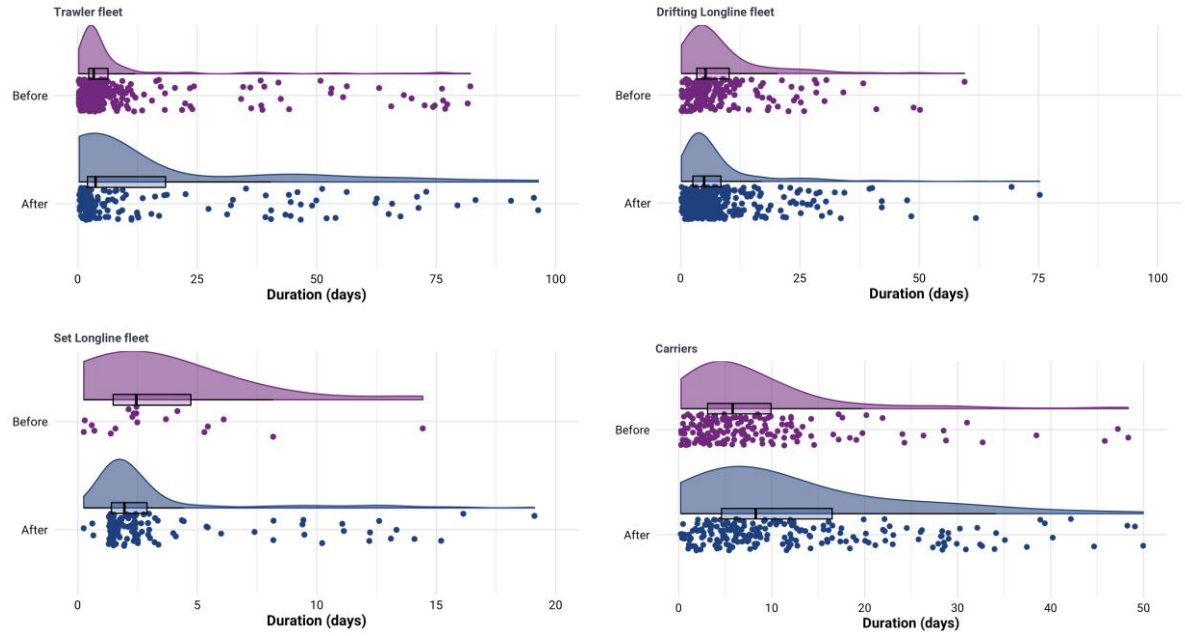


Figure 57: Port visit duration in Walvis Bay by vessel type during the before (purple) and after (blue) periods. Individual data points represent individual port visits; horizontal lines in boxplots indicate the median visit duration and the probability distribution is shown by shaded bands.

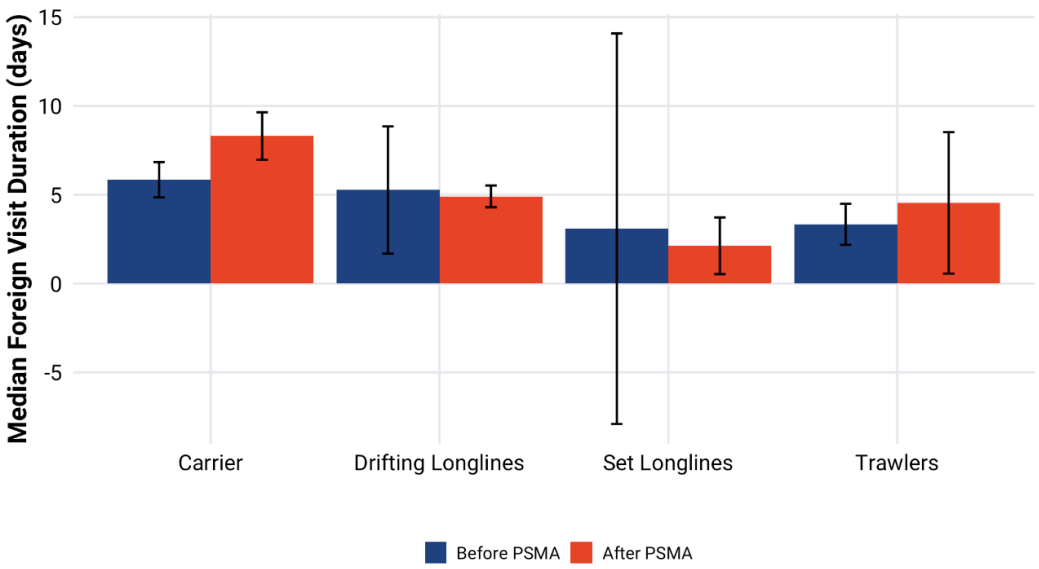


Figure 58: Median duration of port visits by vessel type between the before (blue) and after (red) periods, according to AIS data. Whisker bars represent one standard error.

Time spent at anchorage

AIS records indicate no significant changes in median time at anchorage 'before' and 'after' PSMA implementation (i.e., confidence intervals overlap on all occasions), albeit median time at anchorage increased for carriers and declined for trawlers (Figure 59). Greater variability in the time set longliners spent at anchorage prior to a port visit also occurred, while drifting longline vessels showed the opposite trend, whereby variability in anchorage time declined post-2017.

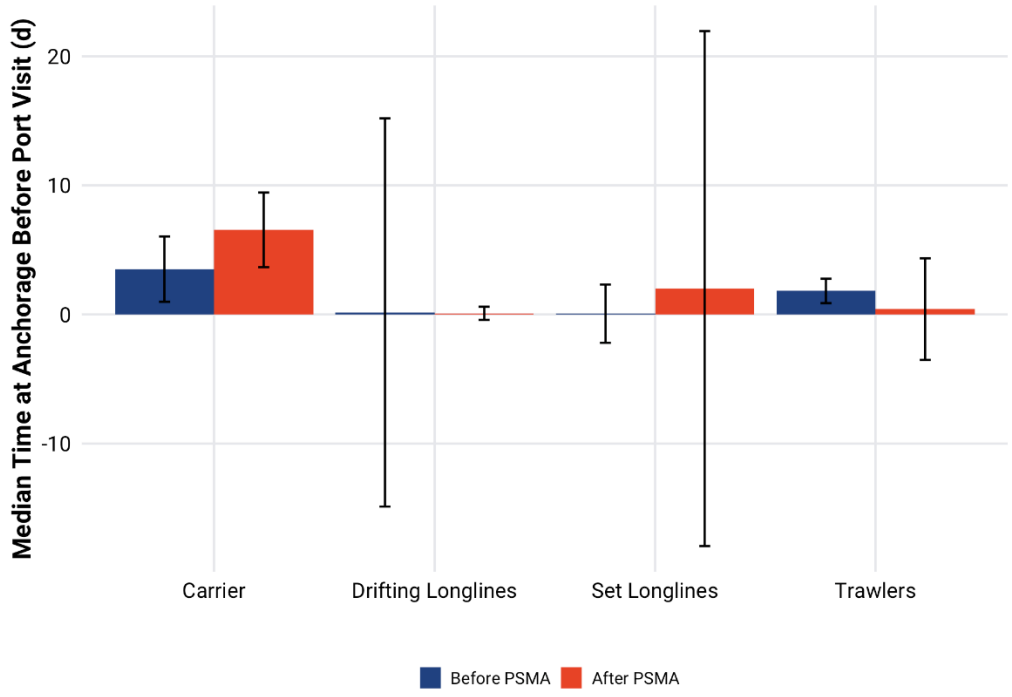


Figure 59: Comparison of time spent at anchorage before (blue) and after (red) PSMA implementation by vessel type.

3.5.2.3 Changes in transhipment activity

The trawl fleet was the main gear type which declined in port visits over time, with the number of visits in 2021 only roughly a quarter of those in 2014/15. To examine whether the introduction of PSMs changed transhipment behaviour for these vessels, we looked at the number of encounters per year and the average number of encounters per vessel per year for the fleet which visited Walvis Bay prior to PSMA implementation but not after.

The total number of encounters per year declined substantially for this fleet in the period after PSMA implementation (Figure 60). Given the number of port visits also declined substantially (Figure 54), these results are likely driven by an overall effort reduction in the fleet (i.e. fewer vessels were active). In addition, the number of encounters per vessel per year also declined in the 'after' period. However, given these trawl vessels generally shifted effort to other areas/fisheries (e.g. SW Atlantic, Guinea Bissau), it is difficult to compare the before and after periods with transhipment activity in the after period likely driven by the dynamics of the 'new' fishery/ies.

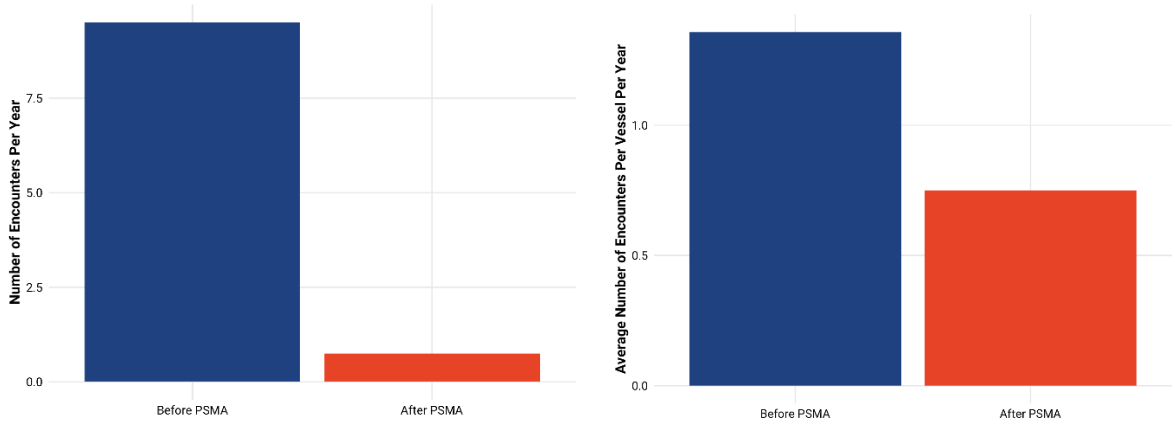


Figure 60: Number of encounters per year (left panel) and average number of encounters per year per vessel (right panel) for trawl vessels visiting Walvis Bay prior to the implementation of the PSMA but not after.

3.5.3 Summary of changes

While the overall number of foreign fishing vessel port visits showed few strong trends across the study period, the composition of the fleet changed significantly with visits by trawlers decreasing and tuna longliners increasing. The decline in visits by trawlers is likely driven both by the decline of foreign flagged trawlers fishing for hake and horse mackerel in the Namibian EEZ over time, as well as by Namibia's refusal in recent years to allow entry to Namibian ports by many pelagic trawlers chartered by Angola due to suspected IUU fishing (in accordance with the PSMA and the Namibian NPOA IUU). An analysis of fishing effort patterns indicates trawlers that visited Walvis Bay prior to the PSMA but not after generally shifted effort to other fisheries/areas including the SW Atlantic, waters off Guinea Bissau and Angola, or no longer appeared in the AIS dataset. The increase in foreign longline vessel visits to Walvis Bay during 2018-2021 was more likely driven by the impacts of the 'Namibianisation Policy' introduced in 2018, rather than PSMA impacts. Under the Namibianisation Policy, many Namibians were granted new rights to fish for ICCAT managed species and chartered foreign flagged longline vessels to catch their fish. Carrier vessel visits to Walvis Bay declined in the period after 2018, consistent with an overall decline in transhipment activity in the ICCAT area. AIS records indicated slight increases in the median port duration by carrier vessels and trawlers, although advice from MFMR indicated that this was unlikely to be PSMA-related.

4 ANALYSIS AND MAIN MESSAGES

For most case study ports, the introduction of PSMs has had relatively little impact on the natural dynamics of port usage

For four of the six case study ports examined here, the implementation of the PSMA (or PSMs) appeared to have relatively little impact on port usage by foreign fishing fleets. This is largely because the choice of port for foreign fishing vessels is primarily driven by commercial and other imperatives which tend to overwhelm any possible 'disadvantage' associated with stronger port controls. For example, in the case of Bangkok, the number of port visits changed little between the before and after periods, largely because Bangkok is the main hub for the processing of canning grade tuna from the WCPO and demand from canneries remains strong. Carriers continue to use Bangkok despite stronger port controls being introduced in 2016 because 'that's where the canneries are'. While alternative ports for tuna processing exist within the region, these don't have the same dominant market position of Bangkok. In the case of Majuro, the number of port visits is largely influenced by the distribution of fishing effort within the WCPO purse seine fishery. As an attractive port for transhipment, Majuro will be used preferentially when fishing effort is concentrated in the central and eastern parts of the WCPO (typical during El Nino periods), but will see fewer port visits when fishing effort is concentrated in the western parts of the WCPO (typical during La Nina periods). The introduction of stronger PSMs in 2017 will have little influence in the context of these more dominant macro trends. For Montevideo, the number of Chinese squid jig vessels and Panamanian flagged carriers declined across the study period, although these trends commenced prior to the implementation of the PSMA and were most likely driven by unrelated factors. Chinese industry sources advised that the trend away from visits to Montevideo was mainly driven by lower squid catches in the SW Atlantic, combined with an increase in the number of Chinese-controlled carriers (flagged primarily to Panama and China), directives from squid companies to preferably use Chinese ports (to reduce the risk of crew absconding in foreign ports) and an increasing domestic demand for squid meaning more squid were transhipped at sea and transported directly back to China. Other carrier visit trends by flag occurred primarily as a result of reflagging, and thus were also unrelated to PSMA implementation.

In other cases, the lack of a strong 'signal' in foreign fishing fleet behaviour around the time of PSMA implementation may be also partly driven by the incremental implementation of PSMs over time. For example, Namibia is a member of a number of RFMOs that each have PSM-related CMMs. Many of these require similar (or identical) measures to the PSMA and were implemented well before Namibia acceded to the PSMA in 2017. To that end, any adjustment in foreign fishing fleet behaviour may have happened well before practical implementation of the PSMA. This lack of a clear signal associated with incremental implementation is also likely to be true of other ports, with few going from '0 to 100' on PSMs overnight – most PSMs are introduced incrementally over time as capacity builds and industry is allowed periods to 'get used to' new arrangements.

For many ports it may also be true that the lack of a clear change post-PSMA is driven by a view amongst the vast majority of foreign fishing vessels that they consider themselves compliant with relevant fisheries laws and therefore have nothing to fear from entry into PSMA ports.

Broadly, these results should provide confidence to most States considering acceding to the PSMA that the Agreement can be implemented without 'scaring off' foreign fishing fleets and forgoing important economic activity associated with FFV port visits.

But, in some cases, new PSMs can have a big impact

The most notable example of a PSM-related impact amongst our case study ports was the response to Peru's requirement to install and operate an approved VMS system, as well as submit VMS data for the previous six months, for all vessels wishing to enter Peruvian ports post-2020. In this case, the introduction of the VMS requirement led to the complete abandonment of Chimbote port by the Chinese high seas squid jig fleet – which had used Chimbote since 2017 as an important port for hull maintenance with up to 129 visits annually

– as well as a significant decline in the use of Callao port by both Chinese and Korean squid jig fleets. While the VMS requirement was introduced in the same year as the COVID pandemic, advice from Chinese industry sources confirmed that opposition to the VMS requirement was the main driver of behaviour. Our analysis indicates that these vessels continued to fish in the same areas, but either remained at sea during our study period (with catch likely transhipped at sea) or returned to Chinese ports for maintenance. In the case of the Korean jig fleet, the VMS requirement contributed to a substantial change in fishing pattern. In this case, industry advice indicates that the VMS requirement, together with low CPUE in the south east Pacific, led to the fleet fishing solely on the Atlantic side of South America (abandoning the typical 'squid route' seasonal migration from the Atlantic side to the Pacific side for the second half of the year). Interestingly, other foreign fleets to whom the VMS requirement did not apply – e.g. the tuna longline fleet – continued to use Peruvian ports (principally Callao) in the same manner throughout our study period.

The VMS requirement was originally introduced in response to concerns around high seas vessels switching off AIS and fishing in Peru's EEZ. While the extent to which the VMS requirement contributed is unknown, independent analyses have highlighted changes in Chinese jigging fleet behaviour in the period after the requirement was introduced (GFW, 2020; 2021b). In particular, there were fewer vessels with AIS irregularities leading to confusion over either identity or location in 2021 compared to 2020, and perhaps more importantly the fleet appeared to have introduced a self-enforced buffer zone adjacent to the Peru and Ecuador (Galapagos) EEZs. While 2020 AIS data showed the fleet fishing right up to the EEZ boundary, the closest AIS record for 2021 was 10nm and 150nm from the Peru EEZ and Ecuador (Galapagos) EEZ boundaries respectively.

In addition to what could be considered positive developments, a number of unintended consequences may have resulted. For example, the exit of the Chinese jigger fleet from Chimbote has reportedly had a significant impact on the local economy for whom vessels making up to 129 visits annually at an average of 12 days each made an important contribution. We understand this has led to a level of opposition to the VMS requirement from local business owners. Some analysts have speculated the choice to remain at sea for longer periods amongst the jig fleet also risks a higher level of labour rights abuses[56].

There is limited evidence of a shift from PSMA designated to non-designated ports

One of the possible consequences of implementing the PSMA was a shift by fishing fleets from PSMA-designated to non-designated ports (either non-designated ports in PSMA Parties, or ports in States not Party to the PSMA) in order to avoid stronger port controls (or to avoid any additional administrative burden). This was particularly the case for fleets with higher risk of involvement in IUU fishing. The available evidence from the case studies indicates that broadly this hasn't happened. As discussed above, in most cases fishing fleet behaviours around port usage have been driven by natural commercial dynamics around the port/fishery, with relatively few changes that could be explained primarily through the introduction of PSMs. In some cases, this may have influenced in part by relatively few inspections being undertaken (e.g. Montevideo).

When changes did occur – for example, the exit of Chinese and Korean flagged squid jiggers from Peruvian ports following the introduction of the VMS requirement in 2020 – the results were mixed. Some vessels appeared to remain at sea for longer, others returned to home ports (particularly during the height of the COVID pandemic), while others called in to both PSMA and non-PSMA ports. While the return to home ports, where PSMA measures do not automatically apply to domestic vessels, could theoretically reduce inspection coverage of these vessels, it is not yet clear whether these are longer term trends.

Of course, our case studies sample only a very small fraction of PSMA-designated ports internationally and each port has its own dynamics. On that basis, it's possible that fleets in other ports may have responded

[56] https://artis0nal.wixsite.com/my-site/en/post/dire-labor-conditions-in-the-squid-fishery

differently, although the risk of vessels shifting to non-designated ports should only reduce in future as more States accede to the PSMA.

There was limited impact on the operational aspects of port usage – e.g. time in port, time at anchor

Another possible consequence of the introduction of stronger port inspection regimes and the requirement for advance entry request under the PSMA was a change in the operational efficiency of using ports – for example, extending the duration of port visits and time at anchor waiting for port entry approval. The available evidence from the case studies indicates no substantial change in the operational aspects of port usage following PSM implementation. Broadly, time in port and wait times at anchor remained relatively constant in the periods before and after PSM implementation (with the exception of time spent at anchorage in Bangkok). This, again, is likely largely driven by the natural operational dynamics of the port (e.g. the time taken for a carrier to fill up hasn't changed post-PSMA), and also by the considerable efforts of port States (for all of whom the economic activity associated with port usage is very important) to make the PSMA process as efficient as possible. For example, in several cases (e.g. Bangkok, Majuro) port States have developed electronic platforms, accessible online, to manage port entry requests and data submission requirements as well as coordinate local agencies.

In the one port for which there was some evidence of change – Bangkok – the median length of carrier visits to port was shorter and wait times at anchor were longer. There are a range of non-PSMA factors that could contribute to this result (e.g. smaller average transhipment volumes resulting in faster unload times), although it is also plausible that wait times at anchorage are slightly longer because vessels now have to wait for approval before entering port, while port visit duration may be shorter partly because onshore processes (e.g. inspection teams, unloading logistics) have had slightly longer to get themselves organised. Nevertheless, Thailand's DoF noted that unload volumes are the key driver of time in port, and because data on these is not available pre- and post-PSMA they cautioned against drawing strong conclusions around the impacts of PSMA processes on the duration of time in port.

AIS should be complemented by other data sources and local knowledge

The emergence of publicly-available AIS data together with sophisticated analysis through 'big data' platforms in recent times has offered unprecedented insights into global fishing patterns and fleet behaviour. In this study, AIS has proven an extremely useful tool to examine the practical impacts of the PSMA. However, AIS coverage remains patchy for some fleets and areas, particularly in the earlier years of our datasets. To that end, supplementing AIS data with other sources of information – e.g. publicly available port visits records, transhipment volumes – has been important to gauge the completeness of the AIS dataset as well as fill in gaps where necessary. For most ports, AIS data appeared reliable enough to be a reasonable reflection of actual trends in fishing fleet behaviour, although for Montevideo we substituted AIS data for a groomed version of official port records as our primary dataset.

The other essential element to ensuring best use of AIS data in studies such as this is to use local knowledge. In practice, there are a myriad of commercial and operational factors which influence fleet behaviour, port usage and PSM application across FFVs which may not be evident from trends in AIS data alone. To that end, involving local experts and stakeholders to help interpret any trends is essential in gaining an accurate understanding of the factors driving fleet dynamics.

5 RECOMMENDATIONS

Much of the analysis in this study focused on changes in fleet behaviour in response to the implementation of PSMs and the underlying drivers, rather than examining the effectiveness of the PSMs themselves. To that end, our recommendations below focus on observations and learnings that should assist the conduct of similar studies in future, as well as other similar work that might usefully be undertaken.

1. **Monitoring of PSM impacts** – for countries interested in implementing the PSMA (or stronger PSMs) and keen to monitor any practical changes in fishing fleet behaviour, AIS offers a potentially valuable and cost-effective dataset. A framework of indicators similar to those used here can be tailored to examine changes in the main issues of interest (e.g. changes in total numbers of vessel visits, changes in flag States, changes by vessel type, duration of vessel visits). One of the main challenges in these types of 'before and after' analyses is that PSMs are often implemented incrementally and the point at which key measures 'start to bite' is not always well-recorded. To that end, countries interested in analysing changes in fleet behaviour post-PSM/PSMA implementation should maintain clear records of key dates of implementation so that trends may be analysed in the appropriate context.
2. **Complement AIS with other available data** – As discussed above, the increasingly widespread use of AIS technology across the global fishing fleet and the emergence of big data platforms including Global Fishing Watch offer previously unavailable opportunities to track and analyse patterns in fishing fleet behaviour. The value of these insights should only improve as AIS data coverage and technology improves over time. Nevertheless, this study highlights that AIS data coverage is better in some fleets, areas and ports than others and can be patchy, particularly the further you go back in time. To that end, future studies using AIS data to analyse changes in fishing fleet behaviour should complement AIS with other relevant data (e.g. fisheries/port agency official records of port activity) to gain insights into the completeness of the AIS dataset and asses the confidence with which conclusions can be drawn. Caution should be exercised when AIS is the only available dataset.
3. **Use of local experts** – The factors driving port usage by fishing fleets are complex and often dynamic. While AIS data is potentially extremely useful in identifying and analysing trends in fleet behaviour, the drivers underlying trends may not be evident from AIS data alone. To that end, stakeholders knowledgeable in the dynamics of the port should be engaged to assist in the interpretation of results.
4. **Monitoring global implementation of the PSMA** – in addition to examining trends in fleet behaviour at the individual port level, AIS data has potential utility in monitoring implementation of the PSMA at the global level. For example, AIS data could be used to track the proportion of port visits by FFVs to designated ports under the PSMA versus non-designated ports (either ports in non-party States, or non-designated ports in party States). Similar trends could be tracked for other relevant indicators (e.g. proportion of visits by hold capacity) or geographic region (e.g. FAO areas, continents). Clearly there would need to be confidence that the underlying data provided an accurate representation of actual visits, but assuming this was the case, indicators of PSMA implementation might be published in relevant publications including the FAO's periodic State of World Fisheries and Aquaculture reports.

6 REFERENCES

Aroni, E. (2018). Estimación De La Captura Ilegal De Dosidicus gigas Por La Flota Que Opera Fuera De La Zee Del Perú (2013-2016). Tesis Para Optar El Título De Ingeniero Pesquero. 93p. (https://repositorio.lamolina.edu.pe/bitstream/handle/20.500.12996/3863/aroni-sulca-eloy.pdf?sequence=1&isAllowed=y)

Bureau of Fisheries, Ministry of Agriculture and Rural Affairs, PRC (BFMARA). (2016). China Fishery Statistical Yearbook 2016. China Agriculture Press.p44-52.

BFMARA. China Fishery Statistical Yearbook 2017. (2017). China Agriculture Press.p38-46.

BFMARA. China Fishery Statistical Yearbook 2018. (2018). China Agriculture Press.p38-46.

BFMARA. China Fishery Statistical Yearbook 2019. (2019). China Agriculture Press.p38-46.

BFMARA. China Fishery Statistical Yearbook 2020. (2020). China Agriculture Press.p38-46.

The General Administration of Customs of PRC. Customs statistics. 2015-2023. http://stats.customs.gov.cn/indexEn (English).

FAO (2020). The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome.

FAO (2022). The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome, FAO.

Global Fishing Watch (GFW) (2020). Analysis of the Southeast Pacific Distant Water Squid Fleet GFW-2021-FA-SQUID2020. July 2021. 52p. (https://globalfishingwatch.org/wp-content/uploads/GFW-2021-FA-SQUID2020-EN-1.pdf)

Global Fishing Watch (GFW). (2021a). A Comparative Analysis of AIS Data with the International Commission for the Conservation of Atlantic Tunas Reported Transshipment Activity in 2019. A report prepared for the PEW Charitable Trust. https://globalfishingwatch.org/wp-content/uploads/ICCAT-2019-Report_final.pdf

Global Fishing Watch (GFW) (2021b). Analysis of the Southeast Pacific Distant Water Squid Fleet GFW-2022-FA-SQUID2021. February 2022. 30p. (https://globalfishingwatch.org/wp-content/uploads/GFW-2022-FA-SQUID2021-.docx.pdf)

Hosch, G., Miller, N., Yvergniaux, Y., Young, E. and Huntington, T. (2023). IUU safe havens or PSMA ports: A global assessment of port State performance and risk. Marine Policy 155 (2023) 105751. (https://doi.org/10.1016/j.marpol.2023.105751)

Marshall Islands Marine Resources Authority (MIMRA) (2022). Annual Report FY2021. (http://www.rmimimra.com/media/attachments/2022/12/19/fy2021-mimra-annual-report.pdf)

McDonald, G., Costello, C., Bone, J., Cabrala, R., Farabeec, V., Hochberg, T., Kroodsma, D., Mangin, T., Meng, K. and Zahn, O. (2021). Satellites can reveal global extent of forced labor in the world's fishing fleet. PNAS2021 Vol. 118 No. 3 e2016238117. (https://www.pnas.org/doi/epdf/10.1073/pnas.2016238117)

Miller, N., Roan, A., Hochberg, T., Amos, J. and Kroodsma, D. (2018) Identifying global patterns of transshipment behavior. Front. Mar. Sci. 5, 240 (2018). (https://www.frontiersin.org/articles/10.3389/fmars.2018.00240/full)

MRAG Asia Pacific (2019). WCPO Transhipment Business Ecosystem Study. 112p. (https://mragasiapacific.com.au/wp-content/uploads/2021/12/Pew-WCPO-Transhipment-Report-final.pdf)

MRAG Asia Pacific (2020). ICCAT Transhipment Business Ecosystem Study. 96p.

National Institute of Fisheries Science (NIFS) (2022). Korea Annual Report on Fishing, Research Activities, and Observer Implementation in the SPRFMO Convention Area In 2021. 10th Meeting of the Scientific Committee. 26 to 30 September 2022, Seoul, Korea. SC10-Doc19.

Park, J., Van Osdel, J., Turner, J., Farthing, C., Miller, N., Linder, H., Ortuño Crespo, G., Carmine, G. and Kroodsma, D. (2023). Tracking elusive and shifting identities of the global fishing fleet. Science Advances. 18 Jan 2023. Vol 9, Issue 3. DOI: 10.1126/sciadv.abp8200

Smit (2023). EIA Scoping (including an impact assessment) report for the proposed new warehouse for bulk copper concentrate on the site of Walvis Bay Cargo Terminal in the port of Walvis Bay. Prepared for: Walvis Bay Cargo Terminal (Pty) Ltd. 86p.

Welch, H., Clavelle, T., White, T., Cimino, M., Osdel, J., Hochberg, T., Kroodsma, D. and Hazen, E. (2022). Hot spots of unseen fishing vessels. Sci. Adv. 8, eabq2109

Williams, P. and Ruaia, T. (2022). Overview of Tuna Fisheries in the Western and Central Pacific Ocean, including Economic Conditions – 2021. Scientific Committee Seventeenth Regular Session. Online Meeting. 11 –19 August 2021. WCPFC-SC18-2022/GN IP-1.

Annex 1: Terms of Reference

The primary scope of work (SOW) in this RFQ is for Provider to identify and study a minimum of five geographically dispersed ports handling different species, in States which have either adopted the PSMA or introduced stricter legislation regarding oversight of landings. Geospatial analysis will be conducted for an agreed time period preceding and following implementation of controls at each port, the date of which will be determined through the analysis of modifications to legislative, institutional and/or operational processes, to see whether any changes to fishing traffic and port visit patterns are discernable. Specifically, documenting Automatic Identification System (AIS) observed changes in visits, time spent in port, or shift of activity between designated and non-designated ports. Also, to identify the potential impacts of tightening port State measures and on increasing transparency of port designation for PSMA implementation. Provider should be aware that the data, data sources and analysis involved in this study will, ultimately, be made public.

Draft of Proposed Deliverables: Provider shall:

1. Within one (1) month of Start Date, submit to Pew a port feasibility study (Port Feasibility Study) that identifies a minimum of five (5) ports (Ports of Interest) that will be the subject of an analysis outlined further below, and meet for one (1) hour with Pew to discuss and agree the Ports of Interest and the cut-off date for each (minimum of 5). Specifically, the Port Feasibility Study shall include the following content:
    a. A prioritized list of Ports of Interest identified in the course of a data exploration exercise that will seek to ensure that sufficient data exists for the ten countries[1] of interest already scoped by Pew.
    b. A compilation of background research for each Port of Interest on implemented port controls or port State measures, to identify a cut-off date for activity preceding and following implementation of changes at each port.
    c. A final assessment of whether, on balance, sufficient data exists for the Port of Interest study to be feasible and whether there are data gaps, and whether reasonable and prudent assumptions can be made.

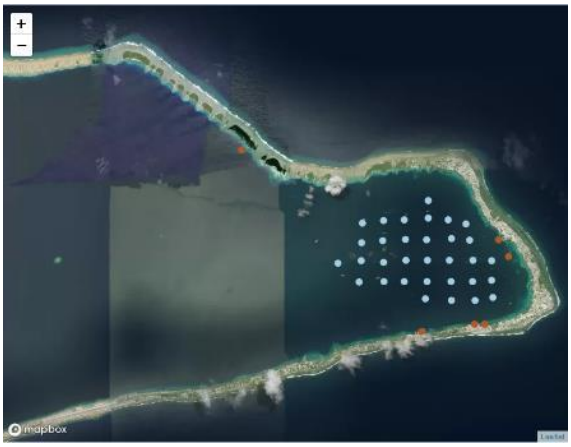
2. Within two (2) months of Start Date, submit to Pew for review a detailed methodology for the analysis of changes to fishing and carrier vessel movements and port visit patterns (Methodology). Provider shall, in consultation with Pew, define the Quality Control Process that will be applied to the Methodology. Specifically, Provider shall include in the Methodology:
    a. A list of criteria for identifying and categorizing port vessel visits.
    b. An explanation of how changes in port dynamics and vessel movements shall be quantified and assessed.
    c. An analysis timeline for each port i.e., to cover sufficient time, before and after the implementation of PSMs.
    d. Assumptions to capture vessels going to port after transshipments and transshipment encounters.
    e. A description of how to identify changes in individual flag States' fleet behavior.
    f. A description of how to identify the reasons for changes i.e., are these for economic reasons, port access restrictions, stricter port controls etc.
    g. Define the Quality Control Process, including, at a minimum, external peer review and verifying data and facts.

3. Within eight (8) months of Start Date, submit to Pew for review and feedback, which shall be given to Provider within fifteen (15) working days of receipt, an Excel workbook containing draft results of AIS data analysis (AIS Workbook), other data source analyses and database for each port, with an accompanying analytical report, that includes background research, discussion, and recommendations (PSMA Before and After Report), as well as a method statement documenting analytic decisions.

4. Within nine (9) months of Start Date, submit to Pew a final AIS Workbook and PSMA Before and After Report as well other data sources.

Annex 2: Port and anchorage areas

Majuro



Bangkok

Chimbote

Callao

Montevideo

Walvis Bay

Note: Red dots represent the port area; blue dots represent the anchorage area. The port area for Bangkok is within the Chao Phraya river.