COMMISSION
SIXTEENTH REGULAR SESSION
Port Moresby, Papua New Guinea
5 – 11 December 2019

A COMPARATIVE ANALYSIS OF AIS DATA WITH WCPFC REPORTED TRANSHIPMENT ACTIVITY IN 2017

WCPFC16-2019-OP10
26 November 2019

Submitted by The Pew Charitable Trusts

Global Fishing Watch

A Comparative Analysis of AIS Data with the Western and Central Pacific Fisheries Commission Reported Transshipment Activity in 2017

Acknowledgements

This report was funded in part by the Gordon and Betty Moore Foundation and produced in cooperation with The Pew Charitable Trusts (“Pew”). The authors would like to thank Claire van der Geest and Quentin Hanich for reviewing this study.

Prepared by: Global Fishing Watch

Contents

List of Acronyms

AIS – Automatic Identification System
CCM – Commission Members, Cooperating Non-Members, and Participating Territories of WCPFC
CCSBT – Commission for the Conservation of Southern Bluefin Tuna
CMM – Conservation and Management Measure
CVP – Carrier Vessel Portal
EEZ – Exclusive Economic Zone
FFA – Pacific Islands Forum Fisheries Agency
GFW – Global Fishing Watch
IATTC – Inter-American Tropical Tuna Commission
ICCAT – International Commission for the Conservation of Atlantic Tunas
IOTC – Indian Ocean Tuna Commission
MCS – Monitoring, Control and Surveillance
NPFC – North Pacific Fisheries Commission
PSMA – Port State Measures Agreement
RFMO – Regional Fisheries Management Organization
RFV – Record of Fishing Vessels
ROP – Regional Observer Program
VMS – Vessel Monitoring System
WCPFC – Western and Central Pacific Fisheries Commission

This report also refers to UN ISO 3166-1 alpha-3 country codes which can be found here for reference https://unstats.un.org/unsd/tradekb/knowledgebase/country-code.

Executive Summary

The WCPFC permits at-sea transshipments of tuna and tuna-like species between carrier vessels and fishing vessels, a practice which is regulated by WCPFC CMM 2009-06 – *Regulation of Transhipment* which states *"…unregulated and unreported transhipment of catches of highly migratory fish stocks at sea, in particular on the high seas, contributes to distorted reporting of catches of such stocks and supports IUU fishing in the Convention Area..."* (CMM 2009-06). The CMM looks to address this by specifying reporting requirements for both carrier vessels and the fishing vessels when these events occur in the Convention Area except for catches that are taken and transshipped wholly in archipelagic waters or territorial seas. Publicly available information on transshipments of WCPFC-sourced and managed species is provided in the WCPFC Secretariat Annual Report on Transshipment and the Annual Report Part I documents of CCMs.

To provide insight into carrier vessel movement and transshipment activity within the WCPFC Convention Area, GFW used commercially available AIS data and machine learning technology to analyze movement patterns of carrier vessels operating in WCPFC waters. A comparative analysis of this AIS data with publicly available WCPFC information relevant to the transshipment of WCPFC-sourced catch was then done to make an assessment of the risk of unreported or unauthorized activity. The analysis included a review of AIS-detected encounters between carrier vessels and fishing vessels that exhibited movements in WCPFC waters, on both the high seas and within Pacific Island coastal State waters, consistent with fishing effort. Attempts were made to categorize these encounters based on vessel authorization status by referencing the WCPFC RFV. Detailed methodology is set out at Annex 2, but for this report, carrier vessel AIS data was used to identify potential encounters (when two vessels are within 500 meters of each other for at least 2 hours and traveling at < 2 knots, while at least 10 kilometers from a coastal anchorage) and loitering (when a carrier vessel travelled at speeds of less than 2 knots for at least 4 hours, while at least 20 nautical miles from shore). From our analysis, AIS-detected encounters and loitering events less than 24 hours in duration, appear to be good indicators of potential transshipment activity.

The results raised the clear possibility that at-sea transshipments involving transfers of WCPFC-managed species in 2017 went unreported. It appears there are extensive data gaps and inconsistencies in reporting submissions that reduce the effectiveness of WCPFC's management of transshipment. As a result, it is assessed that there is increased risk that some authorized at-sea transshipments go unreported as well as catch and transshipments of WCPFC-managed species by unauthorized vessels going unchecked.

The analysis and some of the major findings include:

- At least 233 WCPFC-authorized carrier vessels were observed on AIS to have been present in WCPFC Convention Area waters in 2017 with 103 of them displaying

vessel movement characteristics consistent with the encounters and loitering events outlined above; far more than the 27 distinct carrier vessels that just reported high seas transshipments.

- While 1,089 transshipment events were reported on the high seas, AIS analysis suggested that 2,128 potential high seas events may have occurred that were considered loitering events less than 24 hours in duration or an encounter event. This finding may indicate instances where at-sea transshipments of WCPFC-sourced and managed species went unreported.
    - *Recommendation:* Require all transshipment events be reported to the Secretariat, regardless of location.
    - *Recommendation:* Implement standardized reporting templates for Members to report annual cumulative activities related to transshipment.
    - *Recommendation:* WCPFC should consider use of AIS as a supplemental tool to help monitor fishing activity, including validating potential transshipment events.
- AIS indicated a high degree of carrier vessel activity on the high seas off Japan in dually managed WCPFC and NPFC waters. A similar considerable amount of carrier vessel activity, including encounters with longliners, appears to occur within the WCPFC-IATTC overlap area.
    - *Recommendation:* WCPFC should engage with NPFC and IATTC to establish how best to manage these overlap areas to include effective control, oversight and transparency of all transshipment activity.
- AIS analysis can be effectively used to identify port visit trends by carrier vessels, especially those most often used for onloading and offloading of WCPFC-sourced catch. These may represent the most important port locations to monitor and regulate in port transshipments and landings of WCPFC-managed species.
    - *Recommendation:* WCPFC should continue to enhance their current management measure related to port State measures.
    - *Recommendation:* WCPFC Members should consider the benefits of ratifying and implementing the PSMA as a means to help detect, deter, and eliminate illegal fishing.

Conclusion

The report raises the distinct possibility that numerous at-sea transfers involving WCPFC-managed species in 2017 went unreported. This may be a result of ineffective reporting protocols and processes and reliance on self-reporting by Members without proper tools or independent means of verification and validation of the transshipped species and quantities. WCPFC should amend *CMM 2009-06 – Regulation on Transhipment*, together with supporting MCS measures, to enable more effective transshipment monitoring and reporting. Amendments should support enhanced transparency of carrier vessel activities and at-sea transfers of WCPFC-managed species. Improving WCPFC's ability to cross-reference and validate reported information on transshipments, regardless of source, will increase opportunities to detect anomalous behavior, and for relevant

authorities to respond to, and investigate, potential instances of unreported or unauthorized activity.

1 Introduction

GFW, in partnership with The Pew Charitable Trusts (Pew), is undertaking an assessment of at-sea transshipment activity occurring in the waters of the Convention Areas of the global tuna RFMOs. The purpose is to help expand understanding of transshipment and inform policy development directed at strengthening transshipment management and control. This work includes a series of RFMO-specific annual reports covering transshipment-related activity that is observable from comparative analyses of AIS data combined with reviews of publicly available transshipment information. The reports will cover calendar years 2017 through 2019. While this is the first such report for the WCPFC and covers calendar year 2017, Pew independently conducted a similar study for the WCPFC which covered calendar year 2016.

A second element of work complementing these reports is the development of a publicly accessible web-based Carrier Vessel Portal (CVP) specifically focused on information and activities of carrier vessels authorized by the five tuna RFMOs. The purpose of the CVP is to provide users an easy, single-access data portal for information related to carrier vessels and at-sea transshipments. Initially, the CVP is envisaged to display AIS data linked with RFMO vessel authorization information, with the intention to display additional information as it becomes publicly available, such as Secretariat annual reports, RFMO transshipment declarations, observer reports, and other related data.

AIS use in fishing fleets is increasing with a growing number of flag States mandating its use through their own national fisheries regulations. For example, the European Commission and the United States of America require AIS on fishing vessels over a certain size. Carrier vessels registered over 300 gross tons and on international voyages are already required to broadcast on AIS, as mandated by the International Maritime Organization (IMO) (IMO 2002). The Pacific Islands FFA also requires foreign vessels to be outfitted with AIS as a condition to be placed in Good Standing on the FFA Vessel Register. This makes the use of AIS, and its subsequent analysis, useful in understanding fishing activity that can be used to support and complement existing national and RFMO MCS programs. This is especially true as AIS can provide a greater understanding of fishing vessel interactions, especially when these interactions involve vessels of differing flag States where VMS data is not publicly available or readily shared between authorities.

To help overcome these data gaps, CVP users will be able to access a range of publicly available information that can help provide a greater understanding of transshipment activities as well as assist in potential investigations or development of risk assessments. Intended users include RFMO Secretariats and flag, coastal, and port State authorities. However, the open nature of the portal and easily accessed publicly available data will allow other fishery stakeholders to better understand fleet dynamics and

conduct greater due diligence in recognizing potential risks of anomalous activity directly associated with their supply chains.

1.1 Western and Central Pacific Fisheries Commission

The WCPFC is an intergovernmental organization made up of member governments that share mutual interests in managing and conserving tuna stocks in the western and central Pacific Ocean (Figure 1). The WCPFC was established in 2004 by the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. There are currently 26 Members as well as 7 Participating Territories and seven Cooperating Non-Members that belong to WCPFC (collectively termed CCMs)[1]

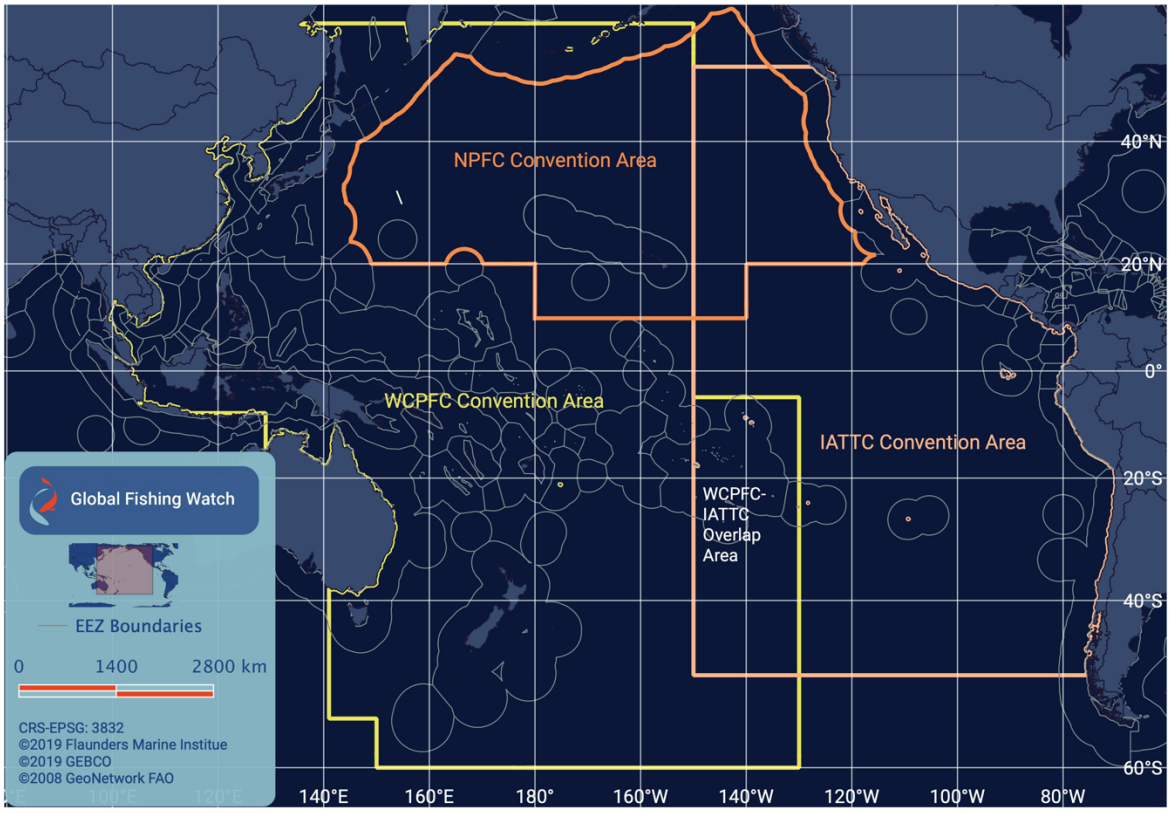


Figure 1 - Convention Areas of the Western and Central Pacific Fisheries Commission (WCPFC), Inter-American Tropical Tuna Commission (IATTC), and North Pacific Fisheries Commission (NPFC)

1.2 WCPFC Transshipment Framework

The WCPFC uses the term “carrier vessel” to refer to vessels that are duly authorized by their flag State and have been entered by the WCPFC Secretariat on the WCPFC Record

[1] https://www.wcpfc.int/about-wcpfc

of Fishing Vessels (RFV) to receive tuna and tuna-like species and sharks, as well as species caught in association with tuna, from both longline and purse seine vessels. The current *WCPFC Conservation and Management Measure on the Regulation of Transhipment* was adopted by WCPFC at its sixth regular session in 2009 (CMM 2009-06). The measure is divided into three primary sections with management measures and reporting requirements developed based on fishing location (e.g., high seas, EEZ, and in port) and vessel type. Section One provides general transshipment management rules and states that the rules apply to all transshipments of highly migratory species caught in the Convention area. However, the rule does not apply to catch taken and transshipped within archipelagic waters or territorial seas. Rules governing transshipment in port or in EEZ waters are left subject to the national laws of the relevant port or coastal State CCM (CMM 2009-06).

Section Two of CMM 2009-06 is specific to transshipment by purse seiners, prohibiting transshipment on the high seas of the Convention Area. While at-sea transshipment by purse seiners is generally prohibited, the measure provides for exemptions. Three purse seine fleets—flagged by Papua New Guinea, the Philippines, and New Zealand—currently have this exemption. Section Three applies to all other vessel types, such as longline, troll and pole-and-line vessels. While transshipment by these vessels is also prohibited on the high seas, CCMs can advise the Commission that it is *"…impracticable for certain vessels that it is responsible for to operate without being able to tranship on the high seas..."* (CMM 2009-06*)*. CCMs have taken advantage of this to the point that reported high seas transshipments, primarily by longliners, have generally increased over the past five years (WCPFC-TCC14-2018-RP03).

For transshipments which occur in port and within coastal State CCM EEZs, the vessels involved must follow port or coastal State reporting requirements. The relevant port, coastal, and flag State CCMs are responsible for reporting these events to the Secretariat on an annual basis (CMM 2009-06). The measure requires that carrier vessels have observers onboard for all transshipments that occur on the high seas but does not require these observers to submit a report to the Secretariat. Unlike the IOTC, IATTC and ICCAT, WCPFC has not established a carrier vessel ROP that is operated and administered by a contracted third party. All oversight of transshipment activity occurring within the WCPFC Convention Area is provided directly by the flag, port and coastal State CCM authorities involved. The Secretariat's role is in auditing the national and regional programs and setting the standards that help ensure a rigorous ROP.

1 Study Objective

This study used commercially available satellite AIS data, combined with the application of machine learning technology and analysis of publicly available information, to analyze the track histories of carrier vessels operating in the WCPFC Convention Area in 2017. The overall objective is to:

1. Provide greater transparency and understanding of carrier vessel activities occurring within the WCPFC Convention Area to better inform the Commission on carrier vessel fleet movement patterns including spatial dynamics, encounters with fishing vessels, and highly frequented ports; and
2. Enable the Commission to make better informed decisions regarding the management of transshipment occurring at sea within the WCPFC Convention Area to strengthen the current WCPFC transshipment regulatory framework where needed to address potential management gaps or loopholes related to shortfalls in transparency, reporting, monitoring, and data sharing.

Additionally, this analysis also provides usable data on vessel activity consistent with transshipping, which can:

1. Demonstrate how AIS analysis can be used as a monitoring and analysis tool that complements the existing WCPFC MCS structure using VMS, flag State authorizations, observer reporting, and transshipment and catch documentation; and
2. Provide data that can be used by national or regional management authorities to initiate investigation of activities of carrier vessels where the data shows anomalous behavior, or potentially unauthorized or unreported transshipping activity, may have occurred.

Note: Any incident identified in this study as possibly anomalous or non-compliant should not be seen as definitive. This report acknowledges that AIS data is only one dataset and additional information available to the Secretariat and flag States would be needed to provide a complete understanding of any potential non-compliant or unauthorized fishing activity. Further investigation by the relevant flag, port and coastal State authorities who have access to the additional non-public information would be needed to make that determination and take appropriate enforcement or regulatory action.

3 AIS Analysis Methods

GFW uses AIS data to provide insight into vessel movements and fishing activity throughout the world, including possible transshipment behavior (i.e., Miller et al. 2018; Boerder et al. 2018; Sala et al. 2018). The GFW database was used in conjunction with public registry data to analyze possible transshipment activity within the WCPFC Convention Area occurring between carrier vessels and both purse seine and longline fishing vessels during the year of 2017. A full description of data methods is described in Annex 2 and explained in detail in Kroodsma et al. 2018 and Miller et al. 2018.

The GFW database contains a table of AIS-detected ‘encounters’ between two vessels and ‘loitering’ events by carrier vessels. Encounters where two vessels meet at sea may indicate potential transshipment activity between two vessels that both appear on AIS.

Encounters are estimated using AIS data, including distance between the two vessels, vessel speeds, and duration in a given area. Loitering by a single carrier vessel may also indicate a potential transshipment in which AIS data is missing for the second vessel. Loitering is also estimated using AIS data, including vessel speed, duration in a given location, and distance from shore. Because transshipment within the WCPFC Convention Area primarily involves purse seiners and longliners, only encounters between carrier vessels and purse seiners and longliners as well as loitering events of carrier vessels were examined for this report (See Annex 2).

The GFW database also contains an estimate of port visits conducted by carrier vessels (see Annex 2). The ports visits are estimated using AIS data, including vessel speed, location, and duration in a given anchorage. This information was used to establish which ports carrier vessels frequented the most related to their operations while in WCPFC Convention Area waters.

Vessel authorization was established by using the publicly available Record of Fishing Vessels (RFV) produced by WCPFC.[2] Carrier vessels listed in the RFV were analyzed based on 2017 authorization. The WCPFC authorization was interpreted using the RFV 'active' status and version date. If a vessel was active based on a version date that was during or after an encounter and/or loitering event, the vessel was considered 'authorized'. This method for determining authorization is recommended by the WCPFC Secretariat who states that a vessel flagged to a CCM that is listed on the RFV with an "active" status indicates that the responsible flag State considers that the vessel is "entitled to fly its flag and is authorized to fish in the Convention Area" (WCPFC-TCC14-2018-RP05). Encounters and/or loitering events are included in the data analysis whether or not the carrier analyzed was authorized by WCPFC and appeared on the RFV during the specific time of the event. If a vessel was not identified on the RFV during an encounter or loitering event, it should not automatically be assumed that it was "unauthorized". In addition to the WCPFC RFV, vessel authorization was established by using the publicly available vessel registry produced by NPFC[3]. It should be noted that the IATTC provides a public registry of authorized carrier and longline vessels, however the registry does not provide historical data with explicit date ranges of authorization, and therefore no 2017 IATTC registry data was used in this analysis.

The full version of the data analyzed, including event and vessel information details, is included in Annex 1 of this report.

4 Overview of WCPFC Carrier Activity in 2017

WCPFC established and maintains a publicly available RFV, which includes all fishing and carrier vessels authorized by WCPFC CCMs. The carrier vessels on this list represent all

[2] https://www.wcpfc.int/doc/historical-record-fishing-vessels-rfv-data
[3] https://www.npfc.int/index.php/compliance/vessels

carrier vessels authorized to transship at-sea within the WCPFC Convention Area; carrier vessels not on the RFV are not authorized to conduct transshipments in the WCPFC Convention Area. WCPFC also provides a publicly available copy of an historical RFV that lists all vessels that were authorized by WCPFC since the inception of the RFV in 2009, including the timeframes during which they were authorized. GFW used this historical RFV along with publicly available documents detailing transshipments and transshipment-related information to assess carrier vessel activity in the WCPFC Convention Area in 2017. In addition to the RFV, the following primary WCPFC documents were used for this study:

- *Flag State CMM Annual Report Part 1*[4], including:
  - *China - WCPFC-SC14-AR/CCM-03*
  - *Chinese Taipei - WCPFC-SC14-AR/CCM-23 (Rev01)*
  - *Liberia - WCPFC-SC14-AR/CNM-32*
  - *Panama - WCPFC-SC14-AR/CNM-34*
  - *Republic of Korea - WCPFC-SC14-AR/CCM-12*
  - *Vanuatu - WCPFC-SC14-AR/CCM-28*
  - *European Union - WCPFC-SC14-AR/CCM-05*
  - *Federated States of Micronesia - WCPFC-SC14-AR/CCM-06*
  - *Japan - WCPFC-SC14-AR/CCM-10*
  - *Kiribati - WCPFC-SC14-AR/CCM-11*
  - *Papua New Guinea - WCPFC-SC14-AR/CCM-19*
  - *Philippines - WCPFC-SC14-AR/CCM-20*
  - *Republic of the Marshall Islands - WCPFC-SC14-AR/CCM-13*
  - *Thailand – WCPFC-SC14-AR/CNM-35*
- *Annual Report on WCPFC Transhipment Reporting with an Emphasis on High Seas Activities (WCPFC-TCC14-2018-RP03)*
- *Standards, Specifications and Procedures for the WCPFC Record of Fishing Vessels (CCM 2014-03)*
- *WCPFC IATTC Memorandum of Understanding (*WCPFC-IATTC-MoU-Jun-2006*)*

4.1 WCPFC Record of Fishing Vessels and Authorizations

Per CMM 2014-03, for a flag CCM to add a fishing vessel to the RFV, *"…all minimum data requirement fields with the exception of the Vessel Identification (VID) must be completed…"*. Attachment 1 of the Measure lists the minimum information on fishing vessels that must be provided by CCMs for inclusion on the RFV. The "start of period of validity of authorization" and "end of period of validity of authorization" are data fields that are both included in the list of minimum data requirement fields. However, many of the dates of authorization for carrier vessels included on the RFV for calendar year 2017 were left blank, had only one of the two authorization dates filled in. WCPFC has previously been made aware of confusion brought on by these inconsistencies, as stated

[4] https://www.wcpfc.int/meetings/14th-regular-session-scientific-committee

in WCPFC-TCC14-2018-RP05, *"As reported to previous TCCs, the Secretariat continued to receive queries relating to expired or blank authorization period for a vessel on the RFV, mostly from high seas boarding and inspection (HSBI) party and markets…"*. Therefore, the Secretariat has continued to advise that a vessel flagged to a CCM that is listed on the RFV with an "active" status indicates that the responsible flag State considers that the vessel is "entitled to fly its flag and is authorized to fish in the Convention Area" (WCPFC-TCC14-2018-RP05).

In 2017, a total of 479 distinct carrier vessels were listed on the RFV and considered to be authorized vessels under WCPFC. These 479 carrier vessels operated under a total of 485 authorizations due to the following 6 flag State CCM changes that occurred during calendar year 2017; one carrier vessel changed flags from Panama to Korea and five carrier vessels changed flag from Vanuatu to Panama. Although best efforts were made to ensure a specific carrier vessel observed on AIS in the Convention Area during 2017 occurred during the timeframe it held a specific flag State authorization, it may help ensure comprehensive understanding and accuracy of authorization information to provide the Secretariat recommended interpretation of the RFV authorization on the public WCPFC RFV webpage. In addition, efforts to ensure the version date of the RFV 'active' status correctly coincides with the date of flag State changes and the RFV 'active' status and dates match completed carrier vessel authorization period information may help clarify any remaining ambiguity in WCPFC vessel authorization status.

4.2 WCPFC Regional Observer Program

Unlike other tuna RFMOs, WCPFC has not implemented an observer program specific for carrier vessels that is managed and administered by an independent service provider on behalf of the Commission. Rather, the WCPFC ROP is specifically designed to supply trained and certified observers while embarked on purse seine and longline vessels. The WCPFC ROP is made up of national and regional observer programs. The observer programs are audited against the Standards and Specifications for the ROP which help to ensure an effective ROP (see https://www.wcpfc.int/regional-observer-programme). Observer duties in WCPFC are related to documenting information for both scientific and compliance purposes unlike some of the other tuna RFMOs which are more targeted at science only.

The Secretariat has developed a set of forms for observers carrying out observer duties on carrier vessels that transship on the high seas, but these forms are only provided to CCMs as guides. While carrier vessels are required to have an observer embarked onboard to observe transshipments carried out on the high seas, there is no requirement for them to submit their observer reports to the Secretariat as an independent means of verification.

4.3 WCPFC Annual Reporting of Transshipment

The 2018 WCPFC Annual Report on Transshipment (WCPFC-TCC14-2018-RP03) details transshipment information based on carrier vessel activities that occurred from January

2017 through July 2018. According to this report, in 2017, 1,089 high seas transshipment events occurred as reported by 27 distinct carrier vessels flagged to China, Chinese Taipei, Republic of Korea, Liberia, Panama and Vanuatu.

In addition to the Secretariat's Annual Report, flag State CCM Annual Report Part 1 submissions are supposed to provide information on fleet transshipment activity occurring within the Convention Area in 2017. According to these documents, the 6 flag State CCMs of the carrier vessels that reported high seas transshipments reported 1,138 transshipment events occurred in 2017 although, in some cases, the location breakdown of events was not provided (high seas, EEZ, in port). Only 2 of the 6 CCMs provided the number of carrier vessels involved in high seas transshipment - Liberia with 4 and China with 1. The number reported by Liberia matched the number of carrier vessels that reported high seas transshipments; however, China's report of 1 carrier vessel involved in transshipment was inconsistent with the 2 Chinese-flagged carrier vessels that self-reported high seas transshipments (Table 1).

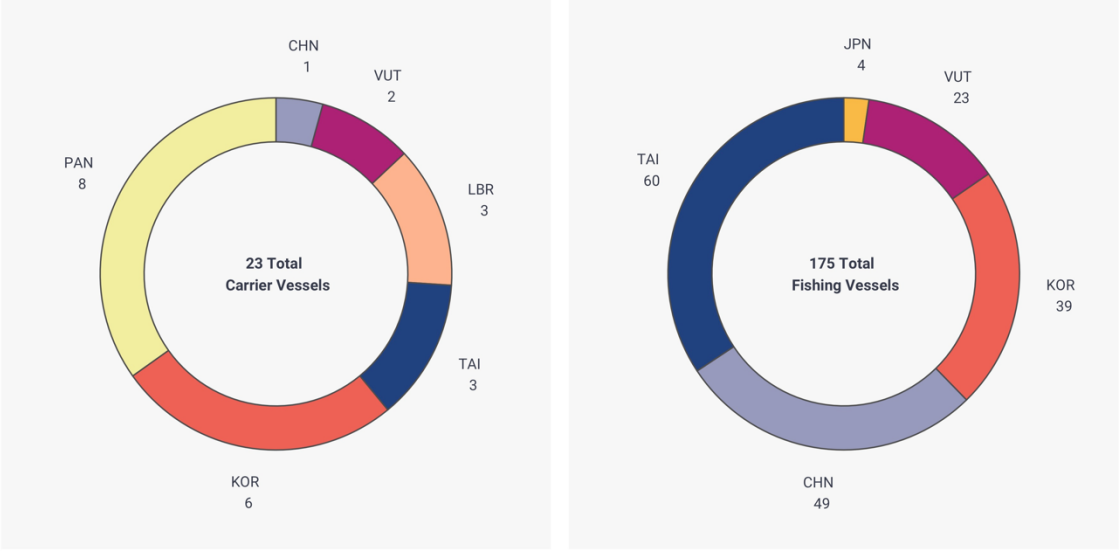
Table 1 – Comparison of WCPFC Reported Authorized Carrier Activity and AIS Detected High Seas Activity

	Data Source	Flag State CCM Annual Report Part 1		WCPFC Record of Fishing Vessels		WCPFC Secretariat Annual Report on Transshipment		Global Fishing Watch AIS Detections and Analysis		
	Flag State	Reported High Seas Events	Reported Carriers Active	Authorized Carriers	Carrier Vessels Reported "Fished"	WCPFC Carrier Vessels Reporting High Seas Events	Reported Number of High Seas Events	Authorized Carrier Vessels on AIS in 2017 (Active in WCPFC)	Authorized Carrier Vessels with Encounters and (Loitering Events)	Authorized Encounter Events and (Loitering Events)
Reported High Seas Transshipping	China (CHN)	246	1	12	5	2	29	12 (11)	1 (3)	8 (76)
	Chinese Taipei (TAI)	191	Not Reported	22	2	3	204	18 (16)	3 (8)	19 (294)
	Liberia (LBR)	248	4	28	4	4	249	28 (23)	3 (6)	69 (172)
	Panama (PAN)	15	Not Reported	121	77	9	280	109 (96)	8 (52)	78 (683)
	South Korea (KOR)	168	Not Reported	33	25	6	200	32 (32)	6 (24)	100 (254)
	Vanuatu (VUT)	270	Not Reported	12	5	3	127	6 (6)	2 (4)	20 (149)
Did Not Report High Seas Transshipping	European Union (EU)	15	Not Reported	9	1	0	0	9 (1)	0 (0)	0 (0)
	Micronesia (FSM)	0	0	1	0	0	0	1 (1)	0 (0)	0 (0)
	Japan (JPN)	0	Not Reported	92	0	0	0	20 (18)	0 (1)	0 (2)
	Kiribati (KIR)	0	0	9	2	0	0	6 (6)	0 (5)	0 (150)
	Papua New Guinea (PNG)	0	0	1	0	0	0	0 (0)	0 (0)	0 (0)
	Philippines (PHL)	Not Reported	Not Reported	134	37	0	0	16 (16)	0 (0)	0 (0)
	Marshall Islands (MHL)	Not Reported	Not Reported	1	1	0	0	1 (1)	0 (0)	0 (0)
	Russian Federation (RUS)	Not Submitted	Not Submitted	2	0	0	0	1 (1)	0 (0)	0 (0)
	Thailand (THA)	0	0	8	0	0	0	8 (5)	0 (0)	0 (0)
	Total	**1153**	**5**	**485**	**159**	**27**	**1,089**	**267 (233)**	**23 (103)**	**294 (1780)**

Through analysis of AIS data, GFW identified the presence of 693 carrier vessels inside the WCPFC Convention Area during 2017. Of these, 233 carrier vessels were authorized by WCPFC during 2017 to conduct transshipment in WCPFC Convention Area waters and were listed on the RFV. Of the 460 carrier vessels which did not appear to be authorized by WCPFC, 434 appeared to be only involved in direct and continuous transit through WCPFC waters to/from other regions of the globe and did not exhibit vessel movements consistent with transshipment while in WCPFC waters. The remaining 26 carrier vessels that did not appear to be authorized by WCPFC were observed to have either an AIS-detected encounter with a fishing vessel or exhibited loitering events while inside the WCPFC Convention Area.

4.4 AIS-Detected Encounters

GFW detected that 24 carrier vessels, 23 of which were authorized by WCPFC, were involved in 295 encounters with 175 distinct fishing vessels on the high seas in the WCPFC Convention Area during 2017 (See Annex 1-0001-0295). One of the 295 encounters occurred between an authorized Panamanian-flagged carrier vessel and a Kiribati-flagged purse seiner. A single carrier vessel not authorized by WCPFC was observed on AIS to have an encounter with a fishing vessel in WCPFC waters on the high seas off Japan. However, these 2 vessels were authorized by the NPFC and the encounter identified could very well be related to authorized activities associated with NPFC-managed species where these NPFC waters overlap with WCPFC. The analysis did not detect any encounters that occurred between carrier vessels flagged to WCPFC CCMs other than the 6 CCMs which reported high seas transshipment events (Figure 2).



Source: Global Fishing Watch

Figure 2 - Distinct Carrier and Fishing Vessels in AIS-Detected High Seas Encounters by Flag State

Korean-flagged carrier vessels were observed to have the most AIS-detected encounters with fishing vessels (100 total events), primarily with vessels flagged to Korea and

Chinese Taipei. Panamanian and Liberian-flagged carrier vessels were also observed in many of the encounters (147 total events), primarily with vessels flagged to Chinese Taipei and China (Figure 3).

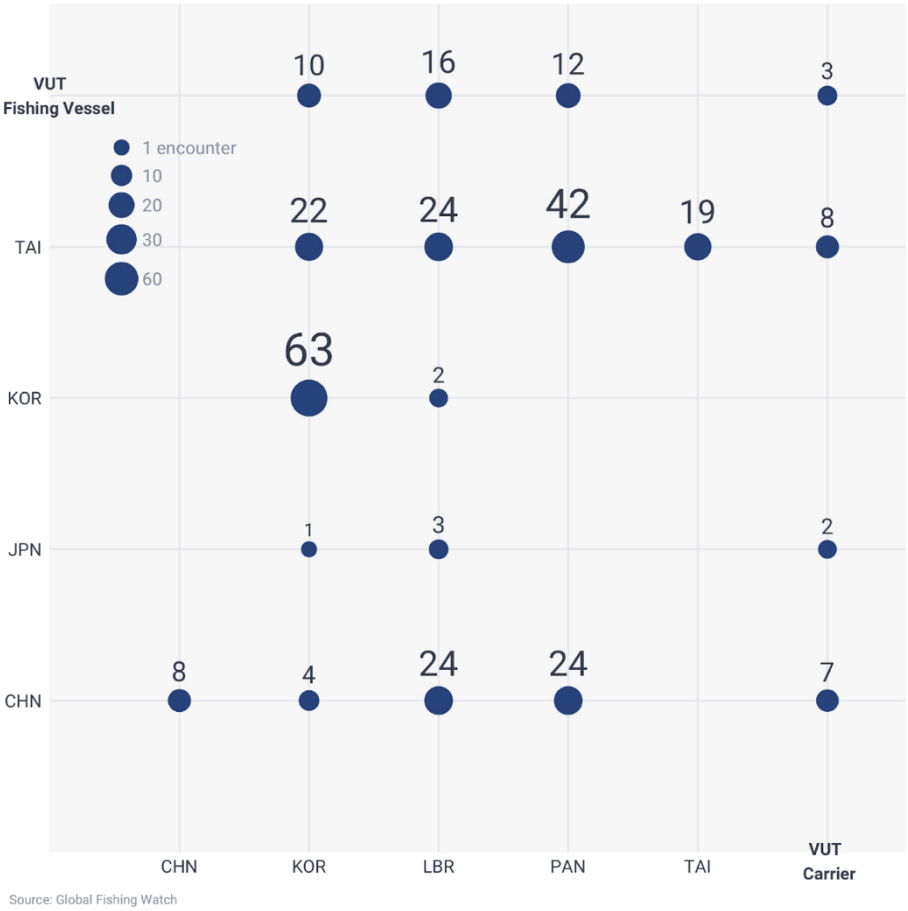


Figure 3 - AIS-Detected High Seas Encounters between Carrier and Fishing Vessels in 2017

The AIS-detected high seas encounters largely occurred between 35 degrees South latitude and 20 degrees North latitude, south of NPFC Convention Area waters, and east of 150 East longitude (Figure 4). These AIS-detected encounters proved consistent with the geolocations of reported high seas transshipment events as illustrated by the Secretariat in their Annual Report on Transshipment (Figure 5).

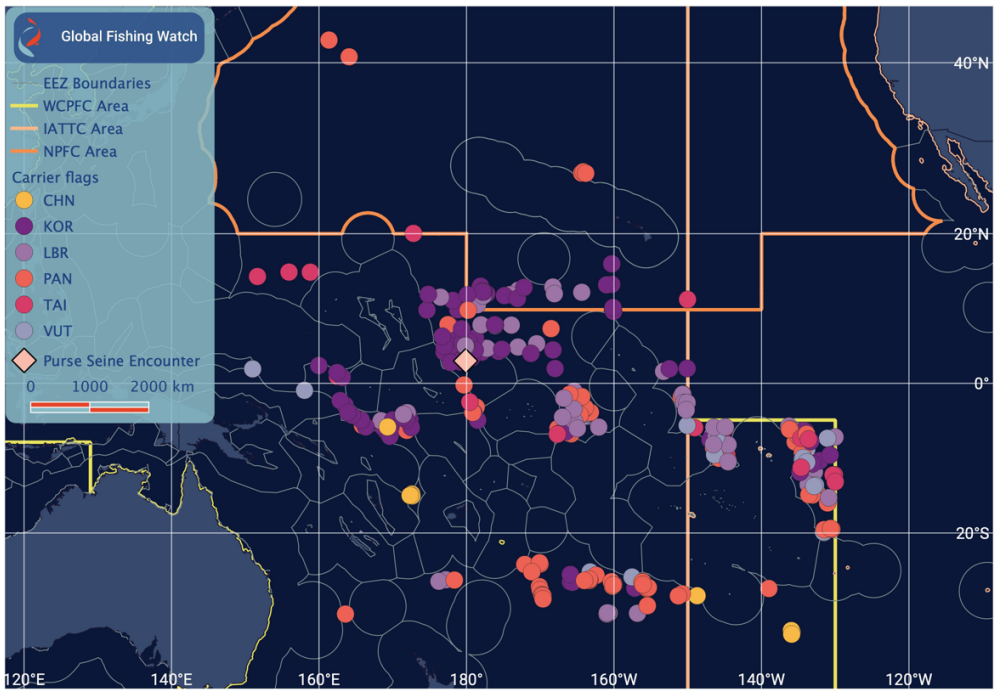


Figure 4 - AIS-Detected High Seas Encounters in the WCPFC Convention Area by Carrier Vessel Flag State

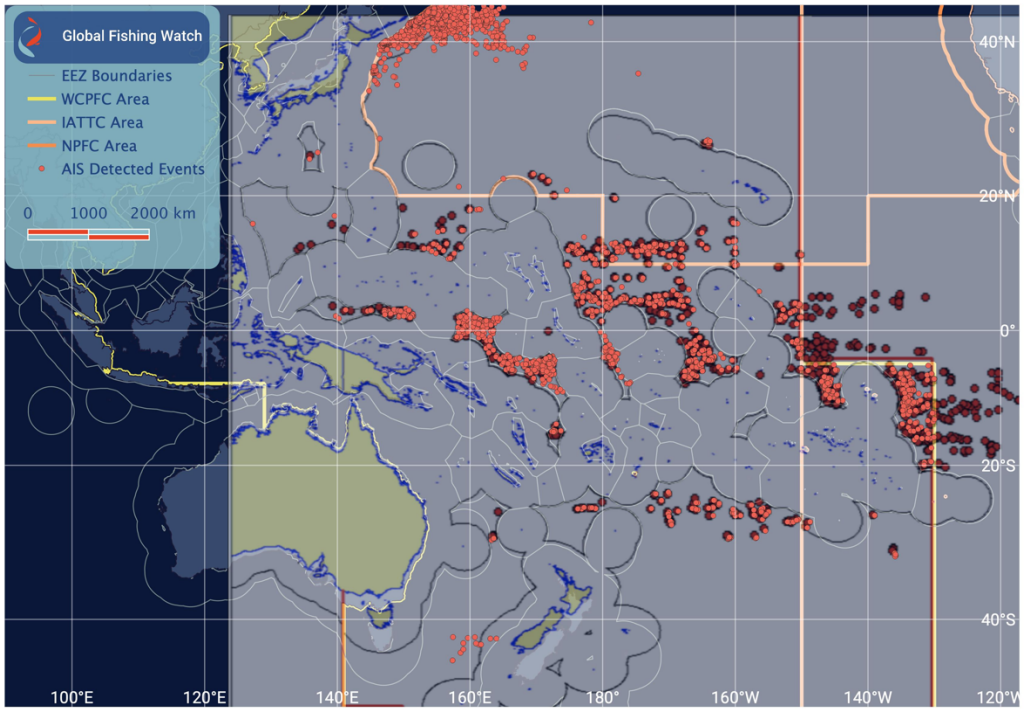


Figure 5 – WCPFC Reported High Seas Transshipments in 2017 (WCPFC-TCC14-2018-RP03) overlaid with AIS-Detected encounters

Additionally, all observed encounters were less than 48 hours in duration, with the majority taking place in 8 hours or less (Figure 6).

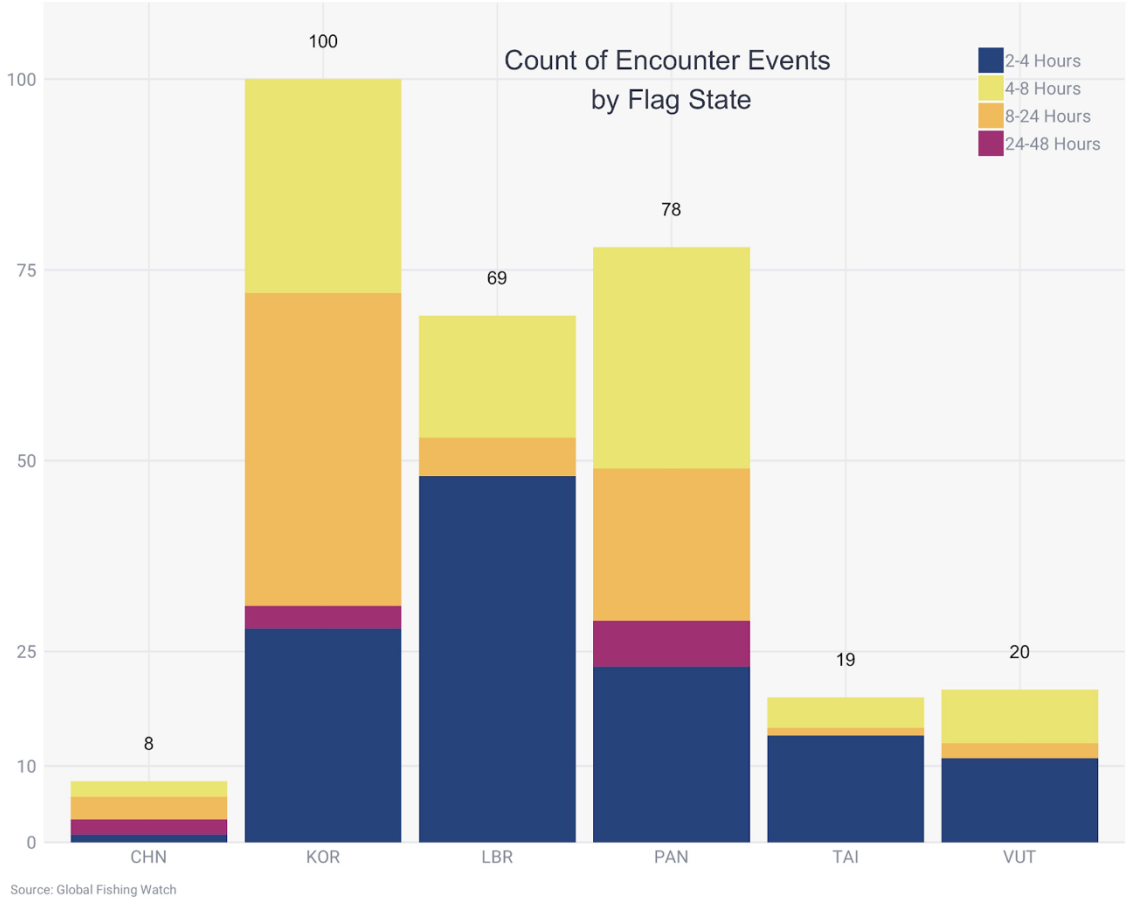


Figure 6 – AIS-Detected Encounters by Carrier Vessel Flag State and Time Duration

In addition to the 295 encounters detected on the high seas, GFW detected an additional 30 encounters within the EEZs of Pacific Island coastal State CCMs (See Annex 1-0296-0325). These 30 encounters involved 19 distinct authorized carrier vessels flagged to the CCMs of Korea, Liberia, Panama, the Philippines, and Vanuatu. It is worth noting that 27 of the 30 encounters occurred with purse seine vessels which, except in several explicit exemptions, are required to transship their catch in port (CMM 2009-06) (Figure 7).

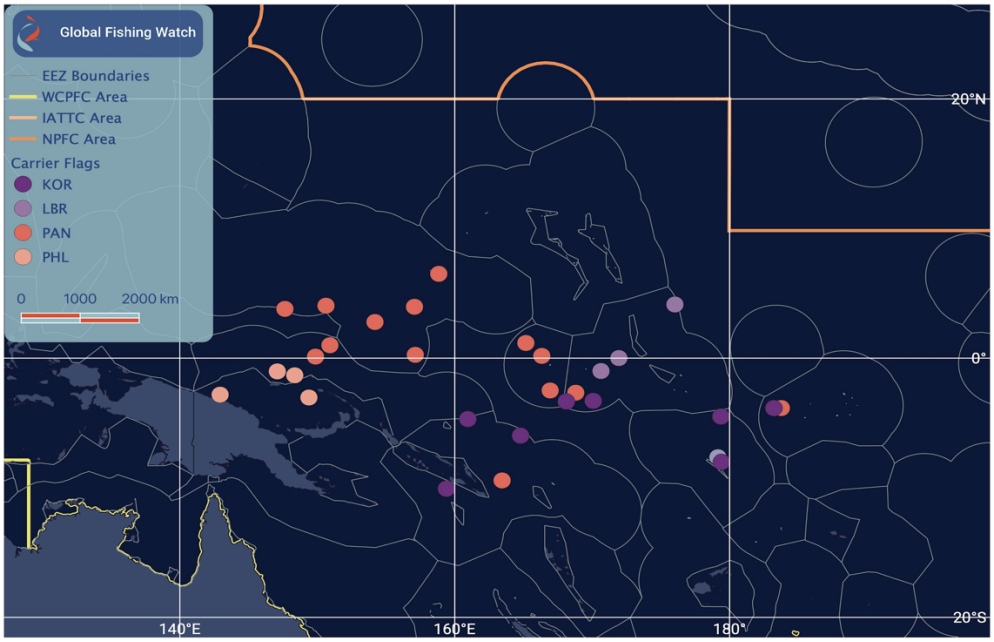


Figure 7 - AIS-Detected Encounters Inside EEZs by Carrier Vessel Flag State

4.5 AIS-Detected Loitering Events

GFW detected 2,395 loitering events on the high seas in the WCPFC Convention Area during calendar 2017 (Figure 8) (See Annex 1-0326-2720). These loitering events involved 129 distinct carrier vessels flagged to 11 different flag States. Of these carrier vessels, 103 were authorized by WCPFC and 7 held authorizations by only NPFC. A total of 19 carrier vessels appeared to not be authorized by either WCPFC or NPFC (Figure 9). More than a third of the loitering events (867 events) were conducted by 58 carrier vessels flagged to Panama, while approximately a third of the events were conducted collectively by carrier vessels flagged to China, Korea, and Chinese Taipei (Figure 9).

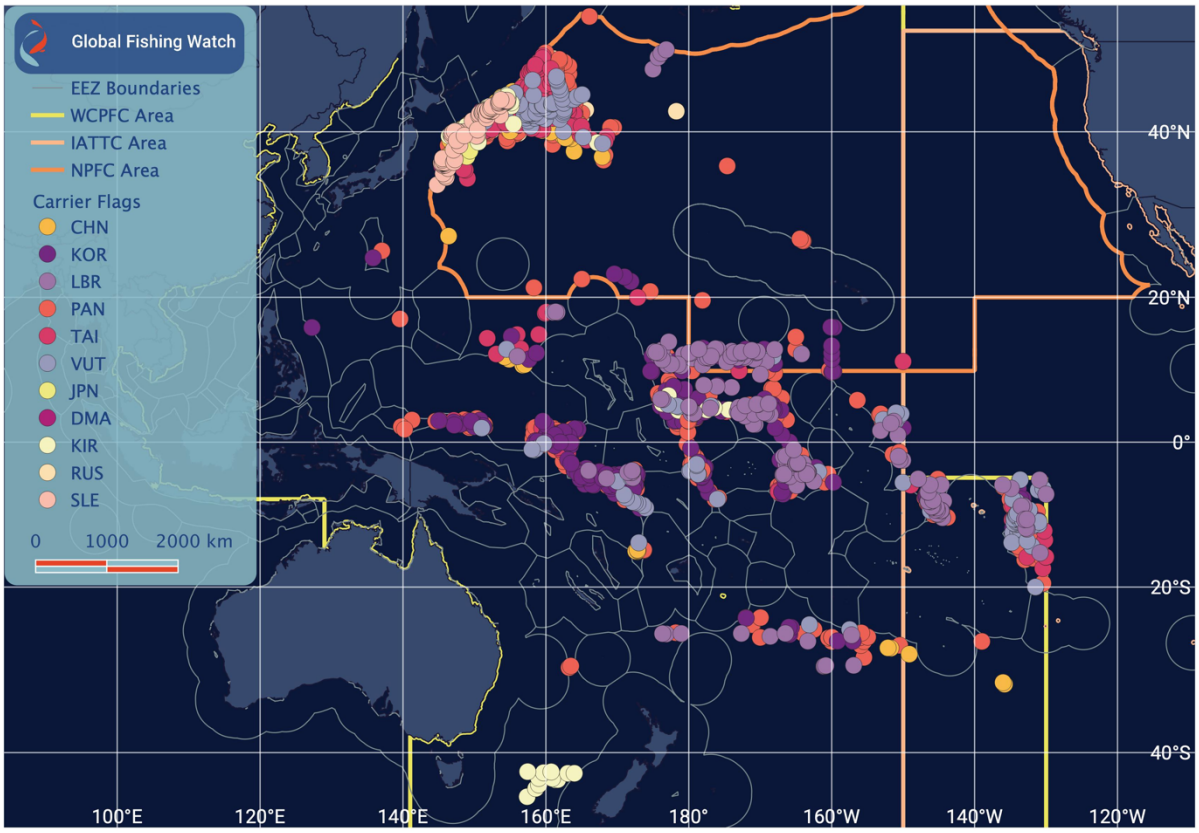
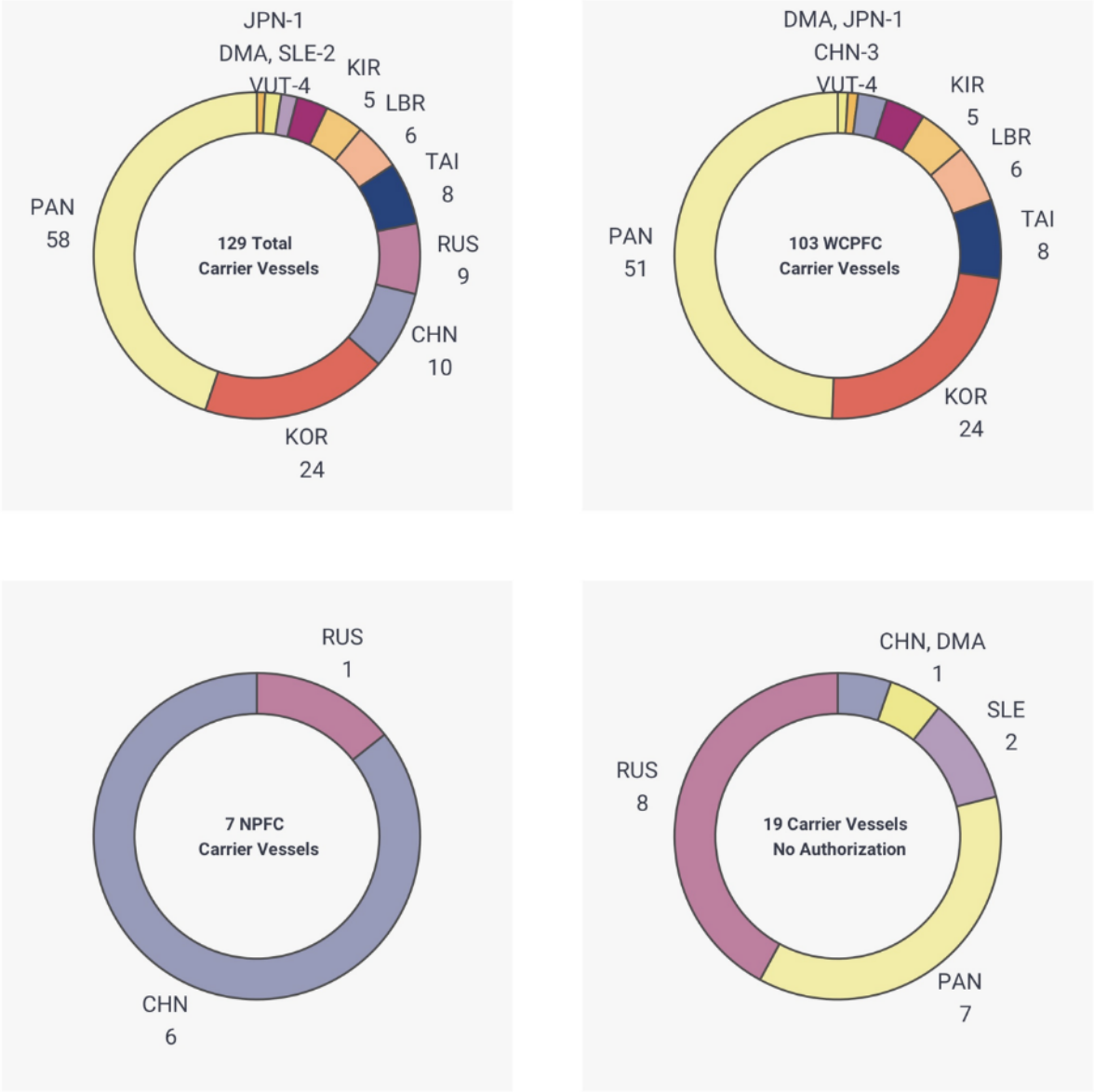


Figure 8 – High Seas Loitering Events in the WCPFC Convention Area by Carrier Flag State



Source: Global Fishing Watch

Figure 9 - Carrier Vessel Flag States in High Seas Loitering Events by Identified RFMO Authorization

In addition to the 2,395 loitering events detected on the high seas, an additional 604 loitering events by carrier vessels were detected to have occurred within the EEZs of Pacific Island coastal State CCMs (See Annex 1-2721-3324). These 604 events involved 96 distinct carrier vessels flagged to 9 different WCPFC flag State CCMs (Figure10).

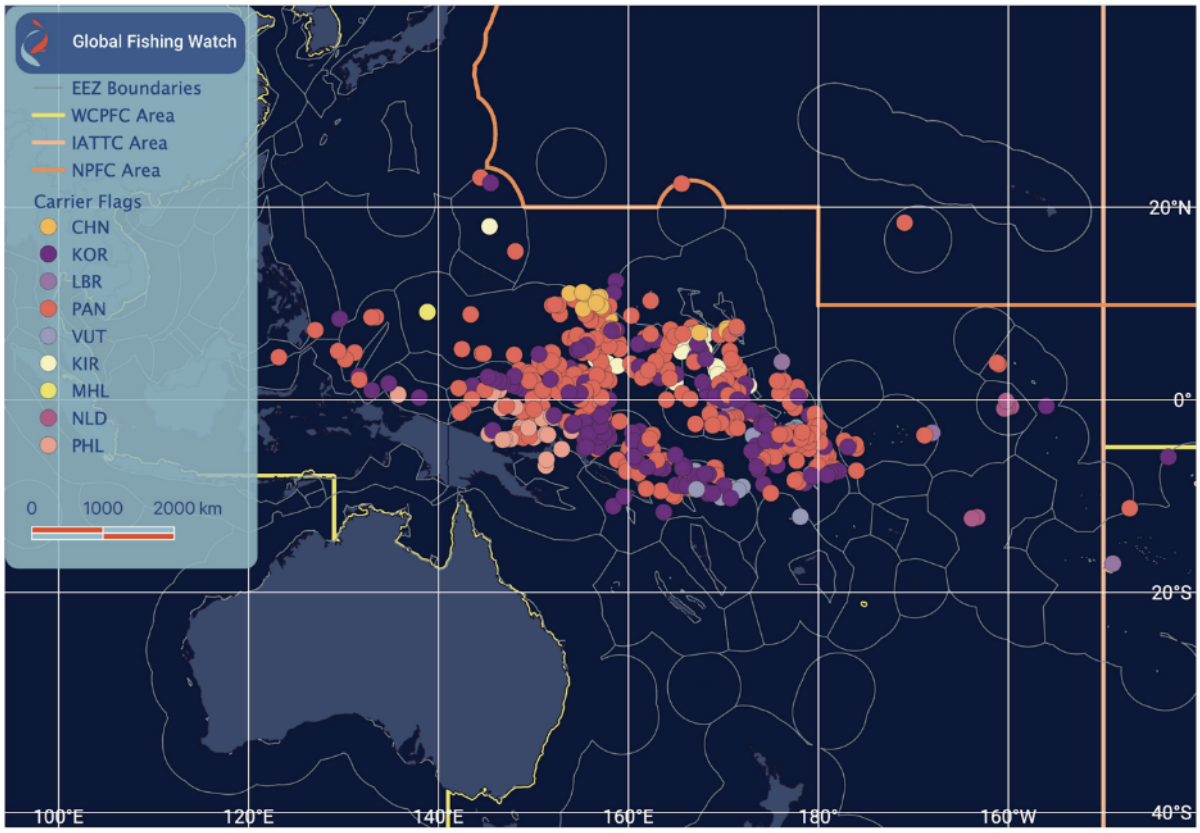


Figure 10 - Loitering Events Inside EEZs within the WCPFC Convention Area by Carrier Vessel Flag State

Figure 11 details the overall duration of observed loitering events. Much like the AIS-detected encounters, the loitering events were less than 24 hours in duration, occurring primarily over periods of between 8 to 24 hours (1,277 events) or shorter at 4 to 8 hours (556 events). A review of ROP reported data on high seas transshipments occurring between vessels authorized under the ICCAT transshipment program indicate that the typical length of time for the active transfer of fish product was reported to be under three hours in duration (See ICCAT ROP reports published during 2016/2017 at https://www.iccat.int/en/ROP.html). This timeframe of active transfer of fish product is likely similar in all ocean regions; however, additional time should be considered for vessel maneuvering prior to and following these high seas transfers. Additionally, the timeframe does not consider multiple transshipments conducted in immediate succession.

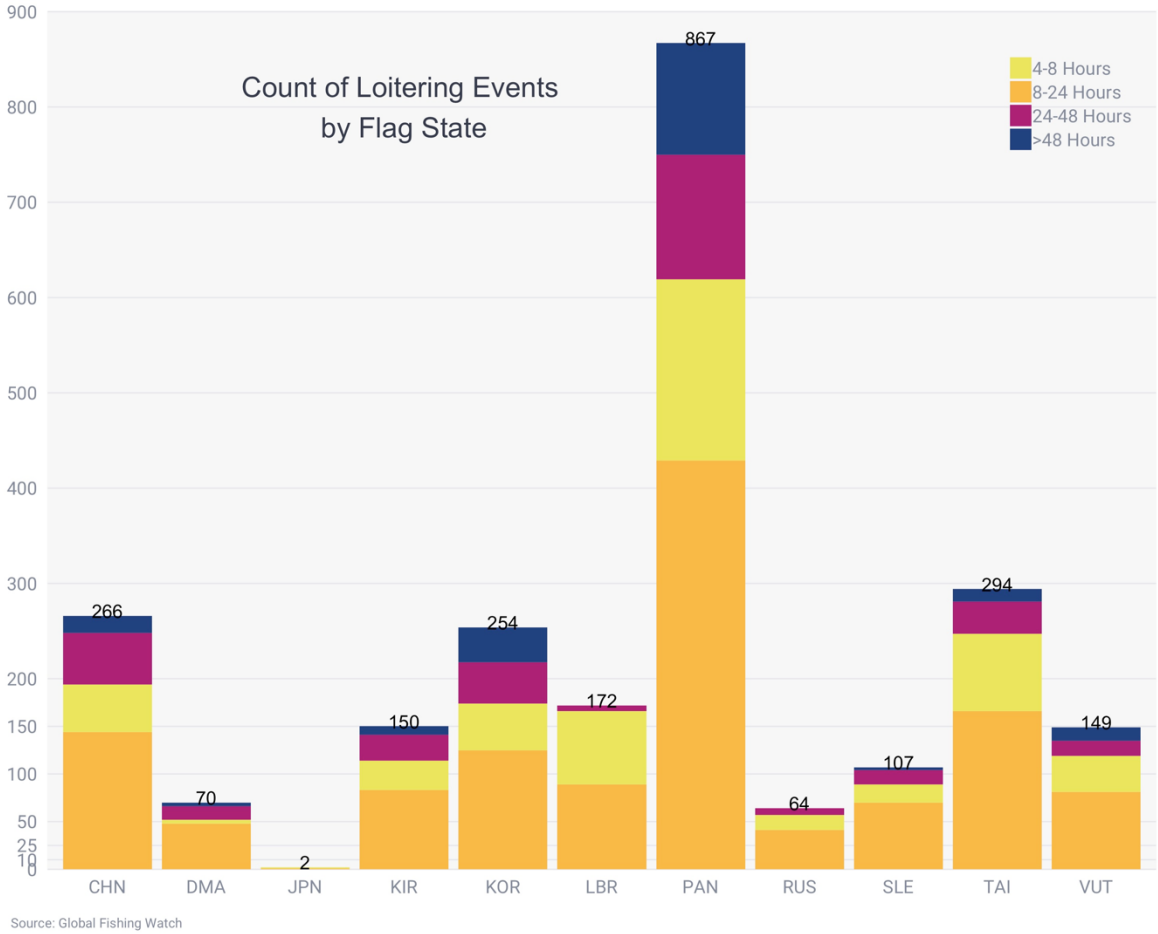


Figure 11 – High Seas Loitering Events by Carrier Vessel Flag State and Time Duration

When all these factors are considered, a reasonable assumption can be made that AIS-detected loitering activities by carrier vessels of less than 24 hours in duration are more likely indicative of a transshipment event than loitering activities greater than 24 hours in duration. Analysis of the AIS-detected loitering activity by carrier vessels indicated that 1,833 of the 2,395 total high seas loitering events were 24 hours or less in duration (Figure 11). which when added to the 295 AIS-detected encounters, totals 2,128 potential high seas transshipment events that may have occurred in 2017. This number is nearly double the number of high seas transshipment events reported in the WCPFC Annual Report on Transshipment (1,089 events) or that was provided by flag State CCM Annual Report Part 1 documents (1,138 events). It is possible that a number of the detected loitering events are indicative of transshipments of WCPFC managed species that went unreported to the Secretariat.

It is important to note that more than half of the observed loitering events occurred on the high seas off Japan where WCPFC waters overlap those of NPFC. The loitering activity of carrier vessels in this region could very well be associated with NPFC-managed species. However, 921 loitering events did occur on the high seas in tropical waters between 30 degrees North latitude and 30 degrees South latitude and these more likely

involved transshipments of WCPFC-managed species or transfers of bait, supplies or crew.

4.6 Key Findings

The following findings are discussed in further detail in Section 9, Key Findings.

- Many more WCPFC-authorized carrier vessels were observed on AIS to have operated in the WCPFC Convention Area waters in 2017 than the 27 distinct carrier vessels that reported high seas transshipments. However, there is very little public information available on the reported activities of these additional carrier vessels.
- Flag State authorization data fields in the publicly available historical WCPFC RFV were missing data for most carrier vessels listed in 2017. The missing historical data adversely impacts the ability for CCM authorities or other independent organizations to conduct retrospective analyses of historical vessel activity reflective of vessel authorization status.
- AIS-detected encounters, as well as AIS-detected loitering events less than 24 hours in duration, appear to be good indicators of potential transshipment activity in the absence of reported data. The total number of high seas loitering events detected via AIS analysis proved to be much higher than the number reported. This may indicate instances where transshipments of WCPFC-managed species on the high seas went unreported.

5 Interactions with other Relevant Pacific RFMOs

Several Pacific fisheries transcend traditional designated RFMO Convention Area boundaries, including the recognized overlap area involving waters of the WCPFC and the IATTC. Additionally, the high seas waters off Japan in the northwest portion of the WCPFC Convention Area overlaps with waters of the NPFC Convention Area. The nature of these three separate RFMOs and the associated fish stocks that each is responsible for presents management challenges that require strong cooperation. This section considers some challenges specifically facing management of transshipment activity across the respective Convention Area boundaries, especially in shared waters.

5.1 Detected Carrier Vessel Activity in Overlapping WCPFC-NPFC Waters

There is no formal or informal information-sharing agreement between WCPFC and NPFC regarding activities that occur in waters that overlap their respective Convention Areas relevant to carrier vessels authorized by both RFMOs. Given the significant level of carrier vessel activity in these overlapping waters, especially on the high seas off Japan, the lack of any arrangement for sharing of information between the two organizations may provide loopholes for vessels to operate in a manner not compliant with the transshipment regulations set out by either organization.

Through AIS analysis, GFW detected a large amount of carrier vessel activity on the high seas off Japan. This region, which consists of overlapping WCPFC and NPFC managed waters north of 30 degrees North latitude and west of 180 degrees longitude, was further analyzed to assess potential patterns of transshipment activity related to these carrier vessels (Figure 12). Within this area, only two AIS-detected encounters were observed. These encounters were conducted by two Panamanian-flagged carrier vessels and a single Chinese-flagged fishing vessel. The fishing vessel was authorized by NPFC at the time of the observed encounters while one of the carrier vessels was authorized by both WCPFC and NPFC. However, it appeared that the second Panamanian carrier involved in one of the two encounters was not authorized by either WCPFC or NPFC at the time of the event.

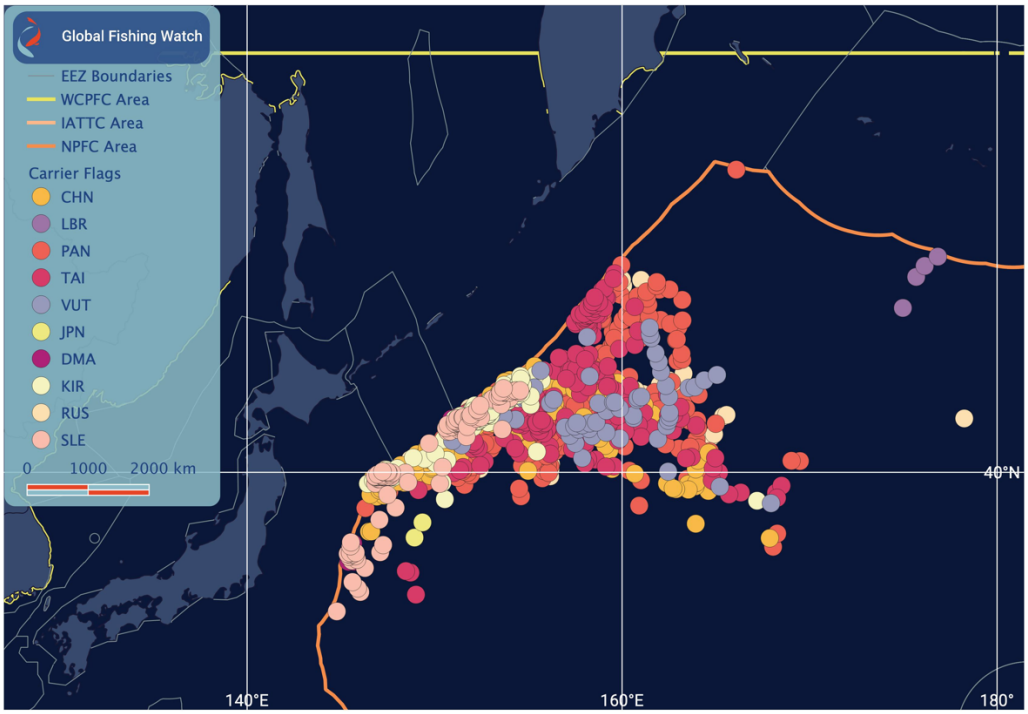


Figure 12 – High Seas Loitering Events within Overlapping WCPFC/NPFC Waters

Though only two encounters were detected in this region, the majority of the loitering events that occurred in the WCPFC Convention Area in 2017 were detected in this area. Almost 61 percent of all loitering events (1,455 events) detected in 2017 occurred on the high seas off Japan in waters managed by both WCPFC and NPFC. The loitering events in this region were conducted by carrier vessels with a combination of WCPFC and NPFC authorizations. A total of 50 distinct carrier vessels were observed with loitering events in this region (Table 2); of these, 16 were authorized solely by WCPFC and should have been involved only in the high seas transshipment of WCPFC-managed species. These 16 carrier vessels were observed to have a total of 466 loitering events on the high seas. This level of activity is concerning given that WCPFC received no reports of high seas

transshipments from authorized carrier vessels in this region in 2017. Most loitering events were less than 24 hours, and therefore there is a strong possibility that these loitering events were transshipments that went unreported to WCPFC.

Table 2 – High Seas Loitering Events within Overlapping WCPFC/NPFC Waters by Flag State and RFMO Authorization

Vessel Flag	Distinct Vessels	Count of Loitering Events	Authorization
Japan	1	1	WCPFC
Kiribati	3	129	WCPFC
Liberia	1	4	WCPFC
Panama	8	210	WCPFC
Chinese Taipei	2	63	WCPFC
Vanuatu	1	59	WCPFC
China	1	60	WCPFC, NPFC
Japan	1	1	WCPFC, NPFC
Panama	5	137	WCPFC, NPFC
Chinese Taipei	3	180	WCPFC, NPFC
China	6	123	NPFC
Russia	1	3	NPFC
China	1	67	Not Identified
Dominica	2*	70*	Not Identified
Panama	4	180	Not Identified
Russia	8	61	Not Identified
Sierra Leone	2	107	Not Identified

*One DMA (Dominican Republic) flagged vessel with 13 loitering events was registered under a different name and flagged to Kiribati in the WCPFC registry until April of 2018 although the IMO database indicates a flag change to DMA occurred in 2016. Because the vessel was not registered with the DMA flag State, we have grouped it into the 'Not Identified' authorization row of this table.

An information-sharing agreement between NPFC and WCPFC could provide WCPFC additional information on the activities of these carrier vessels and whether any transshipments reported to NPFC by these carrier vessels also involved at-sea transfers of WCPFC-managed species. However, with no agreements currently in place, it is likely both RFMOs have little understanding of the full range of activities of carrier vessels

operating on the high seas in this region. This would include whether some or all of them may be conducting at-sea transfers of species managed by both organizations during the same voyage which are not being reported to either RFMO.

Table 2 also outlines that 17 distinct carrier vessels flagged to China, Dominica, Panama, Russia and Sierra Leone appear to have not been authorized by either WCPFC or NPFC to conduct high seas transshipments in their respective Convention Area waters in 2017. These carrier vessels were observed to exhibit 485 separate loitering events. Given the lack of RFMO authorization, it is likely that any high seas transshipments conducted by these carrier vessels during these loitering periods did not get reported to either RFMO. Both WCPFC and NPFC may wish to consider investigating the authorization status and activities of these carrier vessels further to determine whether their activities were compliant with all RFMO management measures.

5.2 Detected Carrier Vessel Activity within the WCPFC-IATTC Overlap Area

As outlined in the June 2006 Memorandum of Understanding (MoU) between WCPFC and IATTC, (WCPFC-IATTC-MoU-Jun-2006), both organizations established efforts to cooperate and collaborate on management efforts, to include fishing activities that occur within the overlap of their respective Convention Areas. As part of the MoU, both organizations agreed to cooperate through the "*…exchange of data and information...*", "*…information-sharing about stocks and species of mutual interest…*", and the "*…active and regular exchange of relevant meeting reports, information, research data and results, project plans, documents, and publications regarding matters of mutual interest…*" (WCPFC-IATTC-MoU-Jun-2006). However, given the number of AIS-detected encounters observed in the WCPFC-IATTC overlap area, the agreement may require strengthening to ensure that cooperation and collaboration specifically extends to transshipment-related activities. Nearly a quarter of the 295 AIS-detected high seas encounters (73 events) observed throughout the WCPFC Convention Area in 2017 occurred in the WCPFC-IATTC overlap area (Figure 13). Most of these encounters were conducted by carriers flagged to Panama (20 encounters), while Liberian- and Vanuatuan-flagged carriers also participated in many of the encounters (15 and 13 encounters, respectively) (Figure 14).

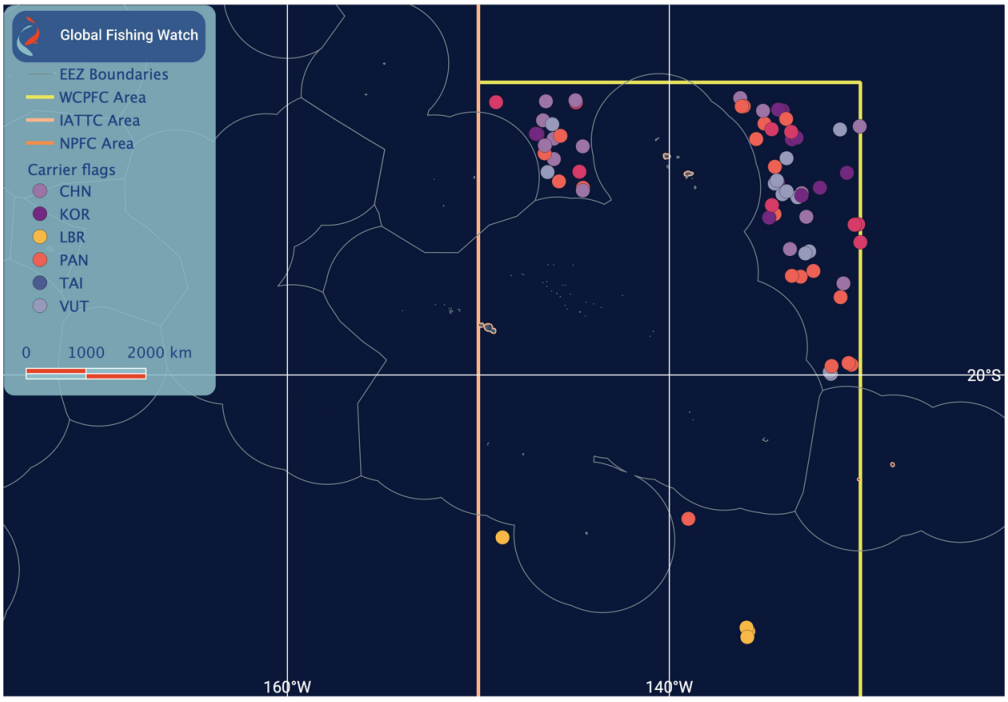


Figure 13 – AIS-Detected High Seas Encounters in the WCPFC-IATTC Overlap Area by Carrier Vessel Flag State

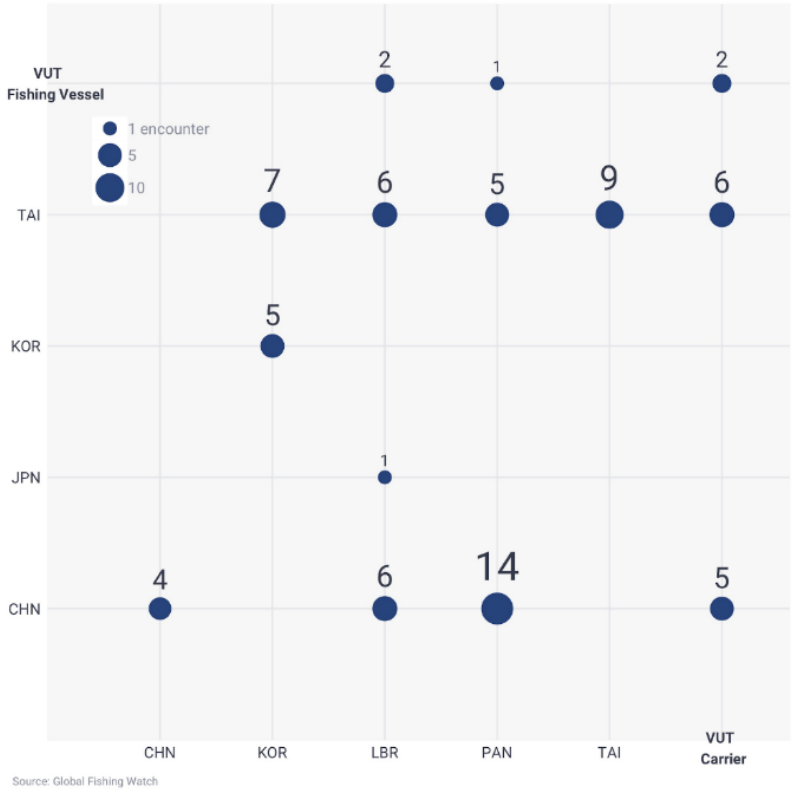


Figure 14 - AIS-Detected High Seas Encounters between Carrier and Fishing Vessels in the WCPFC-IATTC Overlap Area

These encounters were conducted by 14 distinct carrier vessels flagged to six different flag State CCMs and 53 distinct fishing vessels flagged to five different flag State CCMs. Fishing vessels flagged to China and Chinese Taipei were engaged in most encounters accounting for 45 of the 53 fishing vessels identified (Figure 15).

Source: Global Fishing Watch

Figure 15 - Distinct Carrier and Fishing Vessels in AIS-Detected High Seas Encounters within the WCPFC-IATTC Overlap Area

Fewer loitering events were observed in the WCPFC-IATTC overlap area than were observed in the overlapping WCPFC-NPFC waters on the high seas off Japan. A total of 149 loitering events, or approximately six percent of all loitering events observed in the WCPFC Convention Area in 2017 occurred in the WCPFC-IATTC overlap area. As with other regions of the WCPFC Convention Area, carrier vessels flagged to Panama were the dominant fleet observed in loitering events in this region, with a total of 45 events. Additionally, most loitering events in the WCPFC-IATTC overlap area were less than 24 hours in duration, which has a higher likelihood that the loitering is indicative of transshipment activity. It is unclear if any of these potential transshipments were reported to either WCPFC or IATTC.

5.3 Key Findings

The following findings are discussed in further detail in Section 9, Key Findings.

- More than 60 percent of all loitering activity within the WCPFC Convention Area in 2017 occurred on the high seas off Japan where waters are also managed by NPFC. Currently, there is no formal nor informal arrangement between WCPFC and NPFC for sharing information on fishing activities occurring in this region including

high seas transshipments involving carrier vessels, many of which are authorized by both organizations.

- Nearly a quarter of all encounters within the WCPFC Convention Area in 2017 occurred in the WCPFC-IATTC overlap area. In addition, many of the 27 carrier vessels that reported high seas transshipments appeared to use the overlap area to conduct at least some of those transshipments. This suggests that the WCPFC-IATTC overlap area is one of the most highly frequented areas for transshipment activity in the entire WCPFC Convention Area as noted in the annual report by the Secretariat.

6 Port Activity

An analysis of the ports visited by carrier vessels observed in either AIS-detected encounters with longline vessels or loitering events in the WCPFC Convention Area in 2017 indicated 42 port cities in 24 port States were visited after these possible transshipment activities occurred (Figure 16) (See Annex 1-3325-3931).

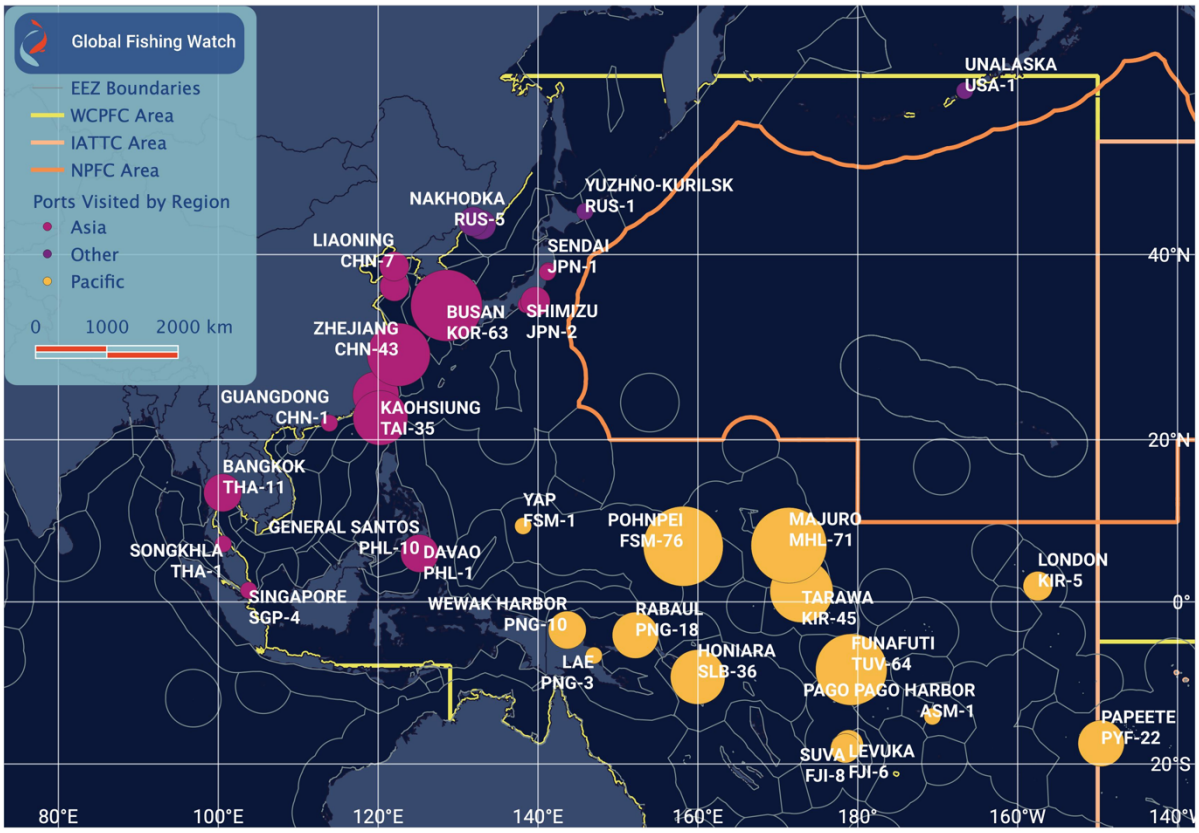


Figure 16 - Count of Port Visits by Carriers after AIS Detected Events within WCPFC

The Pacific ports most visited by carrier vessels after AIS-detected encounters and/or loitering events were Pohnpei, Majuro, Funafuti and Tarawa. The most visited Asian port

was Busan (Table 3). These ports were favored among the top six carrier fleets flagged to the CCMs of Panama, China, Chinese Taipei, Korea, Liberia, and Vanuatu. Panamanian carriers preferred the top five most visited ports by all carriers, while China and Chinese Taipei carriers were observed visiting Chinese ports and other Asian ports more frequently than the Pacific ports favored by other fleets (See Annex 1-3325-3931).

Table 3: Top Pacific and Asian Port Visits by Carrier Vessels in 2017 following an AIS-Detected Event

Pacific Ports				**Asian Ports**		
City	Port State	Count		City	Port State	Count
Pohnpei	FSM	76		Busan	KOR	63
Majuro	MHL	71		Zhejiang	CHN	43
Funafuti	TUV	64		Kaohsiung	TAI	35
Tarawa	KIR	45		Fujian	CHN	25
Honiara	SLB	36		Bangkok	THA	11
Papeete	PYF	22		General Santos	PHL	10
Rabaul	PNG	18		Liaoning	CHN	7
Wewak	PNG	10		Yokosuka	JPN	6
Suva	FJI	8		Shandong	CHN	5
Levuka	FJI	6		Singapore	SGP	4

Of the top port States visited by carrier vessels in 2017 following encounters with fishing vessels and/or loitering events, only Japan, Korea, and Thailand were party to the PSMA[5]. As of today, Fiji and the Philippines are also party to the PSMA. The remaining most visited port States by carrier vessels in both Asia and the Pacific have yet to accede to the PSMA (noting Chinese Taipei is unable to ratify the PSMA). Having a better understanding of carrier vessel port visits by those carrier vessels operating in the WCPFC Convention Area, especially those that have had AIS-detected encounters with fishing vessels at sea, should help WCPFC CCMs determine those ports more conducive to the offloading of WCPFC-managed species to ensure they do not go unreported. Consequently, these ports may represent the most important port locations to ensure effective port inspection programs are in place to more effectively monitor, regulate, and report at-sea transfers and landings of species under WCPFC management.

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

Although the analysis methodologies are slightly different, when the outputs of GFW 2017 port analysis are compared to the WCPFC carrier vessel port visit analysis conducted by Pew for the previous year in 2016 (see The Pew Charitable Trusts 2019), trends begin to emerge (See Annex 1-3325-3955). The most visited Pacific ports were nearly identical in both 2016 and 2017 with the top five ports seen as Majuro, Pohnpei, Tarawa, Funafuti and Honiara. Likewise, for the Asian ports, although the specific ports do not strictly correlate, the Asian destination port States for both 2016 and 2017 remain the same with Korea, China, Chinese Taipei, Thailand, Japan, Singapore and the Philippines all appearing on the lists for both years. Of specific interest is that Singapore has yet to accede to the PSMA and is the only destination port State that is not a CCM of WCPFC. This means that Singapore is not bound by any obligations afforded by the PSMA or the WCPFC port State management measure adopted by WCPFC. In addition, Singapore was also identified as a top destination port for carrier vessels that were identified via AIS analysis to have operated in waters managed by ICCAT, IOTC and CCSBT and appeared to have encounters with fishing vessels while in those waters (See reports: https://globalfishingwatch.org/rfmo-transshipment/). Singapore is not a Contracting Party or Cooperating Non-Contracting Party to these three RFMOs as well and therefore not bound by any of their own implemented port State management measures either.

Table 4: Top Pacific and Asian Port Visits by Carrier Vessels in 2016

Pacific Ports				**Asian Ports**		
City	Port State	Count		City	Port State	Count
Majuro	MHL	165		Busan	KOR	152
Pohnpei	FSM	113		Bangkok	THA	142
Tarawa	KIR	64		Kaoshiung	TAI	134
Honiara	SLB	62		Ningbo-Zhoushan	CHN	61
Funafuti	TUV	55		Shimizu	JPN	49
Rabaul	PNG	36		General Santos	PHL	47
Wewak	PNG	18		Singapore	SGP	33
Papeete	PYF	17		Dalian	CHN	22
Suva	FJI	14		Songkhla	THA	18
Madang	PNG	13		Qingdao	CHN	17

Table 5 details the most frequently visited Pacific and Asian port States the largest WCPFC CCM-flagged carrier fleets. In 2017 the carrier fleets flagged to China, Chinese

Taipei, and Korea all primarily returned to their home ports. The same was true in 2016. The remaining three carrier vessel fleets are flagged to CCMs which have open vessel registries, often called "flags of convenience" because registration is open to any foreign-owned vessels. Of note is that PSMA inspection obligations are targeted for port visits by foreign-flagged fishing vessels and not the domestically flagged fishing vessel fleet of the relevant port State. Therefore, if the port State CCMs of China, Chinese Taipei, and Korea (noting Chinese Taipei is unable to ratify the PSMA) were to accede to the PSMA, the inspection requirements would not necessarily extend to these fleets of carrier vessels when they visited destination ports in the CCMs from which they are flagged.

Table 5: Top Pacific and Asian Port States Visited by Flag State of Carrier Vessel

2016				2017		
Flag State	Pacific	Asian		Flag State	Pacific	Asian
China	*no data*	*no data*		China	MHL	CHN
Chinese Taipei	SLB	TAI		Chinese Taipei	*none*	TAI
Korea	KIR	KOR		Korea	TUV	KOR
Liberia	MHL	JPN		Liberia	MHL	JPN
Panama	MHL	KOR		Panama	MHL	CHN
Vanuatu	PYF	KOR		Vanuatu	PYF	TAI / JPN

6.1 Key Findings

The following findings are expanded further on in Section 9, Key Findings.

- AIS analysis can be effectively used to identify port visit trends by carrier vessels and highlight those ports most often used for onloading and offloading of WCPFC-sourced and transshipped fish species. These, in turn, may represent the most important port locations to monitor and regulate in-port transshipments and the landing of WCPFC-sourced fish product
- Analysis of AIS data indicated a wide variety of ports were visited by carrier vessels following AIS-detected encounters at sea with fishing vessels in the WCPFC Convention Area in 2017. However, none of the top eight Pacific port States visited by carrier vessels and only three of the seven top Asian destination port States were a Party to the PSMA in 2017.

7 Carrier Fleet Dynamics

AIS analysis showed how carrier vessel activity varied by fleet across the WCPFC Convention Area in 201 (Figure 17).

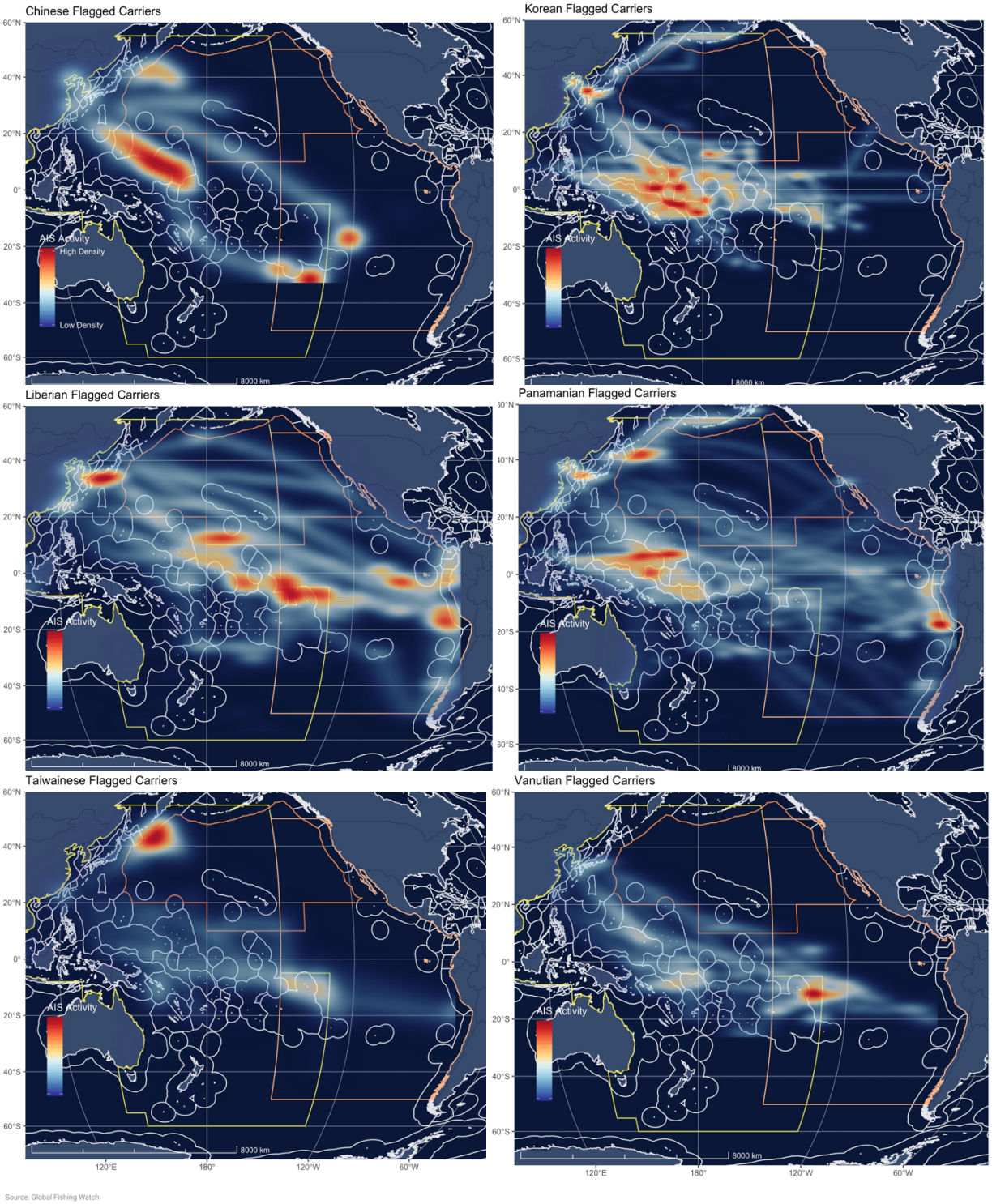


Figure 17: Density of AIS Activity During 2017 for Carrier Vessel Fleets by flag State

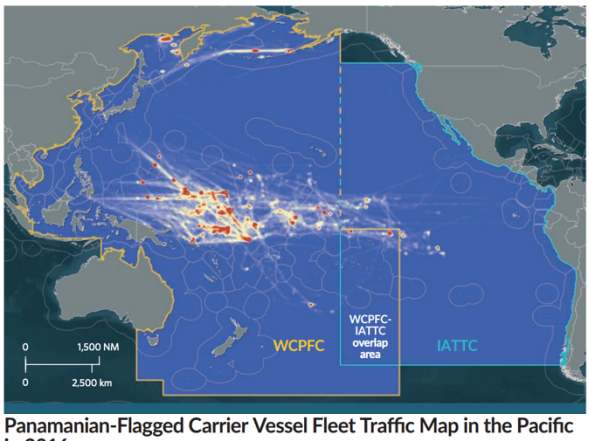
These heat maps summarize the annual activity for carrier vessels flagged to the States of China, Korea, Liberia, Panama, Chinese Taipei, and Vanuatu, which were the most

active carrier vessel fleets in WCPFC waters in 2017 and are the only carrier vessel fleets which reported high seas transshipments.

The carrier fleet movements by flag remain remarkably similar to fleets movements made in 2016 (Figure 18). Trends over time appear to indicate concentrated activity within the WCPFC-IATTC Overlap Area. This is likely a sign the carrier vessel fleets flagged to Chinese Taipei, Vanuatu and Liberia primarily conduct at-sea transshipments of bigeye, yellowfin and albacore with longline vessels. Carrier fleets flagged to Panama and Korea appear to focus on Pacific ports to engage with purse seiners transshipping skipjack tuna as these vessels are almost exclusively required to transship in port.

South Korean-Flagged Carrier Vessel Fleet Traffic Map in the Pacific in 2016

Areas shown in red indicate concentrations of carrier vessel AIS tracks

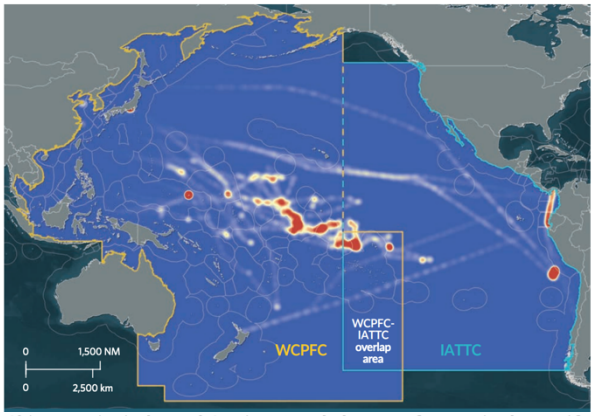


Panamanian-Flagged Carrier Vessel Fleet Traffic Map in the Pacific in 2016

Areas shown in red indicate concentrations of carrier vessel AIS tracks

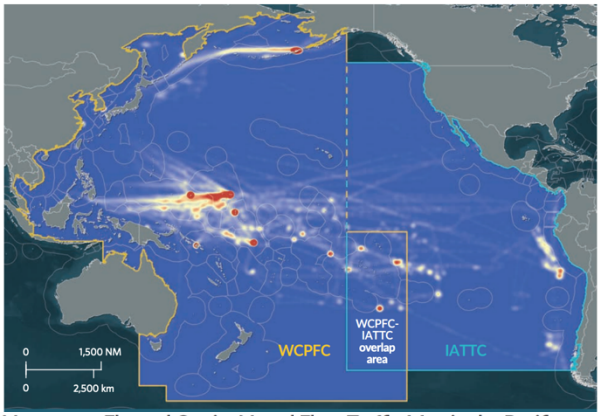
Liberian-Flagged Carrier Vessel Fleet Traffic Map in the Pacific in 2016

Areas shown in red indicate concentrations of carrier vessel AIS tracks



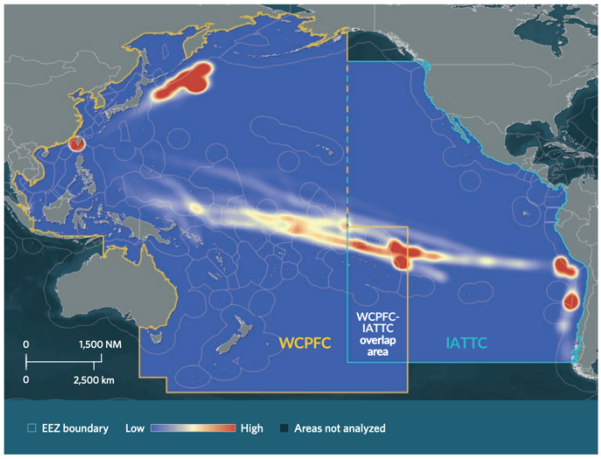
Chinese Taipei-Flagged Carrier Vessel Fleet Traffic Map in the Pacific in 2016

Areas shown in red indicate concentrations of carrier vessel AIS tracks



Vanuatuan-Flagged Carrier Vessel Fleet Traffic Map in the Pacific in 2016

Areas shown in red indicate concentrations of carrier vessel AIS tracks



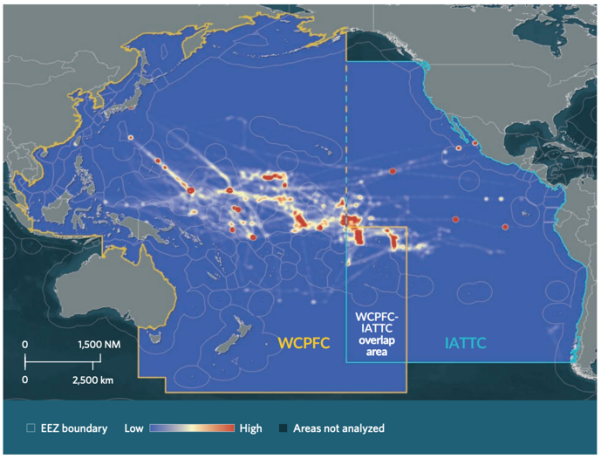


Figure 18: Density of AIS Activity During 2016 for Carrier Vessel Fleets by flag State (The Pew Charitable Trusts 2019)

The Chinese-flagged carrier vessel fleet also appeared to target transshipment of skipjack tuna in Pacific ports as well as southern albacore in the southern portions of the WCPFC-IATTC Overlap Area. The carrier vessel fleets flagged to China, Chinese Taipei and Panama also appear active on the high seas off Japan in 2017 in waters that are dually managed by both WCPFC and the NPFC. This is the same dynamic that was observed in 2016 and represents a region of potential risk of unreported transfers due to current transshipment management reporting shortfalls under both WCPFC and NPFC.

7.1 Key Findings

The following findings are expanded on further in Section 9, Key Findings:

- AIS analysis provides an opportunity to better understand fleet dynamics of carrier vessels and how these differ based on flag State. This understanding provides greater context for both fisheries managers and authorities that can help them make better informed management and compliance risk decisions.

8 Data Caveats

The analysis presented in this report relies on commercially available AIS data and publicly available information. Therefore, AIS data is limited to only those vessels that transmit on AIS and do so by providing accurate vessel identity information. Low satellite coverage or high-density areas can also limit AIS data usefulness. The WCPFC Convention Area has relatively strong Class-A AIS reception, however, there may be a limit on AIS data in the WCPFC Convention Area due to use of AIS, for instance there tends to be less vessel presence in the Southern Ocean (see Kroodsma et al. 2018). AIS data tends to be sparser and more limited for vessels equipped with a Class-B AIS device (Kroodsma et al. 2018). AIS device class often depends on flag State regulations, vessel length, and vessel purpose. Because of the limitations of AIS data, lack of complete and accurate public vessel database registries, and limitations of modelling estimations, the AIS-detected encounter, and loitering data, are represented as accurately as possible but should be considered restrained estimates based on these limitations (see Kroodsma et al. 2018, Miller et al. 2018, and https://globalfishingwatch.org/ for further discussion).

9 Key Findings and Recommendations

Carrier vessel activity in the WCPFC Convention Area during calendar year 2017 was reviewed via a comparative analysis of commercially available AIS data with publicly available information related to carrier vessels and transshipment. The resulting analysis produced the following 12 Key Findings. Recommendations relative to these key findings are provided for consideration by WCPFC Members as options for addressing the issues raised.

- **Key Finding 1:** Many more WCPFC-authorized carrier vessels were observed on AIS to have operated in the Convention Area in 2017 than the 27 distinct carrier vessels which reported high seas transshipments. However, there is very little public information reported on the activities of these additional carrier vessels, as information required to be provided by relevant flag, coastal, and port State CCM authorities on the activities of these vessels proved to be inconsistent, non-standardized, or in many cases, not provided at all.
    - *Recommendation:* The Commission should require that all transshipment events be reported to the Secretariat, regardless of location, to ensure a full accounting of all transshipment activity occurring in the Convention Area as conducted by authorized carrier vessels.
    - *Recommendation:* A standardized reporting template should be implemented for CCMs to report on the annual cumulative activities of their flagged carrier vessels to minimize reporting data gaps, data inconsistencies, and non-standardized reporting information.
- **Key Finding 2:** AIS-detected encounters and loitering events less than 24 hours in duration appear to be good indicators of potential transshipment activity in the absence of reported data. The total number of these high seas encounters and loitering events proved to be much higher than the number reported by CCMs. This may indicate instances where transshipments of WCPFC-managed species on the high seas went unreported.
    - *Recommendation:* WCPFC should consider the use of AIS as a supplemental tool to help monitor and validate transshipment activity and assist in the early detection of potential noncompliant behavior that may require further follow up by the Secretariat or CCM authorities. This would be further strengthened by mandating use of AIS by all WCPFC-authorized vessels.
- **Key Finding 3:** More than 60 percent of all AIS-detected loitering activity within the WCPFC Convention Area in 2017 occurred on the high seas off Japan, where waters are also managed by NPFC. Currently, there is no formal or informal arrangement between WCPFC and NPFC for sharing information on fishing activities occurring in this region including high seas transshipments involving carrier vessels, many of which are authorized by both organizations.
    - *Recommendation:* The Commission should establish a strong information-sharing agreement with NPFC to ensure carrier vessel activity in this region involving transshipments of both WCPFC and NPFC managed species are duly accounted for by the relevant RFMO.
    - *Recommendation:* Both WCPFC and NPFC may wish to consider investigating the authorization status and activities of the carrier vessels which did not appear to be authorized by both RFMs which were detected by AIS to have been operating on the high seas off Japan to determine whether their activities were compliant with all RFMO management measures.
- **Key Finding 4:** Nearly a quarter of all encounters within the WCPFC Convention Area in 2017 occurred in the WCPFC-IATTC overlap. Additionally, many of the 27

carrier vessels that reported high seas transshipments appeared to use the overlap area to conduct at least some of those transshipments. This suggests that the WCPFC-IATTC overlap area is one of the most frequented areas for transshipment activity in the entire WCPFC Convention Area.
    - *Recommendation:* WCPFC should engage with IATTC to conduct a collaborative formal review of how both organizations collectively manage the WCPFC-IATTC overlap area. This would ensure that all management regulations, including those involving transshipment, are clear, transparent, and provide enough management control and oversight that undetected noncompliant behavior is minimized.
    - *Recommendation:* Information on the time and location of transshipments reported by carrier vessels, specifically occurring in the WCPFC-IATTC overlap area, would help eliminate confusion around which relevant RFMO transshipments were being reported to and may help identify possible noncompliant behavior.
- **Key Finding 5:** AIS analysis can be effectively used to identify port visit trends by carrier vessels, and highlight those ports most often used for onloading and offloading of WCPFC-sourced and transshipped fish species. These, in turn, may represent the most important port locations to monitor and regulate in-port transshipments and the landing of WCPFC-sourced fish product
    - *Recommendation:* WCPFC should continue to revise and enhance CMM 2017-02 *on Minimum Standards for Port State Measures* with the aim of giving effect to the PSMA throughout the Convention Area and help minimize opportunities for the introduction of illegally caught or misreported WCPFC-sourced fish from entering the seafood supply chain.
- **Key Finding 6:** Analysis of AIS data indicated a wide variety of ports were visited by carrier vessels following AIS-detected encounters at sea with fishing vessels in the WCPFC Convention Area in 2017. However, none of the top eight Pacific port States and only three of the seven top Asian destination port States were party to the PSMA in 2017.
    - *Recommendation:* WCPFC CCMs that represent those countries most commonly associated with transshipments and landings of WCPFC-sourced fish should consider the benefits of ratifying and implementing the PSMA as a means to help detect, deter, and eliminate illegal fishing.
- **Key Finding 7:** AIS analysis provides an opportunity to better understand fleet dynamics of carrier vessels and how these differ based on flag State. This understanding provides greater context for both fisheries managers and authorities that can help them make better informed management and compliance risk decisions.
    - *Recommendation:* As stated above, WCPFC should consider using AIS as a supplemental tool to help monitor fishing activity, including validating potential at-sea transshipments. In this case, CCM authorities can use analysis of AIS to help target vessels for inspection such as those fleets conducting at-sea transshipment involving higher value species such as bigeye, yellowfin and albacore, or that operate in areas such as the WCPFC-

IATTC overlap area, as these may represent higher risks for misreporting or nonreporting of catch to the relevant RFMO.

- *Recommendation:* Location, date and time, flag of the donor vessel and name of the carrier vessel should be made public as part of WCPFC annual transshipment reporting so that interested parties like fish buyers, port States and researchers can easily access the information for validation and analysis.

10 Conclusion

Detailed analysis of AIS data related to transshipment activity within an RFMO can provide valuable insight into fishing activity, including transshipment patterns, and can help identify potential gaps or loopholes in management measures when they are implemented on the water. AIS data can also provide an additional source of information for management authorities that can be reviewed alongside existing data sources (e.g. transshipment declarations, VMS data, and authorization information) and used to support verification of legal transshipment events. Collective use of these tools can ultimately help build a more complete picture of activities at sea and identify non-compliant activity that may be conducted outside of existing regulations.

By building a more complete picture of transshipment activity, policy makers can focus on strengthening management measures specific to what is happening on the water, particularly on the high seas, far from direct oversight of management and inspection authorities. This study identified risks associated with at-sea transshipment in the WCPFC Convention Area and how those transshipments are monitored and reported by the Secretariat and CCMs. This study shows that gaps in the current WCPFC transshipment regulatory framework and MCS structure appear to be exploited. Preventing transshipments linked to IUU fishing activity in the future will rely on effective management of the activity with the support of such tools as centralized VMS, robust data-sharing arrangements amongst relevant authorities and potential adoption of AIS as a supplemental and complementary monitoring tool. In addition, the current data-sharing MoU with IATTC should be strengthened to specifically include the sharing of all transshipment-related data as well as a similar agreement be established with NPFC due to the amount of transshipment-related activities that occur in these waters of overlapping management jurisdiction by vessels authorized to both organizations.

Port State controls have been identified as vital for detecting IUU fishing activity (FAO 2016, Swan 2016). Carrier vessels unauthorized to transship in WCPFC waters should be closely inspected on port arrival if there are indications the fishing vessels operated in WCPFC waters prior to arrival. If these countries are party to the PSMA, foreign fishing vessels can be denied entry if unreported or potentially unauthorized transshipments in WCPFC waters are identified. States not party to the PSMA that receive unauthorized carriers in their ports that have operated in WCPFC waters should also be directly engaged by WCPFC to establish collaborative mechanisms to strengthen port controls related to these vessels. Additionally, cooperation with these States would help WCPFC

effectively respond to clear cases of any WCPFC-related activity that appears to be in contravention of WCPFC management measures.

The synthesis of AIS data with vessel authorization information to the extent presented in this report is not common practice by RFMO Compliance Committees. AIS data can provide insight into patterns of fishing behavior, for example, possible transshipments within the RFMO Convention Areas by vessel type, flag State, authorization, port visits, and across space and time. GFW intends to help expedite efficient and effective monitoring and regulation in RFMO Convention Areas by highlighting these patterns of activity in order to facilitate timely investigations into potential non-compliant activity. GFW hopes that this will increase the likelihood of successful detection and intervention by relevant State authorities. A second intention of this study is to allow flag State authorities to independently use the AIS-based information to investigate anomalies and possible unauthorized activity of their flag vessels. This is especially true as most of the data needed to do this is not publicly available and requires direct engagement with other relevant authorities such as port State inspectors.

Incorporating AIS into compliance monitoring by WCPFC would be further strengthened by Commission members agreeing to mandate use of AIS by all eligible vessels of CCMs when these vessels operate in the WCPFC Convention Area. This study highlights the value of AIS data, and how a shift towards data transparency in tuna fisheries can lead to a more complete understanding of transshipment activity and stronger controls against IUU fishing.

References

Boerder, K., Miller, N. A., and Worm, B. (2018). Global hot spots of transshipment of fish catch at sea. *Science Advances* 4, eaat7159. doi:10.1126/sciadv.aat7159.

FAO (2016). Agreement on Port State Measures to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing.

Hamilton NE, Ferry M (2018). "ggtern: Ternary Diagrams Using ggplot2." _Journal of Statistical Software, Code Snippets_, *87*(3), 1-17. doi: 10.18637/jss.v087.c03 (URL: https://doi.org/10.18637/jss.v087.c03).

IMO (2002). Resolution A.917(22) Guidelines for the onboard operational use of shipborne automatic identification systems (AIS).

INTERPOL (2014). Study on Fisheries Crime in the West African Coastal Region. Environmental Security Sub-Directorate.

Kahle D and Wickham H. ggmap: Spatial Visualization with ggplot2. The R Journal, 5(1), 144-161. http://journal.r-project.org/archive/2013-1/kahle-wickham.pdf.

Kroodsma, D. A., Mayorga, J., Hochberg, T., Miller, N. A., Boerder, K., Ferretti, F., et al. (2018). Tracking the global footprint of fisheries. *Science* 359, 904–908. doi:10.1126/science.aao5646.

Miller, N. A., Roan, A., Hochberg, T., Amos, J., and Kroodsma, D. A. (2018). Identifying Global Patterns of Transshipment Behavior. *Front. Mar. Sci.* 5. doi:10.3389/fmars.2018.00240.

Ortiz, A. J. (2016). Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing. *Int. leg. mater.* 55, 1157–1179. doi:10.1017/S0020782900030886.

R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Sala, E., Mayorga, J., Costello, C., Kroodsma, D., Palomares, M. L. D., Pauly, D., et al. (2018). The economics of fishing the high seas. *Science Advances* 4, eaat2504. doi:10.1126/sciadv.aat2504.

Swan, J. (2016). Implementation of Port State Measures - Legislative template, framework for procedures, role of regional fisheries management organizations. Rome: FAO.

The Pew Charitable Trusts (2019). Transshipment in the Western and Central Pacific.

WCPFC (2009). Conservation and Management Measure on the Regulation of Transhipment - CMM 2009-06.

WCPFC (2014). Standards, Specifications and Procedures for the Western and Central Pacific Fisheries Commission Record of Fishing Vessels - CMM 2014-03.

WCPFC (2018). Annual Report for the WCPFC Record of Fishing Vessels - WCPFC-TCC14-2018-RP05.

WCPFC (2018a). Annual Report on WCPFC Transhipment Reporting with an Emphasis on High Seas Activities - WCPFC-TCC14-2018-RP03. Available at: https://www.wcpfc.int/node/31649.

WCPFC (2018b). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—China (WCPFC-SC-14-AR/CCM-03). Available at: https://www.wcpfc.int/node/30866.

WCPFC (2018c). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Chinese Taipei (WCPFC-SC-14-AR/CCM-23 Rev01). Available at: https://www.wcpfc.int/node/30865.

WCPFC (2018d). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—European Union (WCPFC-SC-14-AR/CCM-05). Available at: https://www.wcpfc.int/node/30842.

WCPFC (2018e). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Federated States of Micronesia (WCPFC-SC-14-AR/CCM-06). Available at: https://www.wcpfc.int/node/30862.

WCPFC (2018f). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Japan (WCPFC-SC-14-AR/CCM-10). Available at: https://www.wcpfc.int/node/30828.

WCPFC (2018g). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Kiribati (WCPFC-SC-14-AR/CCM-11). Available at: https://www.wcpfc.int/node/30854.

WCPFC (2018h). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Liberia (WCPFC-SC-14-AR/CNM-32). Available at: https://www.wcpfc.int/node/30824.

WCPFC (2018i). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Panama (WCPFC-SC-14-AR/CNM-34). Available at: https://www.wcpfc.int/node/30773.

WCPFC (2018j). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Papua New Guinea (WCPFC-SC-14-AR/CCM-19). Available at: https://www.wcpfc.int/node/30868.

WCPFC (2018k). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Philippines (WCPFC-SC-14-AR/CCM-20). Available at: https://www.wcpfc.int/node/30817.

WCPFC (2018l). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Republic of Korea (WCPFC-SC-14-AR/CCM-12). Available at: https://www.wcpfc.int/node/30867.

WCPFC (2018m). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Republic of Marshall Islands (WCPFC-SC-14-AR/CCM-13). Available at: https://www.wcpfc.int/node/30853.

WCPFC (2018n). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Thailand (WCPFC-SC-14-AR/CNM-35). Available at: https://www.wcpfc.int/node/30860.

WCPFC (2018o). Annual Report to the Commission Part 1: Information on Fisheries, Research, and Statistics—Vanuatu (WCPFC-SC-14-AR/CCM-28). Available at: https://www.wcpfc.int/node/30855.

WCPFC (2019). Historical Record of Fishing Vessels (RFV) Data - as at 31 July 2019. Available at: https://www.wcpfc.int/doc/historical-record-fishing-vessels-rfv-data.

WCPFC and IATTC (2006). Memorandum of Understanding between The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean and The Inter-American Tropical Tuna Commission

Wickham H. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York, 2016.

Annex 2: Detailed Methodology

AIS-Based Data Methods

GFW uses publicly broadcasted AIS data to estimate vessel information and vessel activity, including encounters and loitering events. Vessel encounters are defined when two vessels are within 500 meters of each other for at least 2 hours and traveling at < 2 knots, while at least 10 kilometers from a coastal anchorage (Miller et al. 2018). Whereas, vessel loitering is when a carrier vessel travelled at speeds of < 2 knots for at least 4 hours, while at least 20 nautical miles from shore (see Miller et al. 2018 for original methodology, however the original minimum of 8 hours has been changed to 4 hours for the purposes of this study). Loitering events may indicate a possible encounter for which data is lacking for the second vessel, possibly due to lack of AIS transmission, poor satellite coverage, or the size of the second vessel (Interpol 2014, Miller et al. 2018). To be consistent with the previous report conducted by Pew on transshipment activity in WCPFC in 2016 compared to AIS data (see Pew 2019), any encounter and loitering events that occurred inside the EEZs of China, Japan, Russia, and the U.S. EEZ off Alaska were removed from analysis.

The carrier and fishing vessels analyzed in this report were chosen based on the GFW database of fishing and carrier vessels. The fishing database is defined in Kroodsma et al. (2018) and includes fishing vessels based on registry database information or as defined by a convolutional neural network (see Kroodsma et al. 2018). Fishing vessels capable of fishing tuna were defined by the GFW vessel classification using known registry information in combination with a convolutional neural network used to estimate vessel class (network described in Kroodsma et al. 2018). Any vessels not identified as purse seines or longlines were removed from the analysis. If a fishing class was not identified through the GFW algorithm, a review of vessel tracks and web search using all available vessel identifiers, including vessel name, MMSI, flag State, callsign, and IMO unique identifier were used to assess vessel class. The carrier database is defined in Miller et al. (2018) and was curated using International Telecommunication Union and major RFMO, vessel movement patterns based on AIS, a convolutional neural network used to estimate vessel class (see Kroodsma et al. 2018) and the IMO unique identifier.

In addition, the study examined port visits by carriers after encounters or loitering events. GFW defines ports as any 0.5-kilometer grid cell with 20 or more unique vessels stationary for greater than 12 hours. A port visit includes the port entry and exit of a vessel if the vessel stops. A vessel "enters" port when it is within 3 kilometers of a GFW-defined port. A vessel has ‘stopped’ when it has entered port and slowed to a speed of 0.2 knots and has started movement again when it moves over 0.5 knots. A vessel "exits" port when it is at least 4 kilometers away from the previously entered port. Note, for the purposes of this analysis any port visits that had a duration of less than 3 hours were removed from the data. Port stops can vary in duration from less than an hour to multiple weeks. Generally, very short port stops, as defined by GFW, may be intermediate ports a vessel

stops at before entering a port to conduct activities of interest to this report, such as offloading of catch. Therefore, in an attempt to exclude intermediate ports, this analysis excluded port visits of less than 3 hours, so that all voyages ended at ports where the carrier vessels remained for at least 3 hours. To be consistent with the previous report conducted by Pew on transshipment activity in WCPFC in 2016 compared to AIS data (see Pew 2019), the port States were divided into 'Pacific', 'Asia', and 'Other' for analysis, and were defined based on Pew's previous definitions (see Pew 2019, Appendix A: Methodology). The 'Other' category defined by any port States that were not listed under 'Pacific' or 'Asia' port States by Pew (Pew 2019, Appendix A: Methodology).

The heatmaps are based on the density of AIS positions by authorized carriers across the Pacific Ocean during 2017. The heatmaps were created in 'R' statistical software (version 3.5.2) using 'stat_density2d' function within the ggplot2 library. The bandwidth of the kernel was estimated automatically rather than choosing a fixed bandwidth in an effort to ensure the most appropriate value for each individual heatmap (see https://ggplot2.tidyverse.org/reference/geom_density_2d.html). The n parameter, or number of grid points in each direction, was set at a value of 200, and the number of bins was set at a value of 10.