Global Fishing Watch

A Comparative Analysis of AIS Data with the Indian Ocean Tuna Commission Reported Transshipment Activity in 2018

Acknowledgements

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Prepared by: Global Fishing Watch

2018 AIS-Detected Transshipment Activity in Tuna Regional Fishery Management Organizations

Transshipment of catch at-sea is a major part of the global fishing industry, particularly the tuna sector. However, existing monitoring and regulatory controls over transshipment at-sea are widely considered insufficient[1], with no guarantee that all transfers are being reported or observed in accordance with Regional Fisheries Management Organizations (RFMOs) Conservation and Management Measures (CMMs). Ineffective and/or incomplete monitoring, control and surveillance of at-sea transshipment creates opportunities for illegally caught seafood to enter the supply chain, and may perpetuate human rights abuses aboard vessels and provide an enabling environment for other illicit activities.

To help increase the transparency and understanding of at-sea transshipment activities, Global Fishing Watch (GFW), in partnership with The Pew Charitable Trusts (Pew), is undertaking an assessment of at-sea transshipment activities occurring inside the Convention Areas of the five global tuna RFMOs (https://globalfishingwatch.org/rfmo-transshipment/). Together, GFW and Pew have also launched the Carrier Vessel Portal (CVP). The first of its kind, the CVP is a publicly facing tool focused on at-sea transshipment, that seeks to provide policymakers, authorities, fleet operators, and other fisheries stakeholders information on when and where at-sea transshipment activities are taking place at sea. The CVP uses commercially available satellite Automatic Identification System (AIS) data, combined with machine learning technology and publicly available information provided by RFMO management bodies, including registry data to identify and display information on potential transshipment activity.

Utilizing the information behind the CVP, Pew and GFW are putting out a series of annual reports that compare at-sea transshipment-related activities observable through AIS data with publicly available information generated from RFMO member implementation of the relevant at-sea transshipments CMM. These reports are designed to be RFMO-specific and cover calendar years 2017 through 2019.

These reports assess the activity of carrier vessels and provide indication of possible transshipment events by comparing AIS data of vessels and determining possible “encounters” and “loitering” events. ‘Encounter Events’ are identified when AIS data indicates that two vessels may have conducted a transshipment, based on the distance between the two vessels and vessel speeds. ‘Loitering Events’ are identified when a single carrier vessel exhibits behavior consistent with encountering another vessel at sea, but no second vessel is visible on AIS, also known as a ‘dark vessel’. Loitering events are estimated using AIS data to determine vessel speed, duration at a slow speed and distance from shore.

Note: AIS data is only one dataset and additional information available to RFMO Secretariats, RFMO members, and flag States is needed to provide a complete understanding of any apparent non-compliant or unauthorized fishing activity identified within this report. Only after investigation by the Secretariat or relevant flag and coastal State authorities should that determination be made and appropriate enforcement or regulatory action taken.

For more information on the data used in this study, or to request the data annex, please contact carrier-vessel-portal-support@globalfishingwatch.org.

[1] http://www.fao.org/fileadmin/user_upload/COFI/COFI33Documents/SBD15en.pdf

Contents

List of Acronyms

AIS – Automatic Identification System
CCSBT – Commission for the Conservation of Southern Bluefin Tuna
CMM – Conservation and Management Measure
CNCP – Cooperating non-contracting party
CPC - Contracting and Cooperating Non-Contracting Parties
CVP – Carrier Vessel Portal
EEZ – Exclusive Economic Zone
GFW – Global Fishing Watch
IOTC – Indian Ocean Tuna Commission
IUU – Illegal, Unreported, Unregulated
LSTLV – Large-Scale Tuna Longline Vessels
MCS – Monitoring, Control and Surveillance
PSMA – Port State Measures Agreement
RFMO – Regional Fisheries Management Organization
ROP – Regional Observer Program
SBT – Southern Bluefin Tuna
SIOFA – Southern Indian Ocean Fisheries Agreement
VMS – Vessel Monitoring System
WPICMM – Working Party on the Implementation of Conservation and Management Measures

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

Transshipment in the Indian Ocean Tuna Commission (IOTC) Area of competence[2] (hereinafter referred to as the "IOTC Area") is currently regulated by Resolution 19-06 *on establishing a programme for transshipments by large-scale fishing vessels* and includes reporting requirements for both fishing and carrier vessels to help deter Illegal, Unreported, and Unregulated (IUU) fishing activities and better manage the fishery, as well as the requirement for all carriers transshipping IOTC species to be authorized and to carry and IOTC observer at all times.[i] The Resolution acknowledges the need for greater monitoring, control and surveillance of vessel activity and transshipments due to '*…grave concern that... a significant amount of catches by IUU fishing vessels have been transshipped under the names of duly licensed fishing vessels…*'. Reported Transshipment events have increased by at least 94% between 2014 and 2018.[ii]

Last year, Global Fishing Watch (GFW) submitted a report to the IOTC Working Party on the Implementation of Conservation and Management Measures (WPICMM) in which commercially available Automatic Identification System (AIS) data was used to analyze the track histories of carrier vessels operating within the IOTC Area during calendar year 2017. This year, GFW analyzed carrier vessel activity in the IOTC Area during calendar year 2018[3], to further investigate potential risk of non-compliance, trends in carrier vessel activity over time, and potential management issues in the overlap area between the IOTC Area and the fishing grounds of southern bluefin tuna (SBT), managed by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). This report highlights some findings which should help inform IOTC members' review of the effectiveness of the IOTC transshipment Resolution and consider what additional measures might be required to better detect and deter unauthorized transshipments or transfers of IUU-related catch sourced from the IOTC Area waters.

GFW shared the findings of this report with IOTC Member States for comment prior to final submission to the Commission. Japan conducted a review of the report's findings, analyzed reported activity by Japanese-flagged vessels and those operated by Japanese private companies in 2018, and found no inconsistencies or errors in this report. Japan concluded all of the events conducted by these vessels and detailed in this report were monitored by an observer on board. The full review conducted by Japan can be found at the end of this report, in Annex 2. GFW sent a request to the IOTC Compliance Committee for time and location of 2018 carrier trips with an IOTC observer. While this data was provided by the Committee, it was not shared in time for the submission of this report.

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[2] Details of the IOTC area and species of competence can be found here https://iotc.org/about-iotc/competence

[3] The Carrier Vessel Portal (CVP) data was used for this report, and GFW data methodology is generally consistent with that described in the RFMO Transshipment reports produced for calendar year 2017 (https://globalfishingwatch.org/rfmo-transshipment/), however Annex 1 details the methodology in full.

Governance of Transshipment Activity

Trends in spatial and temporal patterns as well as carrier flag State composition were consistent between GFW detected activity using AIS and IOTC reported[4] transshipment activity. The correlations suggest AIS can be effectively used as a potential complementary source of transshipment verification when used in combination with other data sources. Despite the similarities between the data sources, the actual number of carriers operating inside the IOTC Area did not match. **Nearly half of the carriers (23 vessels) seen operating on AIS were not listed as 'active' carriers by IOTC**. This suggests, either not all Regional Observer Program (ROP) activity is reported back to IOTC or some level of carrier activity remains unobserved and unreported.

The number of ROP-reported transshipments and the number of AIS detected events increased from 2017 to 2018, indicating a rise in at-sea transshipment activity. As a result, IOTC members may want to consider strengthening the monitoring, control, and surveillance (MCS) efforts employed in the IOTC Area, including centralizing the Vessel Monitoring System (VMS) of IOTC CPCs[5], designating a monitoring role to the IOTC Secretariat, limiting carrier vessels to those flagged to IOTC members, and mandating AIS usage as a complementary monitoring tool to ensure the sustainable management of IOTC fisheries.

Governance of Port Activity

Almost a third of AIS-detected activity was conducted by carriers flagged to non-member and cooperating non-contracting (CNCP) States, notably non-member States are not obliged to operate under the ROP. Additionally, many of those carrier vessels operating in IOTC waters went on to visit ports not listed on either the IOTC designated ports of entry nor the Port State Measures Agreement (PSMA) designated ports of entry. This suggests that some transshipments occurring within the IOTC Area appear to have been unmonitored both at-sea and in-port. Strengthening port State control measures and closer cooperation with key destination ports beyond the IOTC-designated ports will allow for identification of transshipments outside of the ROP at the point of landing and greatly improve the verification of legal transshipment activity within the IOTC Area.

Governance Challenges in Overlap Areas

AIS data indicated a high level of potential transshipment activity in the southern portion of the IOTC Area, including in regions overlapping with the CCSBT statistical areas and near several coastal State EEZs, meaning there is risk of under and misreporting southern bluefin tuna (SBT) catch as other tuna species. When vessels misreport catches, it is difficult for member States to have an accurate picture of the overall stock

[4] Reported transshipment activity can be found in two documents: IOTC Secretariat (2019). 1. IOTC-2019-CoC16-04a [E]. Report on Establishing a Programme for Transhipment by Large-Scale Fishing Vessels 2. MRAG and CapFish (2019). A Summary of the IOTC Regional Observer Programme During 2018.
[5] Contracting Parties and Cooperating Non-Contracting Parties of the IOTC

health and status of managed species. In its 2019 report on compliance by members, the CCSBT Secretariat highlighted the inability to distinguish frozen SBT from other tuna species in multi-species at-sea transshipments.[iii] This highlights the importance of strong information sharing agreements between RFMOs, as well as the need for clear mechanisms to independently verify catch reporting.

Conclusion

The 2018 data from the Global Fishing Watch Carrier Vessel Portal provided a comprehensive analysis of patterns of transshipment activity in the IOTC Area, regardless of membership or authorization by the RFMO. The spatial correlation between AIS and ROP data demonstrates that AIS can act as a complementary tool with other fishery specific MCS measures, such as centralized VMS data, observer coverage, and port State controls, to improve verification of legal events and improve the transparency of carrier and fishing activities in the high seas. The presented analysis identifies some of the risks of carrier vessel activity in the IOTC Area. These risks could be mitigated by improvements in the IOTC transshipment resolution, stronger direct links to supporting MCS measures to improve verification of legal at-sea transshipments from illegal ones, and increased transparency and data sharing with other RFMOs.

Finding	Recommendation
● Increased carrier vessel activity from 2017 to 2018	● Strengthen monitoring, control, and surveillance efforts within the IOTC Area through efforts such as the implementation of a centralized VMS program and mandated use of AIS
● Large proportion of possible transshipments conducted by carriers flagged to non-member States	● Ensure that only CPCs and invited experts are authorized to transship with CPC LSTLVs and that all subsequent transshipments within the IOTC Area are covered by the ROP[6] ● Expand the carrier flag State responsibility to include the authorization of transshipments by its carriers and reporting to the Secretariat
● A significant amount of carrier activity observed on AIS that was not reported in the ROP	● Carrier flag States in collaboration with the Secretariat should investigate activity by their vessels identified on AIS as potentially not reporting to the ROP[7] ● Provide a mandate for the IOTC Secretariat (or the contractor in charge of the ROP) to

[6] Excluding Indonesia and Maldives
[7] Global Fishing Watch can provide the analysis to the Secretariat and flag States on request

	verify and cross-check ROP-reported data with other sources, including AIS
● Ports visited by carriers flagged to non-members were not listed as a designated port of entry, either under IOTC or under PSMA	● Strengthen port State control measures and widen cooperation to ensure all carriers landing catch are inspected under IOTC-PSM or the PSMA
● High levels of carrier activity were observed in areas overlapping with other RFMOs which manage non-IOTC species	● Strengthen information-sharing agreements with CCSBT and SIOFA

Activity Overview

The 2018 Annual Report from Marine Resources Assessment Group (MRAG) and Capricorn Fisheries Monitoring (CAPFISH) on the IOTC ROP recorded 1,370 reported transshipment events between carrier vessels and large-scale tuna longline fishing vessels (LSTLVs) within the IOTC Area. This represents just under a 9% increase in reported events over the figures reported in 2017. GFW identified 376 encounters between carrier vessels and fishing vessels transmitting on AIS, as well as 726 loitering events. Excluding loitering events that may duplicate an encounter event, GFW detected approximately 827[8] events in total[9]. Currently IOTC does not publish the coordinates and time of each authorized transshipment event so it is not possible to quantitatively compare these aspects of the two data sets. However, a visual comparison of the two data sets is illustrated in Figure 1, which shows the spatial overlay of the two data sets. There is a close spatial correlation between the GFW detected activity and the reported activity included in the ROP.

[8] Due to the definition of encounter and loitering events, loitering events can overlap with encounter events. Therefore, to determine the total number of possible transshipment events, the two event type totals were not simply summed. Any loitering event that overlapped in time with an encounter event by the same vessel, or was within 4 hours of an encounter event, was removed from the total count (See Annex 3).

[9] There are a few reasons GFW identified fewer events than were reported. First is the low AIS usage by fishing vessels in the Indian Ocean due to a lack of national IMO regulation enforcement or national AIS requirements for the authorized fishing vessel fleets. Second, there is a history of piracy in the northwest Indian Ocean that increased the frequency of vessel masters turning off their AIS transponders to avoid being detected by pirates.

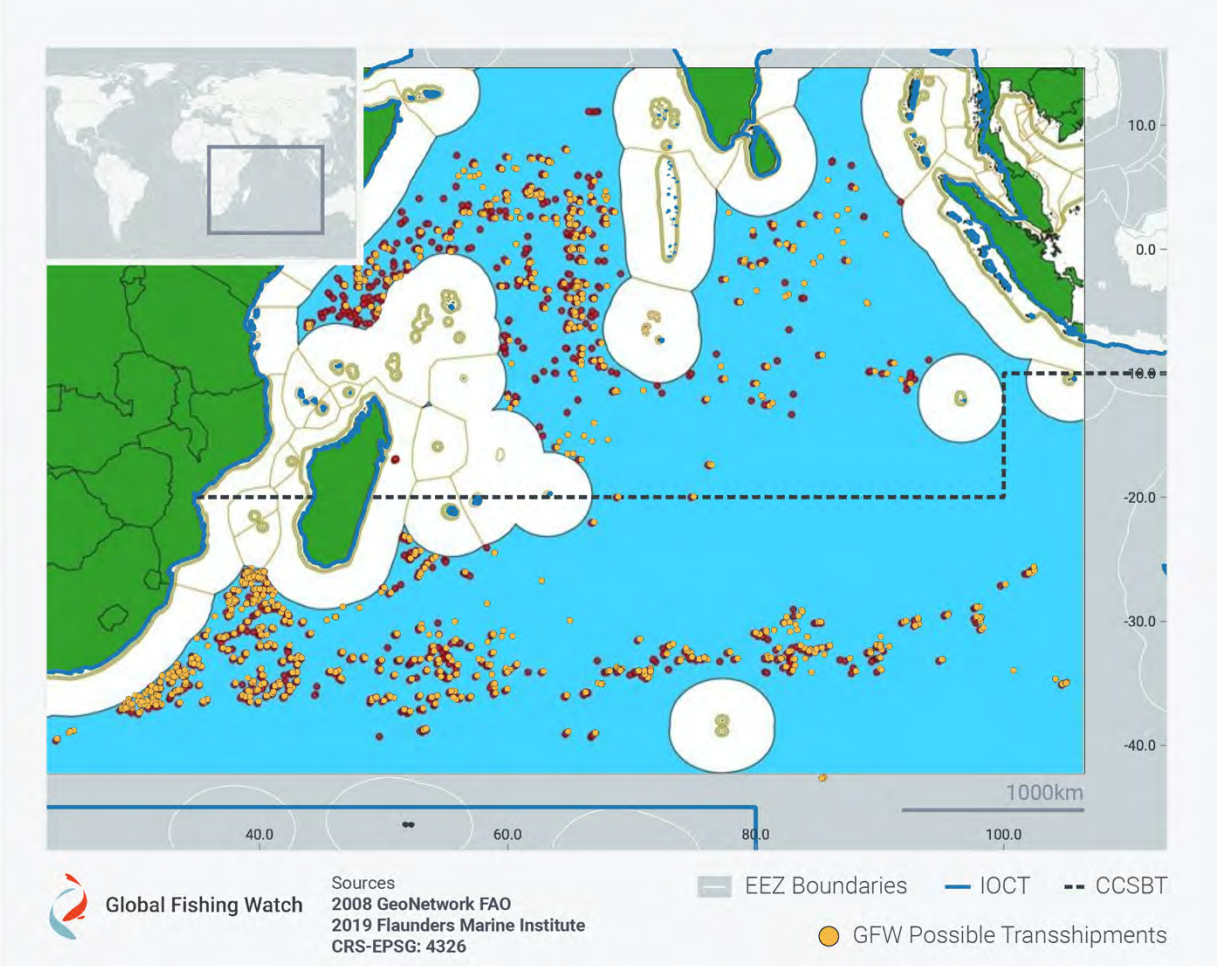

Figure 1 - GFW detected possible transshipment events overlaid with IOTC reported transshipment events (Figure 3 from MRAG and CapFish 2019)

The ROP identified 63 total carrier vessel deployments in the IOTC Area, which are defined as carrier vessel trips with an IOTC observer on board. These deployments were conducted on 23 carrier vessels from eight different flag States. Carrier vessels flagged to Taiwan, Province of China (henceforth "Taiwan, China")[10] were responsible for 30% of the deployments on 23% of the carrier vessels. The remaining trips were conducted by vessels flagged to Liberia, Malaysia, Panama, Republic of Korea (henceforth "Korea"), Japan, Singapore, and China (Figure 2A).

GFW AIS-based data identified 118 total trips, defined as carrier activity in the IOTC Convention Area between port visits that included encounter and/or loitering events (Figure 2B). This definition does not directly equate to the deployments recorded in the ROP which may include multiple trips. GFW data cannot be fully correlated with ROP data due to the absence of deployment dates in the ROP. These trips were conducted by 49 carrier vessels from nine different flag States. Notably, 34 (29%) of the observed

[10] This report follows the same naming convention as IOTC for members, cooperating non-contracting parties, non-members and invited experts.

trips were conducted by carrier vessels flagged to Panama and Singapore, neither of which are members of IOTC, and therefore are not bound by the any of the decisions or conservation measures agreed by the IOTC, including the at-sea transshipments measure. For example, seven Panamanian carrier vessels were listed by IOTC as active in 2018.[i] However, GFW detected 19 Panamanian carriers conducting trips in IOTC in 2018 with encounter and/or loitering events. Therefore, it may be possible that not all carriers flagged to this non-member States, or the respective LSTLV reported transshipment activity to the ROP.

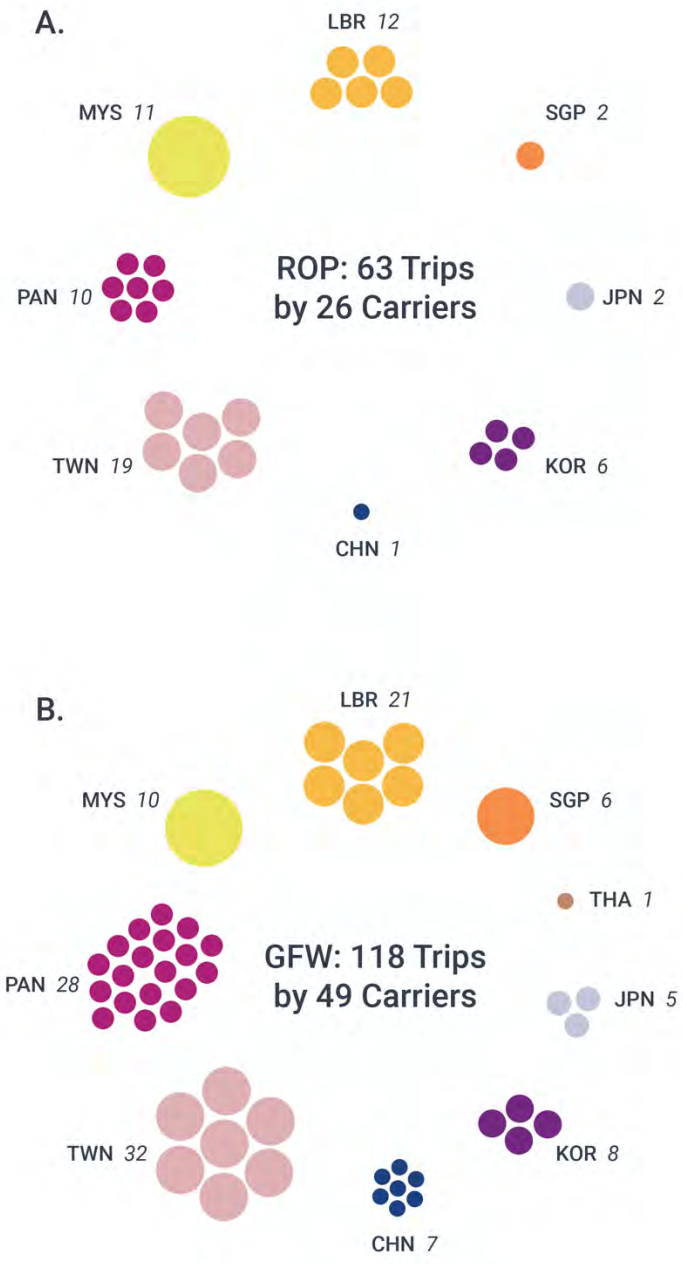

Figure 2A. The total number of IOTC carrier deployments, by fleet, in 2018[iv] B. The total number of AIS-detected carrier trips, by fleet, during 2018 *Note: Bubbles indicate unique carrier vessels*

Both AIS-detected and reported transshipment activity increased from 2017 to 2018 within the IOTC Area. Taiwan, China remains the most active fleet, conducting the majority of reported transshipments and observed encounters. The geospatial similarities between ROP-reported transshipments and observed encounters, as well as the consistency in ROP-reported and observed fleet activity demonstrate the effectiveness of AIS-based data as a tool to supplement traditional MCS efforts. Mandating AIS usage may increase transparency of fishing and transshipment activity in IOTC Area waters, especially in regions where the threat of piracy is reduced.

The potential variation between reported IOTC observer deployments and AIS-detected trips, as well as the volume of potential transshipment activity detected by IOTC non-member flagged carriers, may warrant increased observation and reporting of transshipment at-sea, as there is significant risk that transfers of IOTC species go unreported.

Governance of transshipment activity

At-sea activity

Carrier vessels flagged to nine flag States were observed in encounters and/or loitering events in the IOTC Area in 2018 (Figures 3 and 4). The majority of both loitering and encounter events were conducted by carriers flagged to Taiwan, China (not recognized under the United Nations IOTC framework as a CPC, and although not bound by the decisions of the IOTC Commission does cooperatively participate in the IOTC), Liberia (a CNCP), and Panama and Singapore (both non-members)[11]. The amount of activity conducted by carriers flagged to non-member States is concerning. The carrier flag state has a requirement to ensure the compliance of its vessels with relevant CMMs including the reporting requirements, however this is challenged if the flag state is not a member or cooperating with IOTC. CPCs are held to a higher standard of oversight for transshipment activity which is not the case of non-member State vessels.

Carrier vessels flagged to **Member** States (Contracting Parties) accounted for 45% of the 376 AIS encounters (Figure 5), and include China, Japan and Korea and Taiwan, China. These vessels are required to authorize and report all transshipment activity through their master and are obligated to participate in the ROP.

The only **Cooperating non-contracting party** (CNCP) with operating carriers in the IOTC Area in 2018 was Liberia. These carriers accounted for 20% of AIS encounters observed in 2018. CNCPs are not full members however they are required to authorize and report transshipment activity through their master and comply with ROP requirements.

[11] IOTC terminology has been used to define member status in this report. Members and CNCPs are defined here: (https://iotc.org/about-iotc/structure-commission). Taiwan, China is defined as an invited expert using the IOTC meeting terminology (https://www.iotc.org/about-iotc/observers-iotc-meetings). Non-members are those flag States that do not participate in the IOTC.

The remaining 35% of AIS encounters were carried out by carriers flagged to **non-members** (non-CPCs), Panama (23%) and Singapore (12%). Carriers flagged to non-members should participate in the ROP through a member country and report the transshipment to the LSTLV flag state and Secretariat. However, as non-members the opportunities for ensuring compliance are insufficient compared to carriers from CPC's. It is recommended the Commission amend the transshipments measure to require that carrier vessels be flagged to IOTC members and cooperating non-members to improve the management and monitoring of carriers in the IOTC Area.

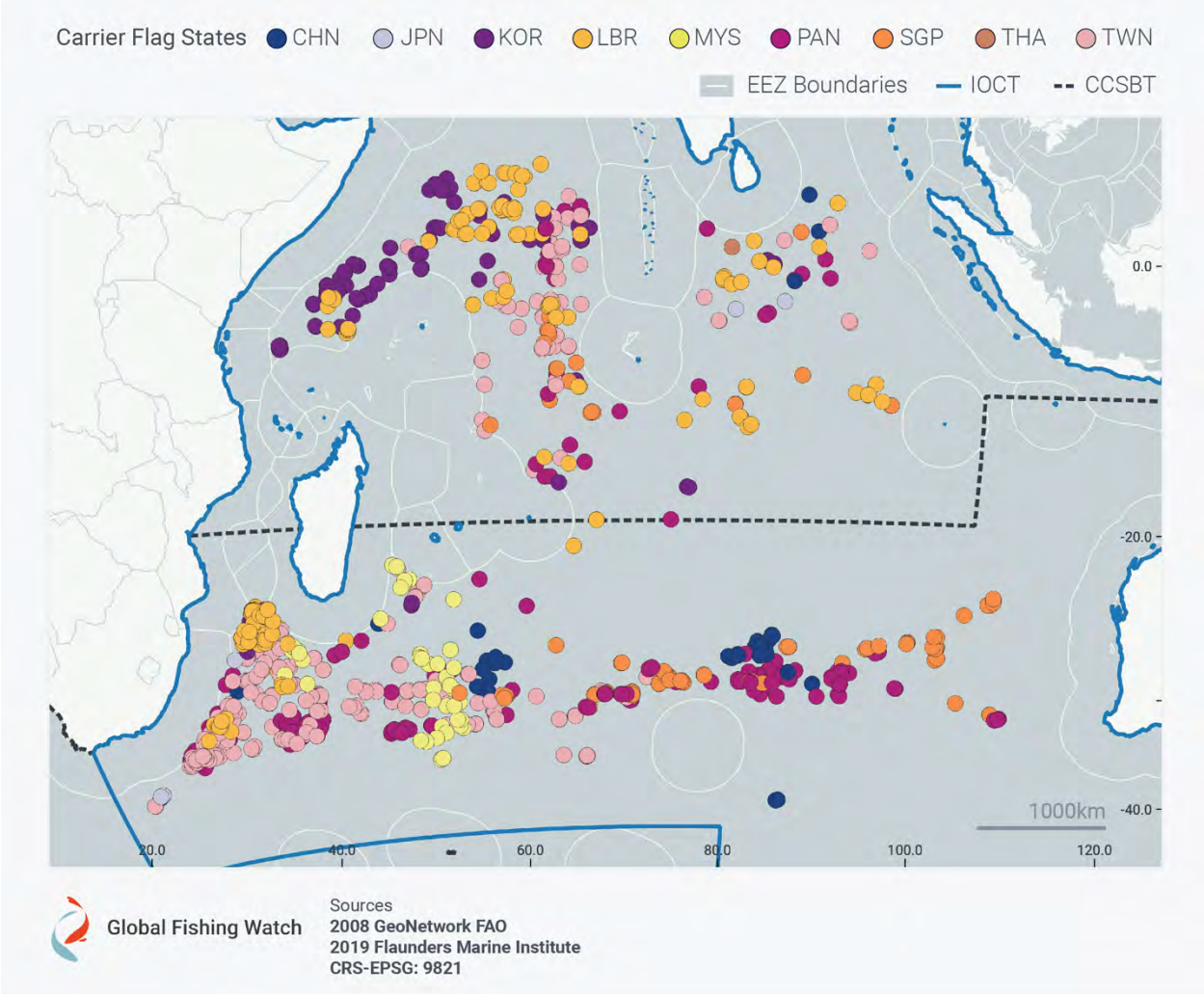

Figure 3. GFW detected possible transshipment events by carrier flag State

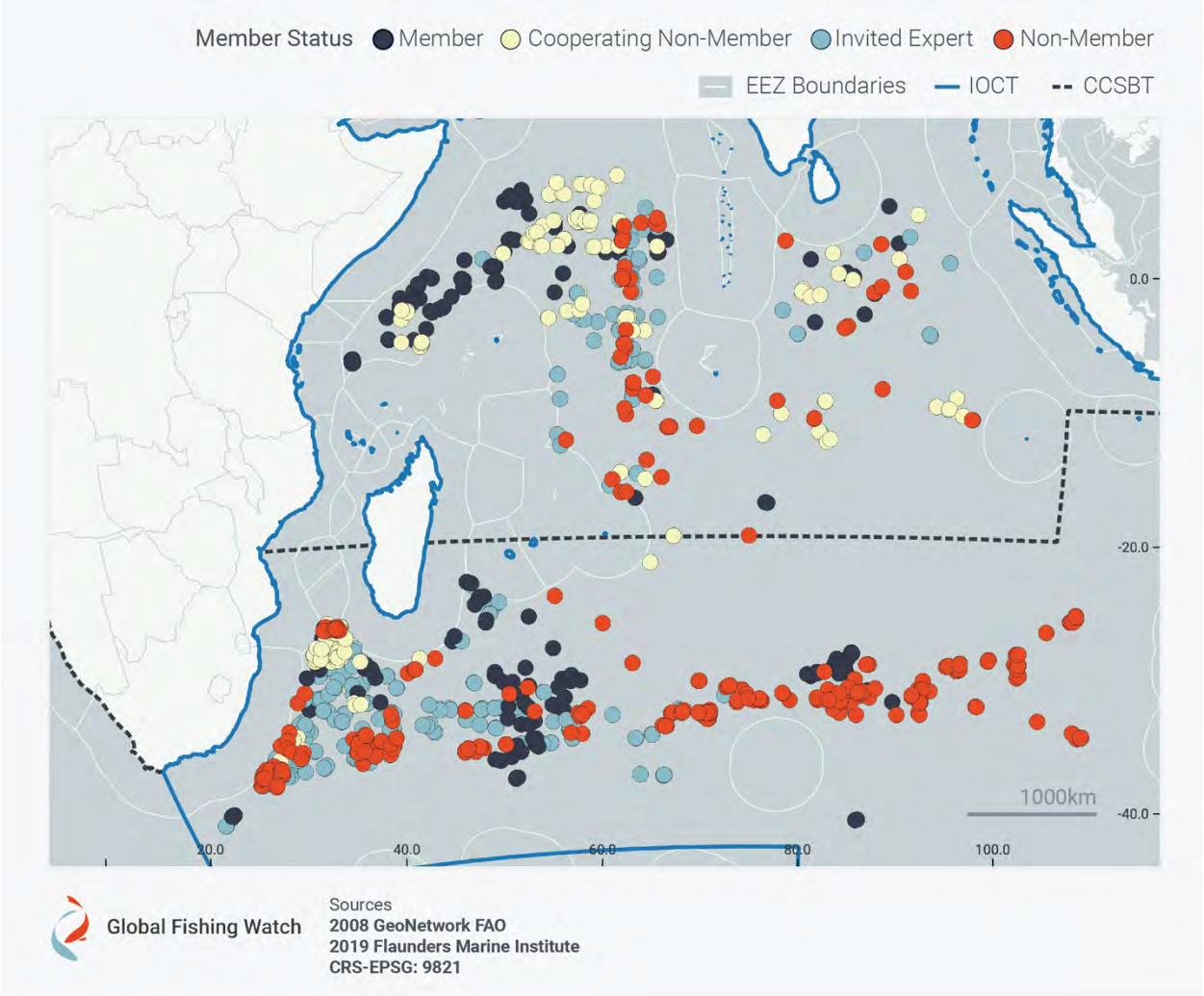

Figure 4. GFW-detected possible transshipment events by membership status

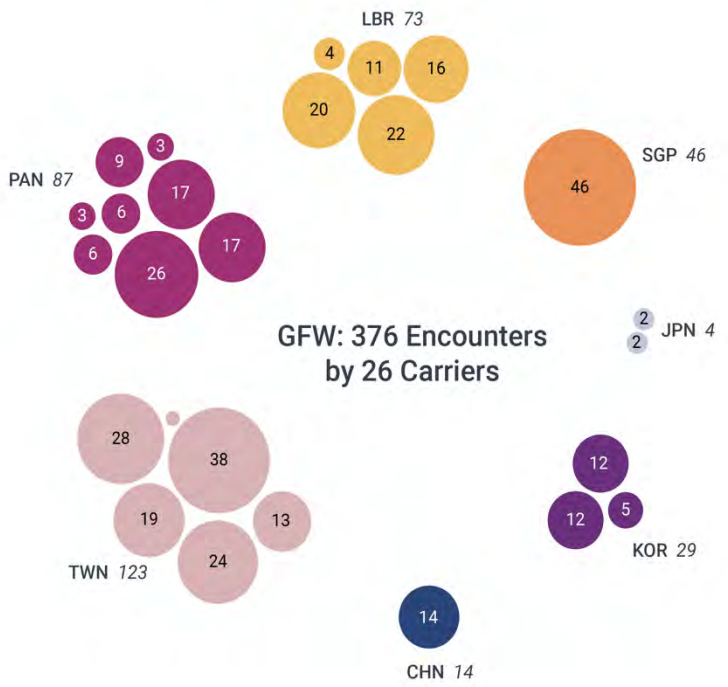

Figure 5. Encounter events by carrier flag State. *Note: Bubbles indicate unique carrier vessels*

Similar to encounter events, a large proportion of observed loitering events were conducted by carrier vessels flagged to non-member States (Figure 6). Panamanian and Singaporean carriers conducted 25% and 10% of the events, respectively, accounting for over a third of all loitering events.

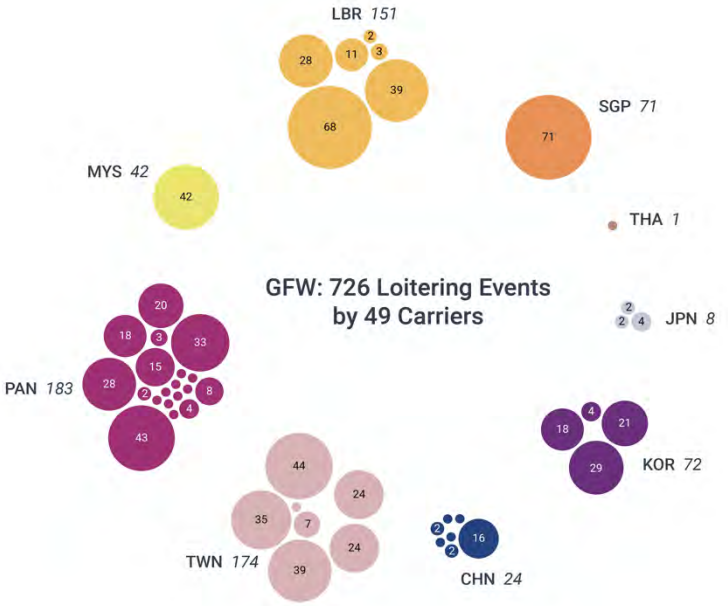

Figure 6. Loitering events by carrier flag State. *Note: bubbles indicate unique carrier vessels*

The AIS data did not indicate any encounters occurred between LSTLVs and carriers without IOTC authorization. Instead, the key risk identified was whether or not all the carriers involved in transshipments with LSTLVs inside the IOTC Area did so within the bounds of *IOTC Resolution 19/06* including the ROP.[i]

The IOTC *Report on Establishing a Programme for Transshipment by Large-Scale Fishing Vessels* lists the carriers 'active' in the ROP in 2018 which included 26 vessels from 8 flag states.[ii] This list of carriers is smaller than the 49 identified by GFW as active on AIS. In fact, 23 of the vessels identified with encounter and/or loitering events on AIS were not on the list of carriers reported active in 2018 (Figure 7). Although some of these, like the single Thai carrier with only one loitering event, are unlikely to pose a risk of unreported transshipment activity, others appear to show characteristics indicative of a typical carrier operating inside the IOTC Area with repetitive instances of AIS-detected encounter and loitering events.

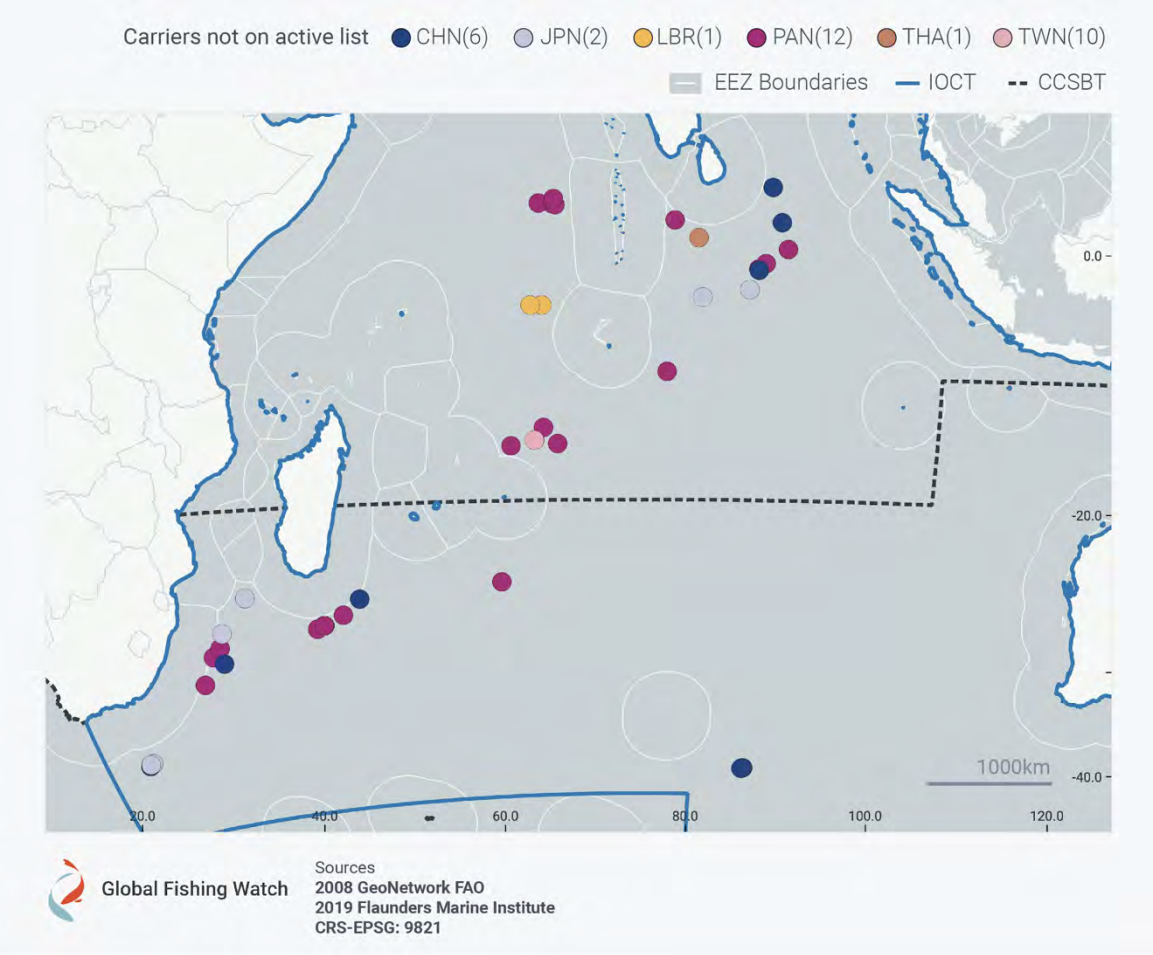

Figure 7. Encounter and loitering events by carrier vessels not included on the list of active carriers in 2018 by flag State. Note the number in parenthesis indicates the number of unique vessels.

Interestingly, AIS analysis indicated that flag States in all three categories of membership (members, CNCP, and non-members) had carrier vessels active in the IOTC Area in 2018 which were not listed as 'active' in IOTC's ROP reporting. For example, two observed encounters occurred between LSTLVS and carriers flagged to Panama and Japan. Both carriers were authorized by IOTC, though neither was listed on the listed active carriers in 2018.[ii] This suggests that, either not all ROP activity is reported back to IOTC or some activity remains unobserved, reducing transparency and potentially enabling illicitly caught fish to enter the supply chain. This also poses the question regarding the LSTLV of CPCs and whether or not they were authorizing this activity with their flag state and notifying the Secretariat.

Port activity

The IOTC has adopted in 2010 a comprehensive port State management measure that is consistent with the later FAO Port State Measures Agreement (PSMA). Implementation of these port State arrangements in the region's developing coastal States is an ongoing process with some. Nine of the 14 port States visited by carrier vessels active in the IOTC Area during 2018 as indicated by vessel movements on AIS are parties to the PSMA[12]. As the IOTC Conservation and Management Measure on PSM is well aligned with PSMA, risks associated with these vessel visits should be negligible, however this does assume that the PSMA and IOTC measures are fully implemented and that the relevant port State has the capacity to enforce the management arrangements.[v] IOTC CMM 16-11 requires States to nominate ports in which IOTC managed species should be landed[13]. Under this regulation, carriers should not land IOTC-managed species at a port which is not listed as an IOTC designated port of entry. The spatial distribution of the AIS-detected port visits is shown in Figure 8 below.

[12] Under the UN framework Taiwan, China is not eligible to ratify the PSMA
[13] https://www.iotc.org/compliance/port-state-measures

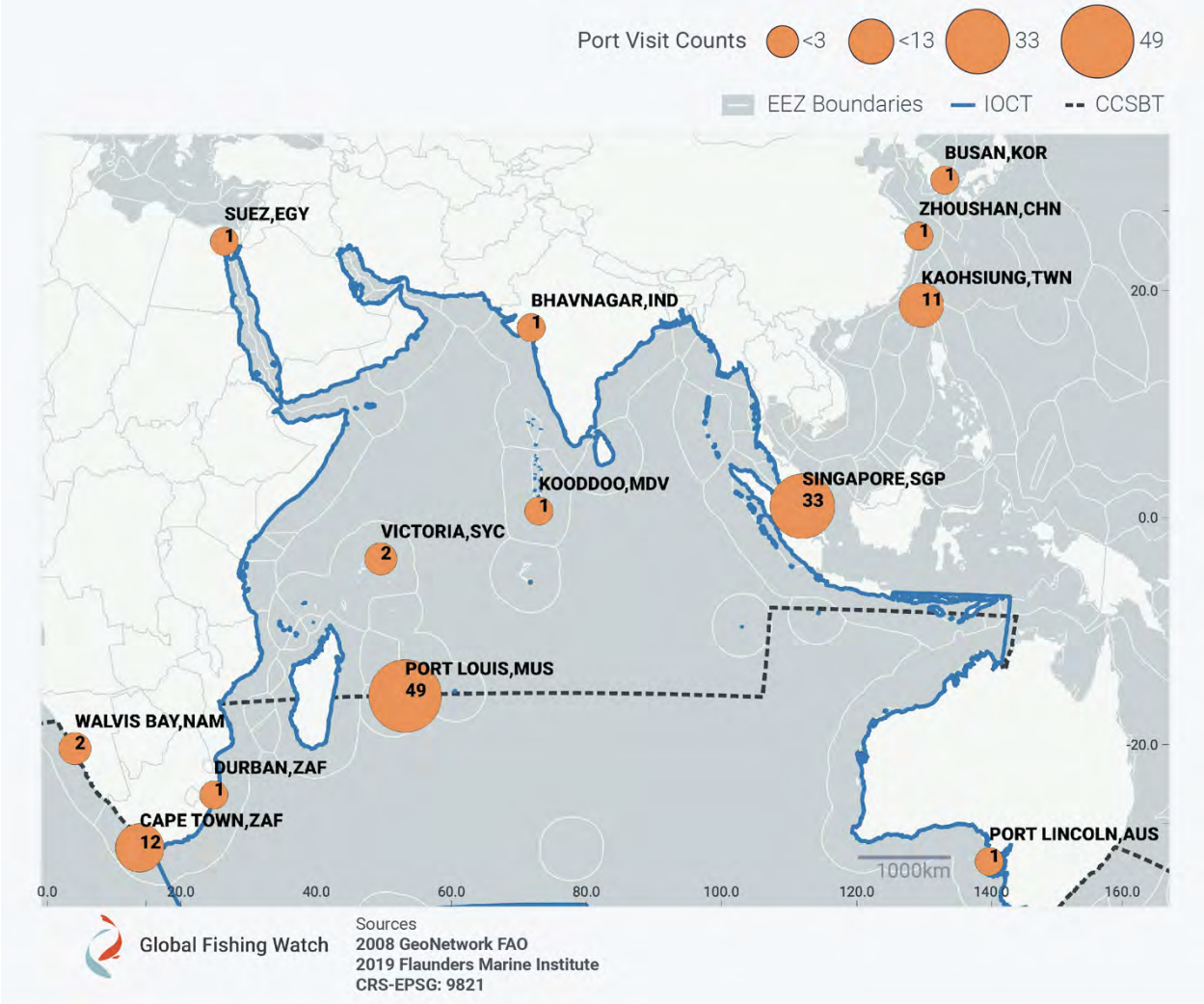

Figure 8: Ports visited by carriers after a detected encounter with a fishing vessel or loitering event within IOTC, 2018.

AIS analysis indicated that only six of the 13 IOTC ports visited by carrier vessels active in the IOTC Area were designated for entry under CMM 16-11. Singapore, Kaohsiung, Zhoushan, Suez Canal[14], Walvis Bay, Bhavangar, Montevideo and Busan are not IOTC designated ports of entry, and should therefore not be used to land IOTC managed species[15]. Korea is not situated within the IOTC Area, and therefore no details of *"Competent Authority and Period of Advance Notice"* to the IOTC were provided[16]. While it is possible that only non-IOTC managed species were landed in these ports, there is

[14] The Suez Canal is often used by vessels to transit from the Indian Ocean to the Mediterranean Sea and therefore this detected port visit may be indicative of the vessel slowing to transit through the canal. The subsequent port visit to the canal was Tangier in Morocco which is also neither a PSMA or IOTC designated port.

[15] Specifically, "This Resolution shall be applied to CPCs' ports within the IOTC Area. The CPCs situated outside the IOTC Area shall endeavor to apply this Resolution"

[16] designated ports (2019-07-26) in https://www.iotc.org/compliance/port-state-measures

potential for non-compliance of the IOTC-PSM, possibly creating a higher risk of misreporting or unreporting if related to IOTC-managed species. Closer cooperation with all destination ports and investigation of suspicious landings by the relevant port State authorities and the IOTC Secretariat is recommended. Additionally, as per Resolution 16/11, CPCs located outside of the IOTC Area shall endeavor to apply the provisions of the resolution, including that the designated port of entry list is up to date to assist the IOTC, its member State and its Secretariat and ensure compliance to CMMs.

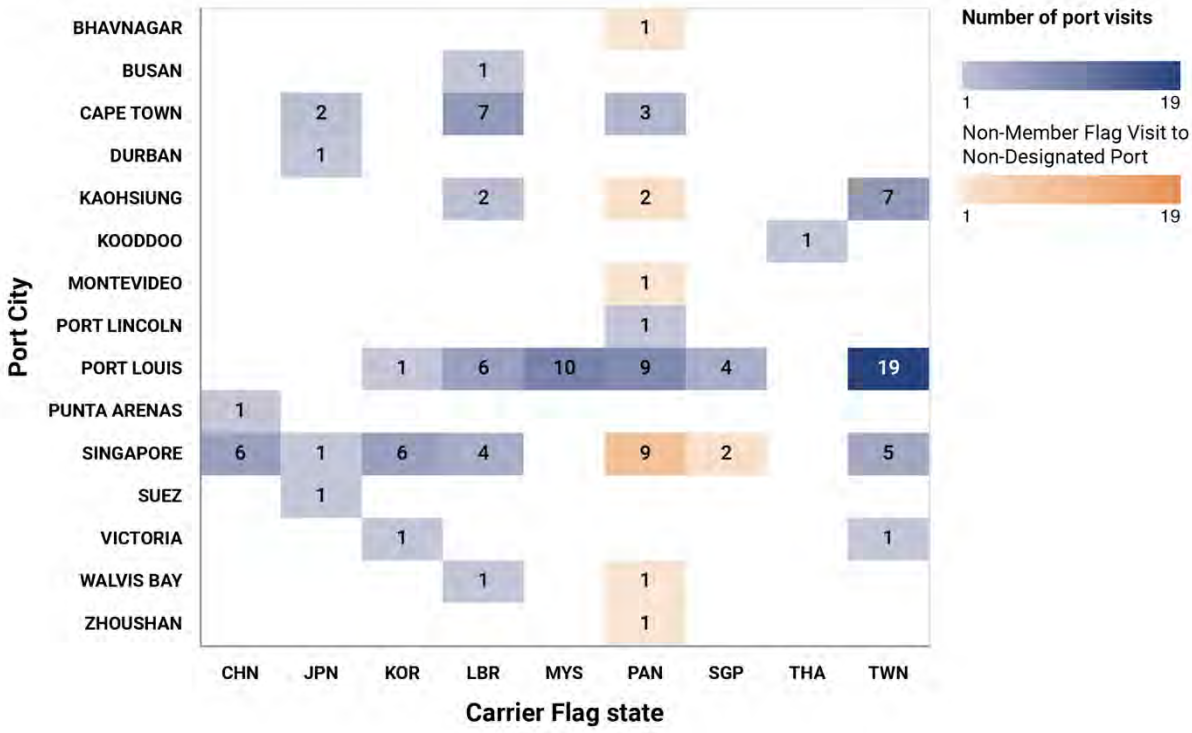

Figure 9. Port visits by carrier flag State after encounter and/or loitering events

Carriers flagged to non-member States, which conducted a third of the observed activity at sea, were observed visiting ports neither designated through PSMA nor IOTC CMM 16-11 on PSMs (Figure 9). Therefore, at-sea and port activity conducted by non-member States may have gone unobserved, unreported, and without proper inspections. The management implications are clear that this poses a significant risk of IUU products entering the supply chain. It is strongly recommended that the IOTC Commission considers requesting the Secretariat to investigate how to use open source data and MCS networks to improve the monitoring and transparency of carrier vessel activity both at-sea and in-port within the IOTC Area.

Governance Challenges

Overlaps with other RFMOs

The IOTC Area overlaps with two other RFMOs: The Southern Indian Ocean Fisheries Agreement (SIOFA) RFMO which shares much of its IOTC Area with the IOTC, and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) which overlaps with the IOTC primarily at 20 degrees South latitude[17]. IOTC manages both tuna and tuna-like species including two mackerel species, marlin, sailfish, and swordfish whereas SIOFA manages non-highly migratory fish species such as orange roughy, Patagonian toothfish, dogfish, and other pelagic species. While SBT is listed as an IOTC species, policy decision making and management of the species is deferred to CCSBT.

When analyzing carrier vessel activity in IOTC waters, two areas of interest emerged as a potential risk for IOTC fisheries management and stock assessment. The two areas identified are within the overlap areas between these IOTC areas and CCSBT and SIOFA, particularly towards the southern boundaries of these IOTC areas. Here, bathymetric features and dynamic currents, including the Agulhas Current and its well-known 'West Wind Drift' off the coast of southern Africa, provide excellent conditions for many different species.[v,vi,vii] This is highlighted in Figure 10 below.

[17] Although CCSBT does not have a defined Convention Area, CCSBT Statistical Areas are used as likely border of SBT (see https://www.ccsbt.org/en/system/files/ESC24_04_SecretariatReviewOfCatches_PUBLIC.pdf)

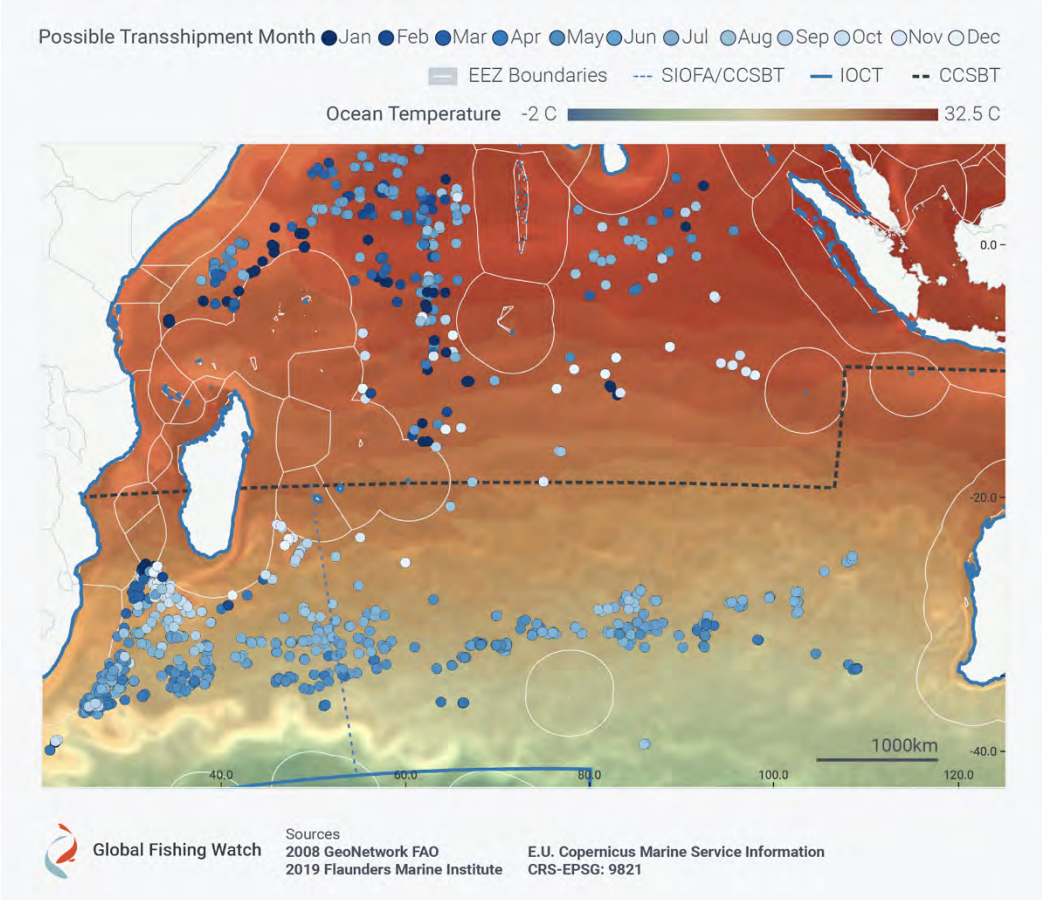

Figure 10: GFW detected transshipment events by month in IOTC and overlapping regions.

Activity above the line drawn through Madagascar North are likely related primarily to IOTC-managed species and squid[viii], while the activity observed in both the IOTC/SIOFA and IOTC/CCSBT overlap areas are likely related to the capture and transfer of co-managed, or non-IOTC managed species.

IOTC/CCSBT Overlap

This region is characterized by the South Indian Current[ix] and the gyre partly formed by this current that produces environmental conditions attracting tuna species such as albacore and SBT.[x] The temporal overlap in activity for both IOTC and CCSBT-managed species in the defined CCSBT overlap area is highlighted in Figure 11. The solid lines indicate the activity of carriers that reported transshipments of SBT through the IOTC ROP.[iv] The dotted lines show the activity of carriers which did not report transshipments of SBT.

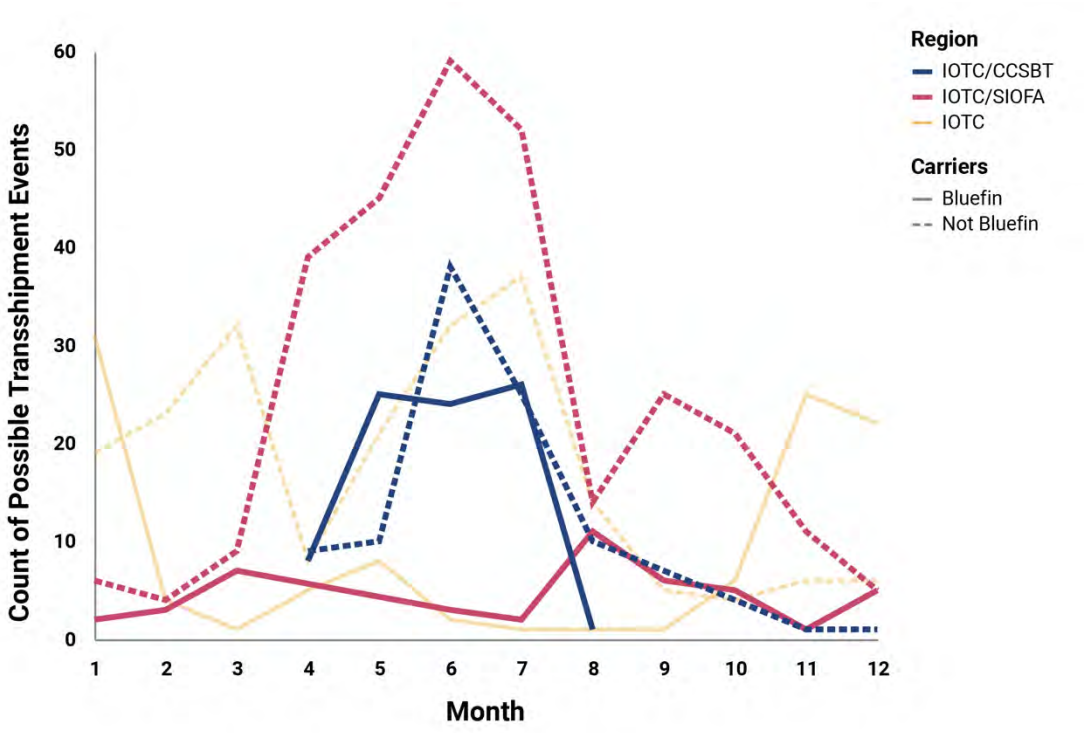

Figure 11. Detected transshipment events in 2018 by month for both carrier vessels that did and did not report SBT transshipments.

The two blue lines indicate a close correlation in transshipment activity with IOTC and CCSBT-managed species which is not apparent in the other two areas of the IOTC Area. The seasonal peak in observed transshipment activity in May through July emphasizes the importance of data sharing between the three management bodies in this area to ensure accurate understanding of the distribution and movement of fish catches throughout the area.

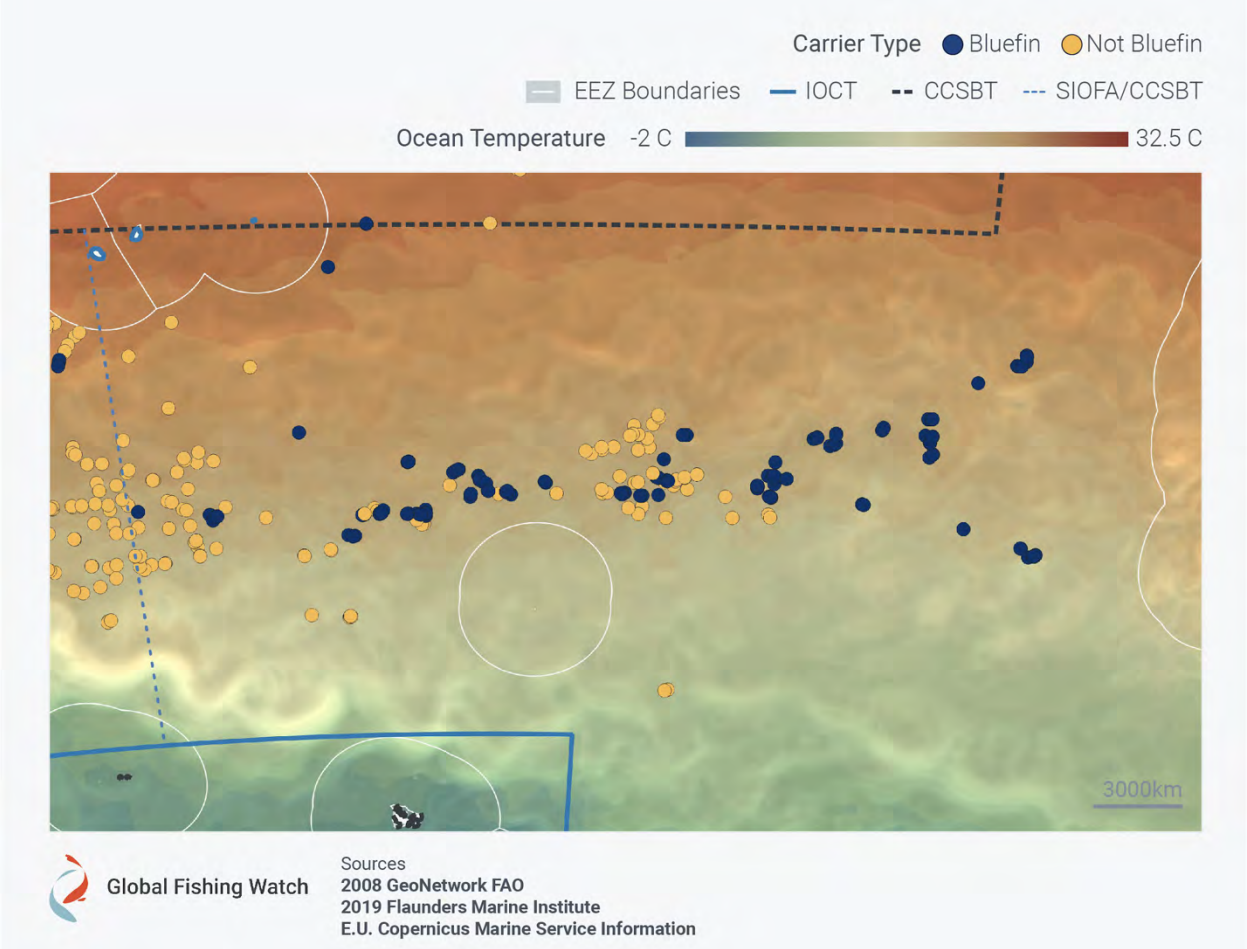

Figure 12. AIS-detected transshipment events in the CCSBT/IOTC overlap by carrier vessels that did reported SBT transshipments in 2018 (84 possible transshipments detected) and carrier that did not report transshipment of SBT in 2018 (94 possible transshipments detected).

Figure 12 above shows the spatial overlap in likely transshipment activity by carrier vessels that were authorized for SBT transshipments during 2018 and those that were not. Albacore and SBT have similar habitats and fishing seasons, making it difficult to discern which of the two species is being transshipped.

Without effective MCS in place at both the commission and member level, there is an increased risk of carriers transshipping potentially unauthorized or unreported SBT within the IOTC/CCSBT region. Additionally, there is an increased risk of unmonitored transshipments of SBT being landed in non-designated ports of entry. Figure 13 shows an example of a vessel which was detected with LSTLV encounters within the IOTC/CCSBT region and which then made a port call in Singapore.

Figure 13. AIS data of an example deployment of a carrier vessel that was IOTC authorized but did not report southern bluefin tuna transshipments and not CCSBT authorized in 2018

In this instance, the embarked observer thought they identified SBT transshipped by the vessel, which was misreported as yellowfin. The IOTC Secretariat requested the flag State of the carrier investigate the vessel's activity, the subsequent investigation did not find any proof of SBT transshipment, but the monitoring gap and potential risk is clear.

IOTC/SIOFA Overlap

In addition to the large pelagic swordfish and tuna fisheries, many other species are found in this region, including sardines, sharks, and sea turtles, as well as commercially important species such as orange roughy.[vii,viii] Although some of these species are not pelagic and caught by different fishing vessels, such as trawlers, that may not transship on the high seas, the overlap of commercial longline fisheries in this area may also impact SIOFA- managed fisheries due to bycatch.[xi] The observed events shown in Figure 14 are likely inclusive of both IOTC- and SIOFA-managed species. It is also well-

reported that oil fish, a species not under the remit of, or managed by, the IOTC, is the fourth highest quantity of fish transshipped by IOTC-registered vessels in 2019.

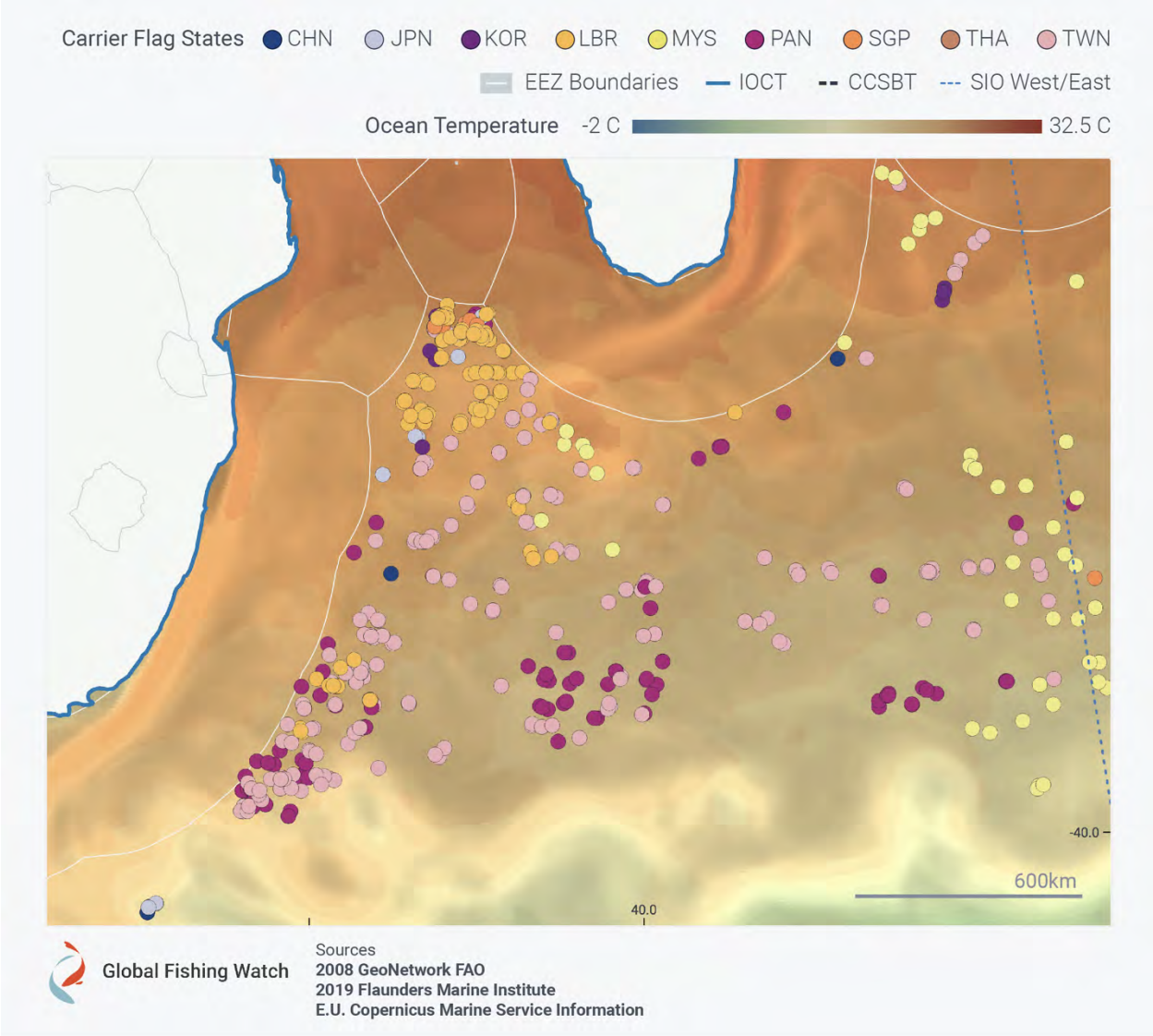

Figure 14. GFW detected transshipment events by carrier flag State in SIOW

Due to the large number of possible transshipment events and temporal variability of events by carriers (Figure 11), the carrier events in Figure 14 may have involved fishing vessels focused on the capture of non-IOTC managed species such as orange roughy, alfonsino, and pelagic armorhead; all of which are under management of SIOFA. Currently, IOTC and SIOFA do not have a Memorandum of Understanding (MoU) but implementing one would significantly help increase monitoring of transshipment activity in the co-managed area.

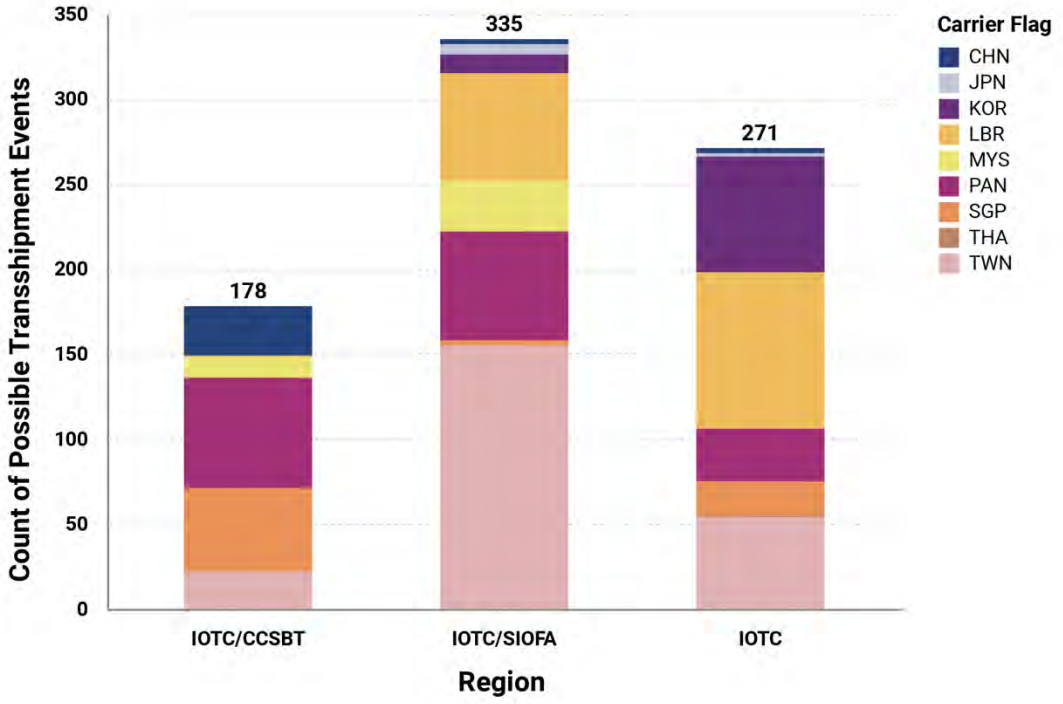

Figure 15. Possible transshipment events conducted in the overlapping IOTC regions by carrier flag State.

It is clear that significant transshipment activities occur within the Indian Ocean in overlapping RFMO Convention areas and possibly as multispecies transshipments with the species that are managed by IOTC, CCSBT and/or SIOFA RFMOs. Without increased MCS enabling verification of legal transshipments events, improved transparency, strong information sharing among these three RFMOs, and the States flagging carriers active in the area, there is considerable risk that catch might be either misreported or unreported with obvious implications for stock assessment and fisheries management decisions.

Conclusion and recommendations

This analysis highlights the complicated nature of managing at-sea transshipment in the IOTC Area. With increasing levels of activity, there appears to be significant risk for potentially non-compliant behavior at-sea and in-port that should be of concern to the Commission, particularly in relation to verification and transparency associated with at-sea transshipment activities of non-member flagged carriers that can legally go unobserved at-sea and in-port. Second, the temporal and spatial overlap of at-sea transshipment activity by carrier vessels in the rich fishing areas overlapping with CCSBT and to a lesser extent SIOFA. This poses a risk of under-reporting or mis-reporting of IOTC-managed catch. Without clear and direct MCS arrangements, these events may go undetected, which would have implications for the accuracy and reliability of stock assessments for all three RFMOs. These key findings and

corresponding recommendations for the Commission to consider are provided in the table below:

Finding	Recommendation
● Increased carrier vessel activity from 2017 to 2018	● Strengthen MCS efforts within the IOTC Area through efforts such as the implementation of a centralized VMS program and mandated use of AIS
● Large proportion of possible transshipments conducted by carriers flagged to non-member States	● Ensure that only CPCs and invited experts are authorized to transship with CPC LSTLVs and that all subsequent transshipments within the IOTC Area are covered by the ROP[18] ● Expand the carrier flag State responsibility to include the authorization of transshipments by its carriers and reporting to the Secretariat
● A significant amount of carrier activity observed on AIS that was not reported in the ROP	● Carrier flag States in collaboration with the Secretariat should investigate activity by their vessels identified on AIS as potentially not reporting to the ROP[19] ● Provide a mandate for the IOTC Secretariat (or the contractor in charge of the ROP) to verify and cross-check ROP-reported data with other sources, including AIS
● Ports visited by carriers flagged to non-members were not listed as a designated port of entry, either under IOTC or under PSMA	● Strengthen port State control measures and widen cooperation to ensure all carriers landing catch are inspected under IOTC-PSM or the PSMA
● High levels of carrier activity were observed in areas overlapping with other RFMOs which manage non-IOTC species	● Strengthen information-sharing agreements with CCSBT and SIOFA

The spatial alignment between the MRAG ROP and this comprehensive analysis of AIS-based CVP data demonstrates an additional method for correlation of information to help build a more comprehensive assessment of vessel activity on the high seas for all flag States and vessel types. This should help enable improved regulation and management of transshipment activity. Member States should consider implementing comprehensive national AIS requirements for their authorized fleets to assist this.

[18] Excluding Indonesia and Maldives
[19] Global Fishing Watch can provide the analysis to the Secretariat and flag states on request

Critically, the Commission should consider tasking the IOTC Secretariat to conduct annual reviews of transshipment activity using all sources of information available to build on this initial analysis by GFW and validate the efficacy of the IOTC transshipment management measures.

Annex 1. Detailed Methodology

AIS-based data methods

Carrier vessels registered over 300 gross tons and on international voyages are already required to broadcast on Automatic Identification System (AIS), as mandated by the International Maritime Organization (IMO).[xii] Although the use of AIS is not globally mandated for fishing vessels, AIS used in fishing fleets is increasing with a growing number of flag and coastal States mandating its use through their own national or regional fisheries regulations. AIS devices broadcast the location of a vessel along with other information, including identity, course and speed. This makes the use of AIS, and its subsequent analysis, very useful in understanding fishing activity that can be used to support and complement existing national and RFMO Monitoring, Control and Surveillance (MCS) programs. This is especially true as AIS can provide a greater insight of fishing vessel activities, especially when these interactions involve vessels of differing flag States where VMS data is not publicly available or readily shared between authorities.

The Carrier Vessel Portal (CVP) is established using GFW datasets developed from AIS data. The CVP uses the same datasets used in the 2017 transshipment reports (https://globalfishingwatch.org/rfmo-transshipment/), including possible transshipment events defined as encounter and loitering events, port visits by carrier vessels, vessel identity information broadcast from AIS, and publicly available vessel registry data.

GFW uses publicly broadcasted AIS data to estimate vessel information and vessel activity, including fishing, encounters and loitering events. Encounters, where two vessels meet at sea, may indicate possible transshipment activity between two vessels. 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.[xiii] 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 by a single carrier vessel where the carrier vessel exhibits behavior consistent with encountering another vessel at sea, but no second vessel is visible on AIS, may also indicate a possible transshipment event but where there is no AIS data for the second vessel, also known as a ‘dark vessel’ (Figure A1). 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.[xiv,xiv]

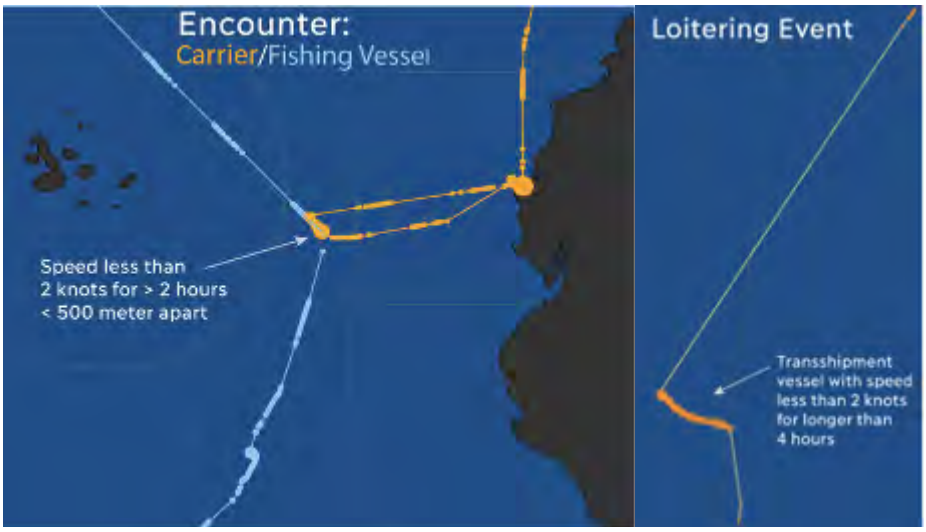

Figure A1 - Examples of vessel tracks during typical 'Encounter' where two vessels meet at sea and 'Loitering' events where a carrier vessel (referred to as transshipment vessel) has behavior consistent with encountering an LSTLV at sea but no LSTLV is visible on AIS

The GFW database also contains an estimate of port visits conducted by carrier vessels (see Annex 3). 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.

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.[xv] 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). Because the IOTC transshipment resolution focuses on LSTLVs, any vessels not identified as longlines were removed from the analysis. The carrier database is defined in Miller et al. (2018) and was curated using International Telecommunication Union and major RFMOs, vessel movement patterns based on AIS, a

convolutional neural network used to estimate vessel class (see Kroodsma et al. 2018) and the International Maritime Organization (IMO) unique identifier.

For the purposes of the IOTC 2018 transshipment analysis the possible transshipment events were restricted to those most likely to be relevant for the analysis. Because the IOTC transshipment resolution focuses on LSTLVs, any vessels not identified as longlines were removed from the analysis. In addition, all loitering events that occurred >= 9 degrees latitude were removed from analysis. GFW recognizes there is a risk that tuna and tuna-like species are transshipped in this region, however this is also a known area of squid-related transshipment events and not an area of reported transshipments by the IOTC (see figure 3 in *A Summary of the IOTC Regional Observer Programme During* 2018- MRAG and CapFish 2019) nor an area of identified encounters between carrier and longline vessels, and consequently may bias an IOTC focused transshipment analysis. In addition loitering events were restricted to those that are <= 24 hours in duration, due to a finding from the 2017 transshipment reports (for example see section 4.6 in the 2017 ICCAT report found here: https://globalfishingwatch.org/rfmo-transshipment/) that these loitering events are more likely to indicate possible transshipment activity.

Vessel authorization was established by using the publicly available vessel registry produced by IOTC[20], CCSBT[21], and Taiwan, China Fisheries Agency's list of IOTC-authorized vessels[22]. In addition to the registry data found in the CVP, the IOTC list of Active Carriers[ii] and vessels that declared transshipment of SBT[iv] was used to identify those vessels that were permitted to conduct transshipment activity. If a carrier or fishing vessel was listed as 'authorized' on any of the public registries during an encounter or loitering event the event was considered 'authorized'. However, if a vessel was not authorized on one of the three registries during the time period of an encounter or loitering event the authorization status is unknown. The ability to determine vessel authorization is largely dependent on the accuracy and comprehensiveness of the public registries, as well as the vessel information (name, MMSI, IMO, callsign) transmitted on AIS by the vessel and used by GFW.

Data caveats

The analysis presented in this report relies on commercially available AIS data and publicly available information. Therefore, the AIS data is limited by those vessels that transmit AIS data and do so by providing accurate vessel identity information. Low satellite coverage or high-density areas can also limit AIS data usefulness, although the IOTC Area has relatively strong Class-A AIS reception[xvi]. However, AIS reception tends to be worse in the North, and may be turned off for security reasons[xvii]. AIS data tends

[20] https://www.iotc.org/vessels/date

[21] https://www.ccsbt.org/en/content/ccsbt-record-authorised-vessels

[22] https://www.fa.gov.tw/en/Record_of_Vessel/index.aspx

to be sparser and more limited for vessels equipped with Class-B AIS devices[xvi]. Class-B AIS reception is quite poor in the northern half of the Indian Ocean basin[xvii]. For further analysis of GFW AIS data quality in the Indian Ocean refer to: Taconet, Kroodsma, and Fernandes 2019. 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 databases and registries, and limitations of modelling estimations, the AIS detected encounter, and loitering data are represented as accurate 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).

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RESULTS OF JAPAN'S INVESTIGATION ON THE REPORT OF Global Fishing Watch (GFW) REGARDING AT-SEA TRANSSHIPMENT

GFW provided a draft report "A Comparative Analysis of AIS Data with the Indian Ocean Tuna Commission" which analyzed movements of carrier vessels in the Indian Ocean by using AIS data. According to their report, their AIS-based data and analysis identified 118 trips by 49 carrier vessels possibly engaged in at-sea transshipment within the Indian Ocean in 2018.
The Fisheries Agency of Japan (FAJ) requested GFW to share the raw AIS-based data used for the report and conducted factual investigation with Japanese private companies operating 15 out of 49 carrier vessels.

1. Main movements identified by the AIS-based data

GFW mainly identified the following two types of movement, judging from AIS data.

Encountor: 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.

Loitering: when a carrier vessel travelled at speeds of < 2 knots for at least 4 hours, while at least 20 nautical miles from shore.

In addition, the GFW database also contains possible port visits made by carrier vessels.

2. The results of factual investigation

With regard to the 15 carrier vessels operated by 5 Japanese private companies, the AIS-based data includes 169 Encounters and 325 Loitering activities. Japan, Liberia, Panama and Singapore were flag-states of these carrier vessels. Of these, Panama and Singapore are neither members nor CNCP of the IOTC.

Encounters

The FAJ confirmed that these carrier vessels actually met other fishing vessels, flagged to Japan, China or Korea etc., at sea in all cases of 169 encounters identified by AIS. Of these, the number of cases involving transshipment of fish was 136, and the remaining 33 cases were meetings solely for other activities such as transshipment of bait and/or parcel and fuel supply, without transshipment of fish. ROP observers were onboard in 161 cases. In the remaining 8 cases, carrier vessels met fishing vessels without ROP observer onboard, but all of these 8 cases were solely for other activities than transshipment of fish.

Total Encounters	169 (ROP observers onboard: 161)
Transshipment or fish	136 (ROP observers onboard: 136)
Other activities*	33 (ROP observers onboard: 25)

(*transshipment of bait and/or parcel and fuel supply etc.)

Loitering Activities

The FAJ confirmed that these carrier vessels actually met other vessels (fishing vessels and carrier vessels) at sea in 249 cases out of 325 loitering activities identified by AIS. Of these, the number of cases involving transshipment of fish was 209, and the remaining 40 were solely for other activities such as transshipment of bait and/or parcel and fuel supply, without transshipment of fish. ROP observers were onboard in 241 cases. All of the remaining 8 cases where carrier vessels met other vessels without ROP observer onboard, were solely for other activities than transshipment of fish. There were 76 cases where loitering activity were identified by AIS but the carrier vessels actually did not meet other vessels. Such cases included various kinds of activities like drifting because of bad weather and placement of trial payaos.

Total Loitering activities	325 (ROP observers onboard: 313)
To meet other vessels	249 (ROP observers onboard: 241)
Transshipment of fish	209 (ROP observers onboard: 209)
Other activities*	40 (ROP observers onboard: 32)

(*transshipment of bait and/or parcel and fuel supply etc.)

Meeting other vessels at sea without ROP observer onboard (8 encounters and 8 loitering activities) were conducted during 4 trips, and all the trips ended by entering port at Cape Town. Perhaps the PEW could contact the port inspectors at Cape Town to know whether there was any problem.

3. Conclusion

- ✓ The FAJ cross-checked data of “Encounter” and “Loitering” provided by GFW with 5 private companies in Japan which operate 15 carrier vessels, including Non-CPC flagged ones. Most cases of “Encounter” and “Loitering” related to 15 carrier vessels were monitored by ROP observers onboard.
- ✓ In total 16 cases of “Encounter” and “Loitering”, carrier vessels met vessels at sea without ROP observer onboard, but all of these meetings were for other activities than transshipment of fish. All of these 16 cases happened during 4 trips ended at Cape Town, and after all the 4 trips the relevant carrier vessels entered Cape Town and were subject to port inspection.
- ✓ There was no sign of any illegal practice related to at-sea transshipment, including in cases where the carrier vessels were flagged to Non-CPCs.
- ✓ Japan completed investigation for 15 out of the 49 carrier vessels which GFW detected in the Indian Ocean. The other 34 carrier vessels must be reviewed by other flag or relevant CPCs.