

TMT BRIEFING

SQUID FISHING IN THE NORTHWEST INDIAN OCEAN - CLEAR AS INK



NOVEMBER 2021

BACKGROUND

Research conducted in 2017 identified the recent establishment and growth of a previously little-known squid fishery on the high seas of the Northwest Indian Ocean (NWIO)¹. Follow up monitoring of the fishery conducted in 2020, as part of a wider analysis of unregulated fisheries in the Indian Ocean², demonstrated that the squid fishing operations in the region had continued to expand significantly. This 2021 brief provides the latest update and information related to the fishery and for the first time provides on-the-water documentation of the fishing vessels and operations involved.

OVERVIEW

The vessels involved in the NWIO squid fishery continue to primarily operate on the high seas, adjacent to the Exclusive Economic Zone (EEZ) of Oman and Yemen, across an area equalling nearly 700,000km². The fishery generally starts around October each year, peaks in terms of number of vessels present in November to January, and then decreases through to late May. Analysis of vessel identities and VIIRS³ imagery indicates that squid continue to be a key target species. However, an increasing number of the fishing vessels operating in this area are multipurpose and it is possible that other species, such as tuna and small pelagic fish, are also targeted.

The high seas fishing grounds fall outside the remit of any regional fisheries management organisation (RFMO) with a mandate to manage species other than tuna and tuna-like species. Like the larger and better-known squid fishery that takes place in the Southwest Atlantic, this means that regulation of the fishery is entirely reliant on participating flag States. Unlike the Southwest Atlantic fishery, evidence from AIS analysis indicates that the vast majority of vessels (if not all) that are targeting squid in the NWIO are flagged to only one country. This represents a challenge but potentially also an opportunity for strengthening the management and regulation of this fishery

¹ Stop Illegal Fishing, Trygg Mat Tracking and NFDS (2017) Squid capture in the Northwest Indian Ocean: unregulated fishing on the high seas. Gaborone, Botswana. <https://www.tm-tracking.org/post/2017/06/05/new-fish-i-africa-report-squid-capture-in-the-northwest-indian-ocean-unregulated-fishin>

² WWF and Trygg Mat Tracking (2020) Unregulated fishing on the high seas of the Indian Ocean. Brussels, Belgium. <https://www.tm-tracking.org/post/unregulated-fishing-in-the-indian-ocean>

³ VISIBLE INFRARED IMAGING RADIOMETER SUITE (VIIRS) collects visible and infrared imagery, and is particularly suited to documenting the bright lights utilised by squid operations at night.

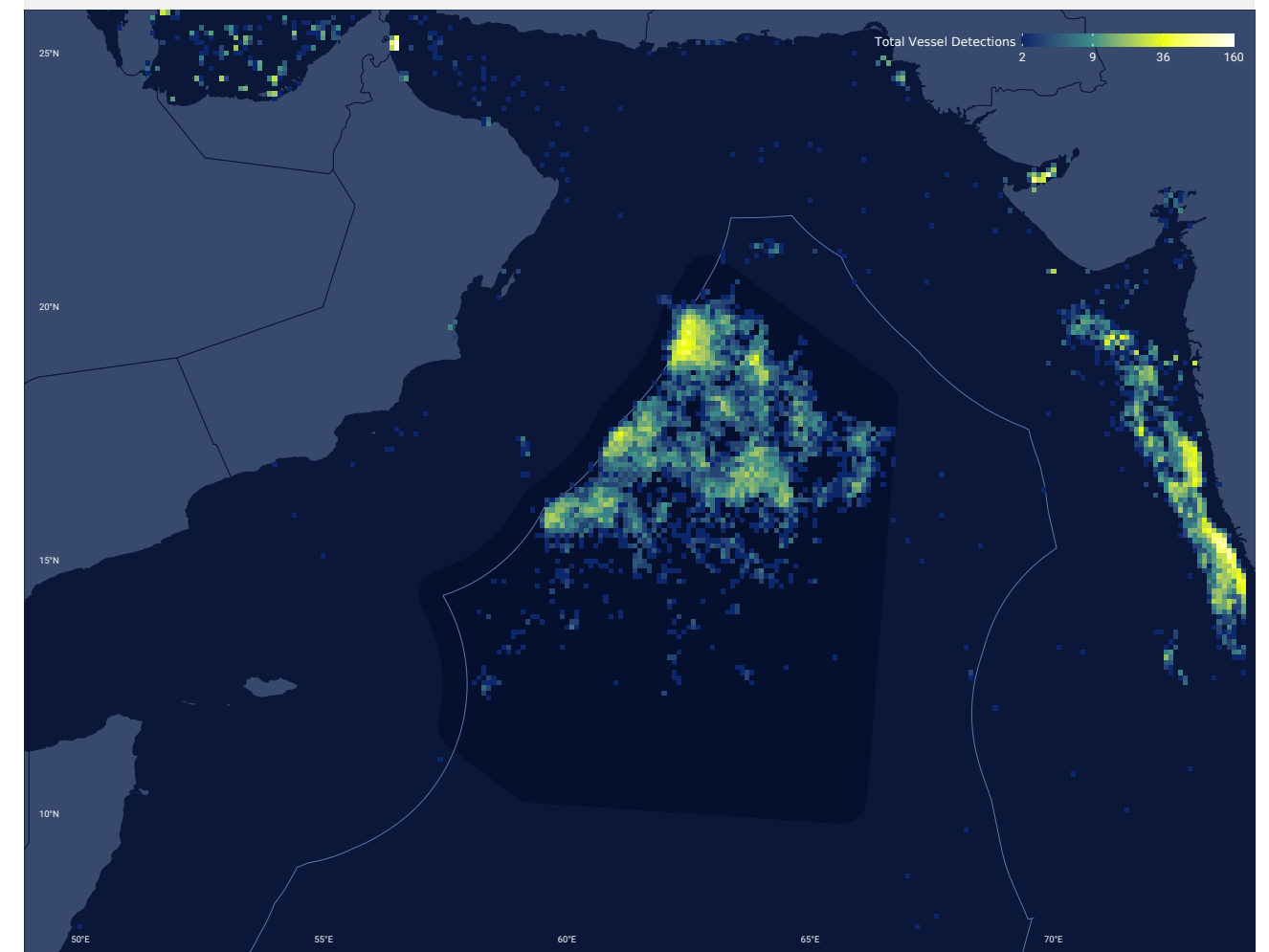
Key findings of this 2021 update are:

- 1) AIS indicates that the vast majority, and likely all, fishing vessels participating continue to be flagged to China. Transshipment at sea takes place with a fleet of reefers, the majority of which are flagged to China and Panama, with a number of other flag States also represented.
- 2) Most detected port visits by both fishing vessels and reefers (direct from participation in this fishery) continue to be to China, suggesting that most of the catch is sent there.
- 3) Previous cross-referencing of vessel information sources indicated that squid jiggers, net vessels and multipurpose vessels participated in the fishery. However, the first at-sea documentation of the fleet, conducted in May 2021, found that all vessels present at that time were fishing with nets. This corroborates sources indicating that an increasing proportion of vessels in China's expanding squid fleet are fishing with large nets – a method that reportedly has lower operating costs, and is likely more intensive, when compared to squid jigging – with potential to significantly increase pressure on squid stocks in the region.
- 4) Net fishing is also likely to be less selective compared to squid jigging, leading to increased levels of bycatch. This was confirmed by at-sea documentation of the fishing operations, which recorded specimens of tuna (skipjack and unidentified large species) on board vessels in the fleet. The fishery overlaps with fishing grounds targeted by tuna purse seiners, which indicates potential for significant tuna bycatch, as well as a possibility of vessels intentionally targeting tuna. At present, none of the vessels are authorised to fish in the Indian Ocean Tuna Commission (IOTC) fishery and there is no mechanism for reporting tuna bycatch in a non-IOTC fishery.
- 5) Other species were also observed being caught. This included small pelagic fish species, which are also unregulated in the region. It is unclear if these are target or bycatch species. Some of the vessels were observed fishing during daylight hours, which indicates the targetting of species other than squid.
- 6) While the high seas fishery is unregulated, there are strong indicators that this fishery also represents an illegal fishing risk to regional States. AIS and VIIRS data indicate that vessels fish close to the EEZ boundaries of Oman and Yemen and incursions have taken place. There is also a report of illegal fishing by vessels from this fleet in the Indian EEZ in 2019.
- 7) The risk presented by this fleet is increased by very low levels of AIS transmission by some vessels while participating in the fishery. A significant number of vessels were identified which transmitted over AIS while en route to the region and then switched AIS off or transmitted only very intermittently whilst on the fishing ground. In addition, the quality of vessel identifier information transmitted over AIS is often poor, making it challenging for authorities in neighbouring coastal States and other stakeholders to monitor the fishery; the majority of vessels were not transmitting any IMO identifiers, and a significant minority were not transmitting any recognisable vessel name and/or callsign.
- 8) A subset of the fleet was also observed through AIS fishing on the high seas of the Eastern Indian Ocean – in two distinct locations, on the Ninety East Ridge and south / southeast of Sri Lanka. The target species for this fishery is not known, but it may be significant that only net vessels, and no jigger vessels were observed fishing in that area. This activity also does not fall within the remit of any RFMO

with mandate to manage non-tuna fisheries. The presence of two vessels that appeared to be operating in a survey pattern, as well as the presence of two Chinese research vessels which were active in the northwest and Eastern Indian Oceans, could indicate the existence of an exploratory fishery and/or that China is engaged in research on stocks in this region.

Methodology

The findings in this brief are based on the analysis of several data sources. These include the results of AIS and VIIRS data analysis conducted by TMT and Global Fishing Watch (GFW) covering the period 2015-2019; further AIS and VIIRS monitoring conducted in 2020-2021; analysis of vessel identities, operational characteristics, and ownership based on the multiple data sources integrated into TMT's Fisheries Analytical Capacity Tool (FACT); and photo, film, and interview documentation of the fleet during a ship tour conducted in the region in May 2021 by Greenpeace International with support from TMT and GFW. For an overview of the AIS methodology, see Annex 1.



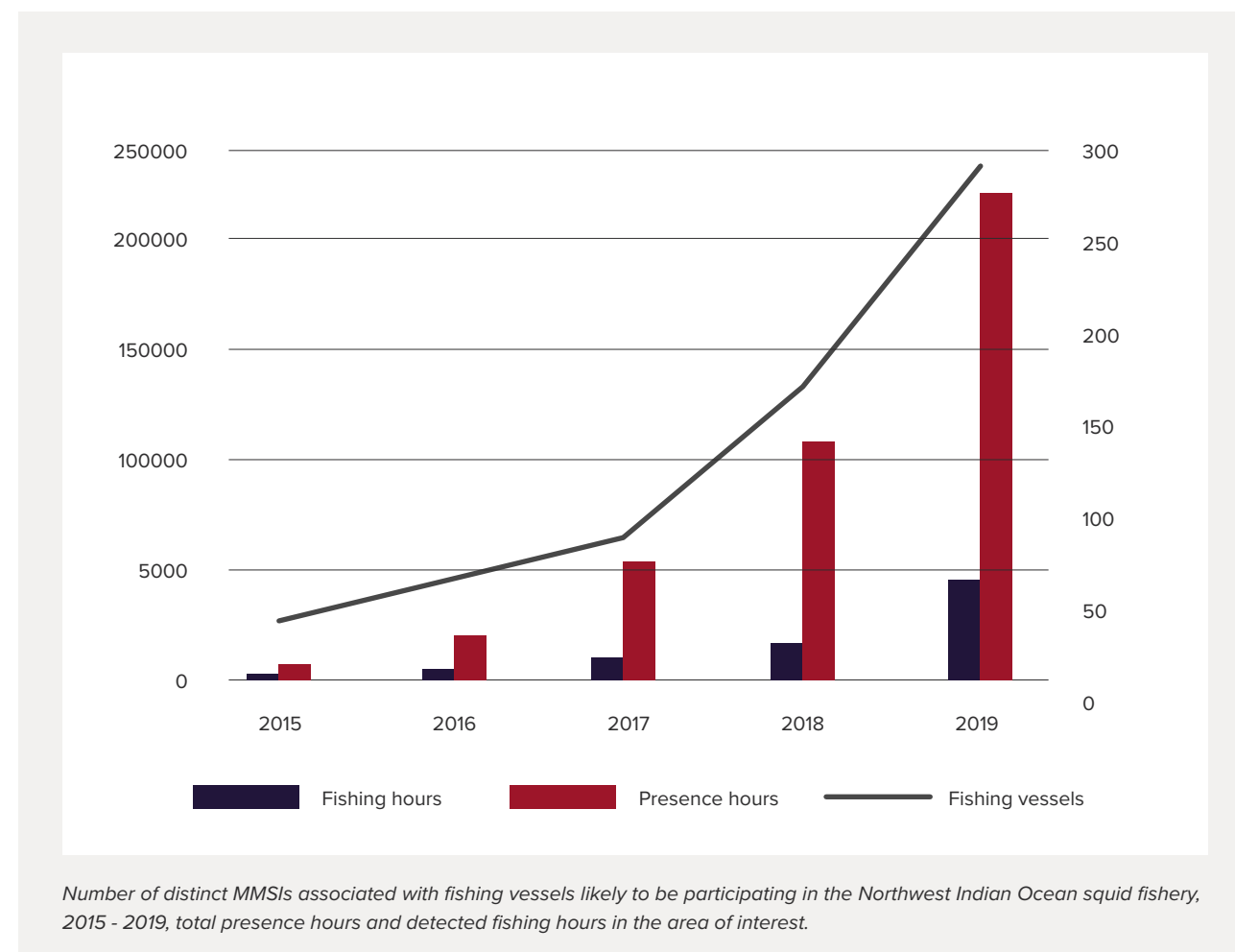
VIIRS satellite imagery showing light sources originating from vessels in the Northwest Indian Ocean, November 2019 to January 2020

CONTINUED GROWTH OF THE FISHERY

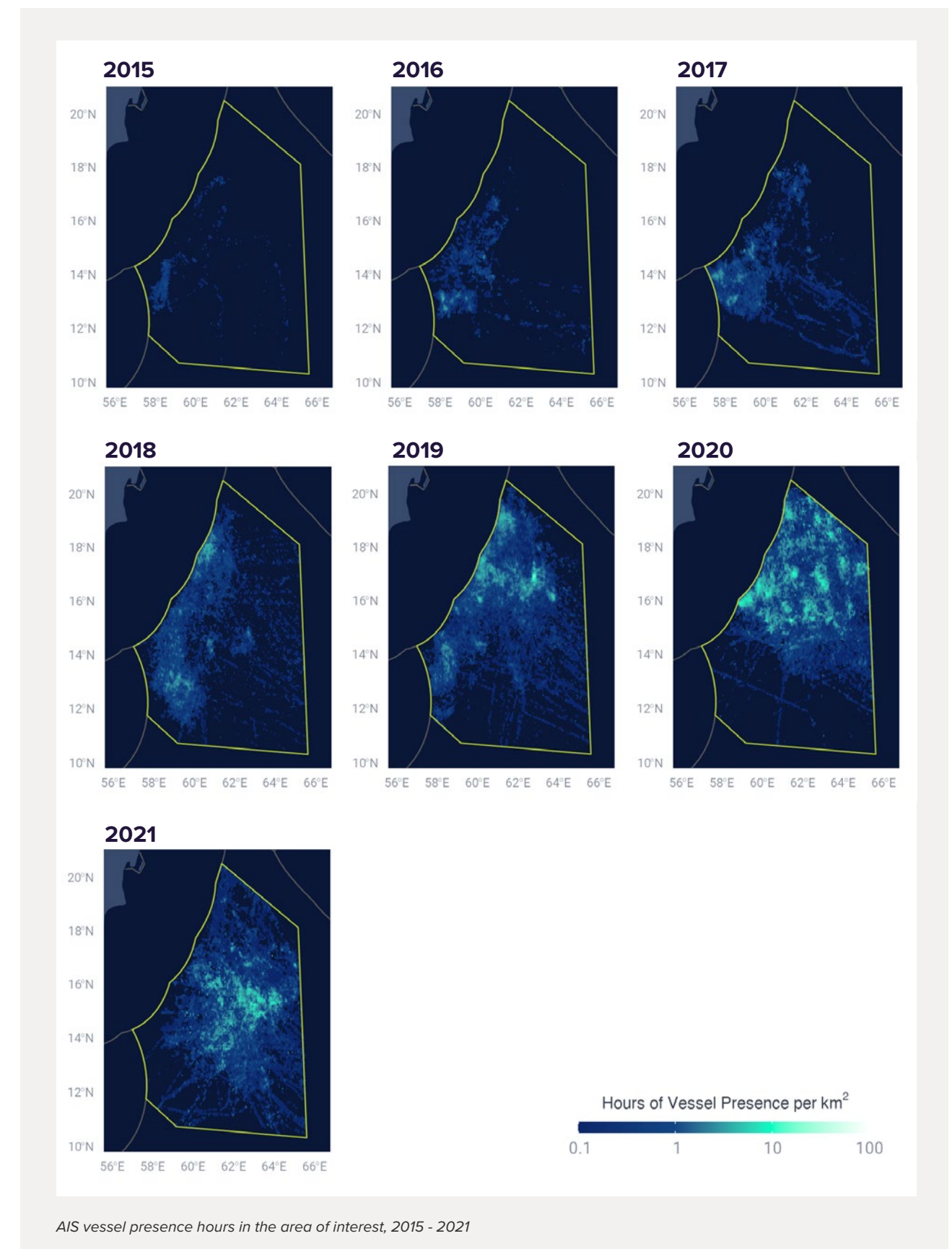
The initial research conducted in 2017 identified four suspected squid vessels operating in the area in 2015, increasing year on year to 53 in 2017⁴. However, due to advances in the AIS analytical methodologies used for this report, which enables the inclusion of vessels that were transmitting on AIS very infrequently or not at all after arrival in the area of interest, the estimated number of vessels detected in the fishery from 2015 has now increased. However, the overall findings mirror those of the earlier research and show that the fishery has significantly expanded year on year since 2015.

Using the new methodology, our analysis has detected 30 distinct MMSIs linked to fishing vessels that were considered highly likely to be engaged in the fishery in 2015 (across both fishing seasons, i.e. at the start and end of the year). This number increased to 55 in 2016, 81 in 2017, 164 in 2018 and 279 in 2019. Some vessels returned to the fishery across several years, giving a total number of 341 MMSIs detected across the period 2015 – 2019.

The total combined hours spent by these vessels in the area of interest increased year on year, in line with the increase in vessel numbers. The total number of fishing hours detected by Global Fishing Watch's algorithm also increased but much less steeply – however this is considered to be an underestimate due to low levels of AIS coverage (see Annex 1 - AIS Analysis Methodology).



⁴ Chen et al (2008) noted that 'A small-scale Chinese commercial jig-fishery targeting *S. oualaniensis* in the Northwest Indian Ocean commenced in 2005' Chen, X., Y. Chen, S. Tian, B. Liu, and W. Qian. An assessment of the west winter-spring cohort of neon flying squid (*Ommastrephes bartramii*) in the Northwest Pacific Ocean. Fish. Res. 92: 221–230 (2008). It is not known how active the fishery was between this observation and 2015.



OVERVIEW OF THE OPERATION

Who are the vessels?

Previous analysis of identifiers transmitted over AIS provided insights into the characteristics of fishing vessels participating in the fishery. Of the 341 MMSIs that were identified, the majority were in the numeric series assigned to China (412 and 413), indicating that they belonged to Chinese flagged fishing vessels. The remainder were identified as likely belonging to Chinese fishing vessels, either because the identifiers transmitted matched the details of known Chinese squid fishing vessels, or because the unofficial MMSI series used and names transmitted indicated Chinese origin, and in many cases tracks showed visits to ports in China.

Cross-referencing with RFMO authorised vessel lists indicated that approximately 45% of the MMSIs were linked to vessels that have at some point been authorised to fish in an RFMO-managed squid fishery – primarily in the North Pacific (North Pacific Fisheries Commission) and a lesser number in the South Pacific (South Pacific Regional Fisheries Management Organisation). Gear type information was available for these vessels from the RFMO authorised vessel lists. This indicated that while the majority were engaged in some kind of line fishing (presumably squid jiggers), approximately 40% of those vessels for which gear type was listed were purse seiners, suggesting that both line and net vessels are present in significant numbers.



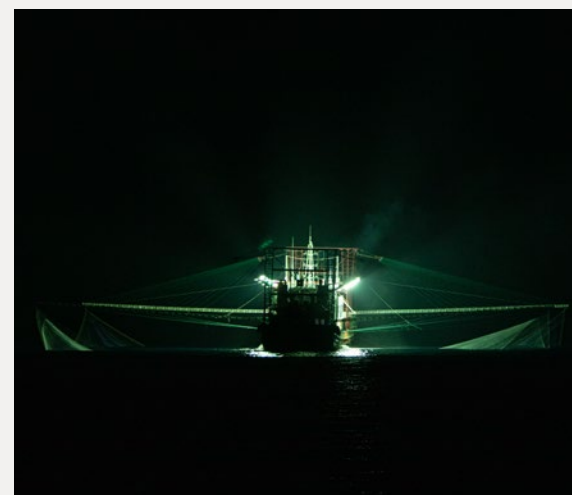
Image of a squid vessel with jiggering machines visible on each deck side – note that this image was taken in the Southwest Atlantic. Whilst AIS indicates that vessels reported to be jiggers do operate in the NWIO, none were physically sighted in the area in May 2021.

However, at-sea documentation of the vessels taking part in the fishery in May 2021 found that all present at that time were fishing with nets rather than jigs, although some officers did identify their vessels as jiggers over ship radio communications. The significance of this absence of jiggers is unknown but may relate to the timing of the documentation – based on AIS analysis May is late in the season, and it is likely that a significant portion of vessels had departed for other fishing grounds or returned to China by that point. Therefore, the dominance of net vessels at this time may be a general reflection of the fleet composition throughout the year or may reflect the fact that net vessels are

active later in the season compared to jiggers. It can be noted however that the lack of jiggers also corroborates sources that indicate an increasing proportion of vessels in China's expanding squid fleet are fishing with large nets – a method that reportedly may have lower operating costs, and is likely more intensive, when compared to squid jiggering, with potential to significantly increase pressure on squid stocks in the region and increase bycatch.

A new gear type in industrial squid fisheries?

Of note is that none of the vessels documented at sea in May 2021 were configured as traditional squid jiggers or purse seiners. Instead, all vessels had either two or four booms, which appear to be used for the deployment of lift nets. Several sources reference the development of vessels fishing with very large nets and booms as a characteristic of China's expanding squid fishery.⁵ This reportedly requires fewer crew compared to other methods of squid fishing, suggesting that operating costs may be lower.



There is limited information available to confirm what squid species are being targeted in the NWIO. An academic paper dating from 2007 describes an exploratory fishery for purple back flying squid (*Sthenoteuthis oualaniensis*), a relatively large species. However, documentation of squid catch using drone footage indicated that the majority consisted of a small individuals, with just a small number of large squid present. In the absence of close-range documentation of catch or detailed catch statistics, the target species has not been confirmed.

Of further interest is that while much of the fishing took place at night using high powered lamps, the images appear to indicate that some of the vessels may also be deploying their gear in daylight. If so the catch from these daytime operations is not clear, but this could indicate additional target species for the vessels in the area.

⁵ For example <https://e360.yale.edu/features/how-chinas-expanding-fishing-fleet-is-depleting-worlds-oceans> and <https://www.idealcryptos.com/chinas-fishing-fleet-the-worlds-largest-drives-beijings-global-ambitions/>



A still capture from drone footage showing sorting of catch on board a squid fishing vessel in the northwest Indian Ocean. The image clearly shows that the majority of catch consists of a small squid species, with small pelagic fish also present. Some specimens of a larger squid species are also visible at the top of the image

Sources indicate that these types of net vessels are becoming increasingly common in Chinese squid fisheries, but there has been limited documentation or analysis of this type of operation to date. This is concerning, as the gear type is clearly less selective and likely more intensive compared to squid jigging, and if it is correct that the labour costs are lower this development has the potential to significantly increase pressure on squid stocks in the region and globally.



Two images of the same vessel – the second indicates gear deployed in the water (in daylight hours), with two booms extended from deck

Port usage

Most detected port visits by fishing vessels active in the fishery are to Fujian, Zhejiang, and Shandong Provinces, China. The most visited ports were Weihai, Fuzhou and Zhoushan. However, as the number of participating vessels has increased since 2017, the relative importance of different ports has changed, presumably reflecting the participation of different fleets in the fishery. For example, while Weihai has remained a major port for the fishery since 2015, both Fuzhou and Zhoushan have increased significantly in importance in recent years, and the relative importance of Taizhou (which had almost as many port visits as Weihai in 2015) has declined.

Other countries seeing port visits were Singapore, visited by vessels transiting through the Malacca Strait, and Busan, South Korea, which was visited by vessels that also fished in the North Pacific but does not appear to have been a destination for vessels returning directly from the NWIO. No other major port hubs for this fleet were detected, suggesting that the majority of catch is either landed when the vessels return to China or transhipped to refrigerated cargo vessels (reefers) at sea.



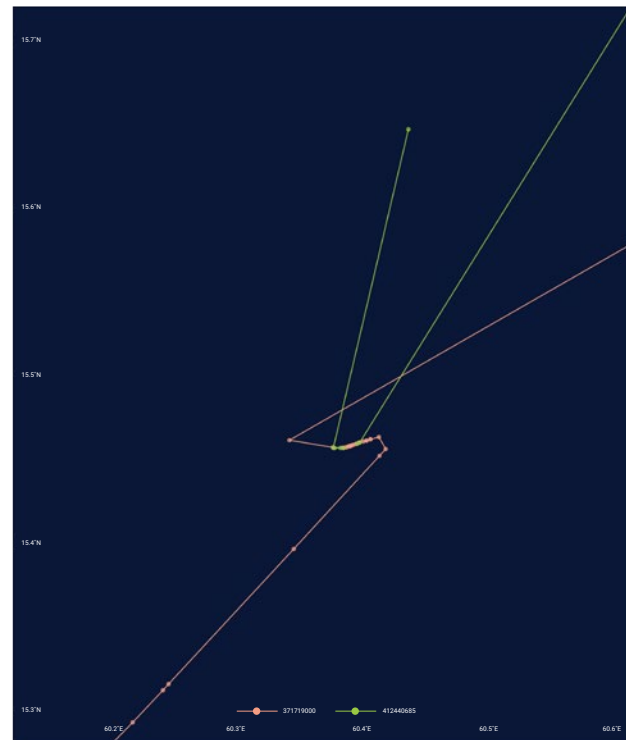
A squid vessel hauling its nets, May 2021

Transshipment at sea

AIS analysis continues to identify significant activity by reefers in the area of interest, as well as fishing vessel and reefer encounters, indicating that significant volumes of catch from this fishery are transhipped at sea. Observations at sea in May 2021 documented multiple instances of transshipment at sea between fishing vessels and reefers, confirming that this activity does take place and represents an important component of the operations of this fishery. However, the numbers of transshipments that take place are uncertain, due to the low levels of AIS transmission by a significant number of the fishing vessels and uncertainty that all carrier vessels are always broadcasting.

Nonetheless, more than 50 reefers were detected from 2015 to 2019 with AIS tracks which indicated either obvious or potential operations in the area of interest. These included vessels that spent extended periods of time in the area, as well as some vessels with global operating patterns which showed some loitering behaviour whilst transiting through the area. Reefer AIS tracks were analysed to detect vessel encounters (with a second vessel tracking on AIS) as well as loitering events, where a second vessel is not detected on AIS but the pattern of reefer movement indicates that it is potentially engaged in an encounter. This analysis found that between 2017 and 2019 there was a significant increase (300%) in encounters and loitering events involving the identified reefers in the area of interest. While a portion of these events are likely to relate to other activities, including bunkering at sea, vessel repairs and vessels awaiting orders, this is reflective of the significant expansion of the fishery across this period and the importance of transshipment at sea to this fleet.

Of the reefers that had clear or potential operations in the area of interest, nearly 40% were flagged to China and approximately one third were flagged to Panama. The remainder were registered to eight flag States, including known open registries (and some flags of non-compliance) and other



Track of fishing vessel and reefer showing a potential encounter in the AOI



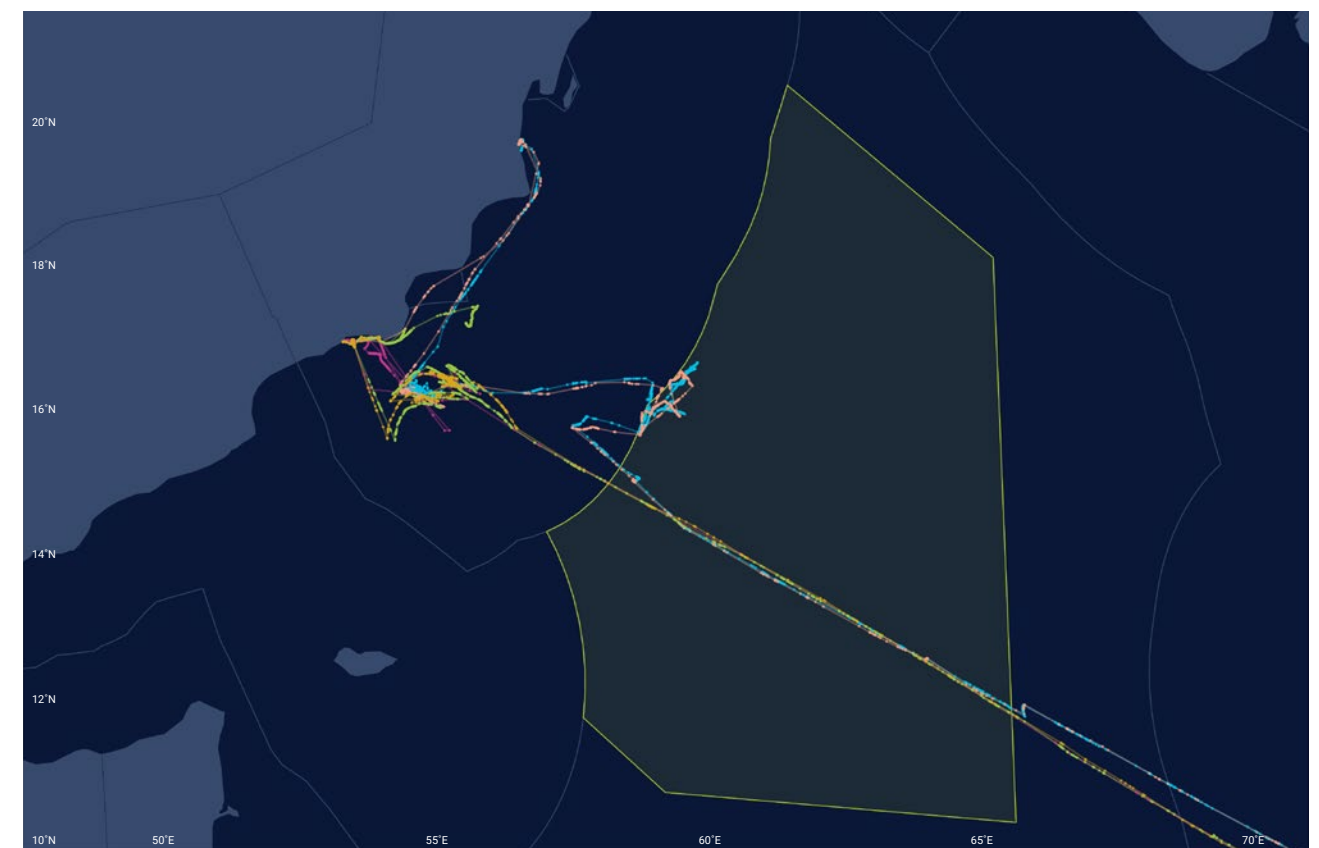
A squid fishing vessel engaged in at-sea transshipment with a Chinese flagged reefer in the Northwest Indian Ocean, May 2021

registries known to flag significant numbers of reefer vessels: Kiribati, Dominica, Germany, Liberia, Togo, Cook Islands, Russia and Sierra Leone. The pattern of port usage by the reefers was similar to the fishing vessels. More than 850 reefer port visits were detected across the period, more than 50% of which took place in China, with Weihai, Fuzhou and Zhoushan again being the most visited ports. The majority of the remaining detected port visits took place in Singapore and South Korea and no other port hubs were identified that were visited by the reefers directly after operations in the area of interest. This again suggests that the vast majority of the catch from this fishery is landed in China, either by reefer or by the fishing vessels themselves.

Port visits in the Northwest Indian Ocean

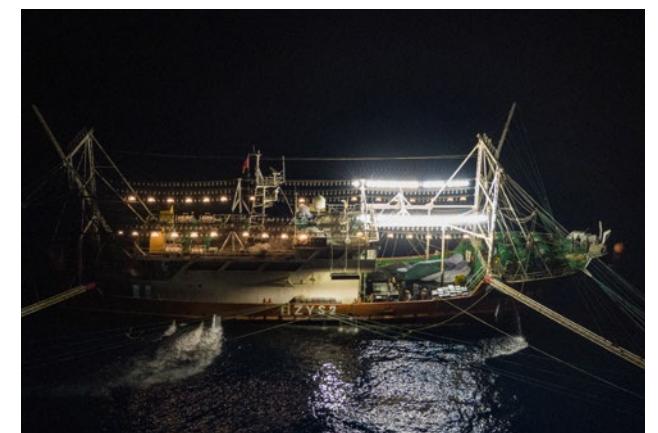
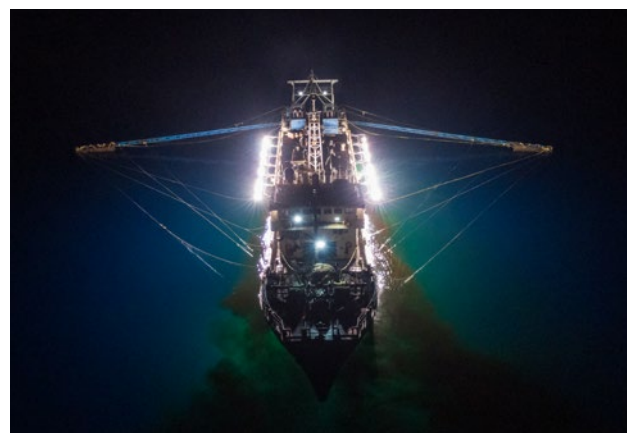
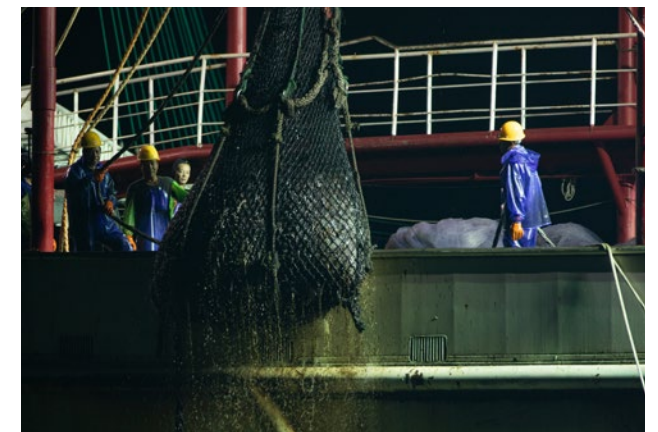
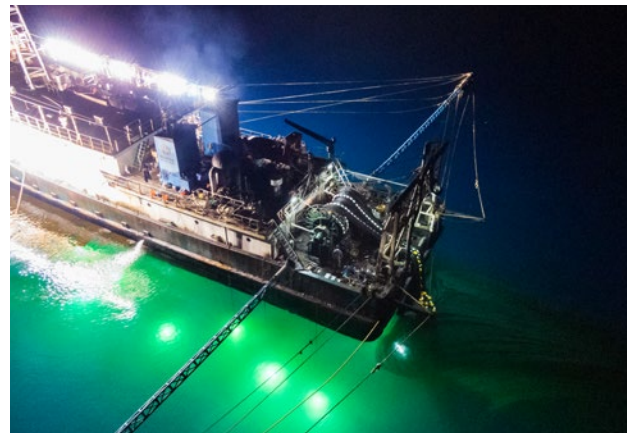
A small portion of the vessels (15 in total) were detected making port calls in the NWIO region during 2018 and 2019. The majority of these were visits to ports in Oman (primarily Salalah, but also Duqm, Mirbat, and Mina Raysut), including some visits by vessels that appeared to also engage in fishing activity or other operations in the Oman EEZ. In addition, a very small number of visits to ports in India, Pakistan and Somalia were detected. It is unclear what the purpose of these port visits was, though it is likely to have included vessel repairs and possibly also resupply/refuelling. The port visits to India likely relate to an IUU fishing case which is outlined in the section on 'Risk factors' below.

From AIS data alone it is not possible to determine whether catch was offloaded in these countries, although the small number of port visits detected suggests that this is unlikely to be a significant trade if it does exist.



Tracks of vessels with port visits to Oman

The following two pages of images provide a snapshot into the night and daytime fishing and transshipment operations of the fleet as documented in May 2021.

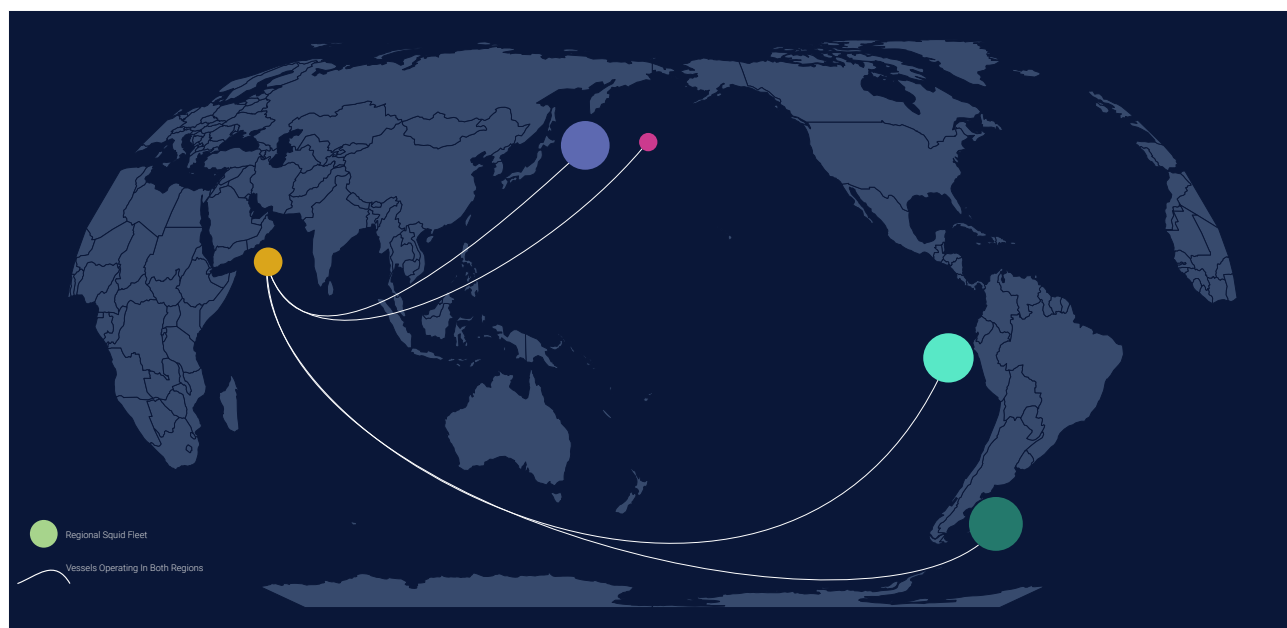


Seasonality and links to other squid fisheries

The fishery continues to be seasonal, although the total number of months during which vessels were detected operating in the area of interest has increased over the years. In 2015 and 2016, fishing activity was concentrated in the northern hemisphere winter, with vessels present from October to April. In subsequent years the season has extended with significant vessel presence starting in September and extending into May, although the peak continues to occur from November to January. It is unclear whether this reflects changes in the seasonality of the fishery related to climate or other factors, or whether vessels are simply extending the time they spend in the fishery as it becomes more developed.

Several of the vessels were detected operating in other known squid or squid-related fisheries, outside of the NWIO squid season. Analysis of the movements of known squid vessels globally indicates connectivity between this fishery and the squid/saury fishery in the Northwest Pacific, as well as the squid fisheries in the Southwest Atlantic and Eastern Central Pacific. It is interesting to note that the 2017 study only identified a link with the North Pacific fishery. The links with the Atlantic and Eastern Pacific squid fisheries have appeared more recently and presumably reflect the increasing number of Chinese squid vessels that are choosing to spend part of the year in the NWIO.

While most vessels were only detected participating in known high seas squid fisheries, there were some examples of vessels that spent part of the year in other fisheries. These include two vessels that came directly to the NWIO after a period operating in West Africa, fishing in the EEZ of Mauritania (where the primary fisheries are for small pelagic fish species), as well as two vessels that went from operating in the high seas of the Western Central Pacific to the NWIO. In the latter case, the vessels were WCPFC authorised, with their gear type listed as ‘lighting purse seine’ and target species listed as ‘small pelagic’. These examples further suggest that some vessels fishing in this area have the capability of targeting other species groups and may be doing so.



Inter-relationship between the northwest Indian Ocean and other known squid fisheries, based on movement of individual vessels between fisheries

It should be noted that China took steps to strengthen the management of its high seas squid fleet in 2020, including the release of a circular on squid management measures, which contained provision for the use of closed seasons for its squid fishing fleets. However, this only provided specific measures for the southwest Atlantic and eastern Pacific, leaving the NWIO fishery with no known, specific management measures at the present time. In fact, the proposed closed season for the Eastern Pacific has some overlap with the fishing season in the NWIO, which raises the possibility that implementation of these measures could lead to a transfer of effort and further expansion of this fishery. In November 2021 China announced a cap on the number of its squid jiggers operating in international waters, however this cap has not been applied to other gear types.

RISK FACTORS

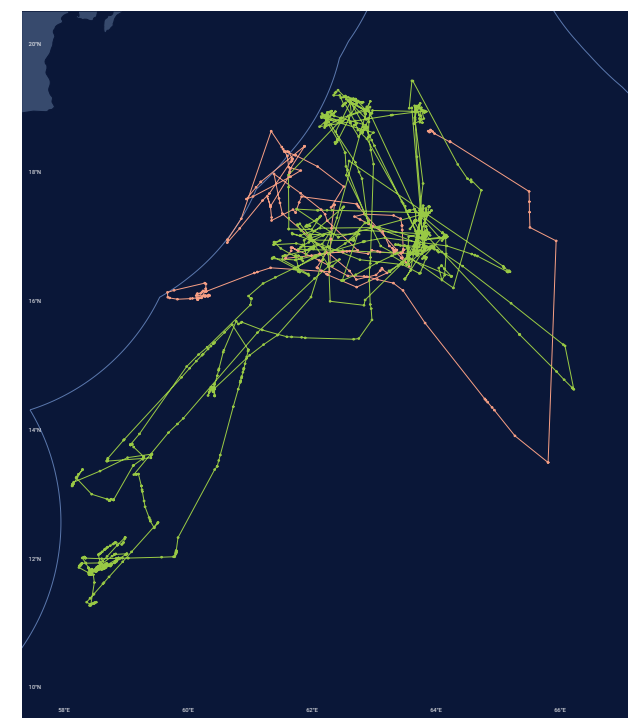
Beyond the general sustainability concerns raised by the rapid expansion of an unregulated fishery in the NWIO, there are several factors that could potentially increase the risk presented by this fishery from both an MCS/IUU and broader fisheries management perspective.

EEZ incursions

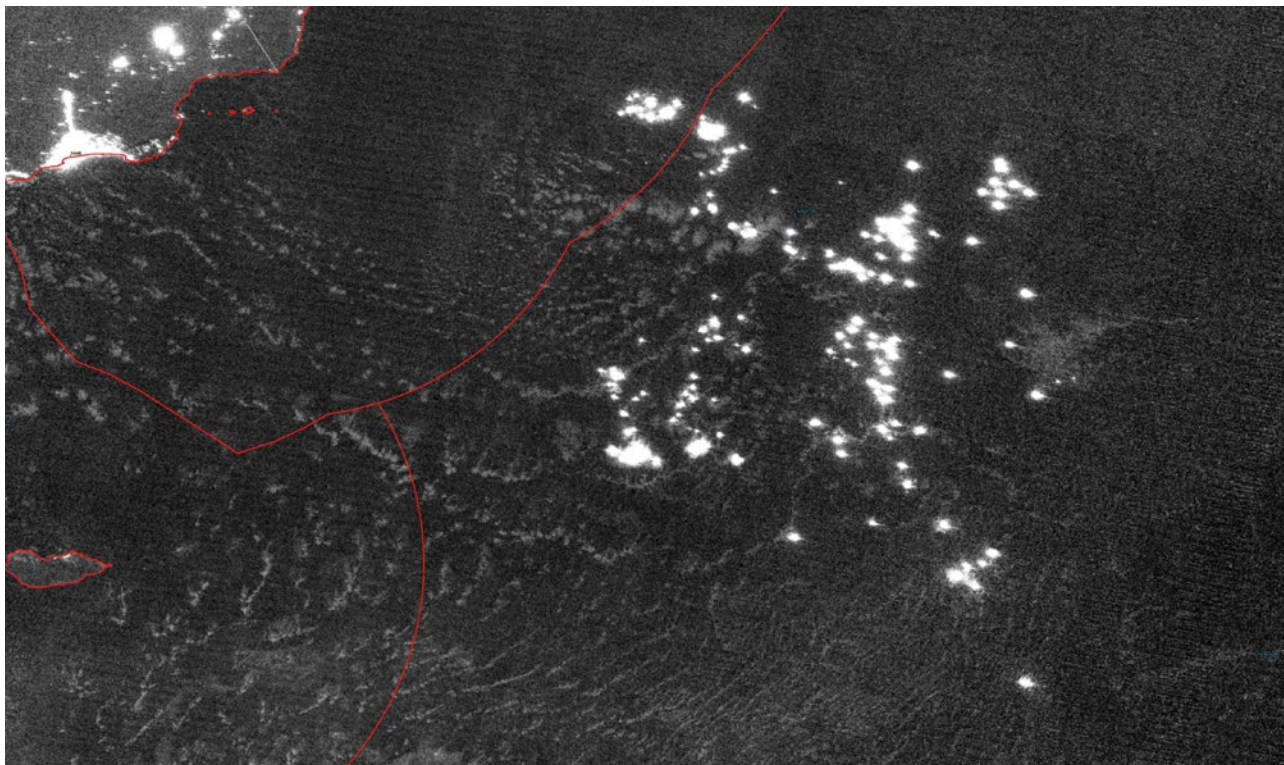
The area targeted by the fleet is close to the EEZ boundaries of both Oman and Yemen. While a small number of vessels have been identified that spend extended periods of time operating far inside the EEZ of Oman (raising the possibility that their activities may have been licensed), the vast majority of vessels appear to operate only on the high seas. However, track analysis did identify that a small number of these vessels made occasional incursions across the Yemen or Oman EEZ boundaries. While it is not possible to determine whether any of these vessels fished during these brief EEZ incursions, these findings raise the possibility that some illegal fishing in Oman or Yemen may be occurring if the vessels are not licensed. Certainly, the presence of a significant number of vessels ‘fishing the line’ of EEZ boundaries in a poorly controlled fishery raises the prospect of IUU fishing occurring, similar to what has been reported in the Southwest Atlantic squid fishery.

Unsurprisingly, the number of vessels that were identified making potential EEZ incursions increased annually with the growing size of the fleet – with 3 vessels detected making potential incursions into the EEZ of Yemen in 2017, which increased to 19 vessels detected making incursions (mostly to Oman, two to Yemen) in 2019.

VIIRS data, which shows the distribution of vessels that fish with high powered lights, indicates that some vessels were present well within the Oman EEZ in February 2021. No signals were received from these vessels over AIS, whilst other vessels present on the adjacent high seas were detected, suggesting that these vessels were not transmitting over AIS whilst operating in the EEZ of Oman.



2018 AIS tracks indicating a possible incursion into the EEZ of Oman (orange) and vessels that appear to be fishing very close to the EEZ boundary



VIIRS imagery showing the distribution of vessels operating with high powered lights, on both sides of the Oman EEZ boundary.
Source: NASA Worldview

In addition to the illegal fishing risk to directly neighbouring EEZs, a news story reported by Indian media in 2019 indicates that the presence of this fishery may be increasing this risk in the wider region.⁶ In June 2019 it was reported that ten Chinese fishing vessels from the FU YUAN YU fleet sought shelter from Cyclone Vayu in Indian waters. However, local fishermen reported that the vessels were fishing illegally whilst inside the EEZ and this was reportedly confirmed by the state Fisheries Department. It was reported that in addition to squid fishing gear, the vessels were also carrying other fishing gear, such as drift nets. The same source also claims that 19 of the 37 crew on board one inspected vessel had expired passports, raising serious concerns about the working conditions in the fleet. The FU YUAN YU fleet operates globally and vessels have been implicated in multiple cases of IUU fishing and non-compliance – for example a group of three FU YUAN YU squid vessels (including at least one that has operated in the NWIO) were detained by South Africa for failing to declare entry into the EEZ as per requirements while en route back from the Southwest Atlantic fishing grounds.⁷

There is relatively little information available regarding non-compliance by squid vessels, due to the fact that a significant portion of squid fishing takes place in the high seas, combined with limited RFMO coverage. However, cases such as these demonstrate the increasing risk presented to neighbouring coastal States by this expanding fishery.

⁶ <https://www.hindustantimes.com/mumbai-news/in-troubled-waters-10-chinese-vessels-found-fishing-illegally-in-maharashtra/story->

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⁷ <https://www.iol.co.za/news/3-more-chinese-fishing-vessels-arrested-2025436>

RISK ASSOCIATED WITH MULTIPURPOSE VESSELS

As already noted in this brief, there are clear indications that a significant proportion of the vessels active in the area of interest are fishing with nets. Further, sources have indicated that some of the vessels are multipurpose, designed to fish with a variety of different gear types, or carry additional gears on board.

Catching Tuna?

The presence of vessels targeting squid with nets in the NWIO presents a risk as these vessel types could potentially be used to target tuna or tuna-like species, and there is evidence that they also catch tuna as bycatch. The squid fishing ground falls entirely within the area of competence of the Indian Ocean Tuna Commission (IOTC), of which China is a member. It also overlaps with areas known to be targeted by IOTC authorised tuna purse seiners. However, none of the 341 MMSIs detected potentially operating in this fishery are linked to IOTC-authorised vessels. This raises the possibility that unauthorised fishing of IOTC species could be occurring. The low level of AIS coverage for many of the vessels, combined with the relatively infrequent port visits in the region, means that this activity would be hard to detect.

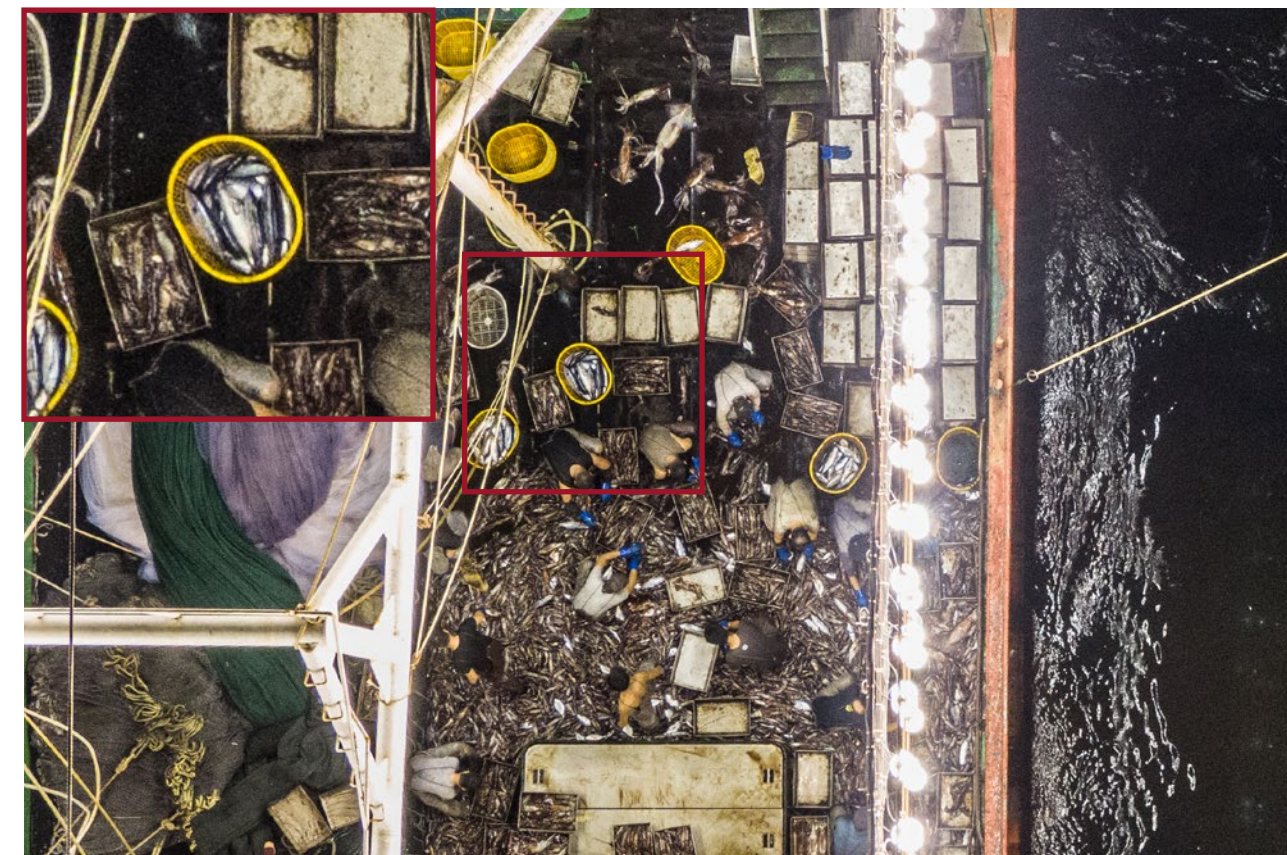


AIS tracks of 14 Tuna Purse seiners authorized to the IOTC, showing operations in and around the NWIO squid fishing area of interest in the first half 2020, showing clear overlap between the tuna and squid fisheries.

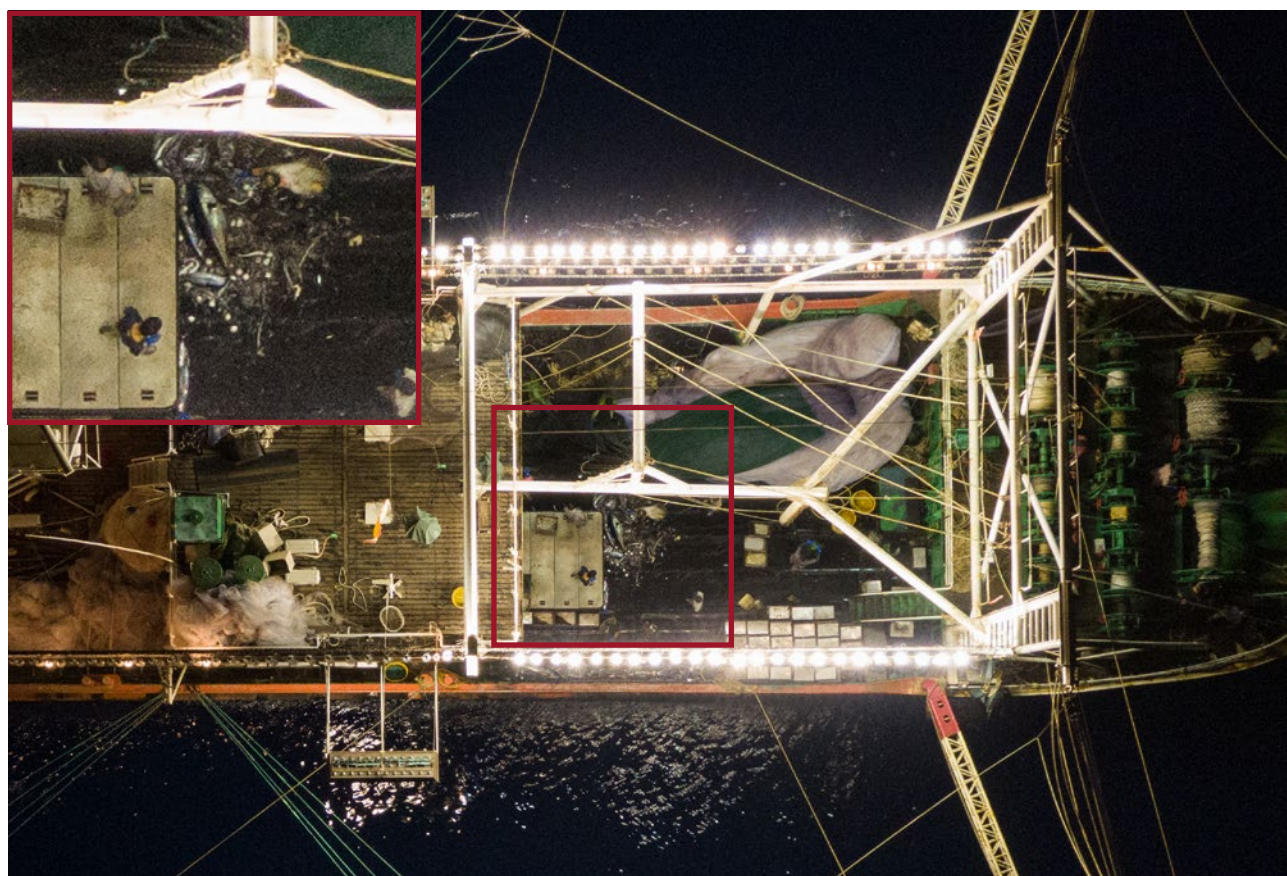
At-sea documentation of catch on board vessels using drone videography in May 2021 identified the presence of large tuna (likely bigeye or yellowfin, but not confirmed) and what appears to be skipjack tuna on the decks of observed vessels – providing clear evidence that IOTC species are being caught in this fishery. In addition, five vessels that were active in the fishery that later called into port in Gwadar, Pakistan were found to be carrying around 30 metric tons of skipjack tuna, yellowfin tuna, and kawakawa mackerel, further substantiating tuna and tuna-like bycatch in the fishery.



Still image from drone footage showing two specimens of large tuna (bigeye or yellowfin, undetermined) on board a Chinese squid vessel



Still image from drone footage showing a basket of what may be skipjack tuna (undetermined) on board a Chinese squid vessel



Still image from drone footage showing one specimen of large tuna (bigeye or yellowfin, undetermined) on board a Chinese squid vessel

It is not however known whether tuna caught by these vessels is commercialised – if this is the case, there is potential for the activities of these vessels to be considered as illegal fishing in the IOTC area.

There are no mechanisms for recording and reporting this bycatch to IOTC, since only vessels on the IOTC RAV are allowed to operate in tuna fisheries and to report to IOTC, and none of their bycatch would be tuna. IOTC's vision and regulatory framework is tuna-centric, and tuna is not considered as bycatch in IOTC's current management approaches. Therefore, the true extent of tuna bycatch by this fleet is not known and cannot be taken into account under current IOTC rules, and in the development of tuna management plans for the region.

Base of the Food Chain

As already noted, footage of catch on board clearly indicates that the primary target species of the net vessels is a small squid species, representing an important forage species in the marine food chain, which indicates another potential mechanism for this fishery to impact tuna populations of the Indian Ocean. Squid are known to form an important component of tuna diets throughout the region, and a potential reduction in their availability through overfishing will very likely have a knock-on impact on tuna stock abundance and health. This in turn could have significant impacts for those fisheries, the economies, and the livelihoods that depend on them.



The BLUE OCEAN 2 appears to be able to operate multiple gear types

Examples of potential risk vessels

The BLUE OCEAN 2 spent time operating in the squid fishery in the NWIO, and then later spent several weeks fishing in the Somali EEZ (Puntland), where it made a port visit to Bosaso. The legal status of the vessel's fishing activity in Somalia is unclear but the fact that the vessel made a visit to port suggests that it may have been licensed to operate in Puntland.

Images do not clearly show what gear the vessel is rigged for. However, the presence of what appears to be a trawl hatch in the stern, as well as cranes on the deck, indicate that the vessel could operate both purse seine and different trawl type nets. This also suggests that it could engage in different fisheries in coastal waters as well as the squid fishery. It may also have been engaged in another activity in the area of interest, such as transshipment. Unfortunately, there was insufficient AIS data available to confirm the nature of its activities on the high seas or in Somali waters.

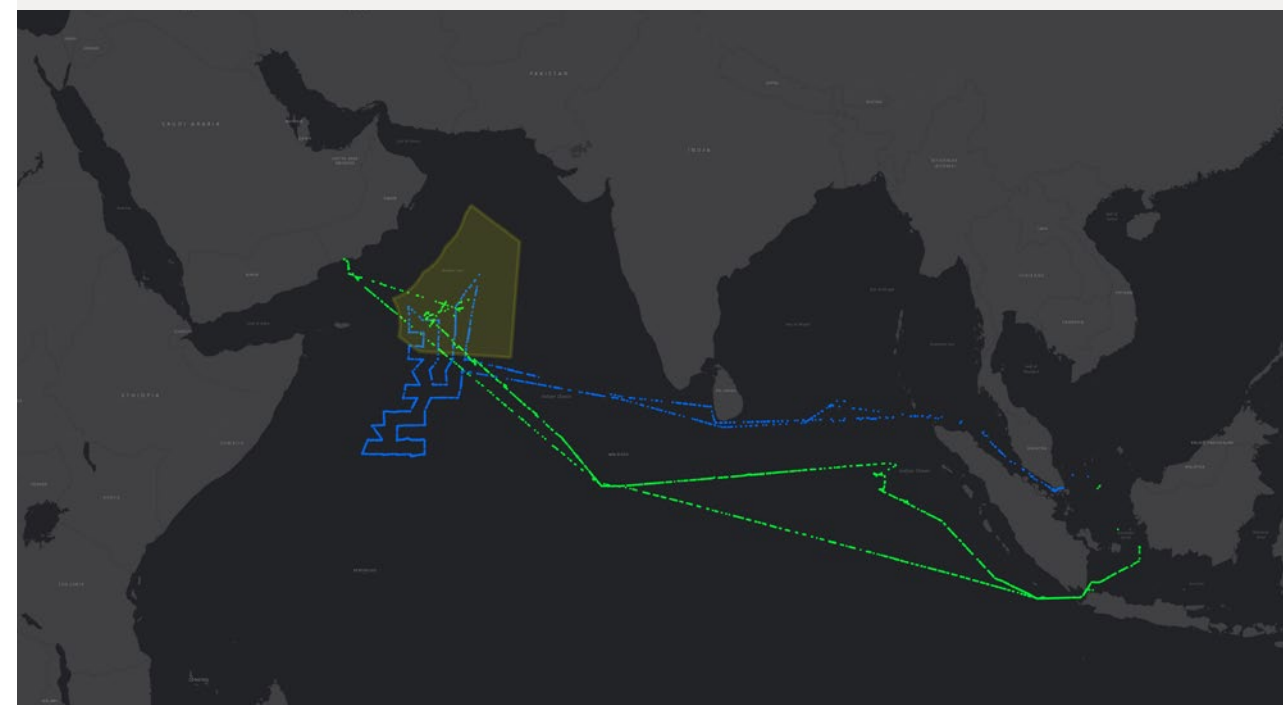
In addition, AIS signals were detected from the area of interest that appeared to be linked to four vessels with a previous history of IUU fishing in the IOTC area – including unauthorised fishing of tuna and tuna like species, and the use of illegal large-scale driftnets. The four vessels detected in the NWIO in 2019 and early 2020 form part of the FU YUAN YU group of vessels that was documented by the NGO Sea Shepherd in 2016 fishing for tuna and tuna-like species in the southeast Indian Ocean, despite not being IOTC authorised.⁸ All four vessels transmitted very infrequently over AIS whilst in the NWIO, making it impossible to determine their activities or current gear type through AIS analysis. It is reported that the vessels have changed ownership since the 2016 incident and are not currently targeting IOTC species. Nevertheless, the presence of these vessels illustrates the potential risk of IUU fishing of IOTC species occurring.

⁸ <https://iuriskintelligence.com/fu-yuan-yu-fleet-illegal-chinese-driftnet-activities-high-seas/>

Chinese research vessels in the Indian Ocean

Throughout 2020, two vessels identified as state-owned Chinese research vessels were detected over AIS operating in the Indian Ocean. Both vessels appeared to operate on the main squid fishing grounds in the NWIO, as well as in the fishing areas identified in the Eastern Indian Ocean.

Whilst the nature of the activity conducted by these research vessels is not known, their area of operations and the overlap with the known squid fishing grounds is an interesting observation and could suggest that China is conducting research on the stocks in the area.



AIS tracks of Chinese research vessels in the Indian Ocean in 2020

MONITORING CHALLENGES AND LACK OF TRANSPARENCY

AIS coverage issues

The IUU risk presented by this fleet is significantly increased by the very low levels of AIS transmission by many of vessels. While some vessels transmitted consistently on AIS for the duration of their operations in the NWIO, a significant number were identified which transmitted over AIS only during the transit from China to the NWIO and then ceased transmissions shortly after arriving in the area of interest.

This means that it is not possible for authorities in neighbouring coastal States or other interested parties to monitor a significant portion of the activity in this fishery, much of which is presumably only visible to flag State authorities via VMS (assuming vessels have this installed and working). This lack of transparency makes it challenging, not only to identify IUU risks associated with this fleet, but also to accurately monitor the expanding levels of fishing activity and assess potential impacts on other fisheries in the region.

The challenges in monitoring this fleet are also exacerbated by the practice of one vessel transmitting via more than one MMSI, in some cases simultaneously. Several vessels were identified which appear to have used two MMSIs whilst operating in the area of interest – in all cases, one was an MMSI in the official Chinese numeric series (412, 413) and the other was an unofficial number not in any nationally assigned series. The reason for this practice is unknown, but it means that without detailed AIS data analysis, it is challenging to ascertain the true number of vessels operating in the fishery.

Vessel identification issues

The transmission of patchy or poor-quality identity information over AIS, the distant high seas nature of the fishery, its unregulated status, and the fact that the vessels are operating out of only one country, all present significant challenges for identifying many of the vessels participating in the fishery.

Matching of the identification details transmitted over AIS (name, callsign, MMSI and IMO number) against sources in TMT's FACT system indicates that 217 of the 341 fishing vessels have been allocated an IMO number. It should be noted that many of these IMO numbers were assigned to individual vessels very recently; this may be an indication of increased Chinese oversight of the fleet.

However, almost no vessels were consistently transmitting their correct IMO number over AIS – in fact no vessels were consistently transmitting a correct IMO number during the 2015 – 2017 period, and only 1 to 2% of vessels did this in 2018 and 2019. While it is not uncommon in many fishing fleets for vessels to not transmit their IMO number, transmission of the callsign is more common; nonetheless, the proportion of vessels transmitting a valid Chinese callsign was also low, never rising above 50% of active MMSIs in any given year.

This patchy transmission of identifiers can make it extremely challenging to confirm which vessels are operating in the fishery – for example, a vessel fishing in the NWIO in 2017 transmitted the name LU RONG YUAN YU 811, which is a match for a squid jigger authorised to NPFC, which has been allocated an IMO number. However, other sources assign that vessel a different MMSI, which was transmitting from a different part of the globe (using the historic vessel name recorded in the IHS database), at the same time as LU RONG YUAN YU 811 was transmitting from the NWIO. This confusion could stem from a number of causes, including errors in vessel databases, however it is certainly exacerbated by the significant portion of vessels that are not transmitting their IMO number or callsign.

More concerningly, several vessels were identified which were transmitting vessel names that are a match for vessels that have been IUU listed by NPFC. However, in the absence of any other vessel details (either transmitted over AIS or recorded in the IUU listing) it is not possible to confirm whether the vessels fishing in the NWIO are the same ones that have a history of unauthorised fishing in the North Pacific.

In addition, not all the vessels active in the fishery were consistently transmitting a recognisable vessel name, instead transmitting no value, a numeric value or alphanumeric combinations such as HHHH. This reflects one of the broader challenges in the use of AIS data to monitor fisheries activities, as the transmitted identifiers are usually manually entered into the AIS unit by vessel officers, and are often entered incorrectly or not at all, making it challenging for coastal State fisheries authorities and others to identify vessels operating in or near their waters, and know their compliance history and risk level.

More broadly, it is noticeable that between 23 and 48% of MMSIs in any given year were transmitting identity details that could not be matched to any vessel known either from RFMO or other vessel identity sources. This is unfortunately not surprising, given that a significant proportion of squid fishing globally does not yet come under the remit of any RFMO (which also means that participating vessels are not subject to any international requirements for usage of IMO numbers). However, this further illustrates the challenge in monitoring a fishery such as this.

	2015	2016	2017	2018	2019
Vessel characteristics					
Has an IMO number	77	53	52	61	67
Has been RFMO authorised	50	44	41	47	46
Unknown⁹	23	47	48	37	32
AIS transmissions					
Valid Chinese MMSI	87	76	84	85	89
Valid Chinese callsign	27	18	11	22	42
Identifiable vessel name	63	65	74	81	87
Correct IMO	0	0	0	1	2

Percentage of MMSIs in the NWIO squid fishery that are linked to a vessel with an IMO number or RFMO authorisation history, versus 'unknown' vessels, by year; and quality of identifier data routinely transmitted over AIS (% of MMSIs active in a given year)

⁹ 'Unknown' was defined as identities that were not matched either to the IHS database of vessels with IMO numbers or to any vessel known from RFMO authorised vessel lists.

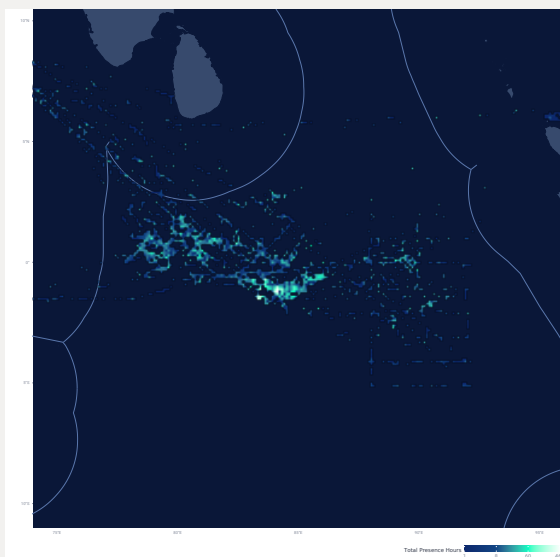
Squid vessels in the Eastern Indian Ocean – Development of a new fishery?

In the course of analysing the movements of vessels participating in the squid fishery of the NWIO, it was observed that a small sub-set of vessels were also fishing on the high seas of the Eastern Indian Ocean. Fishing took place in two distinct locations – in 2017 activity was concentrated in the northern part of the Ninety East Ridge, to the south of the Andaman Islands; while in 2018 and 2019 activity was concentrated further west, in the high seas to the south and southeast of Sri Lanka. Both of these areas are outside of the SIOFA Convention Area, so do not fall under the remit of any RFMO with the mandate to manage non-tuna fisheries.

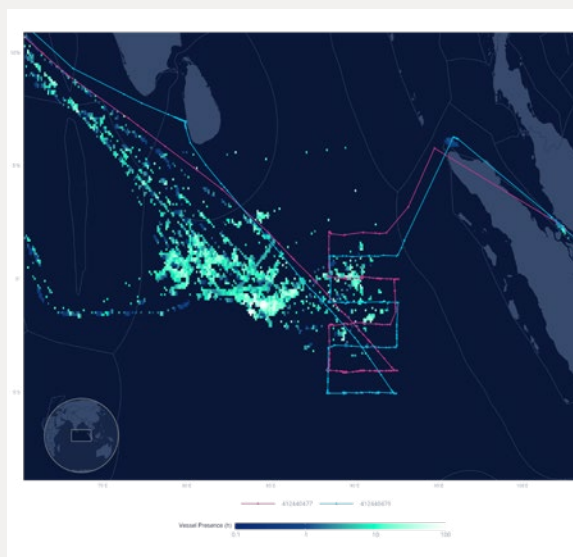
Of the 25 vessels that were detected operating in these areas from 2017 – 2019¹⁰, all were either purse seiners or their gear type was not known. No confirmed squid jiggers were detected operating in this area. This could indicate that the vessels are targeting small pelagic fish, rather than squid, but based on limited AIS data this is uncertain. As in the NWIO, the targeted areas do overlap with the IOTC Convention Area, so there is a potential risk that vessels could be catching tuna or related species as either target species or bycatch.

The majority of fishing activity in these areas took place in June to August, outside the NWIO squid season. However, two vessels were detected fishing on the Ninety East Ridge outside of this clearly defined season – in September and October 2019. Interestingly, both vessels displayed a very uniform movement pattern, such as might be expected by vessels undertaking a fisheries survey – this raises the possibility that the area is being targeted by an exploratory fishery.

While the general activity in the area in 2020 and 2021 has not been analysed, it is interesting to note that one of the Chinese research vessels mentioned earlier in this report also displayed activity on the Ninety East Ridge in 2020.



AIS presence hours of the 25 vessels detected fishing in the Eastern Indian Ocean, 2017 - 2019



Vessel tracks for 2019, including possible survey fishing on the Ninety East Ridge

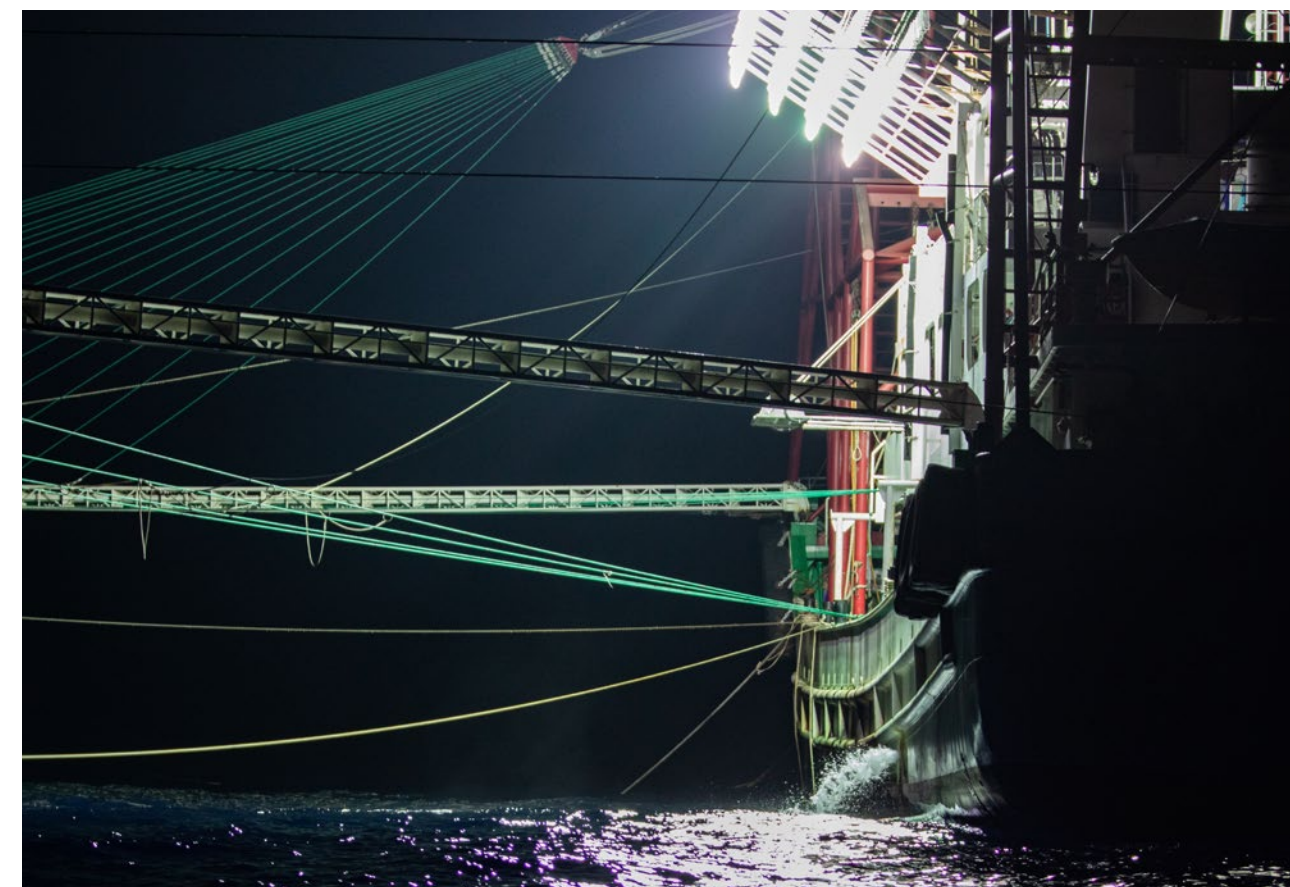
¹⁰ Analysis was based on vessels that had operated in the northwest Indian Ocean, so it is possible that more vessels may have been active in these areas that were not detected in the NWIO

CONCLUSIONS

The northwest Indian Ocean squid fishery is an expanding, unregulated high seas fishery, that is currently subject to very little management and limited regulatory oversight. This represents a threat, not only to the sustainability of squid stocks in the region but also to other regional fisheries, given the key role that oceanic squid plays in the marine food chain.

This update on the fishery, including for the first time at-sea observations of the operation, in many ways raises more questions than it answers. The gear types being used by the vessels, and what appears to be a multipurpose configuration of many, raise questions as to what squid species are being caught, and whether other species are also being deliberately targeted. Bycatch of tuna and other species is now clearly identified, but at what levels and whether this is being commercialised (and is therefore unauthorized) is not known at this time. The low levels of AIS transmission, what appears to be deliberate switching off and/or manipulation of signals, the limited information on the identities of the vessels involved, and potential EEZ incursions into national waters, all underline broader IUU fishing risks.

There is a clear need to address the current management gap by countries in the region, and through the wider international community, as this fishery falls outside the geographical scope of the Southern Indian Ocean Fisheries Agreement (SIOFA) and outside the species mandate of IOTC. Engagement by China in this process will be crucial, both as flag state for the fleet and port state receiving the catches, and as the only party with relevant information on the species, catch levels and fishing operations. Recent Chinese research vessel activity also is poised to add to the picture.



WAYS FORWARD

States are encouraged to exercise due diligence in monitoring their industrial fishing fleets operating in the NWIO region, to ensure as a minimum, that their AIS transponders are functional at all times, and that full and complete catch reports are collected from vessels operating in the region.

The IOTC and SIOFA should jointly embark on a broad discussion that aims to assess the possibilities to regulate the NWIO squid fishery. Potential options include adjusting IOTC's current management paradigm from a tuna-centric to ecosystem-wide approach – still driven by a tuna and tuna fisheries logic, but taking into account the wider ecosystem and the implications of ABNJ forage fisheries that have the potential to seriously impact tuna fisheries. Such an approach would allow forage species such as squid to fall under the direct mandate of IOTC and become monitored and the object of formal management measures. Alternatively, the extension of SIOFA's AoC north to touch the EEZs of Yemen, Oman, Pakistan, India and the (west) Maldives, subjecting squid to SIOFA management measures directly, could also be considered. Considering the presence of tuna on board the vessels active in the NWIO squid fishery, consideration should be made under the IOTC high seas boarding and inspection scheme for at-sea inspections. Port states subject to a port call by the vessels can also inspect the vessels under IOTC port state measure responsibilities.



Annex 1 - AIS Analysis Methodology

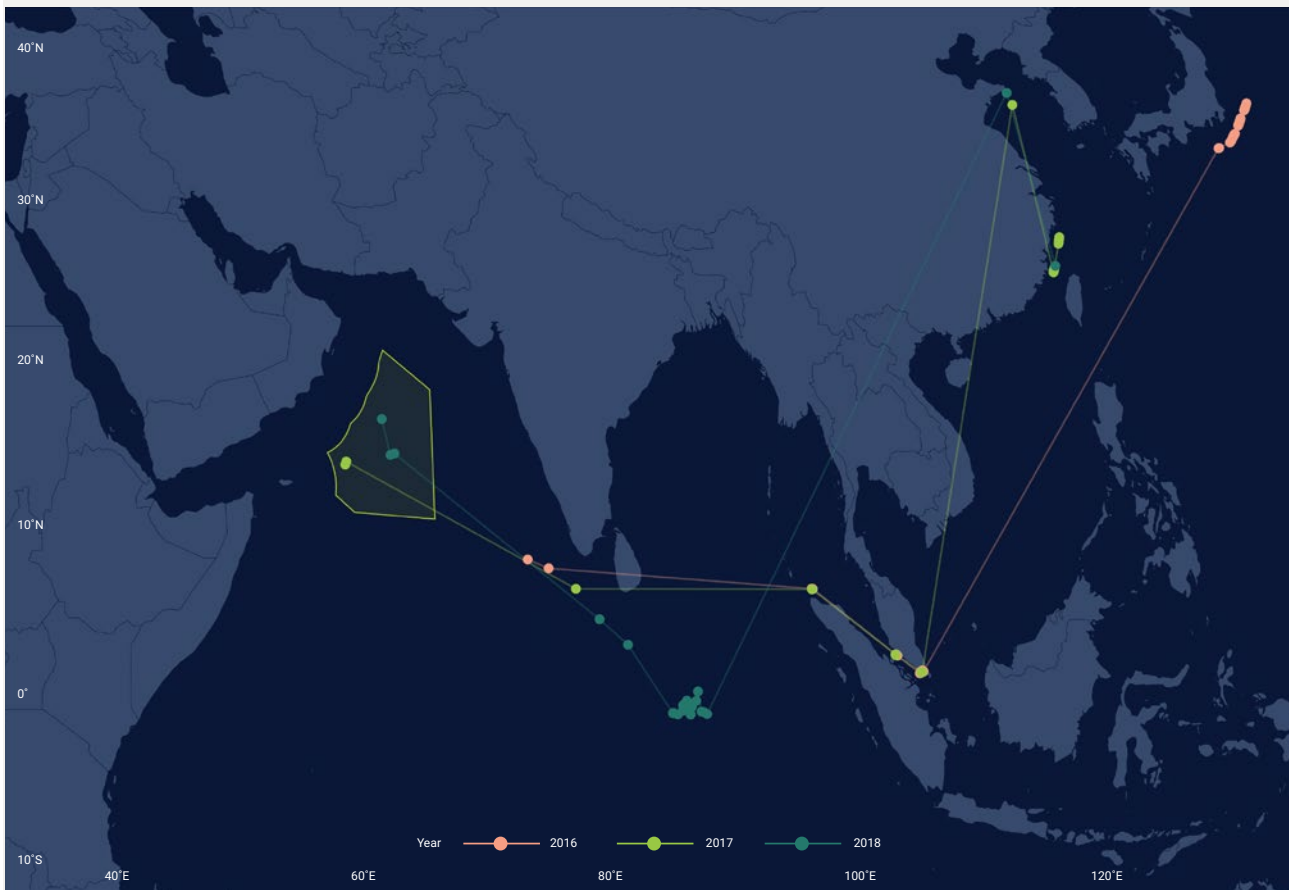
A list of 4601 MMSIs was generated, which consisted of all MMSIs that were detected as active in the area of interest across 2015 – 2019. Due to the very low level of AIS transmission by some vessels participating in this fishery, no minimum time or activity filter was applied at this stage. The list was also not filtered by vessel type, due to the difficulties in correctly identifying fishing vessels where there is insufficient AIS tracking data available to ascertain activity through pattern of movements (and given that a significant minority of fishing vessels do not transmit their type as 'Fishing vessel' over AIS).



Area of interest

A variety of methods were then used to filter this list and identify those MMSIs linked to fishing vessels likely to be participating in the fishery. Firstly, a long-list of AIS signals that were not known to be associated with non-relevant vessels (e.g. known cargo vessels) was produced; this list was then matched against TMT's FACT vessel database to identify vessels contained in public and subscription vessel databases; non-relevant vessels were then removed from the list, based on analysis of the matched identity details as well as identity details transmitted over AIS; finally, AIS tracks for the remaining vessels were analysed visually to confirm that all AIS signals included in the study showed operating patterns consistent with fishing in the area of interest.

Analysis indicated that a significant portion of vessels transmitted consistently or occasionally whilst transiting to and from the region, but appeared to switch off or disappear from AIS shortly after arrival in the area of interest, or signals were received very infrequently. As a result, estimated fishing hours is considered to be a significant underestimate, and this analysis is focused primarily on vessel numbers as an approximation of the scale of the fishery.



Track illustrating vessels with very few positions received after arriving in the AOI

Analysis indicated several cases of one vessel appearing to transmit over two different MMSIs, and there were also cases of vessel identifiers associated with an MMSI changing from one year to the next (which could result from a vessel being renamed, or the MMSI being transferred to a different vessel). Therefore, the analysis focuses on the number of MMSIs detected in the fishery, which is considered to be a good approximation for, but not exactly equal to, the number of vessels. It is also assumed that some vessels were not detected either because they were not transmitting on AIS at all or stopped transmitting before entering the area of interest.

This briefing has been produced by Trygg Mat Tracking (TMT), with data and analytical support from Global Fishing Watch. At-sea documentation of vessels and fishing operations conducted in cooperation with Greenpeace International. All photos ©Trygg Mat Tracking unless otherwise indicated. For more information please contact info@tm-tracking.org www.tm-tracking.org