FAO AREA 57

AIS-based fishing activity in the Eastern Indian Ocean

Figure 57.1. Location of FAO Area 57.

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PREAMBLE

This chapter assesses, through a comparison with fleet statistics and public fisheries data, the capacity of Automatic Identification System (AIS) data and Global Fishing Watch (GFW) algorithms (Kroodsma *et al.*, 2018) to identify and quantify fishing vessel activity in the Eastern Indian Ocean. This assessment reviews fleet activity, main gear types, and spatial distribution of fishing vessel activity and fishing operations.

SUMMARY AND CONCLUSIONS FOR THE EASTERN INDIAN

Class A AIS device reception is good throughout the area, except in northern areas around the Bay of Bengal. However, Class B AIS device reception is good only in the southern half of the Indian Ocean, and very poor in the northern half including the Bay of Bengal. Fishing activity in the eastern Indian Ocean is poorly represented by AIS data, even in the high seas, as many of the fleets operating in the area do not use AIS. All artisanal and semi-industrial gears (e.g., pole and line, gill nets, purse seines and longlines) are poorly represented as in other areas. However, these small-vessel gears represent a larger proportion of the region fleets' activity in comparison with most FAO areas.

INTRODUCTION FOR THE EASTERN INDIAN OCEAN

The Eastern Indian Ocean (FAO Area 57; FAO, 2019) encompasses all marine waters of the Eastern Indian Ocean from the southeast coast of India and Bay of Bengal to the west, and the northwest coasts of Australia (Fig. 57.1). Other boundaries include the coast of Java, Sumatra, Malacca and Malay Peninsula. The following coastal countries/territories border FAO Area 57: Australia, Bangladesh, Christmas Island, Cocos (Keeling) Islands, India, Indonesia, Malaysia, Myanmar, Sri Lanka, Thailand and Timor-Leste (Fig. 57.2). Around 29 percent of the total marine area in FAO Area 57 falls under national jurisdiction, compared to 71 percent in the high seas. This proportion of high sea waters is higher than the average across all FAO Areas (54 percent) and close to the areas with the highest proportion of high seas (e.g., around 80 percent in FAO Area 47, Southeast Atlantic; and FAO Area 87, Southeast Pacific).

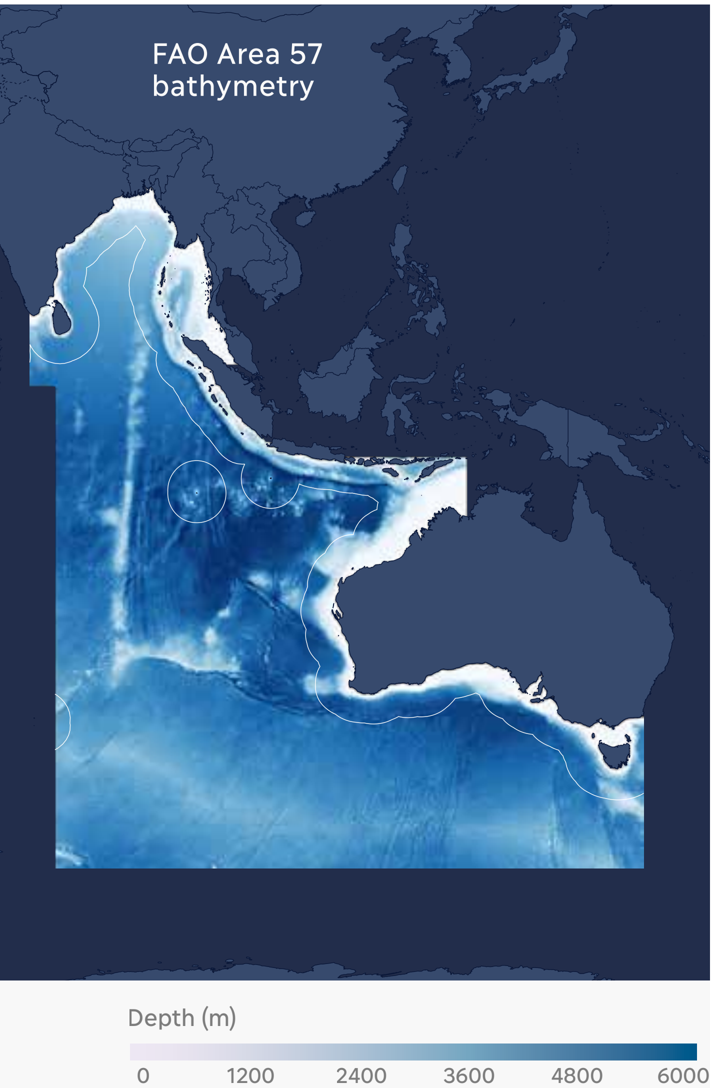


Figure 57.2. FAO Area 57 bathymetry (depth) and 200 miles coastal arc.

The continental shelves throughout the area are narrow with important seamounts such as the Christmas Island Seamounts and the Muirfield Seamount (Fig. 57.2). This area also has important ridges (e.g. Southeast Indian Ridge and Central Indian Ridge) and the Rodriguez Triple Junction that joins these ridges with the Southwest Indian Ridge (Baines *et al.*, 2007). The northern part of the area falls under the influence of heavy rainfall in the monsoon belt resulting in many rivers, frequent floods and riverbank erosion in delta regions (Fernandes, 2018). The Eastern Indian Ocean is still showing an increasing trend in landings, with an increase of up to 50 percent of catches in the last decade, reaching a total of 7.7 million tonnes per annum (FAO, 2016). FAO landings statistics (FishStatJ, 2018) show that in the period from 2010 to 2014, catches were dominated by invertebrate and pelagic fish species (e.g. skipjack tuna and yellowfin tuna, hilsa shad, Indian mackerel), but with a large variety of species fished.

REGION FLEETS AND AIS USE IN THE EASTERN INDIAN

Non-motorized vessels make up over 31 percent of the fleets in the region. Vessels over 24 m, which are the vessels most likely to have AIS, account only for 0.4 percent of fishing vessels (Fig. 57.3). Estimating the number of vessels by different size classes in FAO Area 57 is difficult because the two countries with the largest fleets, Indonesia and India, do not report vessel lengths to FAO. Also, both countries border more than one FAO area, so it is not clear how many of their vessels operate only in FAO Area 57.

Fleets of coastal countries/territories in FAO Area 57

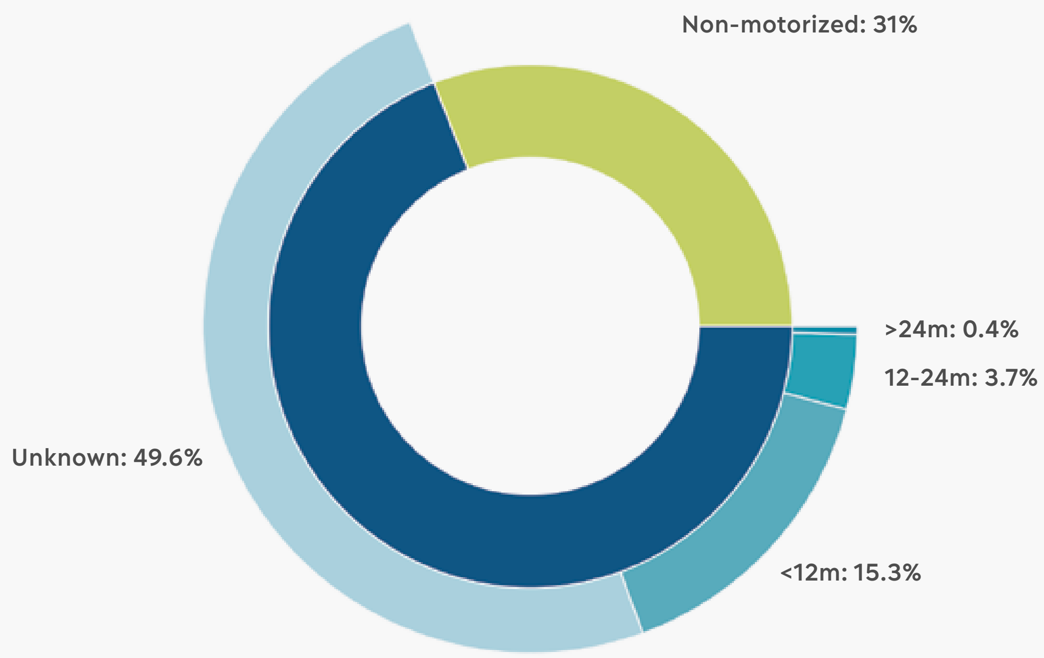


Figure 57.3. Structural composition of fleets of coastal countries/territories in FAO Area 57. In dark blue motorized fishing vessels and in green non-motorized. Distant water fleets active in FAO Area 57 are not included (see next figure). Notice that although some countries/territories border more than one FAO area, their entire fleet size is included here. Source: FAO statistics for year 2017. Statistics were not available for Christmas Island, Cocos (Keeling) Islands and Timor-Leste.

FAO Area 57 has many countries with large fleets, some with many thousands of fishing vessels (Fig. 57.4). Despite these vast numbers, among countries in the area only Australia has more than 80 vessels using AIS, followed by Malaysia with less than 20 vessels, i.e. likely the majority of Malaysia's vessels over 24 m in length. The distant water fleets of Taiwan Province of China and Japan have more vessels with AIS operating in the region than all coastal nations except for Australia.

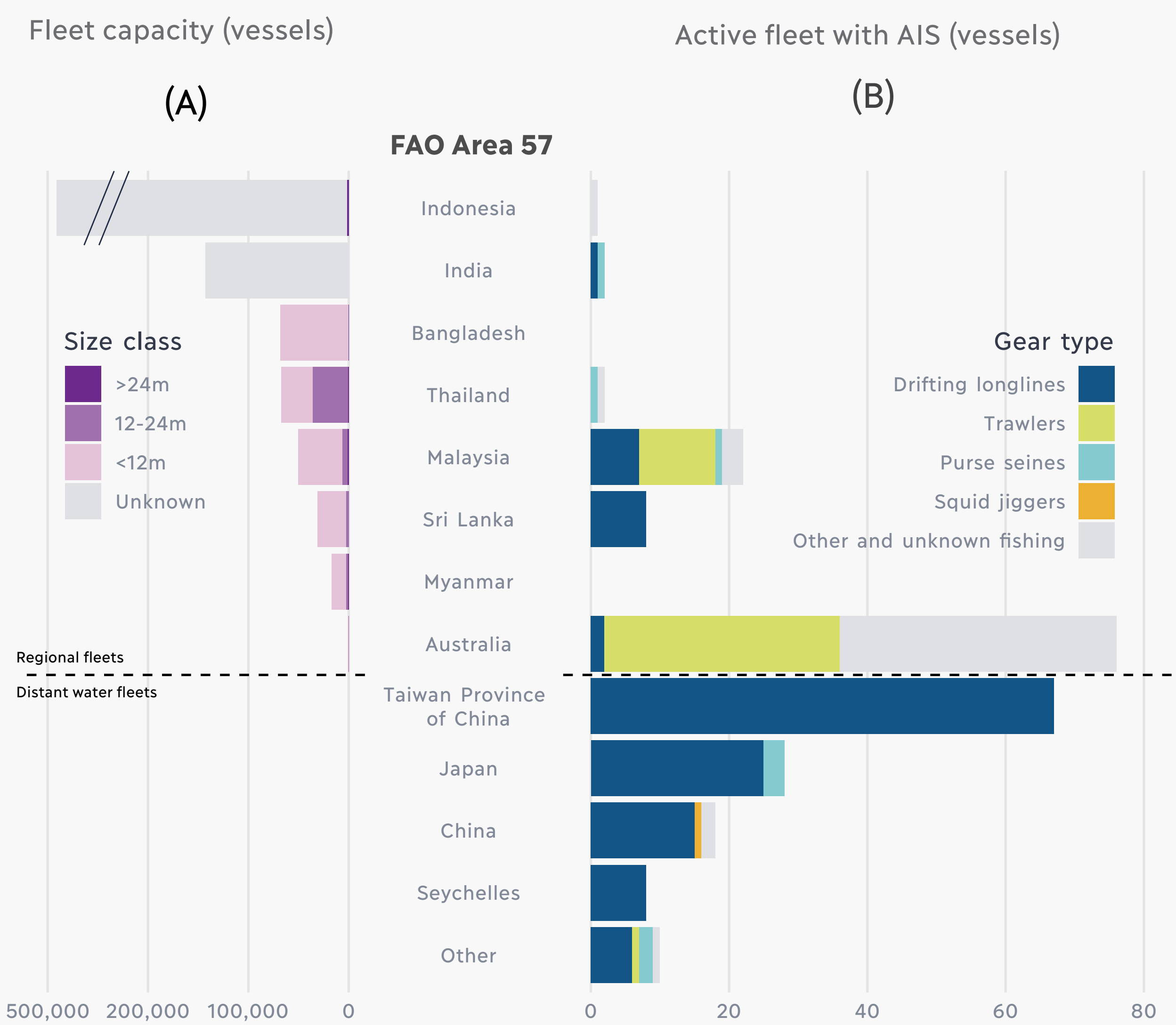
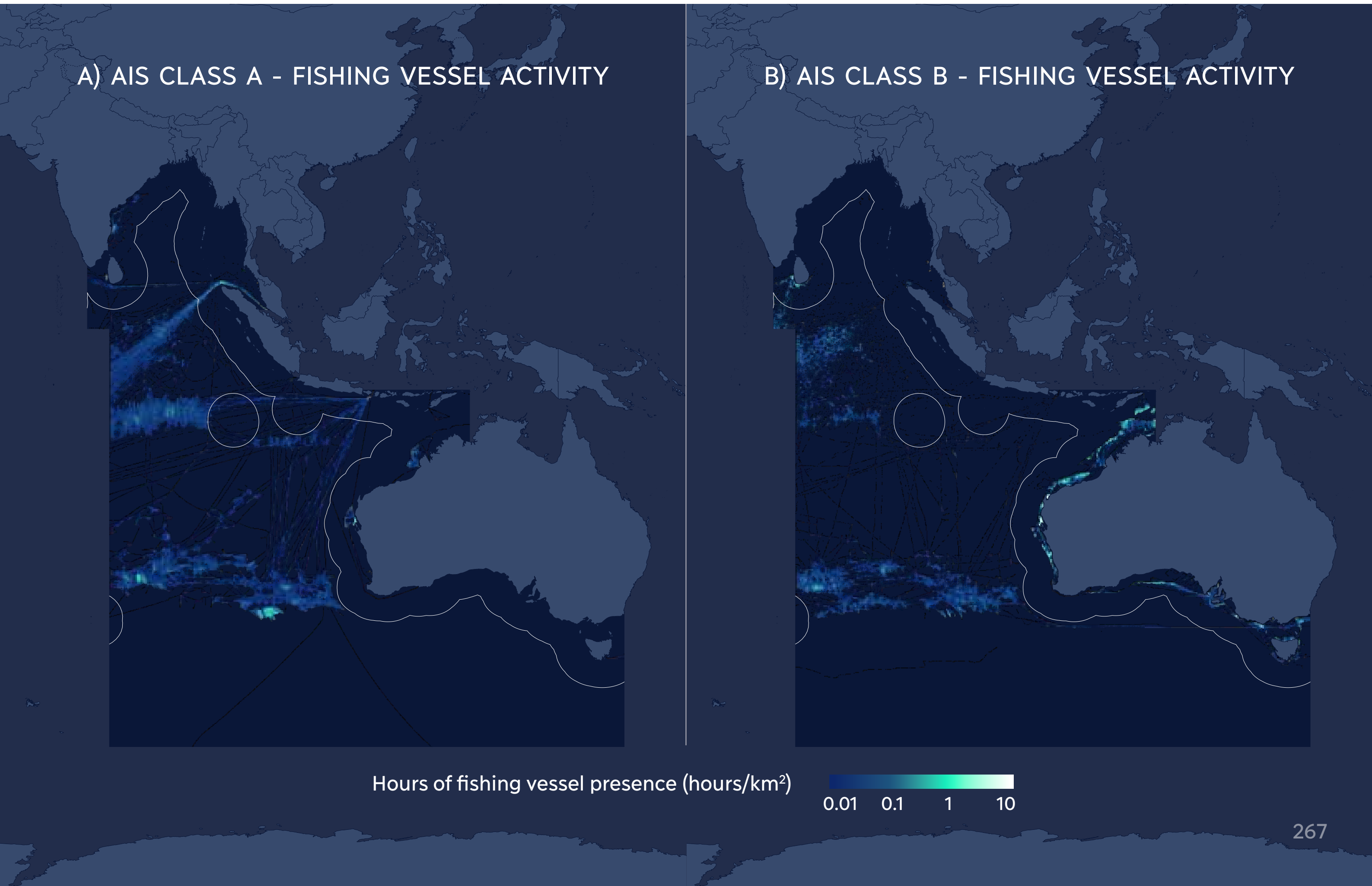


Figure 57.4. Coastal and distant fleets summary based on FAO statistics and AIS data classification by GFW in FAO Area 57 during year 2017. A) Number of motorized vessels as reported to FAO (left panel). The entire fleets of countries/territories are shown, even though these fleets may be active in other FAO areas. Source: FAO statistics. Statistics were not available for the following coastal countries/territories border FAO Area 57: Christmas Island, Cocos (Keeling) Islands and Timor-Leste. B) AIS-identified number of fishing vessels broadcasting AIS during their operations in FAO Area 57 by gear type and flag state (right panel). Dashed lines separate regional fleets (top) from distant fleets (bottom). Only vessels that fished for at least 24 hours in the area are included. Source: GFW.

AIS RECEPTION AND FISHING VESSEL ACTIVITY IN THE EASTERN INDIAN

Figures 57.5a,b show all the activity of fishing vessels (fishing, searching, in transit) captured by AIS in FAO Area 57 (Class A and Class B AIS devices). Vessels in the high seas are equally likely to use Class A and Class B devices, while almost all the coastal Australian fleet uses Class B. AIS reception is very poor in the northern area of FAO Area 57 (Fig. 57.5c,d), to the extent that Class B devices might not even register with satellite receivers. Class B vessels operating in the middle of the area may not have all their fishing activity recorded (Fig. 57.5d), and those operating in the north may have little or no fishing activity recorded.



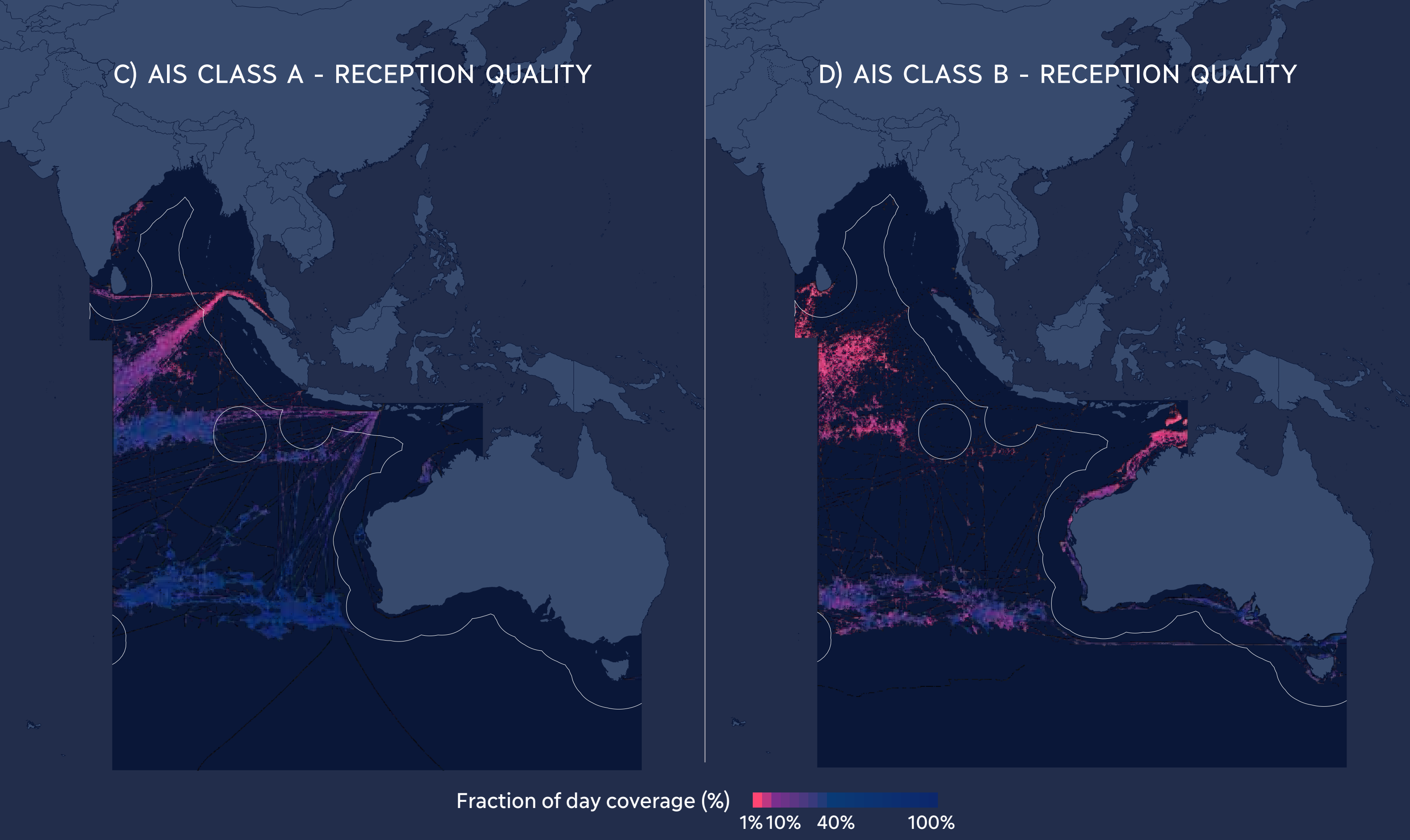
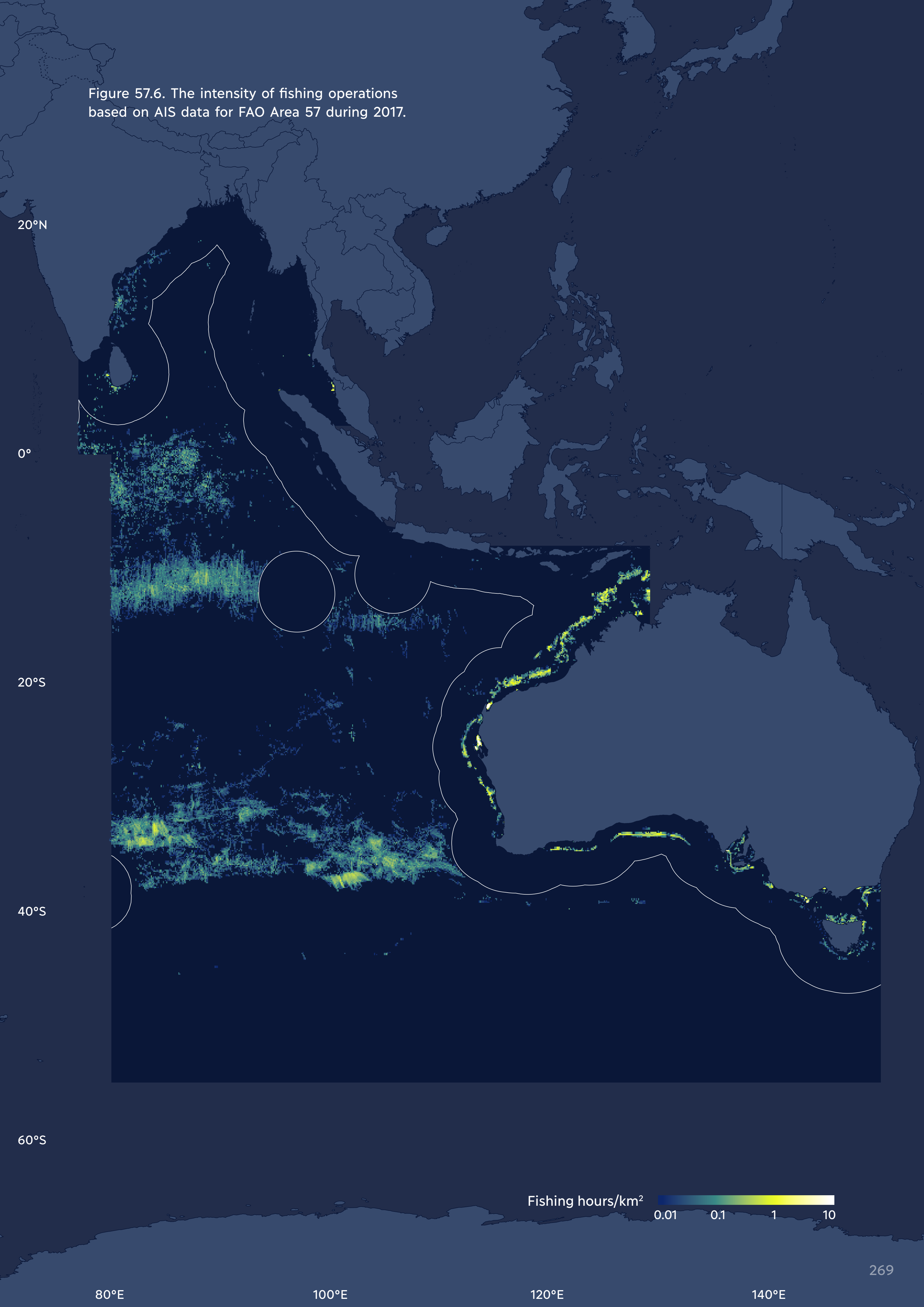


Figure 57.5. Fishing vessel activity and quality of AIS reception for FAO Area 57 during 2017. Top row shows activity of vessels broadcasting using Class A devices (left panel) and Class B devices (right panel). The bottom row shows reception quality maps for devices Class A (left panel) and B (right panel). Blank spaces on the map (i.e. dark blue ocean background) mean that no signals from fishing vessels in this area were received, which is due to either no vessel activity or poor reception.

The limited AIS information available in the area shows fishing operations along the east Indian coast, off western and southern Australia and in the north and south on high seas (Fig. 57.6). Fishing patterns for most of the important fleets in the area are almost entirely missing, including Indonesia, Malaysia, Thailand, Sri Lanka, India and Bangladesh, whose fleets account for around 95 percent of vessels in FAO Area 57 (Fig. 57.4). While VMS is mandatory for most vessels fishing in the high seas, very limited information is available from AIS in terms of identifying the major activities of industrial vessels, semi-industrial or artisanal vessels (i.e. mainly composed by small vessels under 24 m). In the high seas, there is a large tropical tuna and swordfish/albacore fishery in the north of the area frequented by purse seiners and longliners, while the south is dominated by longline vessels (IOTC, 2017b). The fishing activity on the Australian coastline can also be associated with trawlers fishing various species, as well as drifting longliners for tunas and purse seiners for bluefin tuna and other large pelagic species. Most of the fishing activity identified by AIS along the east coast of India can also be associated with longliners, gillnetters and trawlers. AIS data can detect Australian vessels fishing in the Australian coastal area using several different gear types (Hobsbawn *et al.*, 2017).

Figure 57.6. The intensity of fishing operations based on AIS data for FAO Area 57 during 2017.



FISHING VESSEL ACTIVITY AND OPERATIONS BY GEARS IN THE EASTERN INDIAN

This section reviews the spatial distribution patterns of the main fishing gears of FAO Area 57 as estimated by Global Fishing Watch (GFW) based on 2017 AIS data. The most recent datasets available at mid-2018 were used to assess GFW capacity to provide an AIS based characterization of fishing activity by fishing gear in terms of presence/absence, intensity and hot spots. The Introduction chapter describes the rationale and challenges for use of contrasting data sources (e.g. Global Fisheries Landings database (GFLD; Watson, 2017)) for benchmarking AIS data classification.

When comparing fishing activity (Table 57.I) based on AIS data with the GFLD catches, fishing activity in this area is poorly represented by AIS. The activity of all fishing gears is underrepresented, whereas the importance of drifting longlines is overrepresented. Despite these limitations, both datasets agree that trawling is an important fishing activity in the area. Pole and line and set gillnets are two important gears in the area that are not captured by the AIS data.

GEAR TYPES	Catches (GFLD) 2010-2014 average		Total fishing vessel activity (GFW-AIS) 2017	
	Tonnes of catch in 1000s	% of catch	Active days in 1000s	% of active days
Trawls	2 382	33%	5.0	24%
Set gillnets	2 220	31%	5.0	24%
Pole and line	898	13%		
Other	1012	14%		
Purse seines	512	7%	0.4	2%
Drifting longlines	119	2%	10.5	50%
ALL GEARS	7 146	100%	20.9	100%

Table 57.I. Summary table comparing average catch from GFLD during 2010-2014 with fishing vessel activity from GFW in FAO Area 57. Only vessels that fished for at least 24 hours in FAO Area 57 are included.

Gillnets (including drifting and set gillnets) are one of the main fishing gears in the eastern IOTC area, mainly fishing on neritic tuna and tropical tuna (largely skipjack tuna), but also some marlin species (e.g. black marlin), sharks and sailfish species. In FAO Area 57, countries such as Indonesia, Sri Lanka, Bangladesh and India have significant fleets operating mainly in waters under national jurisdiction but also in the high seas (Premchand *et al.*, 2015; Golden *et al.*, 2017; Hewapathirana and Gunawardane, 2017; IOTC, 2017a; Ruchitmat *et al.*, 2017). Sri Lankan gillnet vessels that operate in the high seas, and which are monitored with VMS (IOTC, 2017a), do not appear to be detected in AIS records. The same situation occurs for other costal countries such as Indonesia, Bangladesh and India where artisanal fishing, mainly dedicated to gillnets, are very poorly represented by AIS data. The AIS-based fishing activity attributed to gillnet is therefore significantly underestimated due to most of these coastal flag state vessels being smaller than 24 m and not using AIS. Therefore, no maps of its distribution are provided here.

Trawler fishing in the high seas is mainly carried out in the upper continental slope and mid-slope depth, which is less than 1 percent of the SIOFA area (SIOFA, 2018). In the Bay of Bengal the marine catch is divided into artisanal and industrial trawler fishing. The industrial fishery is a multi-species fishery dominated by hilsa shad and sardine (Shohidullah Miah, 2015; IOTC 2017a, 2017b). For example, the Bangladesh trawling industry (DoFB, 2017) is divided between fish trawlers (85 percent) and shrimp trawlers (15 percent). Although the number of monitored industrial vessels is increasing, the artisanal fleet is dominant in the area with a significant percentage of non-powered and small powered vessels (Fernandes, 2018). Due to poor AIS coverage and concentration of fishing activities in the northern part, the AIS data (Fig. 57.8) significantly underestimate trawler fishing activity in the area, such as the activities of the Bangladesh fleet (consisting of 201 industrial fishing trawlers and catches of 528 997 tonnes (IOTC, 2017b)). This underestimation could be due partly to the misclassification of multi-purpose vessels able to work with different fishing gears, which are common in the area. It should also be noted, regarding Figure 57.8 and comparisons with the bathymetry maps, that the trawling activity may be overestimated in GFLD as records are registered in deep areas and very far from coastal waters where artisanal trawlers mainly operate.

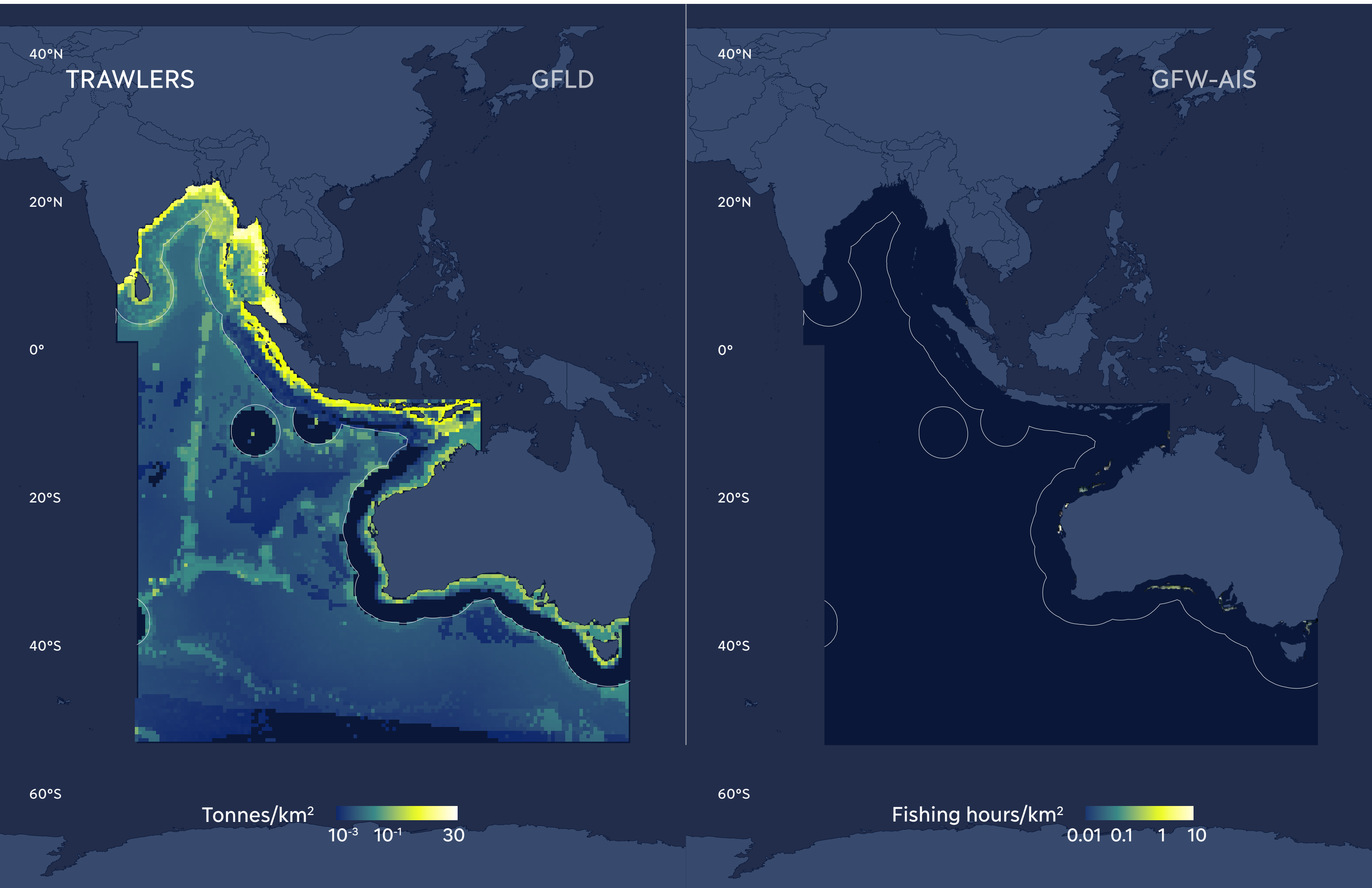


Figure 57.8. Catch and activity of trawlers in FAO Area 57. Maps comparing average catch during 2010-2014 from GFLD (left panel) with trawler fishing operations in 2017 from GFW (right panel). GFLD maps are catches in tonnes/km² and GFW maps are AIS-based fishing operations in hours/km².

AIS data seem to capture well areas of high intensity activity by longliners including the southern area high intensity patches (better than GFLD), but it fails to detect activity in most of the area as shown in GFLD and in RFMO data (Taconet *et al.*, 2018). According to the IOTC, 45 Japanese longliners were active in the south-eastern IOTC area in 2016 (between 0° S and 20° S) (IOTC 2017a, 2017b), though just under 30 Japanese longliners were detected by AIS in the area during 2017. China and Taiwan Province of China also maintain some fishing activity in the area with longline driftnets on the eastern side, mainly for the ice fresh-longliners (Xu *et al.*, 2017). In the northern-most high seas, fishing activity detected by AIS are likely to be mainly Chinese longliners, which tend to operate in the western part of Indian Ocean (Xu *et al.*, 2017). The fishing activity in mid-latitudes of the Cocos (Keeling) Islands and the Christmas Island are mainly longliners targeting bigeye tuna (IOTC, 2017b). The most southern activity is also dominated by longliners targeting bigeye and southern bluefin tuna (IOTC, 2017b). Longliner activity in Bangladesh is dominated by small-scale fisheries targeting coastal species (Rabbani *et al.*, 2014; Adnan *et al.*, 2016), but also sharks and rays (Krajangdara *et al.*, 2008).

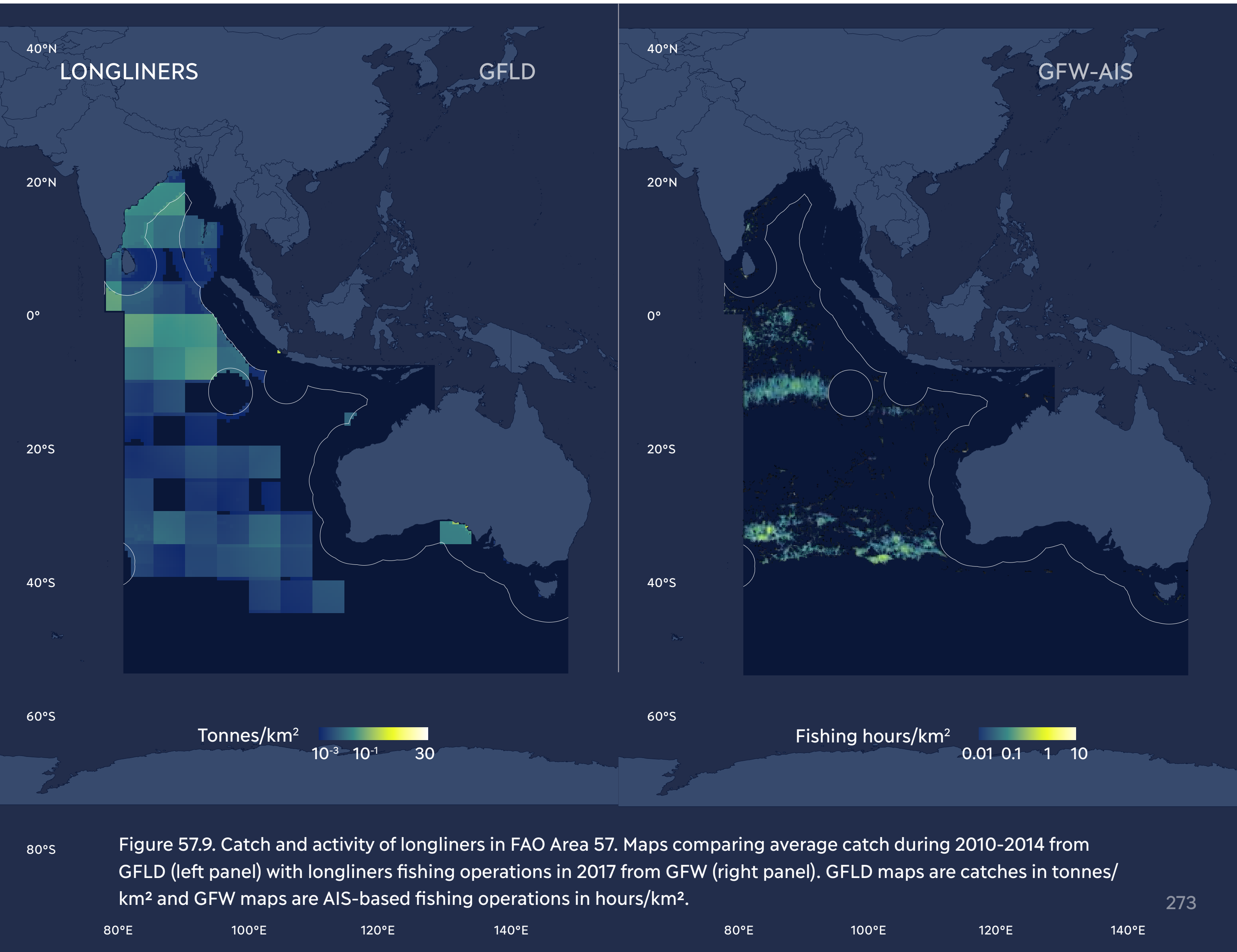


Figure 57.9. Catch and activity of longliners in FAO Area 57. Maps comparing average catch during 2010-2014 from GFLD (left panel) with longliners fishing operations in 2017 from GFW (right panel). GFLD maps are catches in tonnes/km² and GFW maps are AIS-based fishing operations in hours/km².

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