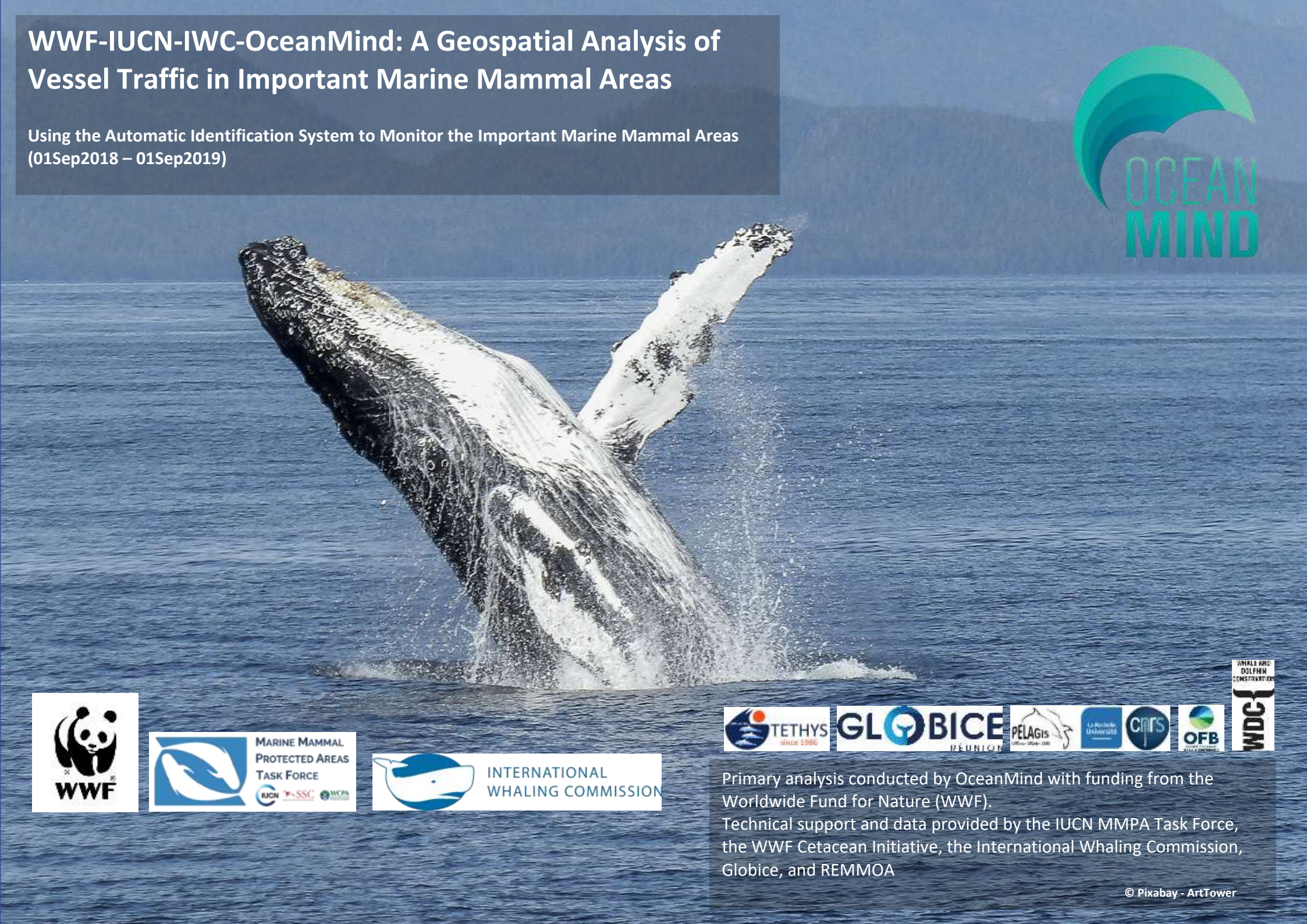
WWF-IUCN-IWC-OceanMind: A Geospatial Analysis of Vessel Traffic in Important Marine Mammal Areas

Using the Automatic Identification System to Monitor the Important Marine Mammal Areas (01Sep2018 – 01Sep2019)



Primary analysis conducted by OceanMind with funding from the Worldwide Fund for Nature (WWF).
Technical support and data provided by the IUCN MMPA Task Force, the WWF Cetacean Initiative, the International Whaling Commission, Globice, and REMMOA

Acronyms and abbreviations			
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area	IWC	International Whaling Commission
AIS	Automatic identification system	MCS	Monitoring, control and surveillance
Atl	Atlantic	Med	Mediterranean region
EEZ/EFZ	Exclusive economic zone / Exclusive fishing zone	NIO	Northeast Indian Ocean
IMMA	Important Marine Mammal Area	PI	Pacific Islands
IUCN	International Union for Conservation of Nature	SAS	Southeast Asian Seas Region
IUU	Illegal, unreported and unregulated fishing	WIO	Western Indian Ocean

Table of Contents

Executive Summary

Background and context

As top predators, marine mammals play a key role in most marine ecosystems (Roman et al., 2014) and can also provide economic benefits through tourism (O'Connor et al., 2009). While some whale populations are rebounding following the near-cessation of commercial hunting (e.g. Zerbini et al., 2019), many marine mammal populations around the world are under threat and in decline due to a wealth of new pressures, including fisheries (Brownell Jr et al., 2019), climate change (Tulloch et al., 2019), and the impacts of maritime traffic, which can bring with it the risk of ship strikes (Pirotta et al., 2019) and disturbance from underwater noise (Erbe et al., 2019). The International Convention for the Safety of Life at Sea (SOLAS) of the IMO requires 'AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size'.

Efforts to mitigate the many threats posed to marine mammals require place-based management measures in the areas that are most important for their life processes, including feeding, reproducing, migrating, and resting (Agardy et al., 2019). Identifying these important areas in a globally standardized fashion that is based on scientific evidence has been the main aim of the IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force (MMPATF). At the time of writing this report, the MMPATF has worked with marine mammal experts around the globe to identify 114 Important Marine Mammals Areas (IMMAs) in five regions. These are viewable on the MMPATF website through a searchable database or in map form through the e-Atlas.

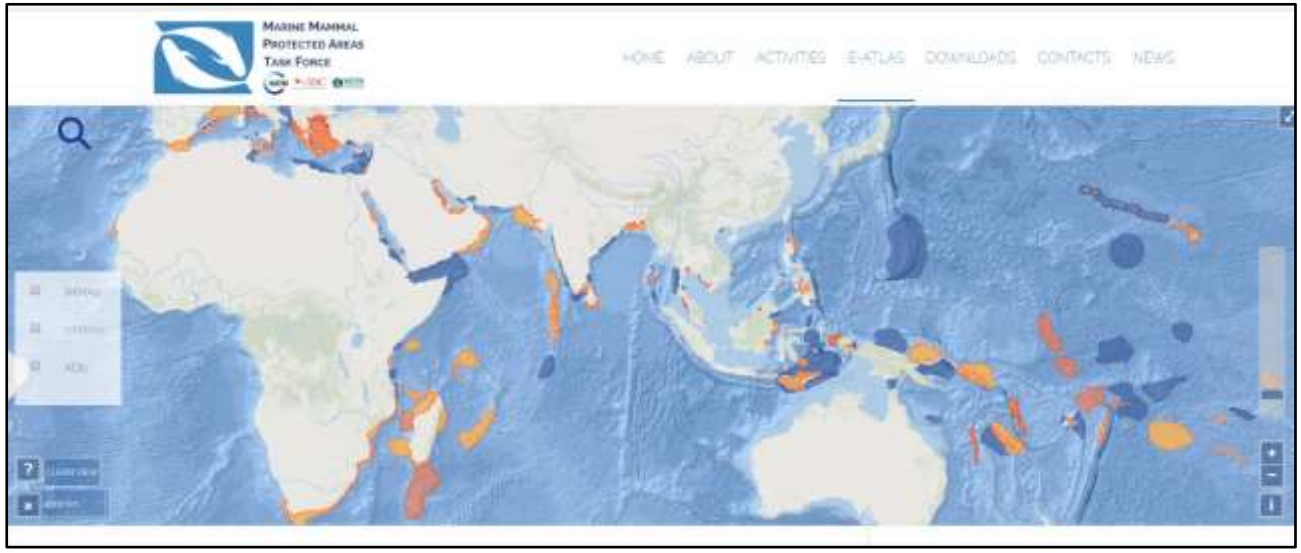


Figure 1 | Screenshot from the IUCN MMPATF Website portraying the 114 Important Marine Mammal Areas (IMMAs) that have been proposed, reviewed and formally published on the eAtlas as of January 2020.

In addition to coordinating the effort to identify IMMAs, The MMAPTF collaborates with other intergovernmental bodies as well as non-governmental bodies to identify and promote concrete conservation measures that can be implemented in each IMMA to mitigate threats. For example, collaboration with the MMPATF is embedded in the International Whaling Commission's (IWC) Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020 (Cates et al., 2017). In April 2019, the IUCN MMPA Task Force, IWC and ACCOBAMS jointly hosted a workshop to evaluate how the data and process used to identify Important Marine Mammal Areas (IMMAs) can assist the IWC to systematically identify areas of high risk for ship strike, a key goal of the Commission's Strategic Plan(Cates et al., 2017). The workshop report generated a number of recommendations, including the following: '*the IWC working with the IUCN MMPA Task Force and the CMS and its daughter agreements, undertake an initial analysis of global IMMAs, overlaid with shipping data, to identify potential high risk areas*….'(IWC, 2019). This report represents a response to that recommendation, providing a first broad-scale overview of the potential risk that marine traffic poses to marine mammals within those areas.

The report is divided into two main parts: 1) a broad-scale overview of vessel activity in each of the 114 IMMAs identified to date; and 2) two case studies that examine the nature of vessel traffic and co-occurrence with marine mammal distribution on a finer scale in two IMMAs that were selected on a number of agreed criteria.

Overview of results:
OceanMind conducted a geospatial analysis by overlaying the AIS transmission from all categories of vessels that transmitted signals between 1 September 2018 and 1 September 2019 with the shape files of all 114 IMMAs. This exercise revealed that almost every IMMA is affected by vessel traffic, with a total of 113 (97.4 %) of the IMMAs containing vessel activity during the year in question, while there were no AIS transmissions received in the other 2 areas. Furthermore, this phase of the analysis indicated that:

- **28 IMMAs experienced a likely increase in vessel activity over the analysis period.**
- **38 IMMAs included well-defined shipping lanes for merchant vessels.**
- **16 IMMAs showed vessel activity in an estimate of over 75% the marine area included in the IMMA.**
- **2 IMMAs registered no AIS transmissions throughout the year and could therefore not be assessed for its vessel activity without consolidating further detection methodologies**

In the next phase of analysis, a matrix containing the values for overall density of vessels within each IMMA (IUCN MMPA Task Force, 2018), as well as the species and criteria for which IMMAs were identified, was analysed to identify the 10 IMMAs that appeared to have the highest risk for ship strikes to whales, and the 10 that appeared to have the highest risk for bycatch from fishing vessels transmitting AIS. In this assessment, sperm whales and baleen whales were considered most susceptible to ship strikes, and small cetaceans were considered most susceptible to bycatch. IMMAs were ranked separately for ship strike risk and bycatch risk based on the summed values assigned for vessel density, IMMA species, and IMMA criteria (see p. 21 for more detail) The assessment suggests the following IMMAs to be of higher risk for marine mammals:

Top 10 IMMAs where target species are potentially at risk from merchant shipping traffic as indicated by AIS data from 1 September 2018-1 September 2019, and the target species and criteria for which the IMMAs were identified.

Top 10 IMMAs with potential risk for Ship Strike	Country/Region	Key Species of concern
South West to Eastern Sri Lanka IMMA	Sri Lanka, Southeast Asia	Blue whale [VU]; Sperm whale [VU]
Hellenic Trench IMMA	Greece, Mediterranean	Sperm whale [EN – Mediterranean subpopulation]; Cuvier's beaked whale [DD – Mediterranean subpopulation]
Dhofar IMMA	Oman, Arabian Sea	Blue whale [VU]; Bryde's whale [LC]; Humpback whale [EN – Arabian Sea subpopulation]; Sperm whale [VU]
Savu Sea and Surrounding Areas IMMA	Indonesia, Southeast Asia	Sperm whale [VU]; Blue whale [VU]
Northwest Madagascar and Northeast Mozambique Channel IMMA	Madagascar, Southwest Indian Ocean	Omura's whale [DD]; Blue whale [VU]; Fin whale [VU]; Humpback whale [LC]; Sperm whale [VU]
North West Mediterranean Sea, Slope and Canyon System IMMA	France, Spain, Italy, Mediterranean	Fin whale [VU – Mediterranean subpopulation]; Sperm whale [EN – Mediterranean subpopulation];
Mascarene Islands and Associated Oceanic Features IMMA	France (Overseas Territory) and Mauritius, Southwest Indian Ocean	Sperm whale [VU]; Humpback whale [LC]
Alboran Deep IMMA	Spain, Mediterranean	Sperm whale [EN – Mediterranean subpopulation]; Cuvier's beaked whale [VU – Mediterranean subpopulation]
South West of Madagascar and Mozambique Channel IMMA	Madagascar, Southwest Indian Ocean	Sperm whale [VU]; Blue whale [VU]; Antarctic minke whale [NT]; Fin whale [VU]
Muscat Coastal Waters and Offshore Canyons IMMA	Oman, Arabian Sea	Bryde's whale [LC]; Sperm whale [VU];

Top 10 IMMAs where target species are potentially at risk from bycatch as indicated by species present and density of AIS transmissions from 1 September 2018-1 September 2019, and the target species and criteria for which the IMMAs were identified.

Top 10 IMMAs with potential risk for fisheries interactions	Country/Region	Key Species of concern
Berau and East Kutai District, Kalimantan IMMA	Indonesia (Borneo), Southeast Asia	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Sperm whale [VU]
Comoros Island Chain and Adjacent Reef Banks IMMA	France (Overseas Territories) and Comoros, Southwest Indian Ocean	Indo-Pacific bottlenose dolphin [NT]; Pantropical spotted dolphin [LC]; spinner dolphin [LC]; Indian Ocean humpback dolphin [EN]; Dugong [VU]
Greater Pemba Channel IMMA	Tanzania, Southwest Indian Ocean	Common bottlenose dolphin [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]
Main Hawaiian Archipelago IMMA	Hawaii, USA, Pacific Islands	spinner dolphin [LC]; Common bottlenose dolphin [LC]; Pygmy killer whale [LC]; Short-finned pilot whale [LC]; Blainville's beaked whale [DD]; Melon-headed whale [LC]; Dwarf sperm whale [DD]; Pantropical spotted dolphin [LC]; Rough-toothed dolphin [LC]; Cuvier's beaked whale [LC]; false killer whale [NT];
Mascarene Islands and Associated Oceanic Features IMMA	France (Overseas Territories) and Mauritius, Southwest Indian Ocean	Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]; spinner dolphin [LC]; Sperm whale [VU]; Humpback whale [LC]
Savu Sea and Surrounding Areas IMMA	Indonesia, Southeast Asia	spinner dolphin [LC]; Melon-headed whale [LC]; Fraser's dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Sperm whale [VU]; Blue whale [VU]
Seychelles Plateau and Adjacent Oceanic Waters IMMA	Seychelles, Southwest Indian Ocean	spinner dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]; Blue whale [VU]; Sperm whale [VU]
Sindhudurg-Karwar IMMA	Pakistan, Arabian Sea	Indian Ocean humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]
Tanon Strait IMMA	Philippines, Southeast Asia	Indo-Pacific bottlenose dolphin [VU]; spinner dolphin [LC]
Toliara, St. Augustine Canyon and Anakao IMMA	Madagascar, Southwest Indian Ocean	Humpback whale [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]; Risso's dolphin [LC]; Short-finned pilot whale [LC]

These two top 10 lists were then assessed against a list of agreed criteria (see Annex 1) to select two IMMAs that would become the focus of more in-depth analysis of the nature of vessel traffic and the risk it presents in relation to what is known of marine mammal distribution and habitat use within the IMMA. Taking all of the agreed criteria into consideration, as well as an agreed desire to highlight areas that had not yet

been the focus of similar published or ongoing studies (as is the case in the Mediterranean(Frantzis et al., 2019) or Sri Lanka (Priyadarshana et al., 2016) or the Arabian Sea(Willson et al., 2016)), the two IMMAs chosen to be the focus of more in depth analysis were:

- The Mascarene Islands and Associated Oceanic Features IMMA
- Savu Sea and Surrounding Areas IMMA

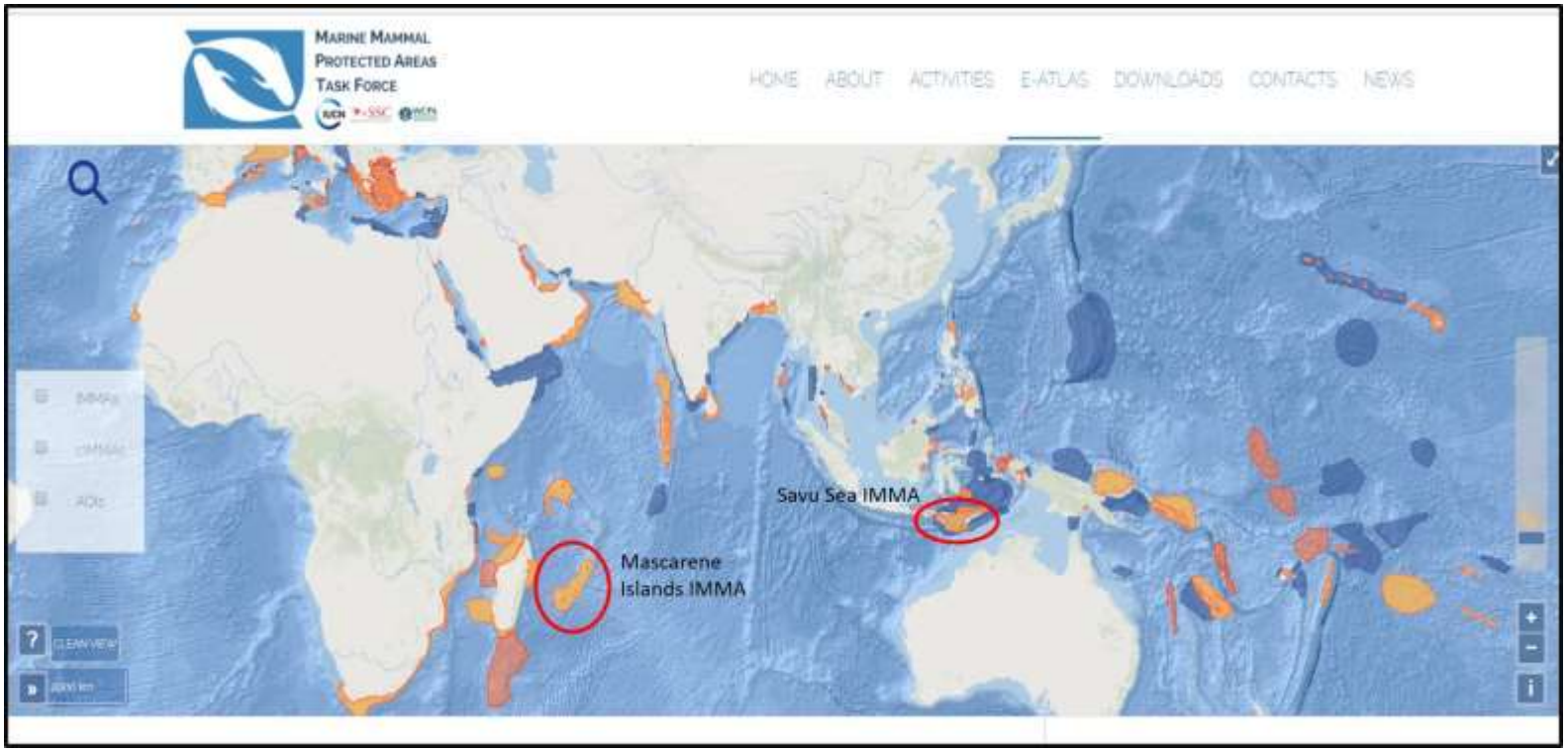


Figure 2 | Location of the two IMMAs chosen to be the focus of more in-depth analysis of the potential risks posed by vessel traffic to the marine mammal species present.

The Mascarene Islands and Associated Oceanic Features IMMA Case Study: Summary Results

Data on marine mammal distribution in the Mascarene Islands IMMA was provided by two research groups that conducted aerial, boat-based, and satellite tracking surveys of cetaceans around the islands of La Reunion and Mauritius. A co-occurrence analysis of cetaceans and vessel traffic as indicated by AIS transmissions between 1 September 2018 and 31 August 2019 highlighted some areas where merchant vessel traffic may present a risk of ship-strike interactions with sperm whales and humpback whales. These areas occurred predominantly within the territorial waters around La Reunion and Mauritius, providing an opportunity for the competent authorities of those nations to implement precautionary measures, such as speed restrictions, to mitigate these threats. Other more comprehensive measures to mitigate ship strike risk, such as the designation of Areas to be Avoided (ATBA) or Traffic Separation Schemes (TSS) (See Appendix II for a full table of options), would require more comprehensive data on marine mammal distribution throughout the IMMA and at different times of year to ensure that movement of shipping lanes would not unintentionally displace risk from one whale species to another.

By contrast, fishing vessels transmitting AIS were located further offshore, but still within the Exclusive Economic Zones (EEZs) of France and Mauritius. Although no vessels reported using gillnets, the fishing gear associated with the highest risk of bycatch globally, trawlers and longlines were operative, and are known to present some risk of byatch and/or other forms of fisheries interactions such as depredation (stealing bait from lines), which puts marine mammals at risk of retribution from fishers. Mitigating the bycatch risk will also require more fine-scale data on cetacean distribution and interaction with fisheries as well as wider scale collaboration with the Indian Ocean Tuna Commission, the Fishing Industry and other key regional stakeholders.

Savu Sea and Surrounding Areas IMMA: Summary Results

Data on marine mammal distribution in the Savu Sea IMMA was derived from OBIS Seamap and three peer-reviewed publications reporting on cetacean observations in the region. This sparser dataset was used to generate approximate positions for cetaceans and assess areas of likely cooccurrence of cargo vessels transmitting AIS and species most at risk of ship strikes, such as blue whales, which are known to migrate through the IMMA. A finer scale analysis and the acquisition of cetacean distribution data throughout the whole IMMA and at different times of year would enable managers to determine what types of mitigation measures would be most effective to implement. Future measures could include the designation of Areas to be Avoided (ATBA) or Traffic Separation Schemes (TSS) (See Appendix II for a full table of options), In the meantime, vessel speed restrictions carry little extra cost or risk to shipping companies, and may prevent ship strikes with endangered blue whales.

Assessing bycatch risk in the IMMA was not possible due to the low number of fishing vessels transmitting AIS in the region. However, the lack of fishing vessel AIS transmission is certainly not indicative of low fishing effort in the region, as fisheries is known to be a highly important

source of employment, income and food in the region. Artisanal fishing vessels operating in the region do not carry AIS, and as such, other methods will be more appropriate for assessing bycatch risk, including other technologies to track vessels, such as the more fisheries specific Vessel Monitoring Scheme (VMS). Alternatively, on-board observer schemes or the use of remote electronic monitoring on fishing vessels may be more practical. In the Savu Sea IMMA, Enabling conditions are in place, through ongoing collaboration between international NGOs, government and local stakeholders to collect the additional data required to design effective mitigation, and to plan for implementation of those precautionary measures that can already reduce risks at little cost to industry.

Part I: IMMA-wide Analysis of AIS transmission densities

OceanMind conducted vessel category, vessel transmission density and spatial-temporal analysis of AIS transmissions in each IMMA. The results of this analysis are comprised within this document and consolidated in the table below. All vessels of more than 300 gross tonnage are required by the IMO to transmit on AIS for international voyages (500 gross tonnage for national voyage) using Class A transponders. There are additional regulations in many countries for vessels of smaller size, including the use of Class B transponders for fishing vessels.

In our global IMMA-wide assessment, vessels were assigned into two broad categories of 'merchant' and 'fishing vessels. We considered fish carriers (refrigerated cargo vessels carrying fish and capable of at-sea transhipment), fish bunkers (oil product tankers capable of at-sea transhipment and that regularly supply fishing fleets), hazardous cargo and general cargo under this 'Merchant' category as opposed to the Fishing Vessel category. Fishing vessels were categorized as those known to be carrying fishing gear intended for active fishing. Fishing vessel activity was assessed and included in the table to assess the risk of fishing activities with marine mammals' presence.

To put this information in relation to the size of the area, vessel density was calculated by counting all unique vessel identities transmitting on AIS for those vessel types (merchant and fishing) divided by the overall area of the IMMA. Table 1 below includes unique vessel identities that were counted over the entire year's worth of assessed data, while the tables for each individual IMMA on pages 27-366 include the total number of unique vessel identities transiting in that IMMA broken down by month and by vessel category. By using unique identities, we avoid considering vessels multiple times within a given time (e.g. per month or over the whole time period). A single identity can therefore re-occur each month but would still only 'count' as a single identity for 'total identities' in the tables below. As such, the total numbers, and the density calculated as vessels per square kms in these tables may fail to accurately reflect vessels that perform repeated journeys (e.g. ferries) but are only counted once. In some IMMAs these repeated journeys will contribute more to ship strike risk and underwater noise than the tables may account for. Therefore, it is important to consider the AIS density heatmaps for each individual IMMA on pages 29-367, which are based on individual AIS transmissions, and not unique merchant vessel identities, thus not reflecting repeated journeys by the same vessel.

At the same time, it is important to bear in mind that the heatmaps may be biased toward slow vessel traffic because slow vessels will transmit more signals in the same time period than fast vessels will. This is accounted for within the case studies. However, it is important to note that faster ships potentially present a greater risk of ships strikes and generate more UW noise than slower ships.

Table 1: Break down of all 114 IMMAs with respect to Vessel AIS transmissions within the IMMA boundaries, including the total number of unique merchant (Mer) and fishing vessel identities and densities over the time period 01Sep2018 – 31Aug2019. Additionally, the table includes the target marine mammal species for which the IMMA was identified.

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Akamas and Chrysochou Bay IMMA	Med	284	10	10	0.04	0.04	Mediterranean monk seal [EN]
Akrotiri IMMA	Med	46	135	20	2.93	0.43	Mediterranean monk seal [EN]
Alborán Corridor IMMA	Med	20217	11524	353	0.57	0.02	Fin whale [VU – Mediterranean subpopulation]; Sperm whale [EN – Mediterranean subpopulation]
Alborán Deep IMMA	Med	22661	10987	217	0.48	0.01	Long-finned pilot whale [DD – Mediterranean subpopulation]; Risso's dolphin [DD - Mediterranean subpopulation]; Sperm whale [EN – Mediterranean subpopulation]; Cuvier's beaked whale [VU – Mediterranean subpopulation]
Alborán Sea IMMA	Med	55938	11575	383	0.21	0.01	Common bottlenose dolphin [VU – Mediterranean subpopulation]; Common dolphin [EN – Mediterranean subpopulation]
Aldabra Atoll IMMA	WIO-AS	380	0	1	0	0	Dugong [VU]; Humpback whale [LC]
Austral Archipelago IMMA	PI	32292	67	14	0	0	Humpback whale [LC]
Babuyan Marine Corridor IMMA	NEIO-SAS	16894	530	1	0.03	0	Humpback whale [LC]; Rough-toothed dolphin [LC]
Balearic Islands Shelf and Slope IMMA	Med	22709	2203	189	0.1	0.01	Sperm whale [EN – Mediterranean subpopulation];
Balikpapan, Adang and Apar Bays IMMA	NEIO-SAS	6285	1677	17	0.27	0	Irrawaddy dolphin; Dugong [VU] [VU]
Bazaruto Archipelago and Inhambane Bay IMMA	WIO-AS	16280	197	45	0.01	0	Dugong [VU]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Berau and East Kutai District, Kalimantan IMMA	NEIO-SAS	19470	1988	85	0.1	0	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Sperm whale [VU]
Bintuni Bay IMMA	NEIO-SAS	5559	88	59	0.02	0.01	Australian humpback dolphin [VU]
Bismarck Sea IMMA	PI	225234	3603	136	0.02	0	Killer whale [DD]; Sperm whale [VU]
Bohol Sea IMMA	NEIO-SAS	29518	1805	19	0.06	0	Blue whale [VU]; Sperm whale [VU]; Melon-headed whale [LC]; Fraser's dolphin [LC]
Buleleng IMMA	NEIO-SAS	583	110	2	0.19	0	Spinner dolphin [LC]; Fraser's dolphin [LC]
Cabo Blanco IMMA	Med	19333	1103	298	0.06	0.02	Mediterranean monk seal [EN]
Campanian and Pontino Archipelago IMMA	Med	4948	921	99	0.19	0.02	Sperm whale [EN – Mediterranean subpopulation];
Cape Coastal Waters IMMA	WIO-AS	6359	1518	294	0.24	0.05	southern right whale [LC]
Central Aegean IMMA	Med	58265	8269	372	0.14	0.01	Mediterranean monk seal [EN]
Chilika Lagoon IMMA	NIO	319	0	0	0	0	Irrawaddy dolphin [EN]
Chios and Turkish Coast IMMA	Med	3839	3192	157	0.83	0.04	Mediterranean monk seal [EN]
Cilician Basin IMMA	Med	714	546	22	0.76	0.03	Mediterranean monk seal [EN]
Coastal Northern Bay of Bengal IMMA	NEIO-SAS	40113	2887	13	0.07	0	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Indo-Pacific Indo-Pacific Finless porpoise [VU]
Coastal Shelf Waters of Southern Madagascar IMMA	WIO-AS	18575	1675	26	0.09	0	Humpback whale [LC]
Coastal Shelf Waters of the South East LevatineLevantine Sea IMMA	Med	3814	1119	24	0.29	0.01	Common bottlenose dolphin [VU – Mediterranean subpopulation]; Common dolphin [EN – Mediterranean subpopulation]
Comoros Island Chain and Adjacent Reef Banks IMMA	WIO-AS	62920	1765	12	0.03	0	Sperm whale [VU]; Indo-Pacific bottlenose dolphin [NT]; Pantropical spotted dolphin [LC]; spinner dolphin [LC]; Humpback whale [LC]; Blue whale [VU]; Indian Ocean humpback dolphin [EN]; Dugong [VU]
Con Dao IMMA	NEIO-SAS	869	10	1	0	0	Dugong [VU]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Cook Islands Southern Group IMMA	PI	431499	145	60	0	0	Humpback whale [EN – Oceania subpopulation]; spinner dolphin [LC]
Dhofar IMMA	WIO-AS	19168	1859	27	0.1	0	Blue whale [VU]; Bryde's whale [LC]; Humpback whale [EN – Arabian Sea subpopulation]; Sperm whale [VU]; false killer whale [NT]; Indian Ocean humpback dolphin [EN]
Eastern Lesser Sunda Islands and Timor Coastal Area IMMA	NEIO-SAS	1259	387	1	0.31	0	Dugong [VU]
Farasan Archipelago IMMA	WIO-AS	5889	79	1	0.01	0	Bryde's whale [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Dugong [VU]
Greater Pemba Channel IMMA	WIO-AS	6647	100	8	0.02	0	Common bottlenose dolphin [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]
Gulf of Ambracia IMMA	Med	402	15	1	0.03	0	Common bottlenose dolphin [VU – Mediterranean subpopulation];
Gulf of Corinth IMMA	Med	2379	670	56	0.28	0.02	Striped dolphin [VU – Mediterranean subpopulation]; **Common dolphin [CR – Gulf of Corinth subpopulation]**
Gulf of Kutch IMMA	WIO-AS	2677	1324	8	0.49	0	Dugong [VU]; Indian Ocean humpback dolphin [EN]
Gulf of Mannar and Palk Bay IMMA	NEIO-SAS	20664	496	112	0.02	0.01	Dugong [VU]
Gulf of Masirah and Offshore Waters IMMA	WIO-AS	23881	1770	13	0.07	0	Humpback whale [EN – Arabian Sea subpopulation]; Indian Ocean humpback dolphin [EN]
Gulf of Salwa IMMA	NEIO-SAS	10676	1964	1637	0.18	0.15	Dugong [VU]; Indian Ocean humpback dolphin [EN]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Hellenic Trench IMMA	Med	56601	8606	154	0.15	0	Sperm whale [EN – Mediterranean subpopulation]; Cuvier's beaked whale [DD – Mediterranean subpopulation]
Iloilo and Guimaras Straits IMMA	NEIO-SAS	341	221	4	0.65	0.01	Irrawaddy dolphin [CR - Iloilo-Guimaras subpopulation]
Indus Estuary and Creeks IMMA	WIO-AS	2868	577	5	0.2	0	Indian Ocean humpback dolphin [EN]; Indo-Pacific Finless porpoise [VU]
Ionian Archipelago IMMA	Med	9607	1079	5	0.11	0	Common dolphin [EN – Mediterranean subpopulation]; Mediterranean monk seal [EN]
Kaimana, West Papua IMMA	NEIO-SAS	2174	29	1	0.01	0	Australian humpback dolphin [VU]; Indo-Pacific bottlenose dolphin [NT]; Bryde's whale [LC]; Dugong [VU]
Kelibia IMMA	Med	349	127	20	0.4	0.06	Common bottlenose dolphin [VU – Mediterranean subpopulation]
Kien Giang and Kep Archipelago IMMA	NEIO-SAS	8889	4	41	0	0	Irrawaddy dolphin [EN]; Dugong [VU]
Kikori Delta IMMA	NEIO-SAS	2033	31	2	0.02	0	Australian snubfin dolphin [VU]; Australian humpback dolphin [VU]
Kisite-Shimoni IMMA	WIO-AS	726	15	0	0.02	0	Common bottlenose dolphin [LC]; Indian Ocean humpback dolphin [EN]; Humpback whale [LC]
Kona Coast of Hawaii Island IMMA	PI	96	4	3	0.04	0.03	Spinner dolphin [LC]
Kuching Bay IMMA	NEIO-SAS	476	5	0	0.01	0	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]
Lakshadweep Archipelago IMMA	NEIO-SAS	86717	6219	313	0.07	0	Cetacean species diversity criterion only

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Lampedusa IMMA	Med	17527	1096	149	0.06	0.01	Fin whale [VU – Mediterranean subpopulation]; Common bottlenose dolphin [VU – Mediterranean subpopulation]
Lamu Offshore IMMA	WIO-AS	61373	285	21	0	0	Blue whale [VU]
Madagascar Central East Coast IMMA	WIO-AS	55524	192	46	0	0	Humpback whale [LC]
Madeira and Desertas Islands	Med	760	65	30	0.09	0.04	Mediterranean monk seal [EN]
Main Hawaiian Archipelago IMMA	PI	61951	249	185	0	0	spinner dolphin [LC]; Common bottlenose dolphin [LC]; Pygmy killer whale [LC]; Short-finned pilot whale [LC]; Blainville's beaked whale [DD]; Melon-headed whale [LC]; Dwarf sperm whale [DD]; Pantropical spotted dolphin [LC]; Rough-toothed dolphin [LC]; Cuvier's beaked whale [LC]; false killer whale [NT]; Humpback whale [LC]
Main Hawaiian Islands IMMA	PI	6400	222	170	0.03	0.03	Hawaiian monk seal [EN]
Main Solomon Islands IMMA	PI	278494	318	189	0	0	Indo-Pacific bottlenose dolphin [NT]; Dugong [VU]; Omura's whale [DD]
Malampaya Sound IMMA	NEIO-SAS	197	0	0	0	0	Irrawaddy dolphin [CR - Malampaya Sound subpopulation]
Maldives Archipelago and Adjacent Oceanic Waters IMMA	WIO-AS	162543	1572	292	0.01	0	Blue whale [VU]; Humpback whale [LC]; Sperm whale [VU]; spinner dolphin [LC]; Pantropical spotted dolphin [LC]
Marquesas Archipelago IMMA	PI	100460	54	42	0	0	Melon-headed whale [LC]; spinner dolphin [LC]
Mascarene Islands and Associated Oceanic Features IMMA	WIO-AS	234052	5856	596	0.03	0	Sperm whale [VU]; Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]; spinner dolphin [LC]; Humpback whale [LC]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Matang Mangroves and Coastal Waters IMMA	NEIO-SAS	2387	591	88	0.25	0.04	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]
Menai Bay IMMA	WIO-AS	648	28	1	0.04	0	Indo-Pacific bottlenose dolphin [NT]; Indian Ocean humpback dolphin [EN]
Mersing Archipelago IMMA	NEIO-SAS	1245	15	2	0.01	0	Dugong [VU]
Miani Hor IMMA	WIO-AS	402	0	0	0	0	Indian Ocean humpback dolphin [EN]; Indo-Pacific Finless porpoise [VU]
Mozambique Coastal Breeding Grounds IMMA	WIO-AS	80936	1118	72	0.01	0	Humpback whale [LC]
Muscat Coastal Waters and Offshore Canyons IMMA	WIO-AS	4703	3797	17	0.81	0	spinner dolphin [LC]; short-beaked common dolphin [LC]; cCommon bottlenose dolphin [LC]; Bryde's whale [LC]; Risso's dolphin [LC]; Sperm whale [VU]; false killer whale [NT]
Nakhiloo Coastal Area IMMA	WIO-AS	401	0	0	0	0	Indian Ocean humpback dolphin [EN]; Indo-Pacific Finless porpoise [VU]
New Caledonia Southern Seamounts and Banks IMMA	PI	18759	154	17	0.01	0	Humpback whale [EN – Oceania subpopulation]
New Caledonian Lagoons and Shelf Waters IMMA	PI	27800	208	45	0.01	0	Humpback whale [EN – Oceania subpopulation];Dugong [VU]; Indo-Pacific bottlenose dolphin [VU]
North East Arabian Sea IMMA	WIO-AS	129364	5121	99	0.04	0	Humpback whale [EN – Arabian Sea subpopulation]; Blue whale [VU]; Sperm whale [VU]; Dwarf sperm whale [DD]; pygmy sperm whale [DD];
North West Hawaiian Islands IMMA	PI	12552	2	0	0	0	Hawaiian monk seal [EN]
North West Hawaiian Islands IMMA (restricted to Kure and Midway Atolls, and the Pearl and Hermes Reef polygons)	PI	4661	3	0	0	0	Hawaiian monk seal [EN]; spinner dolphin [LC]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
North West Mediterranean Sea, Slope and Canyon System IMMA	Med	145297	4377	322	0.03	0	Fin whale [VU – Mediterranean subpopulation]; Sperm whale [EN – Mediterranean subpopulation]; Risso's dolphin [DD – Mediterranean subpopulation];
Northern Adriatic IMMA	Med	33438	2813	428	0.08	0.01	Common bottlenose dolphin [VU – Mediterranean subpopulation];
Northern Coast and Islands of the Thracian Sea IMMA	Med	5441	264	137	0.05	0.03	Black Sea Harbour Porpoise [EN]
Northern Coast of Cyprus IMMA	Med	518	37	6	0.07	0.01	Mediterranean monk seal [EN]
Northern Gulf and Confluence of Tigris, Euphrates and Kuran IMMA	WIO-AS	4220	877	5	0	0	Indian Ocean humpback dolphin [EN]
Northern Red Sea Islands IMMA	WIO-AS	2125	283	0	0.13	0	Indian Ocean humpback dolphin [EN]; Indo-Pacific bottlenose dolphin [NT]
Northern Sporades IMMA	Med	10623	822	61	0.08	0.01	Mediterranean monk seal [EN]
Northwest Madagascar and Northeast Mozambique Channel IMMA	WIO-AS	120614	709	64	0.01	0	Omura's whale [DD]; Blue whale [VU]; Fin whale [VU]; Humpback whale [LC]; Indian Ocean humpback dolphin [EN]; Melon-headed whale [LC]; Sperm whale [VU]; Dugong [VU]
Oman Arabian Sea IMMA	WIO-AS	96146	3868	42	0.04	0	Humpback whale [EN – Arabian Sea subpopulation]
Palmyra Atoll IMMA	PI	93	1	0	0	0	Melon-headed whale [LC]
Samoan Archipelago IMMA	PI	12549	75	164	0.01	0.01	Humpback whale [EN – Oceania subpopulation]; spinner dolphin [LC]; Rough-toothed dolphin [LC]
Satun-Langkawi Archipelago IMMA	NEIO-SAS	5494	43	269	0.01	0.05	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Savu Sea and Surrounding Areas IMMA	NEIO-SAS	160513	1988	15	0.01	0	Sperm whale [VU]; spinner dolphin [LC]; Melon-headed whale [LC]; Fraser's dolphin [LC]; Blue whale [VU]; Indo-Pacific bottlenose dolphin [NT]
Seychelles Plateau and Adjacent Oceanic Waters IMMA	WIO-AS	158283	342	192	0	0	spinner dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]; Blue whale [VU]; Sperm whale [VU]
Shelf of the Gulf of Lion IMMA	Med	13003	2077	132	0.16	0.01	Common bottlenose dolphin [VU – Mediterranean subpopulation];
Similajau-Kuala Nyalau Coastline IMMA	NEIO-SAS	1236	260	3	0.21	0	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]
Sindhudurg-Karwar IMMA	WIO-AS	4327	547	77	0	0	Indian Ocean humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]
Society Archipelago IMMA	PI	19029	99	99	0.01	0.01	Humpback whale [EN – Oceania subpopulation]; spinner dolphin [LC]; Rough-toothed dolphin [LC]
South East African Migration Corridor IMMA	WIO-AS	35583	5273	251	0.15	0.01	Humpback whale [LC]
South West of Madagascar and Mozambique Channel IMMA	WIO-AS	139494	267	41	0	0	Sperm whale [VU]; Indian Ocean humpback dolphin [EN]; Blue whale [VU]; Antarctic minke whale [NT]; Fin whale [VU]
South West to Eastern Sri Lanka IMMA	NEIO-SAS	28699	10476	1475	0.37	0.05	Blue whale [VU]; Sperm whale [VU]; spinner dolphin [LC]
Southern Andaman Islands IMMA	NEIO-SAS	14441	80	8	0.01	0	Dugong [VU]; Indo-Pacific bottlenose dolphin [VU]
Southern Bali Peninsula and Adjacent Slope IMMA	NEIO-SAS	2239	280	32	0.13	0.01	Bryde's whale [LC]; spinner dolphin [LC]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Southern Coastal and Shelf Waters of South Africa IMMA	WIO-AS	121324	7628	839	0.06	0.01	Indian Ocean humpback dolphin [EN]; Bryde's whale [LC]; Indo-Pacific bottlenose dolphin [NT]; Common dolphin [LC]; Cape fur seal [LC]; Humpback whale [LC]
Southern Egyptian Red Sea Bays, Offshore Reefs and Islands IMMA	WIO-AS	19425	119	0	0.01	0	Dugong [VU]; Indian Ocean humpback dolphin [EN]; Risso's dolphin [LC]; spinner dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]
Southern Gulf Waters IMMA	WIO-AS	26141	3568	65	0.14	0	Indian Ocean humpback dolphin [EN]; Dugong [VU]; Indo-Pacific Finless porpoise [VU]; Indo-Pacific bottlenose dolphin [NT]
Southern Shelf Waters and Reef Edge of Palau IMMA	PI	1490	21	64	0.01	0.04	Dugong [VU]
Strait of Gibraltar and Gulf of Cadiz IMMA	Med	4539	11243	183	2.48	0.04	killer whale [CR – Strait of Gibraltar subpopulation]
Sundarbans IMMA	NIO	3663	421	0	0.11	0	Irrawaddy dolphin [EN]; South Asian river dolphin [EN]
Swatch-of-No-Ground IMMA	WIO-AS	1960	308	0	0.16	0	Indo-Pacific bottlenose dolphin [VU]; Bryde's whale [LC]
Tanon Strait IMMA	NEIO-SAS	5371	395	5	0.07	0	Indo-Pacific bottlenose dolphin [VU]; spinner dolphin [LC]
Toliara, St. Augustine Canyon and Anakao IMMA	WIO-AS	6069	24	5	0	0	Humpback whale [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]; Risso's dolphin [LC]; Short-finned pilot whale [LC]
Tolitoli IMMA	NEIO-SAS	2467	41	3	0.02	0	Dugong [VU]
Tongan Archipelago IMMA	PI	50034	91	39	0	0	Humpback whale [EN – Oceania subpopulation]spinner dolphin [LC]
Vatu-i-Ra IMMA	PI	14294	38	128	0	0.01	Humpback whale [EN – Oceania subpopulation]; spinner dolphin [LC]

IMMA	Region	Area SqKm	Mer vessels	Fishing vessels	Mer /km2	Fishing /km2	Qualifying Species in IMMA and IUCN Red List Conservation Status
Wakatobi and Adjacent Waters IMMA	NEIO-SAS	26816	925	16	0.03	0	Sperm whale [VU]; spinner dolphin [LC]
Watamu-Malindi and Watamu Banks IMMA	WIO-AS	951	21	5	0.02	0.01	Common bottlenose dolphin [LC]; Humpback whale [LC]
Waters of Ischia and Ventotene IMMA	Med	1068	372	63	0.35	0.06	Fin whale [VU – Mediterranean subpopulation]; Common bottlenose dolphin [VU – Mediterranean subpopulation]; short-beaked cCommon dolphin [EN – Mediterranean subpopulation]
Waters of New Caledonia and Loyalty Islands IMMA	PI	155056	315	54	0	0	Sperm whale [VU]; Humpback whale [EN – Oceania subpopulation]
Western Lesser Sunda Islands and Sumba Coastal Area IMMA	NEIO-SAS	759	65	25	0.09	0.03	Dugong [VU]
Western Ligurian Sea and Genoa Canyon IMMA	Med	8526	2030	31	0.24	0	Cuvier's beaked whale [VU - Mediterranean subpopulation]

For more information about individual IMMAs, consult the IMMA searchable database at: https://www.marinemammalhabitat.org/immas/immas-searchable-database/ or the IMMA eAtlas: https://www.marinemammalhabitat.org/immas/imma-eatlas/

The analysis for vessel activity includes a general overview of vessel types and unique MMSI transmission per month and in total (Table), a temporal (Graph) and spatial (Heatmap) overview of the activity. The value range of the heatmaps can be used as an orientation of the activity, but are not normalised, which is why our evaluation is based on all three outputs. This includes an overview of the activity as the follows:

- **28 IMMAs indicated a likely increase in vessel activity over the analysis period.**
- **38 IMMAs included well defined shipping lanes for merchant vessels.**
- **16 IMMAs showed possible vessel activity in an estimate of over 75% the area of interest.**
- **2 IMMAs comprised no AIS transmissions and could therefore not be assessed for its vessel activity without consolidating further detection methodologies**

In the next phase of analysis, a matrix containing the values for overall density of AIS signals within each IMMA, as well as the species and criteria for which IMMAs were designated, was analysed to identify the 10 IMMAs that appeared to have the highest risk for ship strikes to whales, and the 10 that appeared to have the highest risk for bycatch from fishing vessels transmitting AIS[1]. This ranking was conducted in the following manner:

For shipping:

- For those large cetaceans considered to be most susceptible to ship strike (sperm whales and baleen whales), the IMMAs in which these were identified were filtered and the number of 'concern' species summed (resulting in a longlist of IMMAs containing these species).
- This long list of IMMAs was then compared against the IMMA database to determine the number of IMMA Selection Criteria (A, Bi, Bii, Ci, Cii, Ciii and Di only) that were used to support the identification of the IMMA for the above species, and the total number of criteria were summed.
- The values of Merchant and Fishing vessel activity and area for each IMMA (see Table 2 below) were log transformed. This action resulted in values for AIS transmission density across the dataset of a magnitude commonly 0.1 - 10, rather than the raw values provided.
- These values were then summed together providing a total ranking across all the IMMAs. Those which ranked highest are likely have high ranks in all classes, whilst those with one or two high ranking classes alongside medium ones will outrank those areas with only medium or lower combine ranks across the board.
- Finally, to reduce the list further to areas that support regionally relevant high diversities of marine mammal species (which may or may not be affected by the traffic area and intensity) the longlist above was further shortened through the use of the Dii (Diversity) Criterion.
- The Top 10 IMMA Shortlist was derived by the 10 highest combined ranking IMMAs calculated as above.

For Fisheries bycatch

- This process was then repeated for the bycatch 'concern' small cetacean species (*Delphinus, Tursiops, Phocoena, Lagenodelphis, Neophocaena, Stenella*) which met the criteria in each IMMA, as well as the combined number of criteria which each species qualified for (cross-referenced from the eAtlas).
- These were conferenced against the log-transformed values for density of AIS transmissions within each IMMA.
- The top 10 short list derived from this exercise included two areas also on the top 10 list for possible ship strike risk.

[1] Note that only vessels of 300 gross tonnage or above are required by the IMO to transmit AIS, so this likely excludes a large number of smaller fishing vessels of both commercial and artisanal nature.

Top 10 IMMAs where target species are potentially at risk from merchant shipping traffic as indicated by AIS data from 1 September 2018-1 September 2019, and the target species and criteria for which the IMMAs were identified.

Top 10 IMMAs with potential risk for Ship Strike	Country/Region	Key Species of concern
South West to Eastern Sri Lanka IMMA	Sri Lanka, Southeast Asia	Blue whale [VU]; Sperm whale [VU]
Hellenic Trench IMMA	Greece, Mediterranean	Sperm whale [EN – Mediterranean subpopulation]; Cuvier's beaked whale [DD – Mediterranean subpopulation]
Dhofar IMMA	Oman, Arabian Sea	Blue whale [VU]; Bryde's whale [LC]; Humpback whale [EN – Arabian Sea subpopulation]; Sperm whale [VU]
Savu Sea and Surrounding Areas IMMA	Indonesia, Southeast Asia	Sperm whale [VU]; Blue whale [VU]
Northwest Madagascar and Northeast Mozambique Channel IMMA	Madagascar, Southwest Indian Ocean	Omura's whale [DD]; Blue whale [VU]; Fin whale [VU]; Humpback whale [LC]; Sperm whale [VU]
North West Mediterranean Sea, Slope and Canyon System IMMA	France, Spain, Italy, Mediterranean	Fin whale [VU – Mediterranean subpopulation]; Sperm whale [EN – Mediterranean subpopulation];
Mascarene Islands and Associated Oceanic Features IMMA	France (Overseas Territory) and Mauritius, Southwest Indian Ocean	Sperm whale [VU]; Humpback whale [LC]
Alboran Deep IMMA	Spain, Mediterranean	Sperm whale [EN – Mediterranean subpopulation]; Cuvier's beaked whale [VU – Mediterranean subpopulation]
South West of Madagascar and Mozambique Channel IMMA	Madagascar, Southwest Indian Ocean	Sperm whale [VU]; Blue whale [VU]; Antarctic minke whale [NT]; Fin whale [VU]
Muscat Coastal Waters and Offshore Canyons IMMA	Oman, Arabian Sea	Bryde's whale [LC]; Sperm whale [VU];

Top 10 IMMAs where target species are potentially at risk from bycatch as indicated by species present and density of AIS transmissions from 1 September 2018-1 September 2019, and the target species and criteria for which the IMMAs were identified.

Top 10 IMMAs with potential risk for fisheries interactions	Country/Region	Key Species of concern
Berau and East Kutai District, Kalimantan IMMA	Indonesia (Borneo), Southeast Asia	Irrawaddy dolphin [EN]; Indo-Pacific humpback dolphin [VU]; Sperm whale [VU]
Comoros Island Chain and Adjacent Reef Banks IMMA	France (Overseas Territories) and Comoros, Southwest Indian Ocean	Indo-Pacific bottlenose dolphin [NT]; Pantropical spotted dolphin [LC]; spinner dolphin [LC]; Indian Ocean humpback dolphin [EN]; Dugong [VU]
Greater Pemba Channel IMMA	Tanzania, Southwest Indian Ocean	Common bottlenose dolphin [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]
Main Hawaiian Archipelago IMMA	Hawaii, USA, Pacific Islands	spinner dolphin [LC]; Common bottlenose dolphin [LC]; Pygmy killer whale [LC]; Short-finned pilot whale [LC]; Blainville's beaked whale [DD]; Melon-headed whale [LC]; Dwarf sperm whale [DD]; Pantropical spotted dolphin [LC]; Rough-toothed dolphin [LC]; Cuvier's beaked whale [LC]; false killer whale [NT];
Mascarene Islands and Associated Oceanic Features IMMA	France (Overseas Territories) and Mauritius, Southwest Indian Ocean	Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]; spinner dolphin [LC]; Sperm whale [VU]; Humpback whale [LC]
Savu Sea and Surrounding Areas IMMA	Indonesia, Southeast Asia	spinner dolphin [LC]; Melon-headed whale [LC]; Fraser's dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Sperm whale [VU]; Blue whale [VU]
Seychelles Plateau and Adjacent Oceanic Waters IMMA	Seychelles, Southwest Indian Ocean	spinner dolphin [LC]; Indo-Pacific bottlenose dolphin [NT]; Common bottlenose dolphin [LC]; Blue whale [VU]; Sperm whale [VU]
Sindhudurg-Karwar IMMA	Pakistan, Arabian Sea	Indian Ocean humpback dolphin [VU]; Indo-Pacific Finless porpoise [VU]
Tanon Strait IMMA	Philippines, Southeast Asia	Indo-Pacific bottlenose dolphin [VU]; spinner dolphin [LC]
Toliara, St. Augustine Canyon and Anakao IMMA	Madagascar, Southwest Indian Ocean	Humpback whale [LC]; Indian Ocean humpback dolphin [EN]; spinner dolphin [LC]; Risso's dolphin [LC]; Short-finned pilot whale [LC]

These two top 10 lists were then assessed against a list of agreed criteria (see Appendix 1) to select two IMMAs that would become the focus of more in-depth analysis of the nature of vessel traffic and the risk it presents in relation to what is known of marine mammal distribution and habitat use within the IMMA. Taking all of the agreed criteria into consideration, as well as an agreed desire to highlight areas that had not yet

been the focus of similar published or ongoing studies (as is the case in the Mediterranean(Frantzis et al., 2019) or Sri Lanka (Priyadarshana et al., 2016) or the Arabian Sea(Willson et al., 2016)), the two IMMAs chosen to be the focus of more in depth analysis were:

- **The Mascarene Islands and Associated Oceanic Features IMMA**
- **Savu Sea and Surrounding Areas IMMA**

Further details on these two case studies can be found in Part II of this report below page 367.

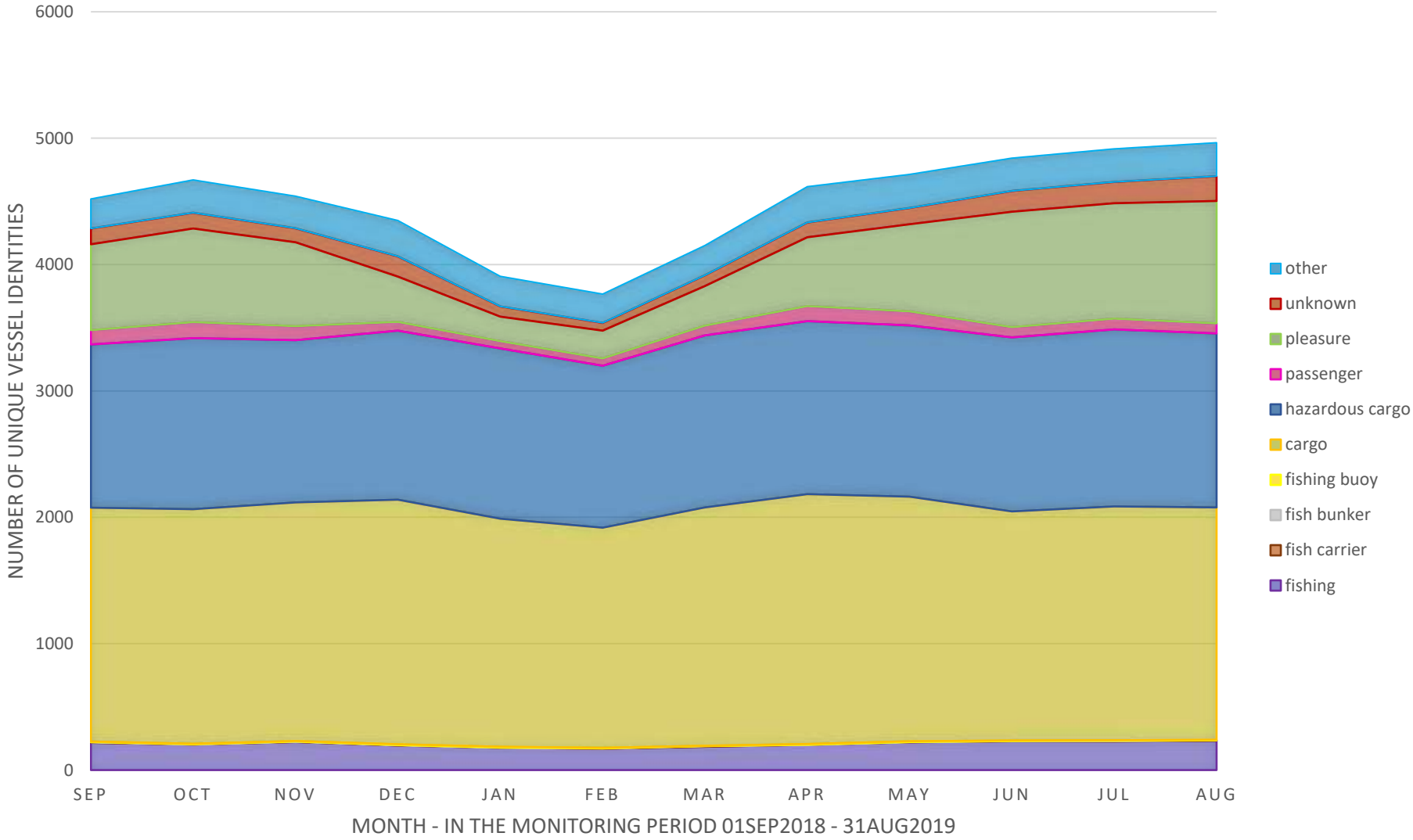
The following analysis between page 27 and 367 focuses on the individual IMMAs. The tables and figures represent vessel traffic through the number of unique vessel identities transiting through the IMMA per month and over the whole period (total). This allows an overview of the activity by the number of vessels, but as mentioned previously, it does not reflect repeated journeys through the IMMA. For this purpose, the associated heatmaps show the AIS positional density which is based on the transmissions from AIS transceivers.

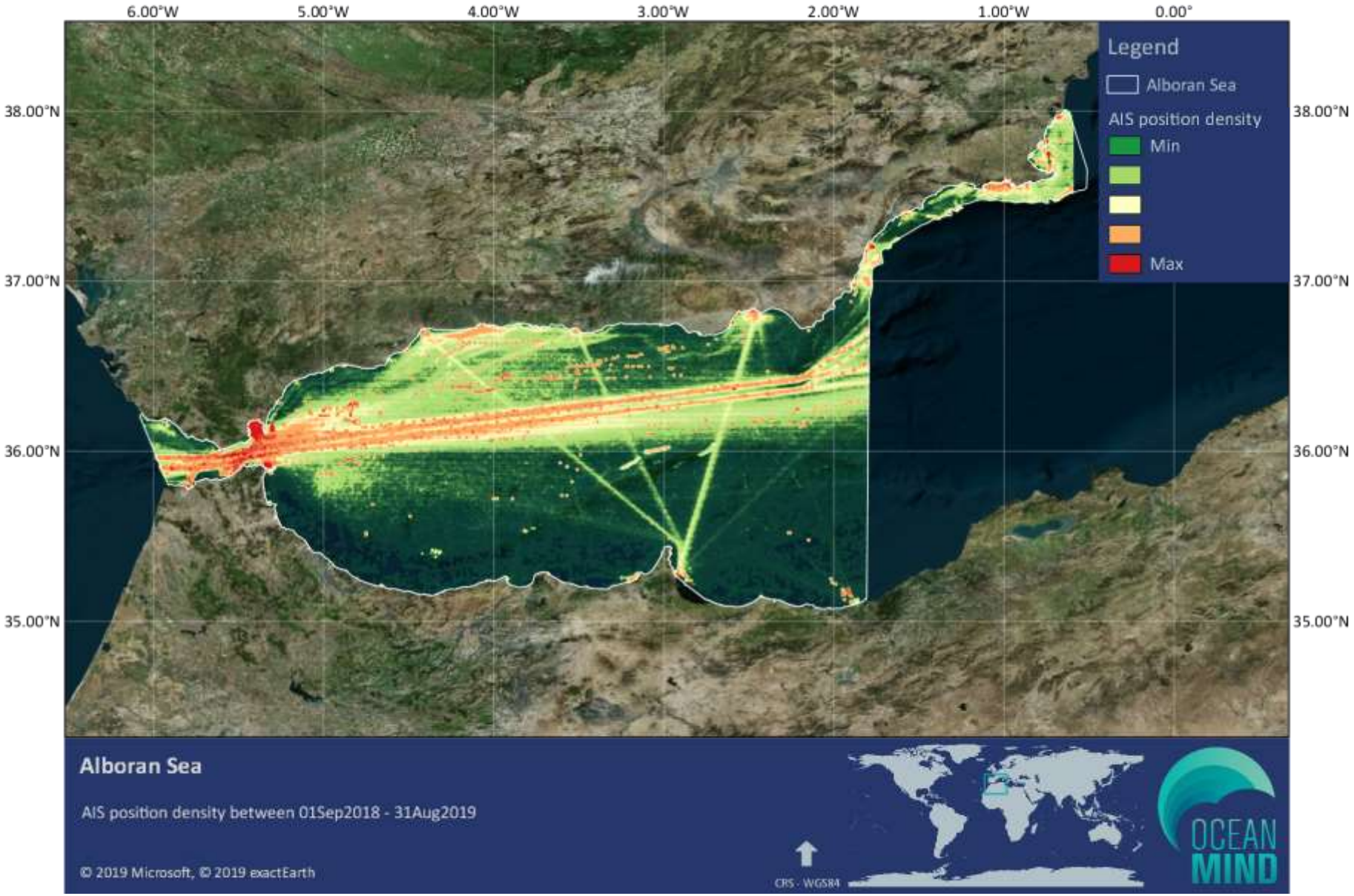
1 Mediterranean region

1.1 Alboran Sea IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	217	202	221	194	176	168	185	200	220	227	225	231	383
Fish carrier	3	1	3	3	1	2	5	0	1	2	5	4	11
Fish bunker	1	1	1	2	2	2	0	1	1	1	1	0	4
Fishing buoy	5	4	4	5	5	4	3	6	5	3	4	4	13
Cargo	1850	1856	1889	1935	1805	1742	1886	1976	1936	1814	1851	1839	6798
Hazardous cargo	1291	1354	1284	1337	1348	1281	1361	1369	1356	1376	1400	1377	4762
Passenger	113	126	110	70	56	58	77	119	110	81	85	80	297
Pleasure	681	742	664	358	194	220	312	544	690	913	914	968	3359
Unknown	124	123	112	162	83	62	86	117	128	165	168	196	570
Other	233	260	252	283	236	227	235	283	267	259	263	265	883
Total	4518	4669	4540	4349	3906	3766	4150	4615	4714	4841	4916	4964	17080

NUMBER OF VESSELS AGGREGATED BY CATEGORY - ALBORAN SEA

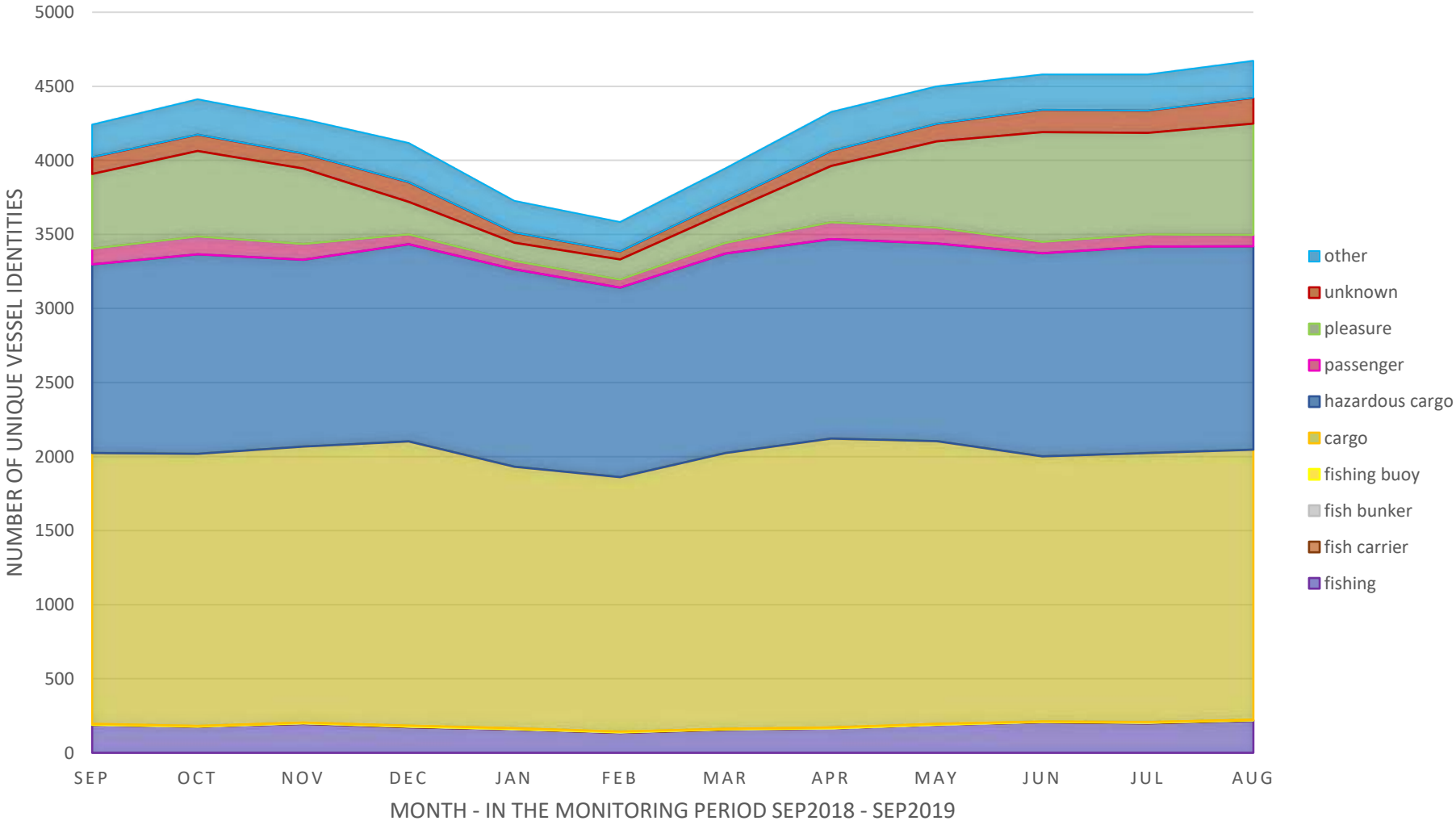


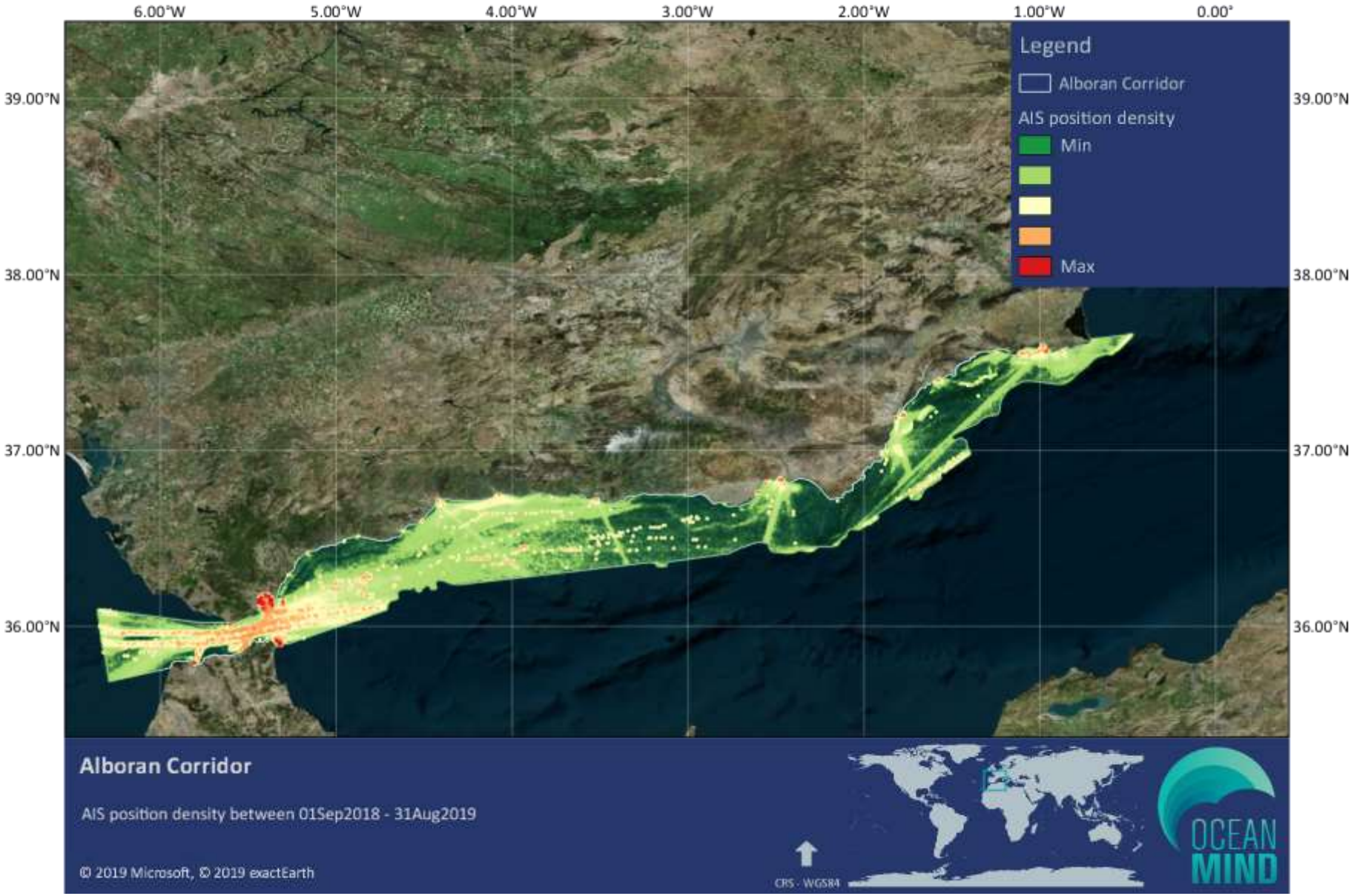


1.2 Alboran Corridor IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	186	176	196	173	157	135	155	164	188	206	199	216	353
Fish carrier	3	1	3	3	1	2	4	0	1	2	4	4	10
Fish bunker	1	1	1	2	2	2	0	1	1	1	1	0	4
Fishing buoy	5	4	4	5	5	4	3	6	5	3	4	4	13
Cargo	1828	1837	1863	1920	1767	1718	1861	1950	1909	1789	1816	1822	6767
Hazardous cargo	1274	1346	1262	1330	1333	1280	1347	1347	1334	1372	1394	1374	4743
Passenger	107	121	106	66	55	54	73	114	107	77	82	77	290
Pleasure	504	578	509	221	124	136	205	380	583	740	686	752	3016
Unknown	114	110	102	133	68	53	77	101	119	151	150	173	489
Other	220	238	232	264	214	200	222	263	253	239	244	250	862
Total	4242	4412	4278	4117	3726	3584	3947	4326	4500	4580	4580	4672	16547

NUMBER OF VESSELS AGGREGATED BY CATEGORY - ALBORAN CORRIDOR

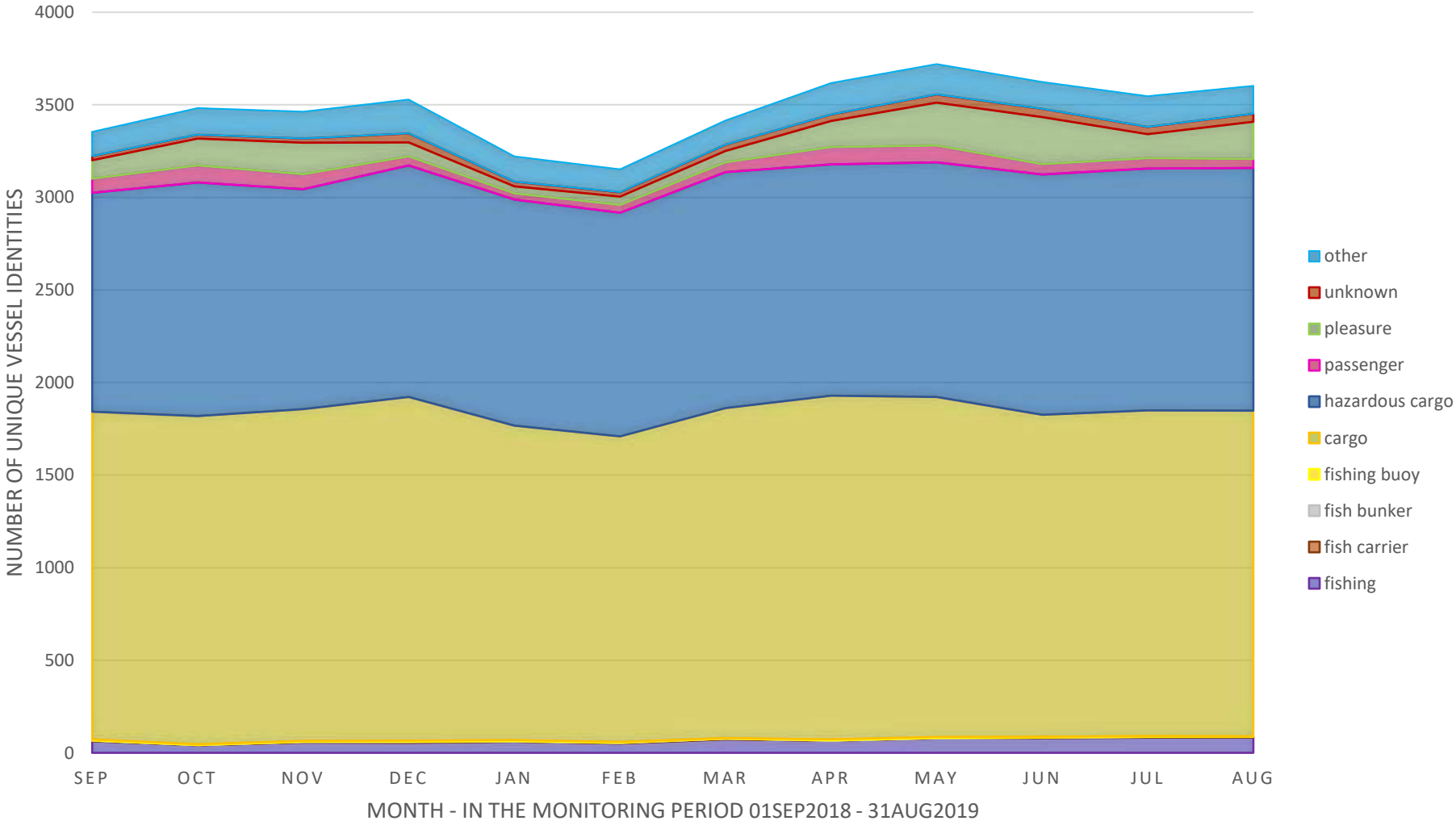


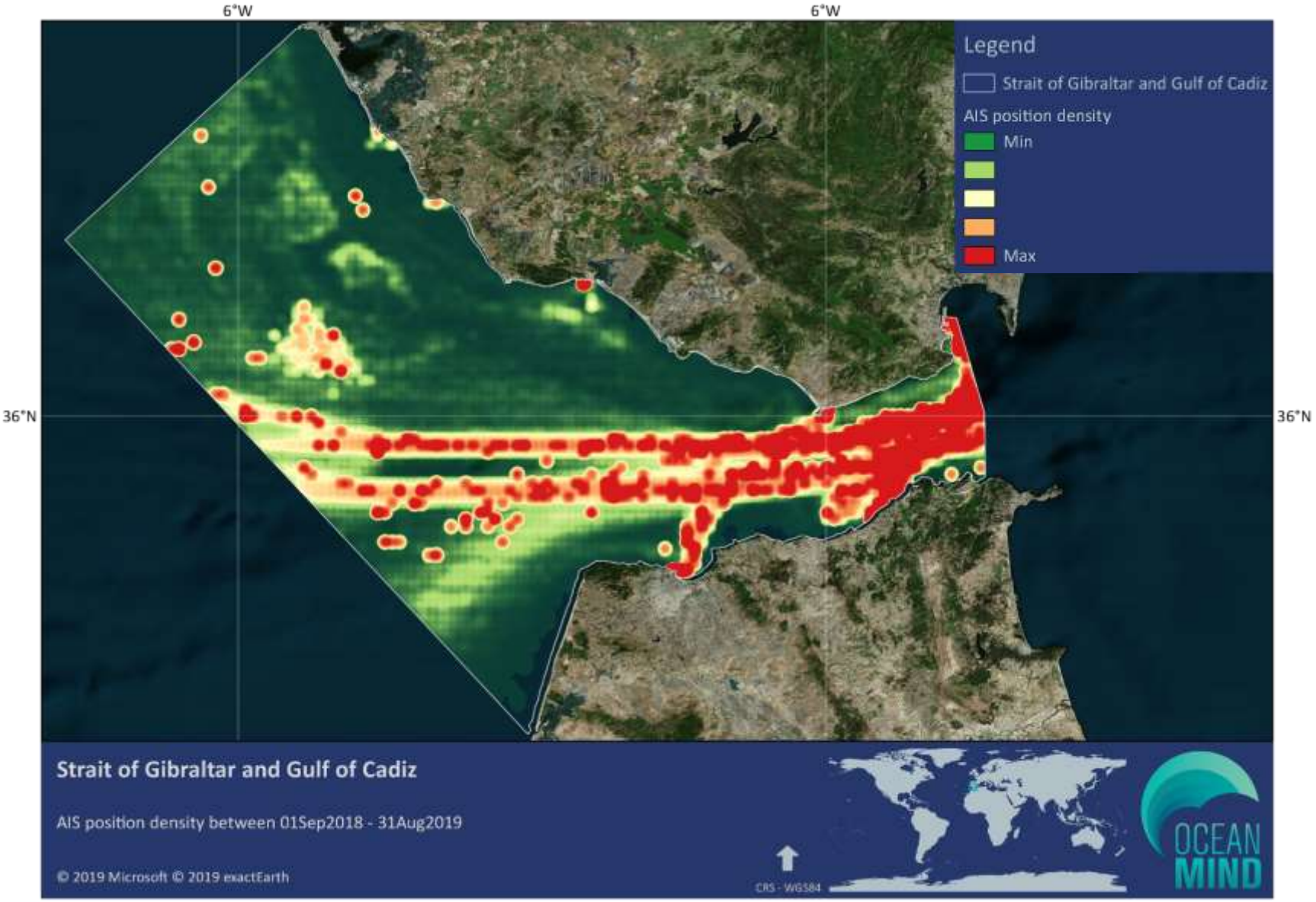


1.3 Strait of Gibraltar and Gulf of Cadiz IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	63	41	56	55	60	51	73	66	78	80	82	83	183
Fish carrier	3	1	3	3	1	2	4	0	1	2	4	4	10
Fish bunker	1	0	1	2	2	2	0	1	1	1	1	0	4
Fishing buoy	5	4	4	5	5	4	3	6	5	3	4	3	12
Cargo	1771	1772	0	1857	1699	1650	1782	1856	1837	1740	1758	1758	6626
Hazardous cargo	1181	1262	1792	1250	1221	1208	1274	1249	1267	1298	1307	1310	4603
Passenger	77	92	1188	49	34	42	53	94	91	56	56	50	261
Pleasure	99	146	81	76	37	45	62	140	232	253	130	201	1132
Unknown	23	21	171	48	26	24	33	36	44	45	39	42	167
Other	131	144	22	183	137	124	132	170	164	145	165	152	702
Total	3354	3483	145	3528	3222	3152	3416	3618	3720	3623	3546	3603	13700

NUMBER OF VESSELS AGGREGATED BY CATEGORY - STRAIT OF GIBRALTAR AND GULF OF CADIZ

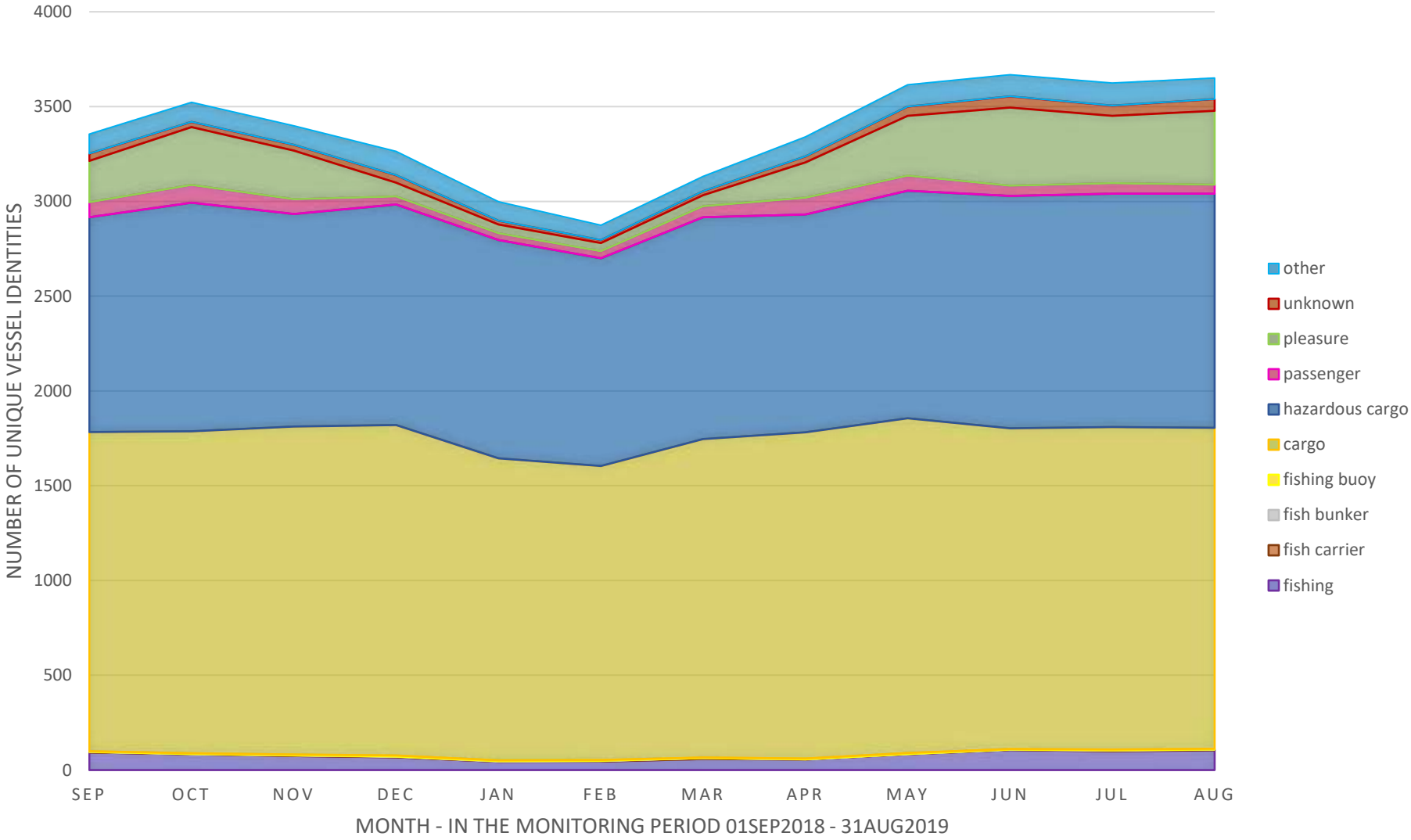


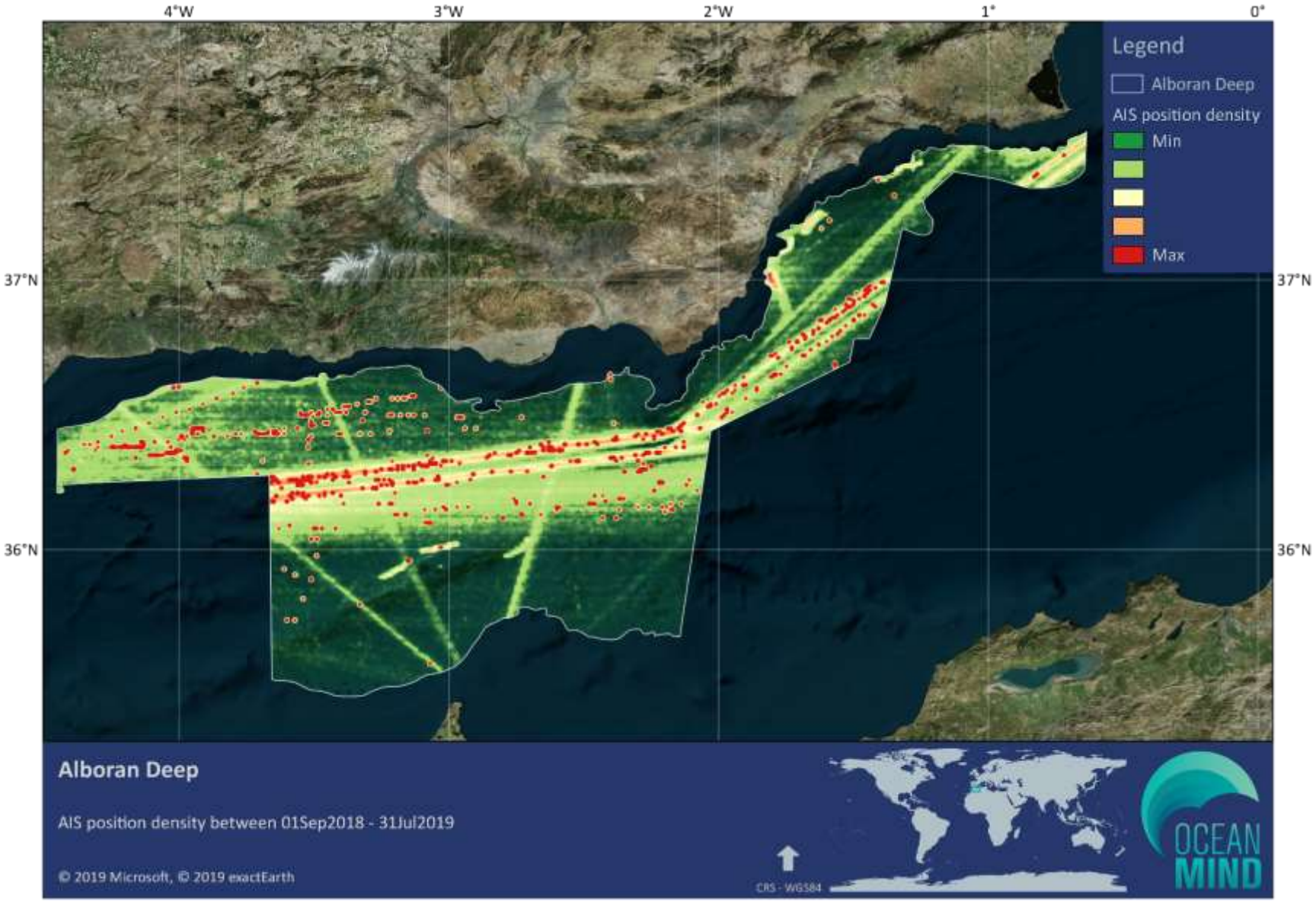


1.4 Alboran Deep IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	92	83	74	67	44	45	58	56	83	106	99	104	217
Fish carrier	3	1	3	3	1	2	5	0	1	1	4	4	10
Fish bunker	1	0	1	2	2	2	0	1	1	1	1	0	4
Fishing buoy	3	4	4	5	4	4	3	4	5	3	4	4	13
Cargo	1684	1699	1730	1743	1594	1551	1680	1721	1766	1692	1702	1693	6536
Hazardous cargo	1133	1206	1122	1163	1151	1096	1170	1149	1200	1225	1230	1235	4437
Passenger	80	94	77	43	35	37	58	88	79	54	56	48	261
Pleasure	218	304	257	73	47	43	59	186	316	413	355	390	2005
Unknown	37	29	30	39	20	16	20	32	49	59	54	61	191
Other	103	103	100	126	100	78	78	103	115	114	119	112	631
Total	3354	3523	3398	3264	2998	2874	3131	3340	3615	3668	3624	3651	14305

NUMBER OF VESSELS AGGREGATED BY CATEGORY - ALBORAN DEEP

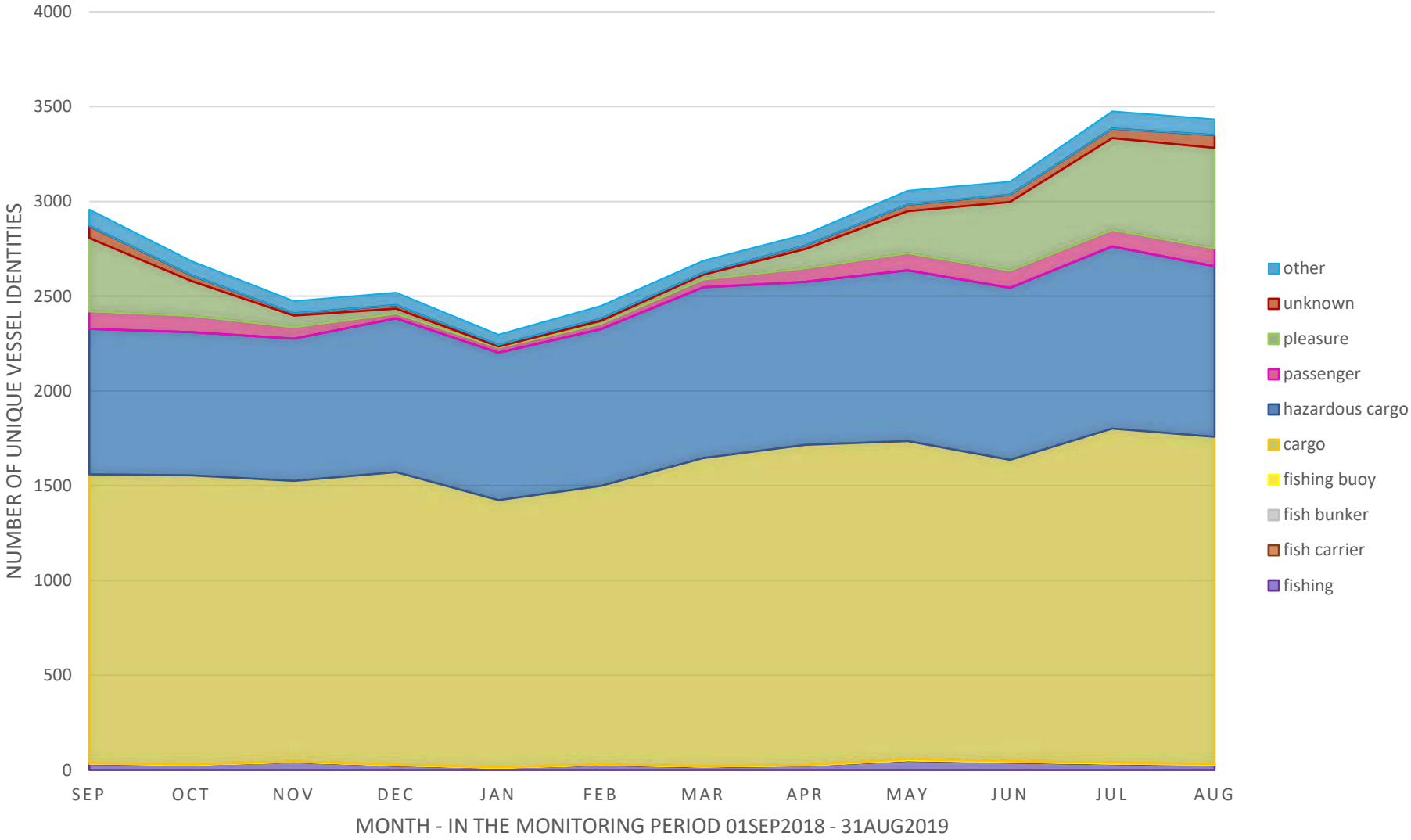




1.5 Hellenic Trench IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	32	28	42	22	12	26	16	22	49	40	32	24	154
Fish carrier	2	0	2	2	0	2	2	1	2	2	3	4	8
Fish bunker	0	0	0	2	0	0	0	2	2	1	0	1	3
Fishing buoy	2	1	1	2	1	1	1	2	4	3	3	2	9
Cargo	1524	1526	1481	1544	1411	1470	1627	1688	1678	1591	1763	1727	5701
Hazardous cargo	767	755	750	810	778	827	900	861	901	907	961	899	2894
Passenger	93	86	59	26	26	27	41	71	90	89	87	94	239
Pleasure	387	184	62	26	6	17	26	102	222	364	485	531	1696
Unknown	63	30	12	19	9	11	9	18	34	38	50	67	251
Other	87	75	65	65	54	67	65	60	74	69	91	83	459
Total	2957	2685	2474	2518	2297	2448	2687	2827	3056	3104	3475	3432	11414

NUMBER OF VESSELS AGGREGATED BY CATEGORY - HELLENIC TRENCH

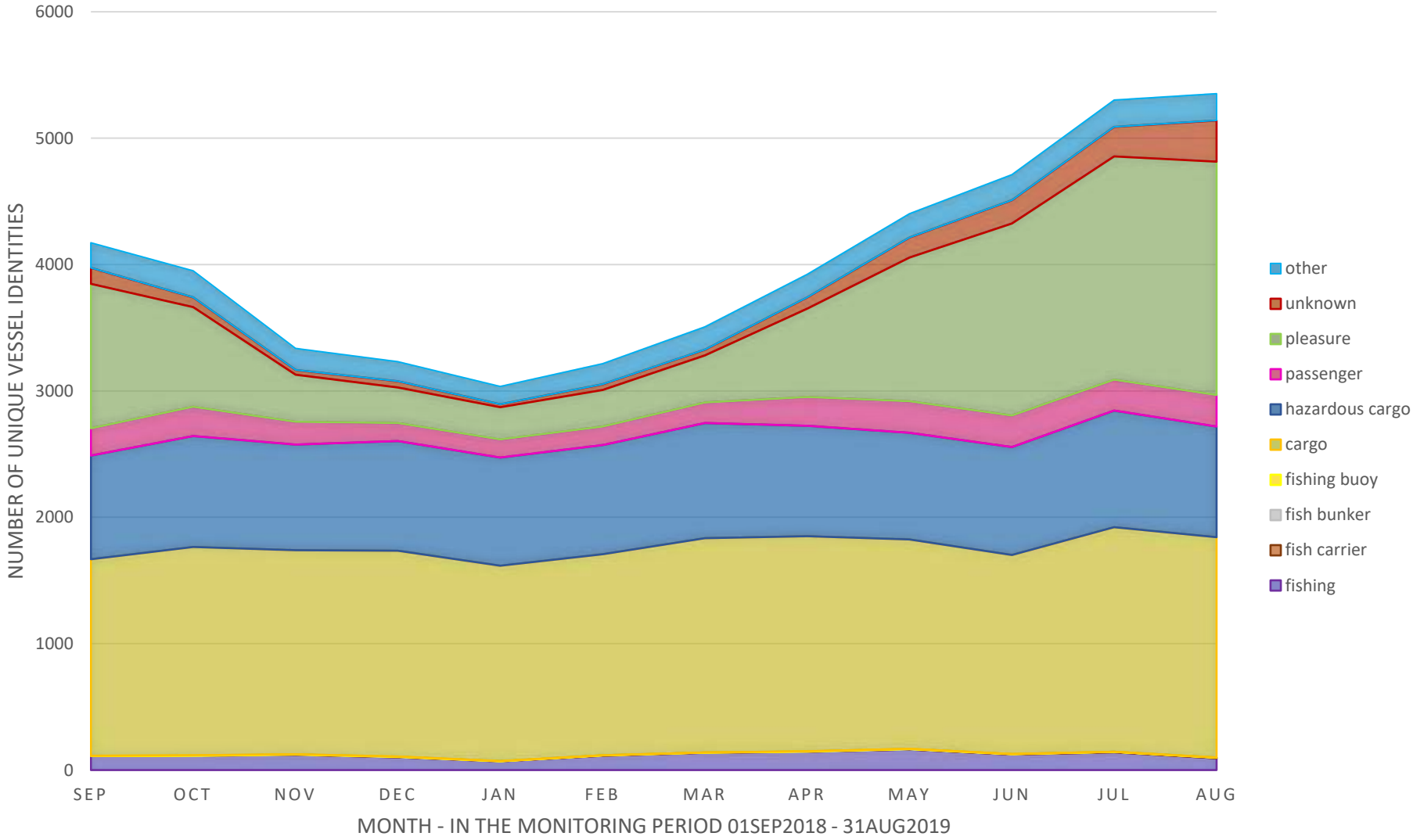


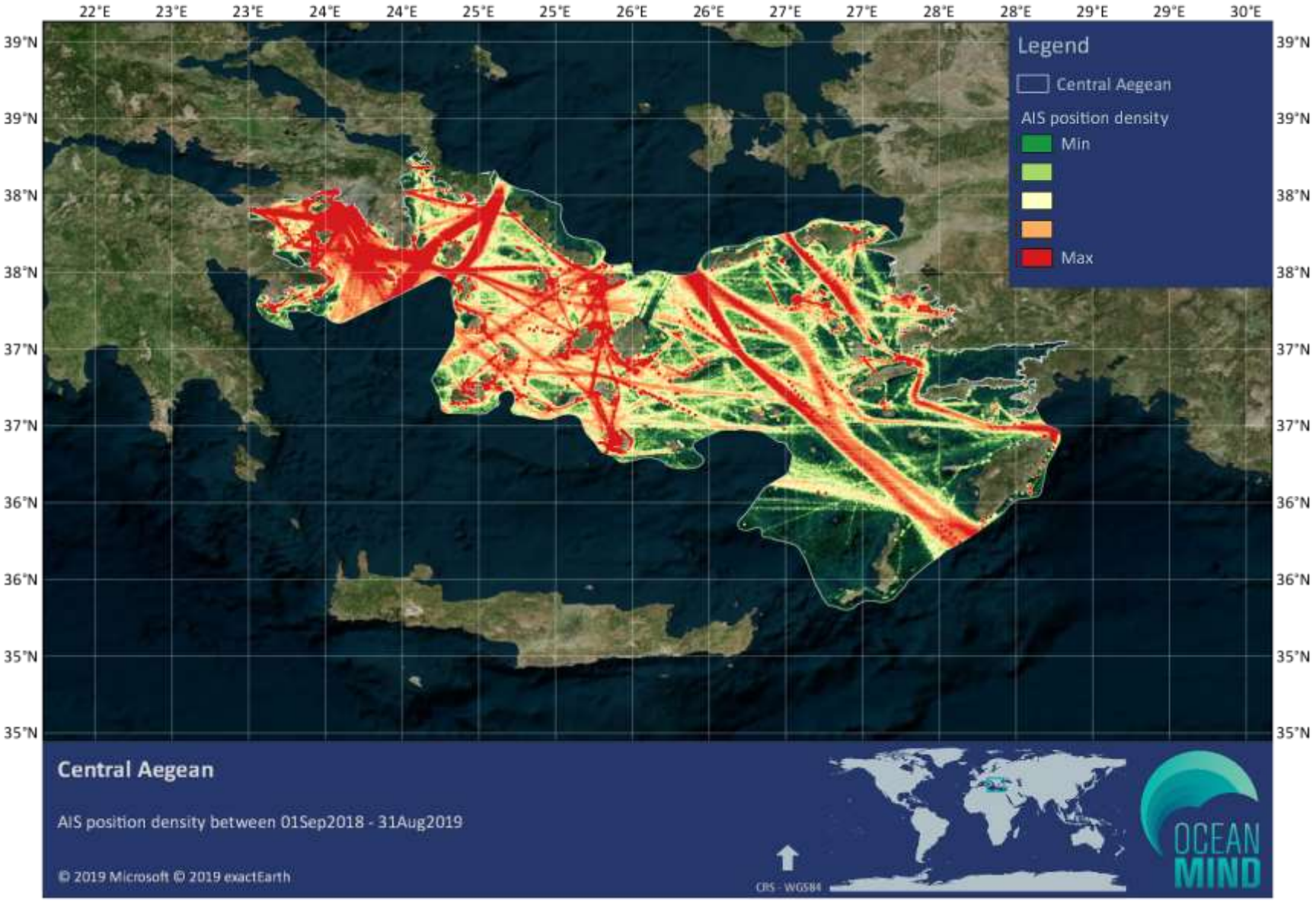
1.6 Central Aegean IMMA

OceanMind could not assess the vessel activity for Central Aegean for July 2019 and could therefore not run an accurate spatial analysis for the IMMA.

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	111	114	121	102	69	113	137	144	162	123	141	94	372
Fish carrier	0	0	2	2	1	2	2	1	2	2	3	4	7
Fish bunker	0	0	0	2	0	1	0	1	2	1	0	1	3
Fishing buoy	2	2	1	1	1	0	0	2	2	1	1	1	7
Cargo	1555	1649	1615	1628	1546	1591	1695	1702	1657	1575	1776	1742	5526
Hazardous cargo	821	877	836	869	856	865	911	874	843	853	923	876	2733
Passenger	215	232	180	141	143	146	164	227	251	251	244	249	468
Pleasure	1143	789	374	283	255	290	371	701	1136	1519	1767	1847	3462
Unknown	128	78	36	49	23	45	46	88	158	184	234	326	745
Other	197	210	171	155	142	163	181	182	189	203	213	212	624
Total	4172	3951	3336	3232	3036	3216	3507	3922	4402	4712	5302	5352	13947

NUMBER OF VESSELS AGGREGATED BY CATEGORY - CENTRAL AEGEAN

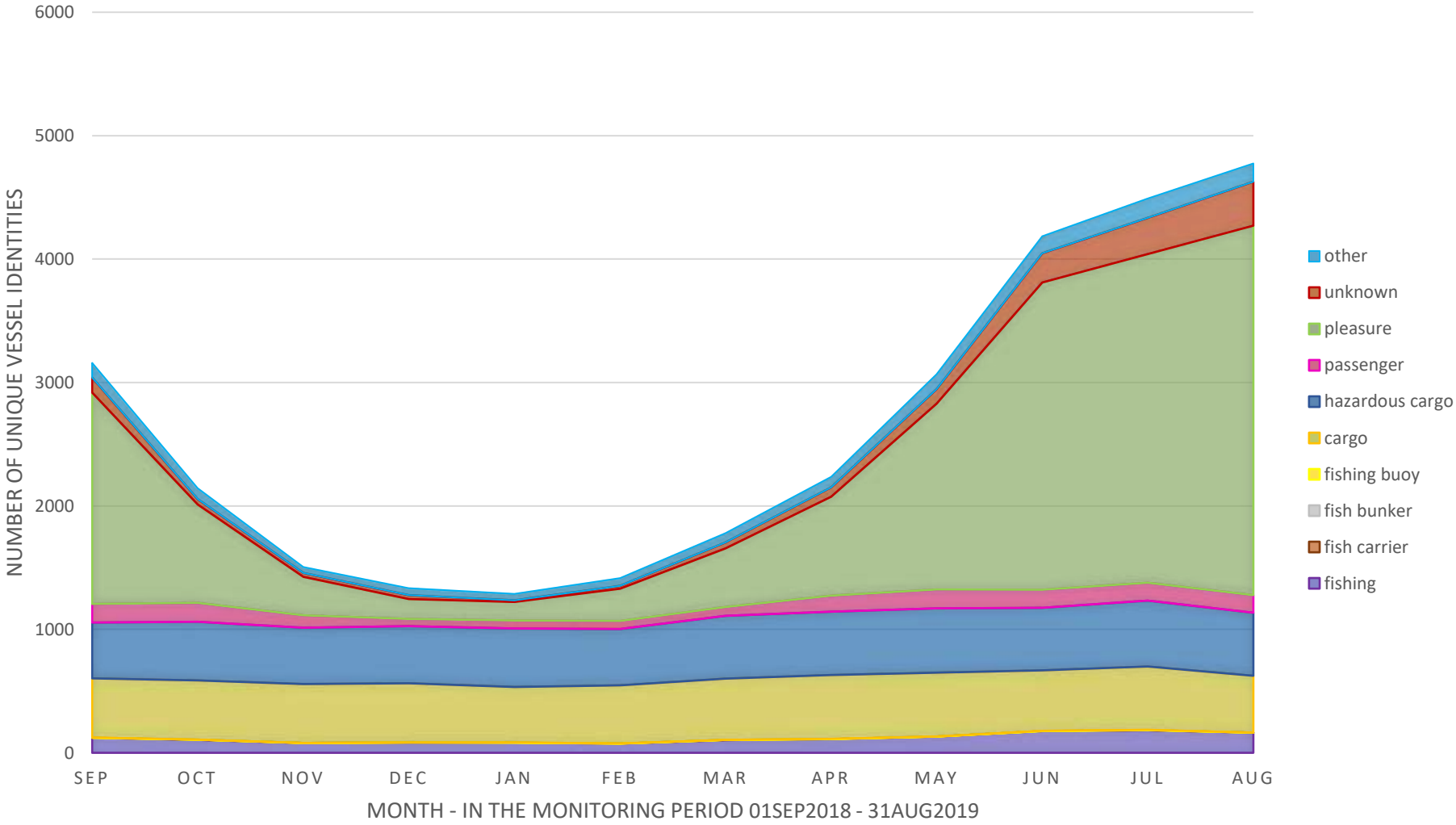


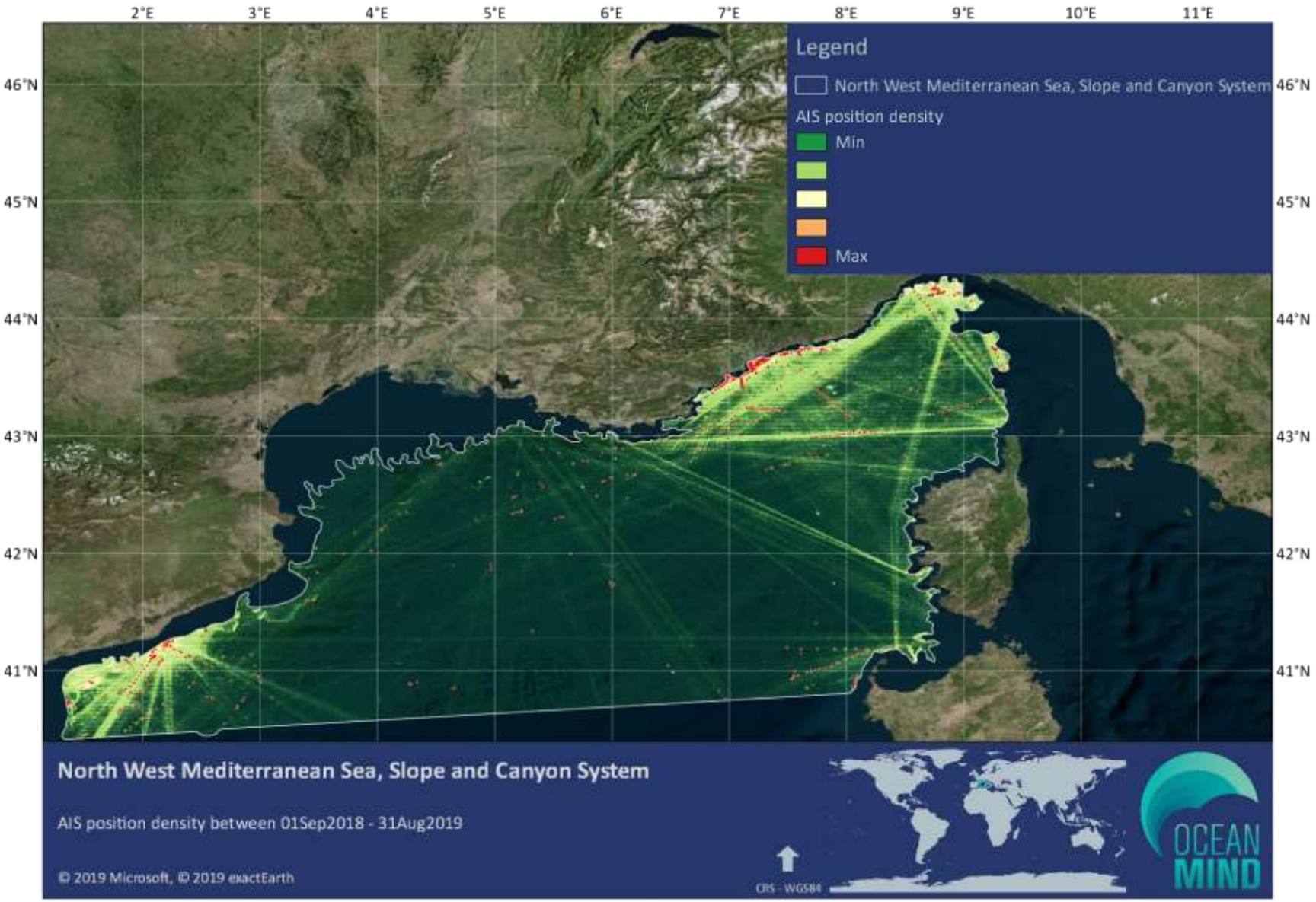


1.7 North West Mediterranean Sea, Slope and Canyon System IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	122	105	79	83	81	75	103	111	131	176	182	163	322
Fish carrier	0	1	0	0	0	0	1	0	0	0	2	0	3
Fish bunker	0	0	0	0	1	0	0	1	0	0	0	0	1
Fishing buoy	1	0	0	1	1	1	0	1	2	2	2	1	7
Cargo	481	480	478	479	450	470	497	517	517	490	513	459	2285
Hazardous cargo	452	475	457	463	475	457	509	513	520	506	534	511	2088
Passenger	149	153	100	59	65	65	70	131	153	147	145	143	324
Pleasure	1713	797	311	160	149	261	476	801	1506	2490	2662	2993	5912
Unknown	121	46	33	32	13	24	49	75	117	235	293	357	800
Other	120	87	47	56	52	62	74	87	121	140	157	148	390
Total	3159	2144	1505	1333	1287	1415	1779	2237	3067	4186	4490	4775	12132

NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTH WEST MEDITERRANEAN SEA, SLOPE AND CANYON SYSTEM

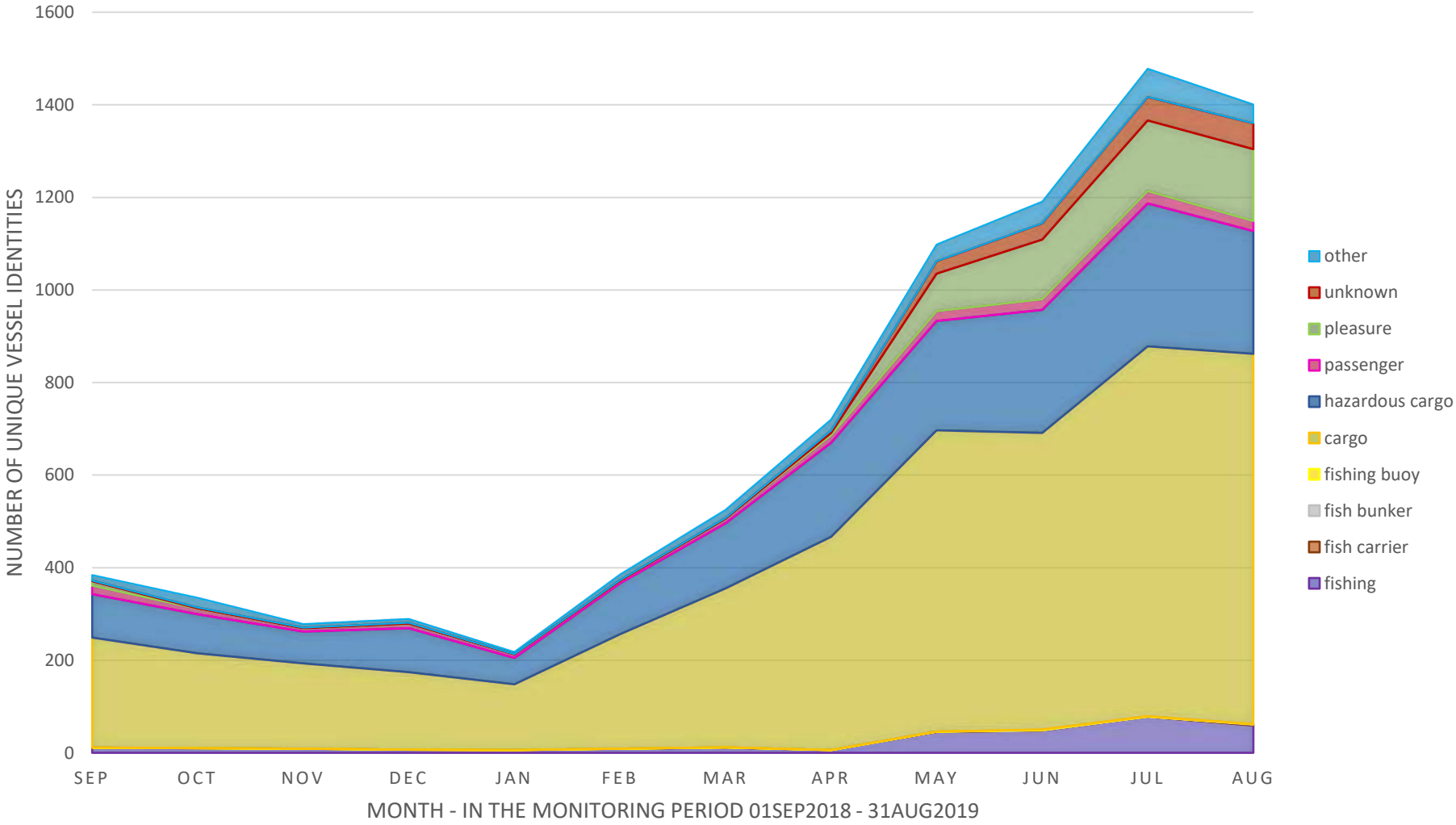


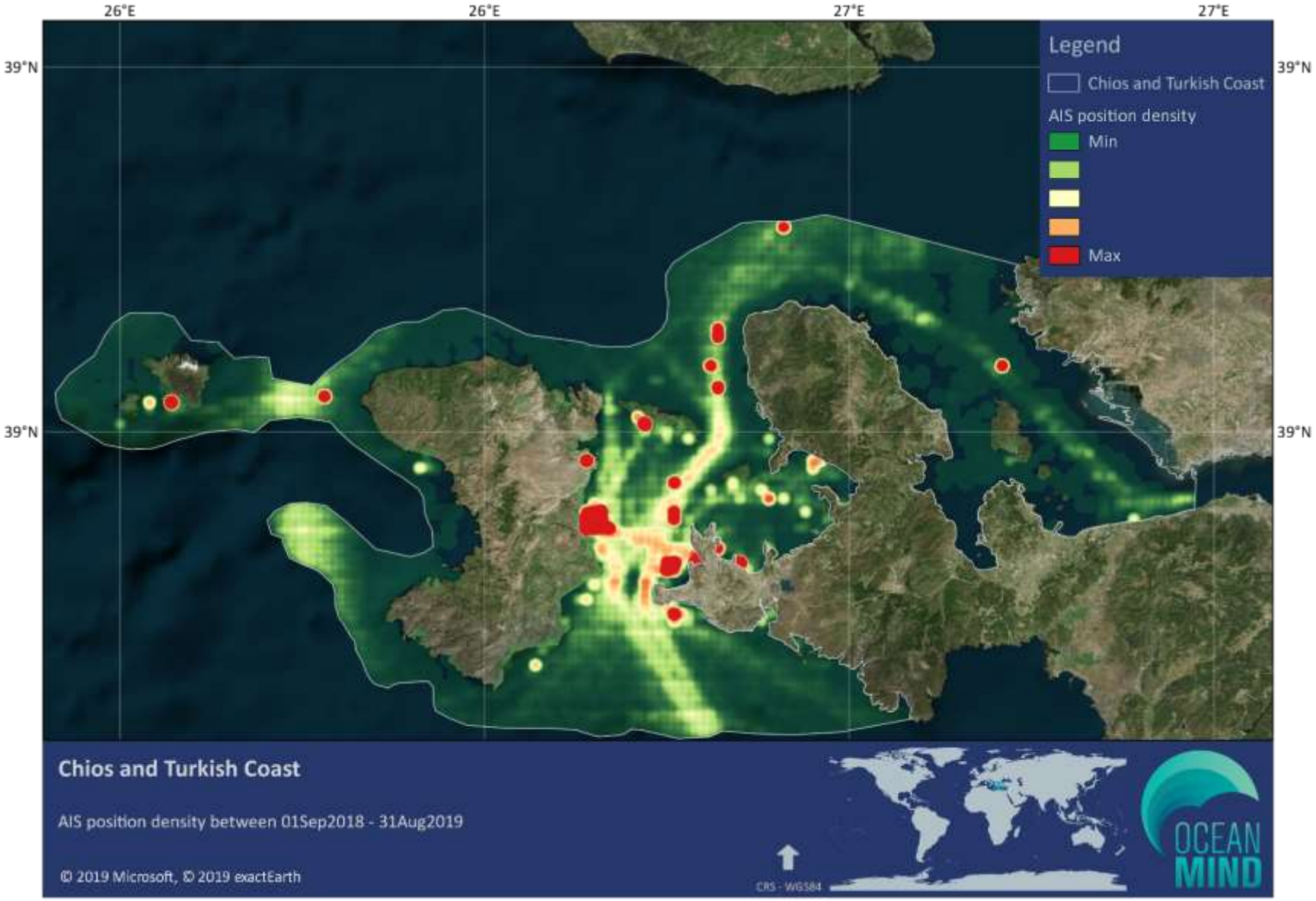


1.8 Chios and Turkish Coast IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	11	10	9	7	6	9	11	6	45	48	78	59	157
Fish carrier	0	0	0	0	0	0	1	0	1	0	0	2	4
Fish bunker	0	0	0	0	0	0	0	0	0	1	0	1	1
Fishing buoy	0	0	0	0	0	0	0	0	0	1	1	0	1
Cargo	238	205	184	167	142	247	343	461	651	641	799	800	2382
Hazardous cargo	94	84	69	95	57	110	141	203	236	266	309	265	805
Passenger	18	12	7	9	8	6	10	16	21	23	27	22	46
Pleasure	10	1	0	1	0	0	0	5	81	129	152	155	386
Unknown	1	2	1	2	0	1	1	5	27	35	51	56	102
Other	12	21	8	8	5	12	18	24	36	47	61	41	165
Total	384	335	278	289	218	385	525	720	1098	1191	1478	1401	4049

NUMBER OF VESSELS AGGREGATED BY CATEGORY - CHIOS AND TURKISH COAST IMMA

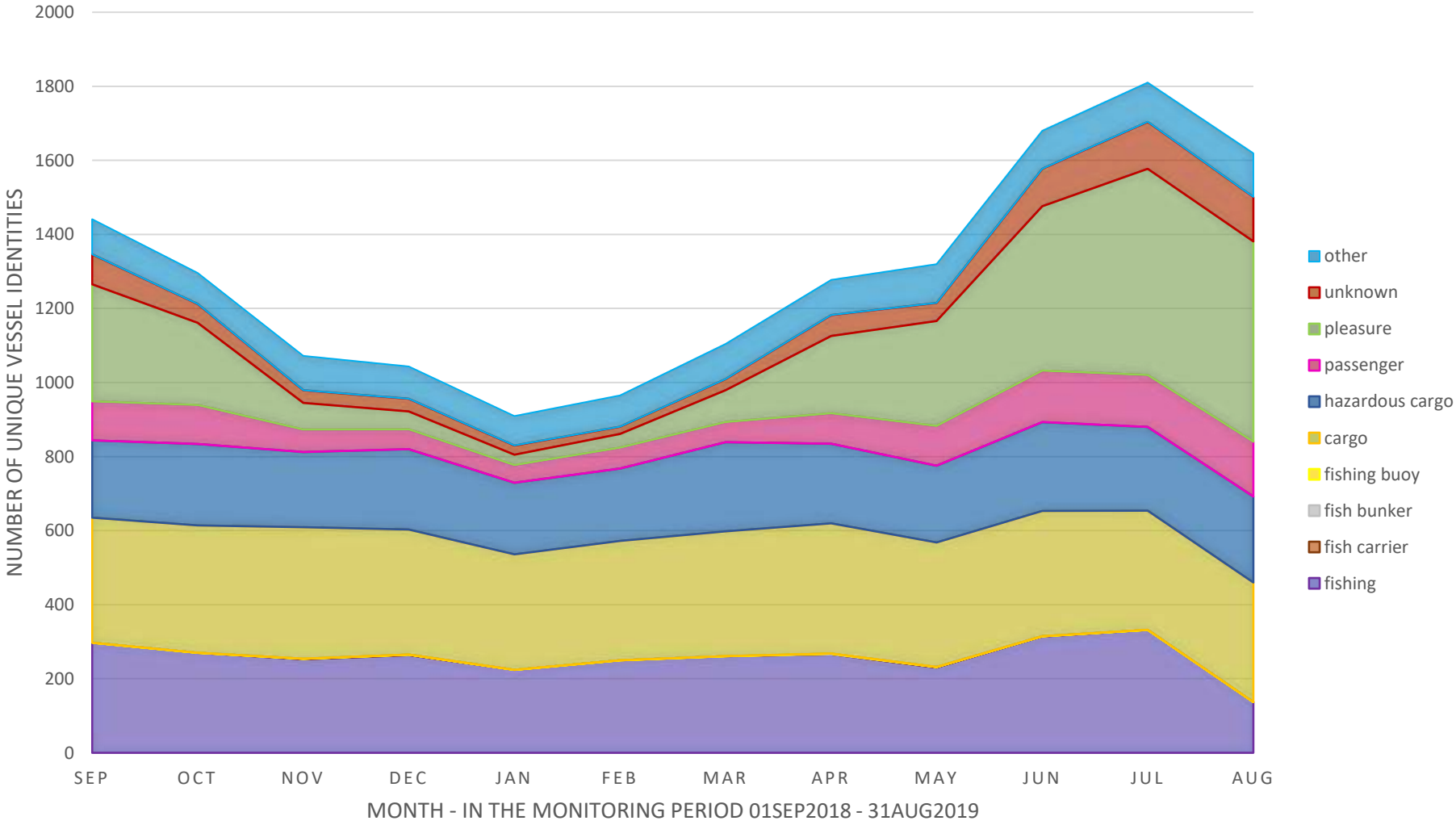


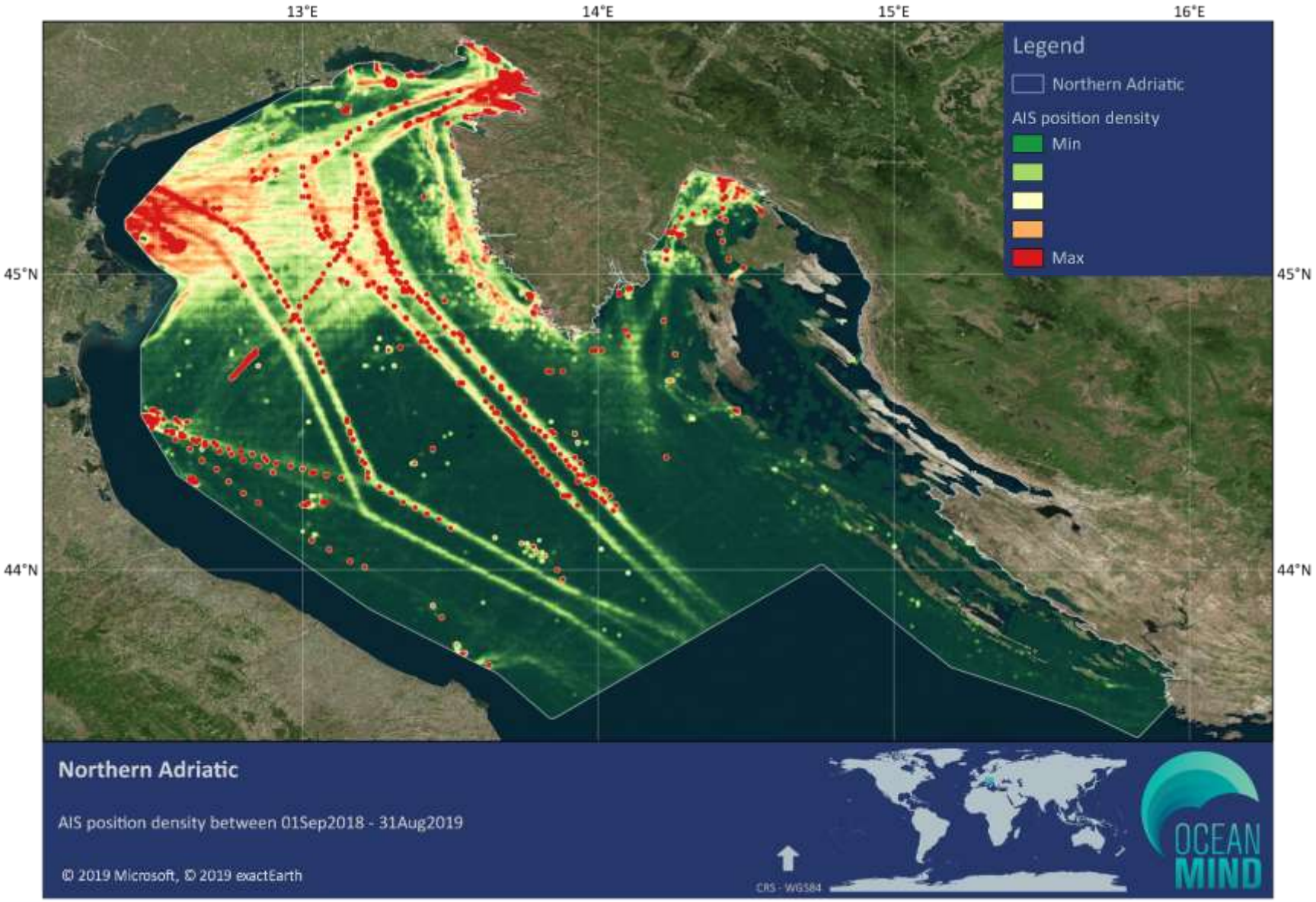


1.9 Northern Adriatic IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	297	270	253	264	224	250	261	266	230	314	332	137	428
Fish carrier	0	0	1	1	0	0	0	0	2	1	0	0	3
Fish bunker	0	0	0	0	0	0	0	2	0	0	0	0	2
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	338	344	355	338	312	322	337	352	336	338	322	323	1792
Hazardous cargo	209	220	203	217	193	196	241	215	207	240	226	232	1016
Passenger	105	105	61	54	48	56	54	82	108	139	140	148	266
Pleasure	316	222	72	48	28	37	86	209	283	444	557	541	1181
Unknown	81	51	34	34	25	20	30	56	49	101	127	120	299
Other	95	84	93	87	79	84	95	95	105	103	106	118	240
Total	1441	1296	1072	1043	909	965	1104	1277	1320	1680	1810	1619	5227

NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHERN ADRIATIC

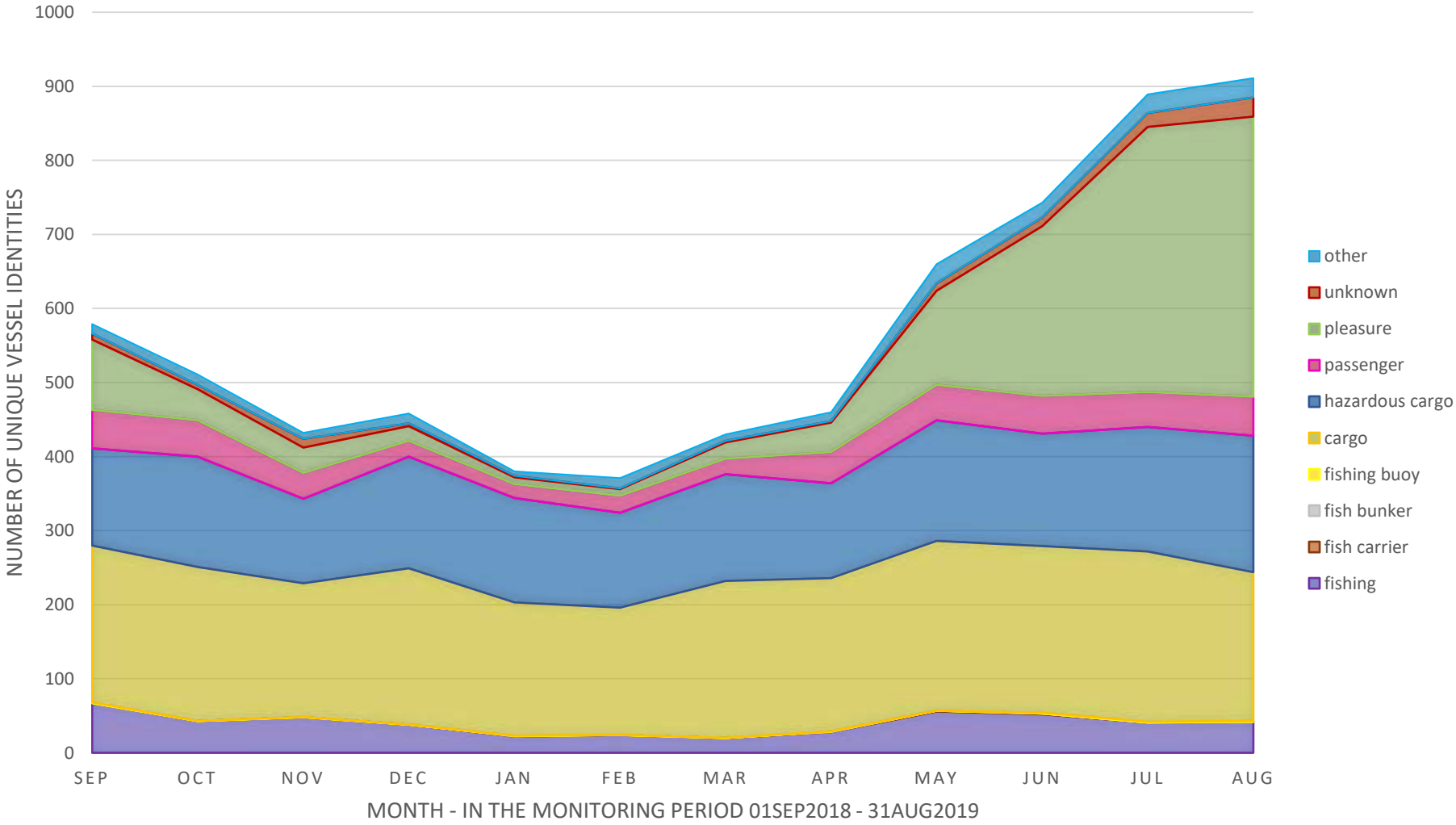




1.10 Balearic Islands Shelf and Slope IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	67	43	48	38	22	24	20	28	56	52	41	42	189
Fish carrier	0	0	0	0	0	0	0	0	1	1	0	0	2
Fish bunker	0	0	0	0	1	0	0	1	0	0	0	0	1
Fishing buoy	1	0	0	0	0	0	0	0	0	1	1	1	3
Cargo	212	208	181	211	180	172	212	207	229	225	230	201	1296
Hazardous cargo	131	149	114	151	141	128	144	128	163	152	168	184	904
Passenger	52	49	35	21	19	23	21	42	48	51	47	53	163
Pleasure	95	42	34	20	9	9	22	40	127	229	358	378	1021
Unknown	8	6	12	4	2	1	2	2	10	12	19	26	79
Other	13	14	8	13	6	14	9	12	26	20	25	26	122
Total	579	511	432	458	380	371	430	460	660	743	889	911	3780

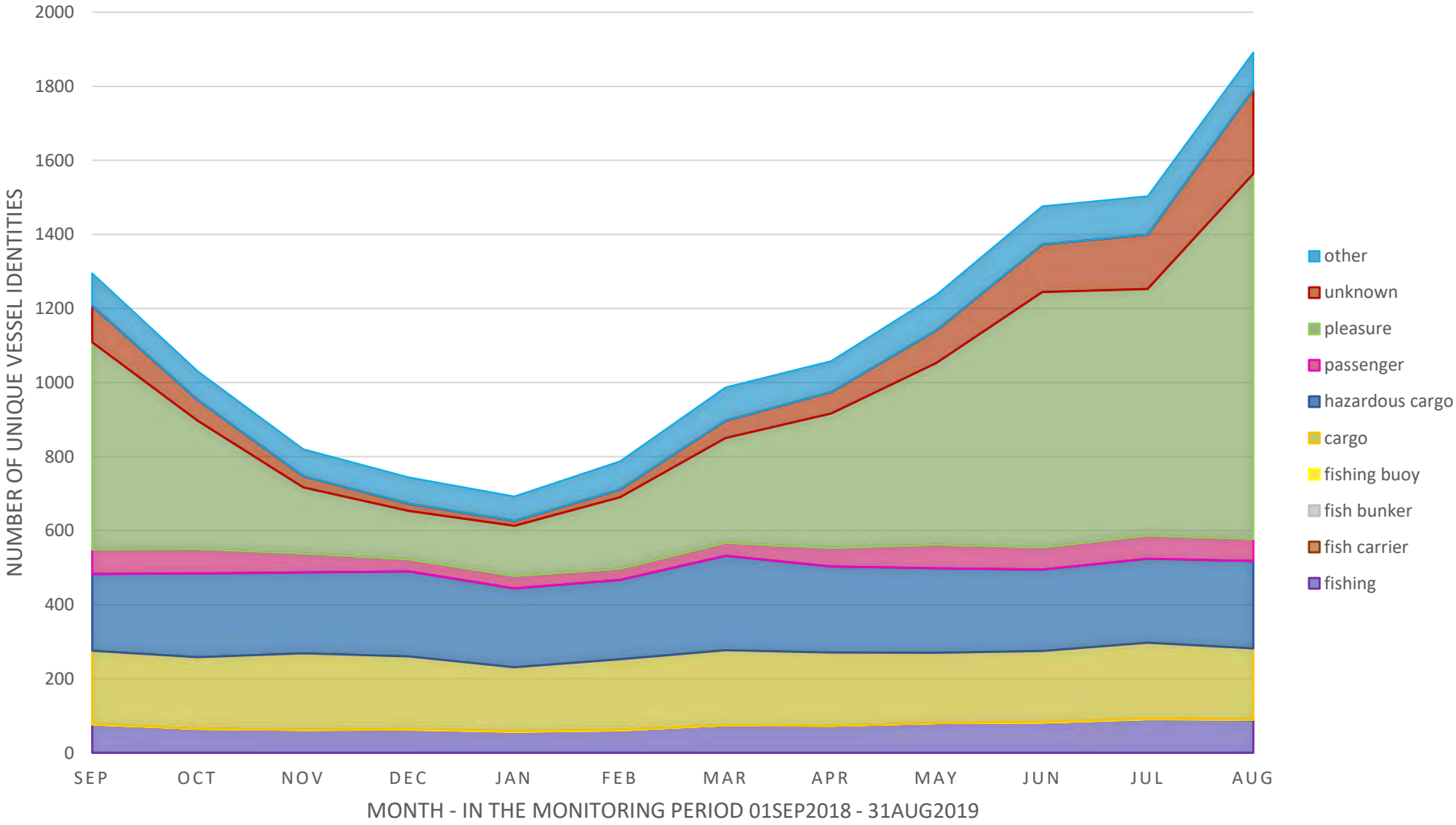
NUMBER OF VESSELS AGGREGATED BY CATEGORY - BALEARIC ISLANDS SHELF AND SLOPE

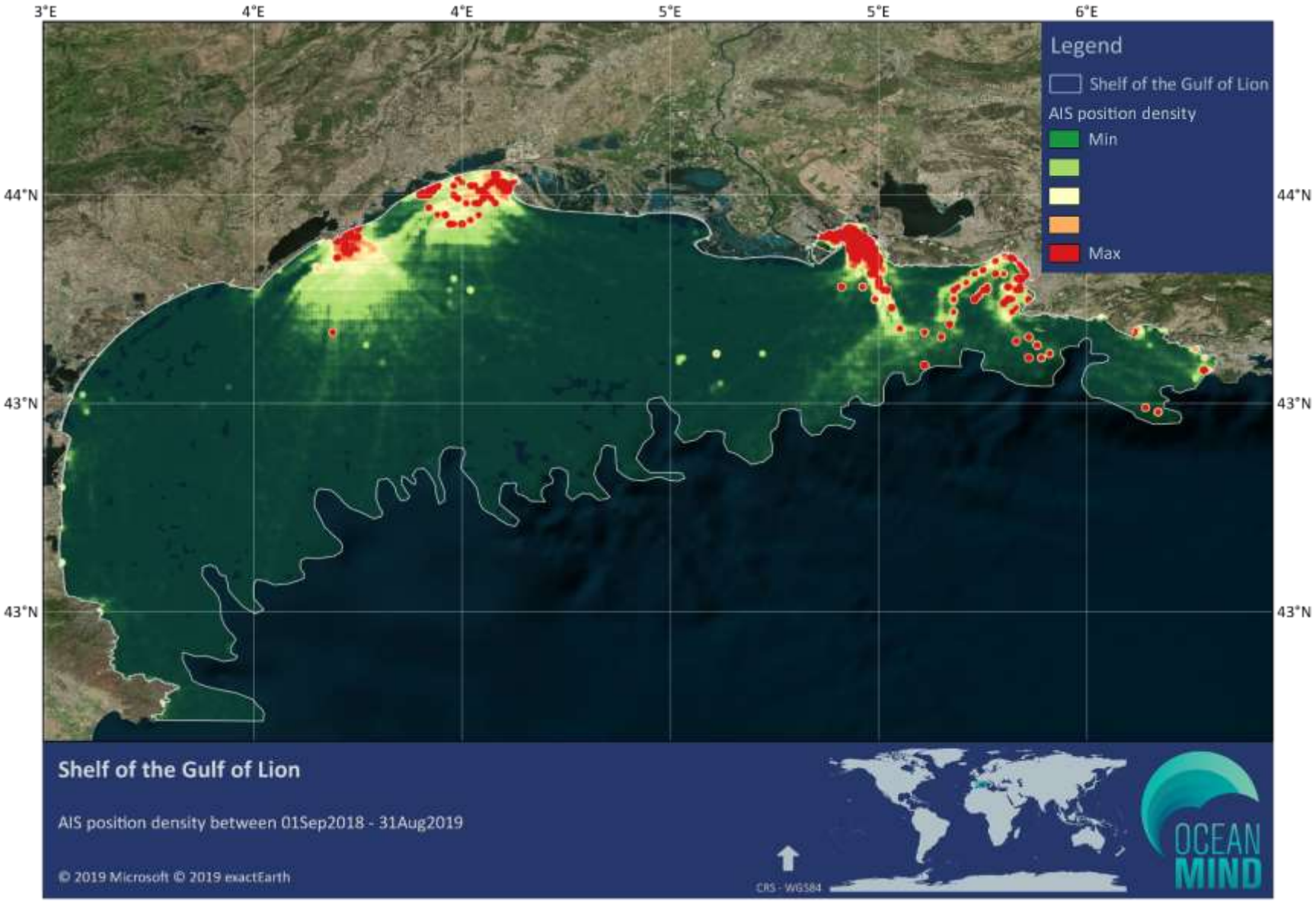


1.11 Shelf of the Gulf of Lion IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	77	65	62	63	57	61	75	73	80	82	91	89	132
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	1	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	1	0	0	1	1	1	0	0	0	1	1	0	4
Cargo	198	193	207	196	173	191	202	198	190	192	205	192	969
Hazardous cargo	207	226	218	230	213	214	255	232	228	220	227	236	1107
Passenger	66	66	51	32	33	30	35	50	64	59	62	59	154
Pleasure	560	347	179	131	136	193	283	363	491	690	667	987	1969
Unknown	98	56	30	20	13	21	47	58	88	129	146	227	448
Other	88	78	73	71	66	76	90	84	96	103	104	101	202
Total	1295	1031	820	744	692	787	987	1058	1237	1476	1503	1892	4986

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SHELF OF THE GULF OF LION

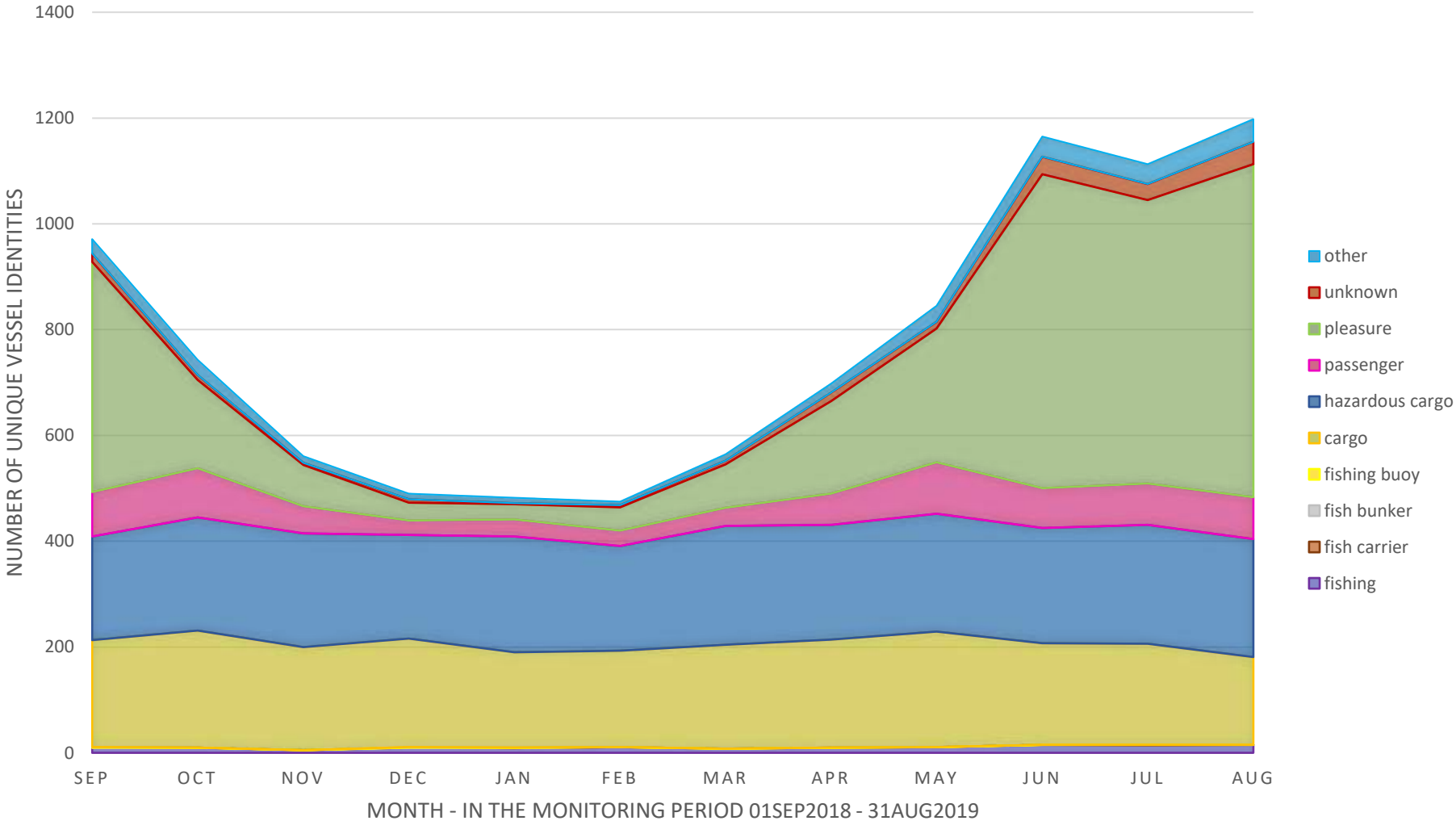


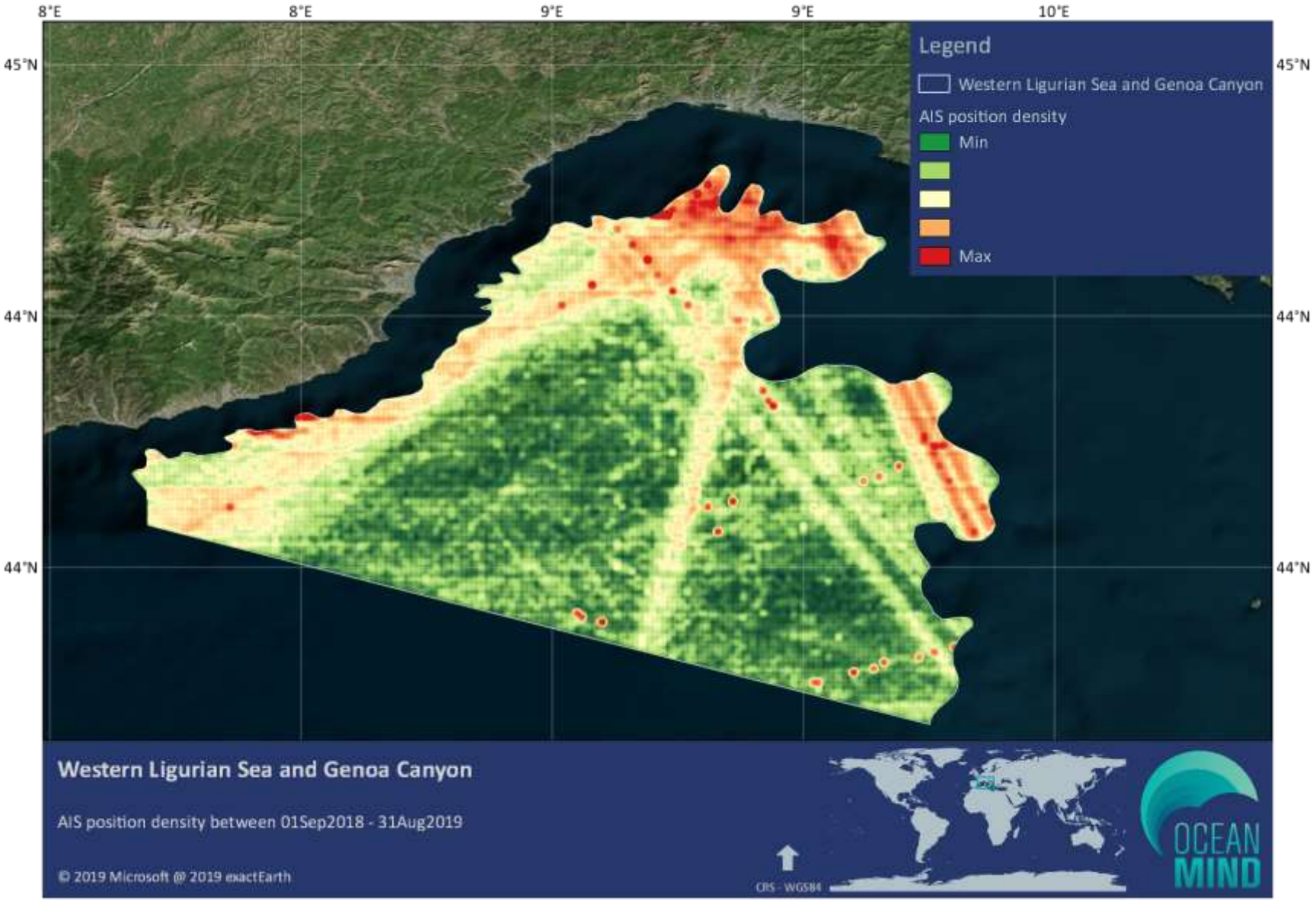


1.12 Western Ligurian Sea and Genoa Canyon IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		Jun	Jul	Aug	Total
Fishing	10	10	5	10	9	11	8	10	11	15	14	15	31	10
Fish carrier	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Fish bunker	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Fishing buoy	1	0	0	1	0	0	0	0	0	0	0	0	2	1
Cargo	202	221	195	205	180	182	196	204	218	192	191	166	1069	202
Hazardous cargo	196	214	215	196	219	198	225	217	223	218	225	223	959	196
Passenger	84	93	51	27	32	29	34	59	97	75	78	79	212	84
Pleasure	435	167	78	34	29	44	82	175	253	594	536	630	1817	435
Unknown	16	9	4	6	2	4	7	16	13	33	30	42	130	16
Other	27	29	13	11	10	7	12	17	30	38	38	43	139	27
Total	971	743	561	490	482	475	564	698	845	1165	1113	1198	4361	971

NUMBER OF VESSELS AGGREGATED BY CATEGORY - WESTERN LIGURIAN SEA AND GENOA CANYON

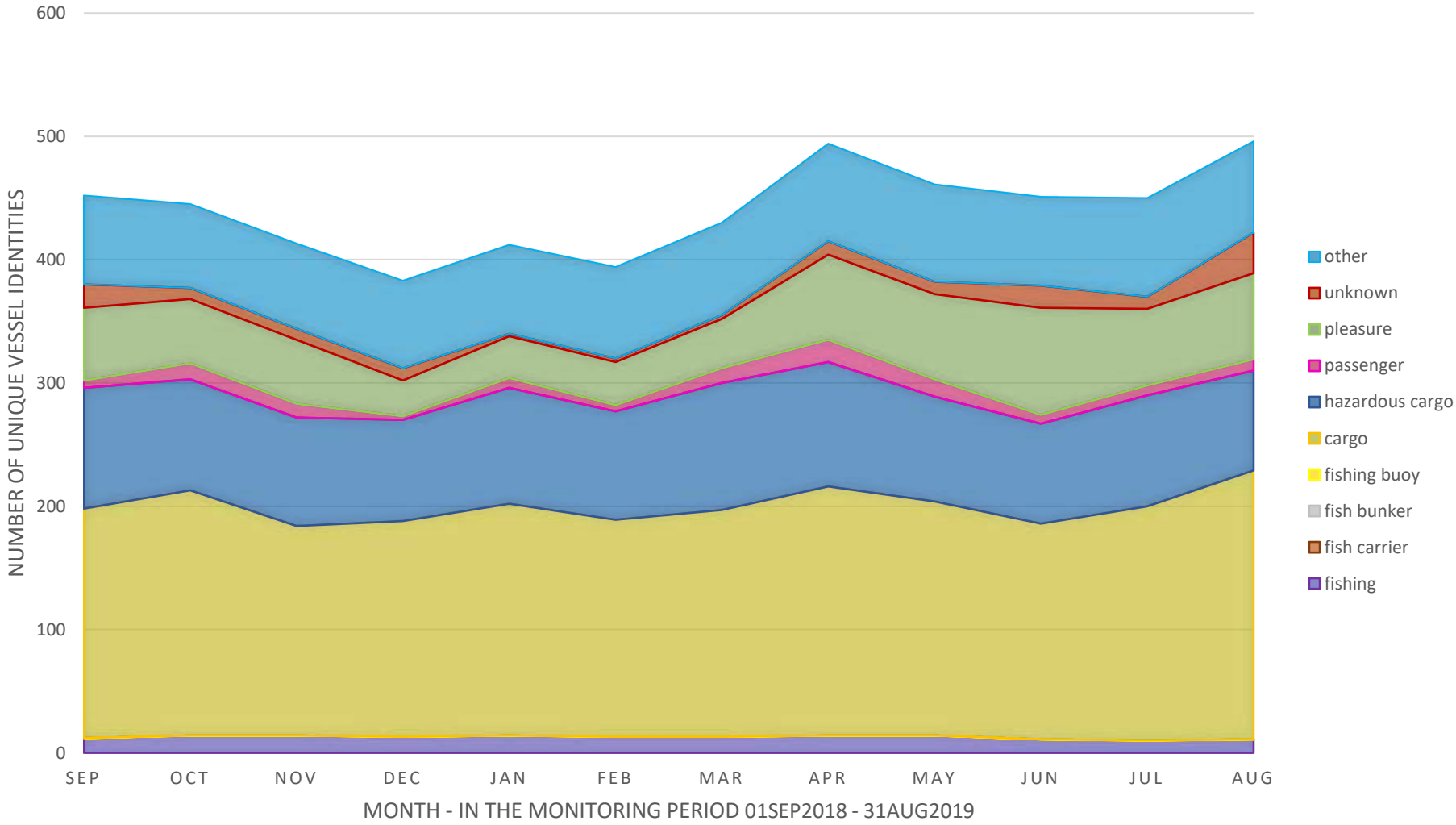


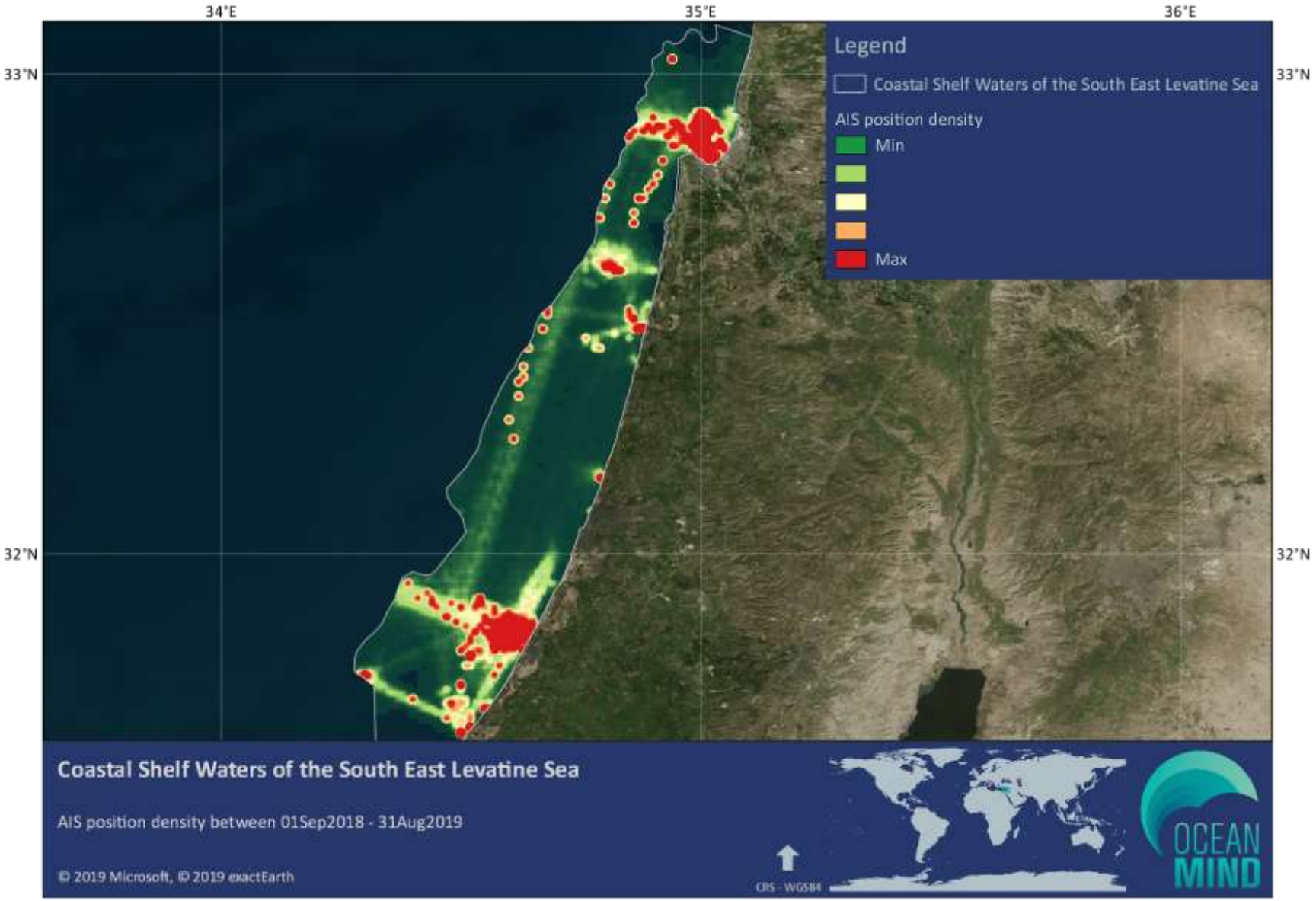


1.13 Coastal Shelf Waters of the South East Levatine Sea IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	12	14	14	13	14	13	13	14	14	11	10	11	24
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	186	199	170	175	188	176	184	202	190	175	190	218	800
Hazardous cargo	98	90	88	82	94	88	103	101	85	81	90	81	319
Passenger	6	13	11	3	8	5	12	18	14	7	8	9	44
Pleasure	59	52	52	29	34	35	40	69	69	87	62	70	142
Unknown	19	9	9	10	2	3	3	11	10	18	10	33	75
Other	72	68	69	71	72	74	75	79	79	72	80	74	141
Total	452	445	413	383	412	394	430	494	461	451	450	496	1545

NUMBER OF VESSELS AGGREGATED BY CATEGORY - COASTAL SHELF WATERS OF THE SOUTH EAST LEVATINE SEA

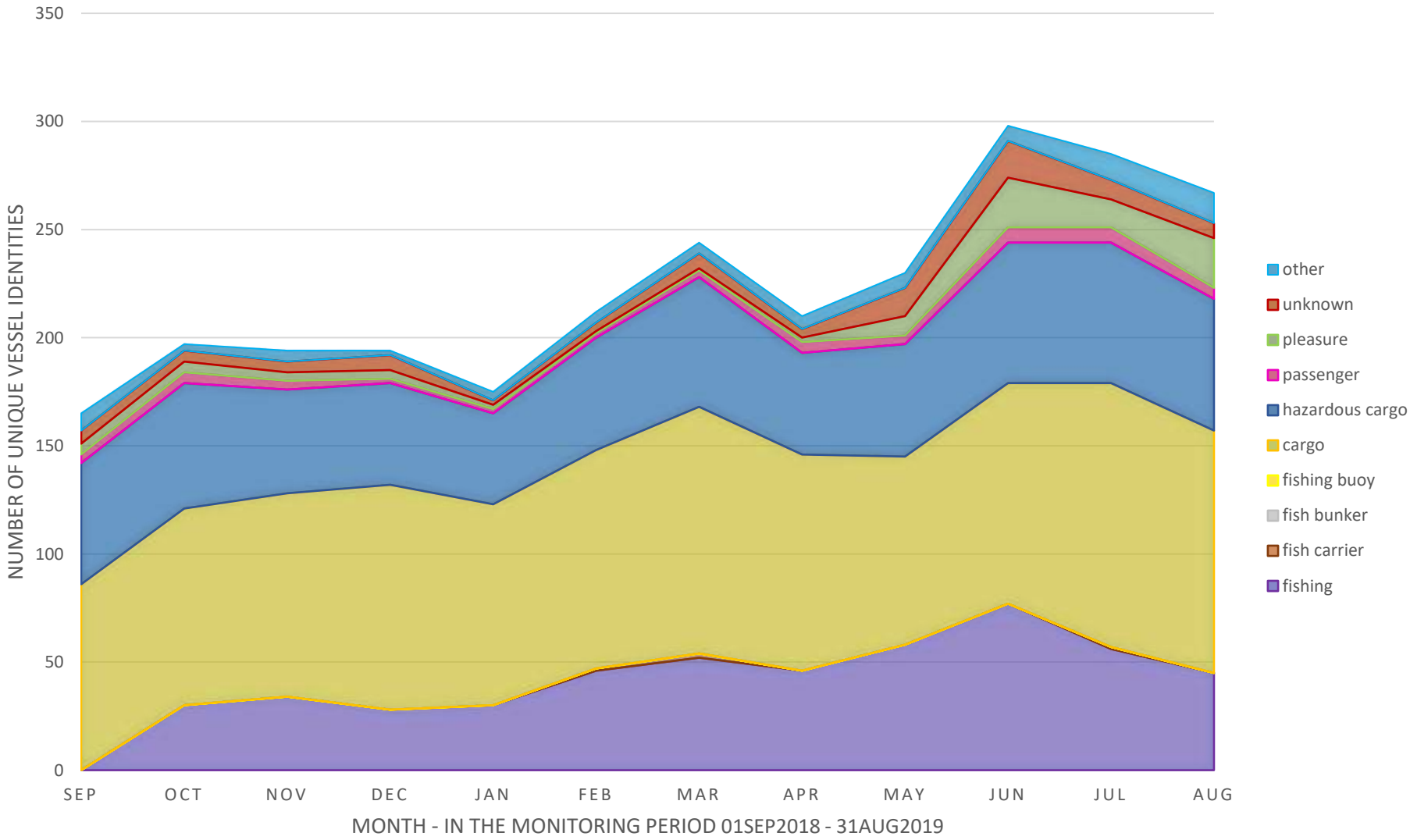


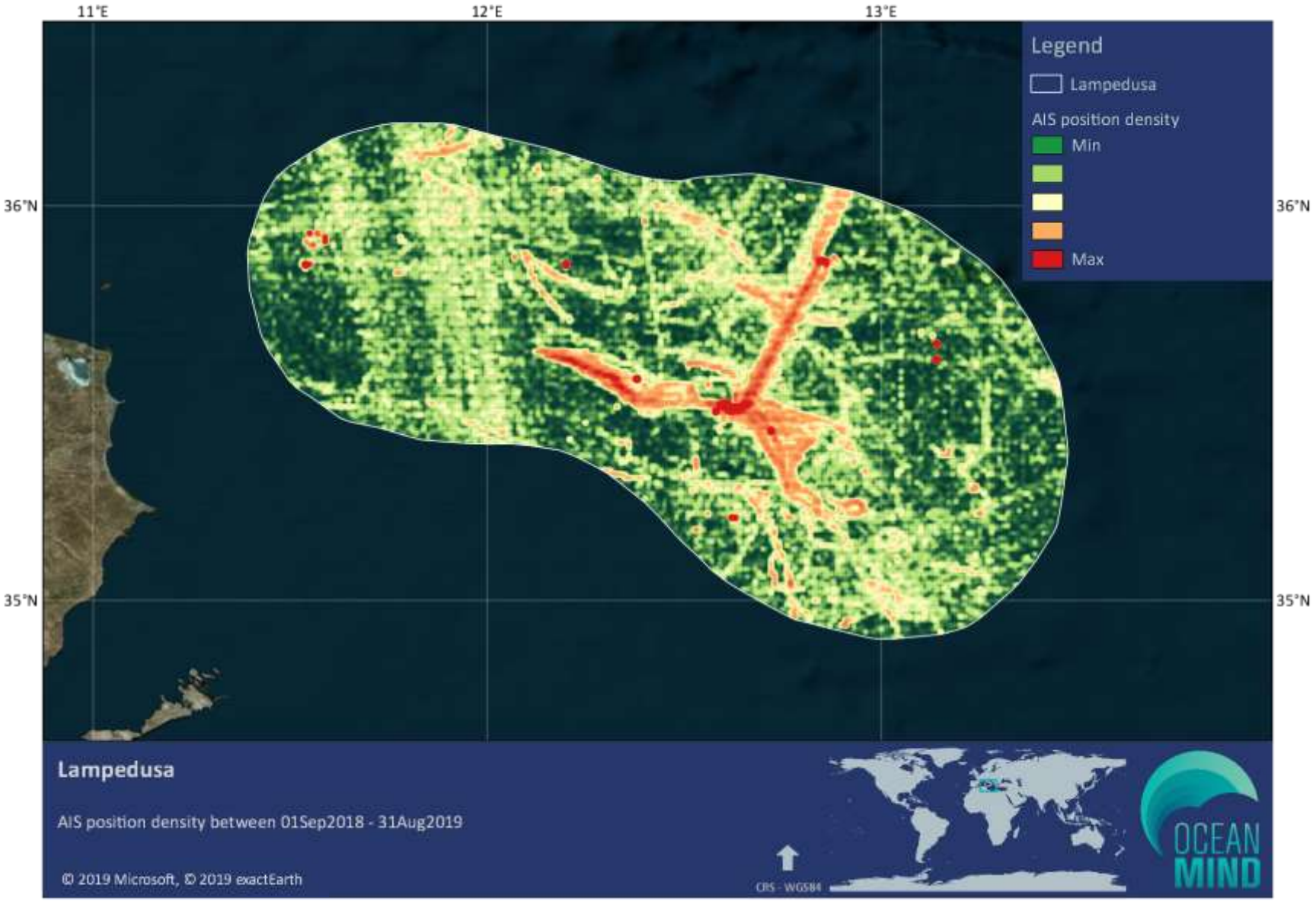


1.14 Lampedusa IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	37	30	34	28	30	46	52	46	58	77	56	45	149
Fish carrier	0	0	0	0	0	1	2	0	0	0	1	0	3
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	86	91	94	104	93	101	114	100	87	102	122	112	691
Hazardous cargo	56	58	48	47	42	52	60	47	52	65	65	61	402
Passenger	4	5	4	2	2	2	3	5	4	7	7	5	13
Pleasure	5	5	4	4	2	1	1	2	9	23	13	23	66
Unknown	6	5	5	7	2	4	7	4	13	17	9	7	30
Other	8	3	5	2	4	5	5	6	7	7	12	14	48
Total	165	197	194	194	175	212	244	210	230	298	285	267	1402

NUMBER OF VESSELS AGGREGATED BY CATEGORY - LAMPEDUSA

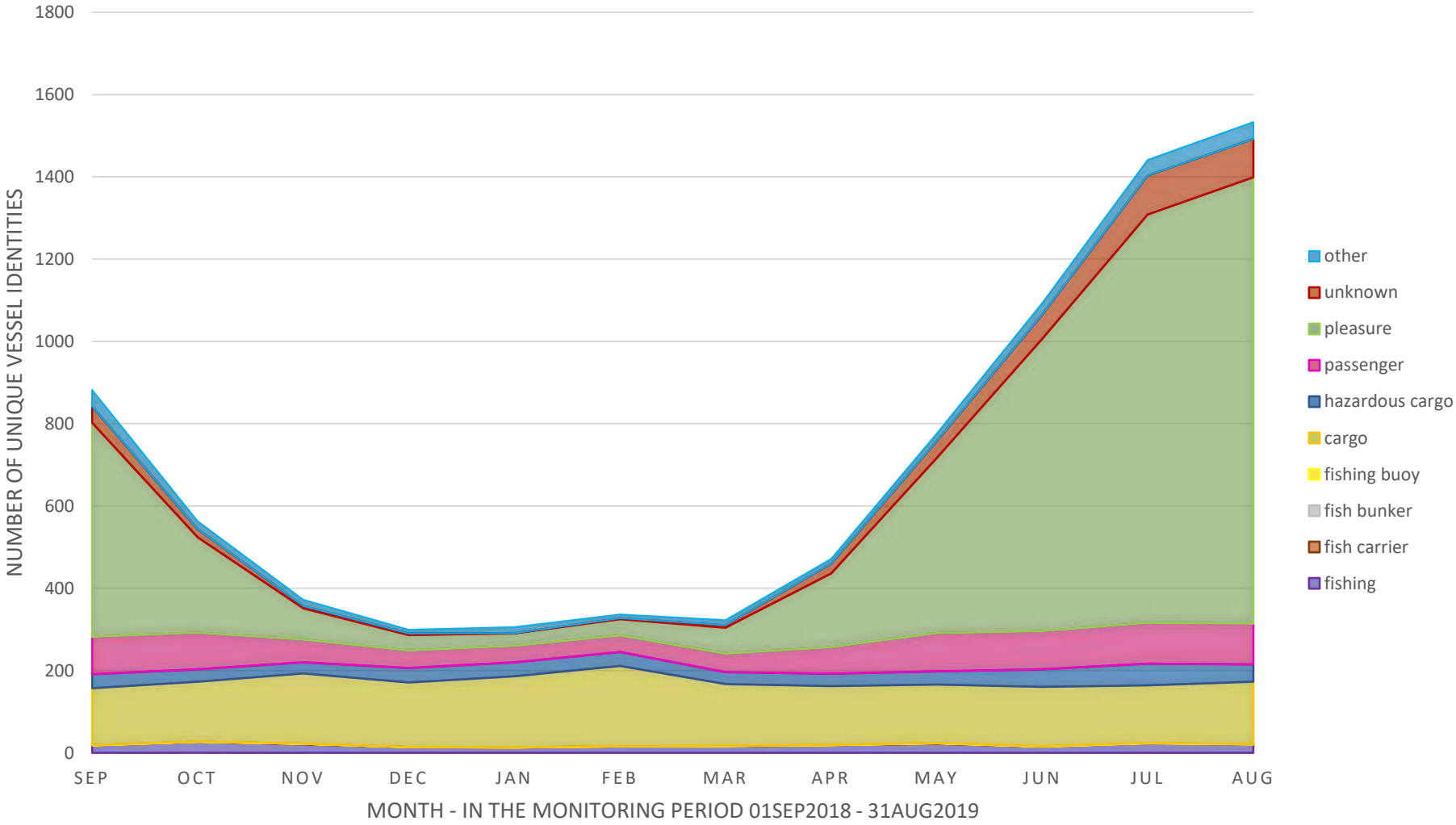


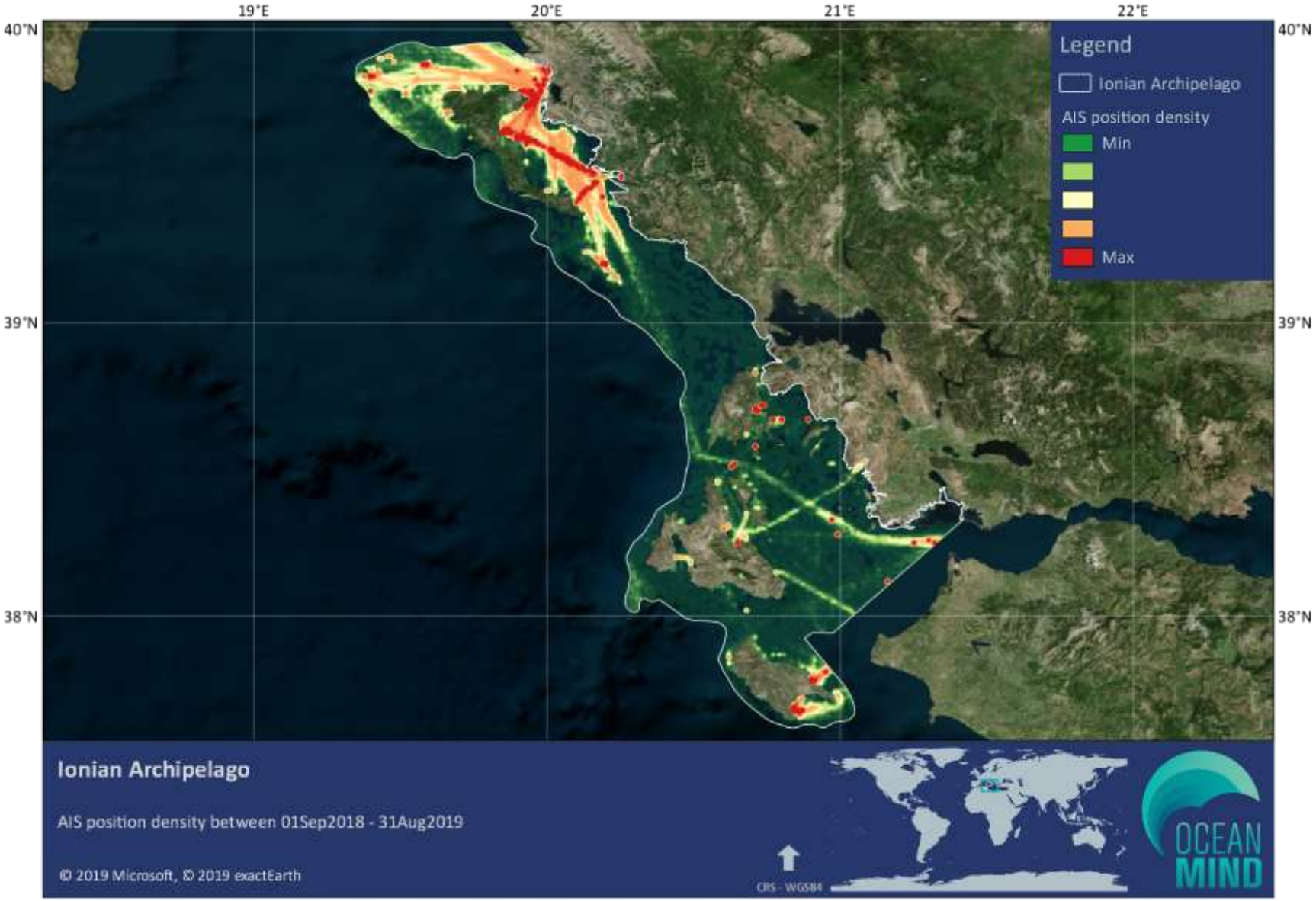


1.15 Ionian Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	18	27	21	14	13	16	16	19	22	15	23	21	59
Fish carrier	0	0	1	0	0	0	0	0	1	0	0	0	2
Fish bunker	0	0	0	0	0	0	1	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	0	0	0	1	1	1	0	1
Cargo	139	146	171	157	173	195	150	143	142	144	140	152	883
Hazardous cargo	34	30	27	35	34	34	29	30	32	43	53	42	193
Passenger	91	89	55	43	40	40	45	65	93	93	99	99	174
Pleasure	520	232	76	37	30	40	63	179	425	710	992	1085	2499
Unknown	40	20	6	4	1	2	6	24	41	59	95	93	255
Other	40	19	15	9	14	9	12	11	18	28	38	41	131
Total	882	563	372	299	305	336	322	471	775	1093	1441	1533	4198

NUMBER OF VESSELS AGGREGATED BY CATEGORY - IONIAN ARCHIPELAGO

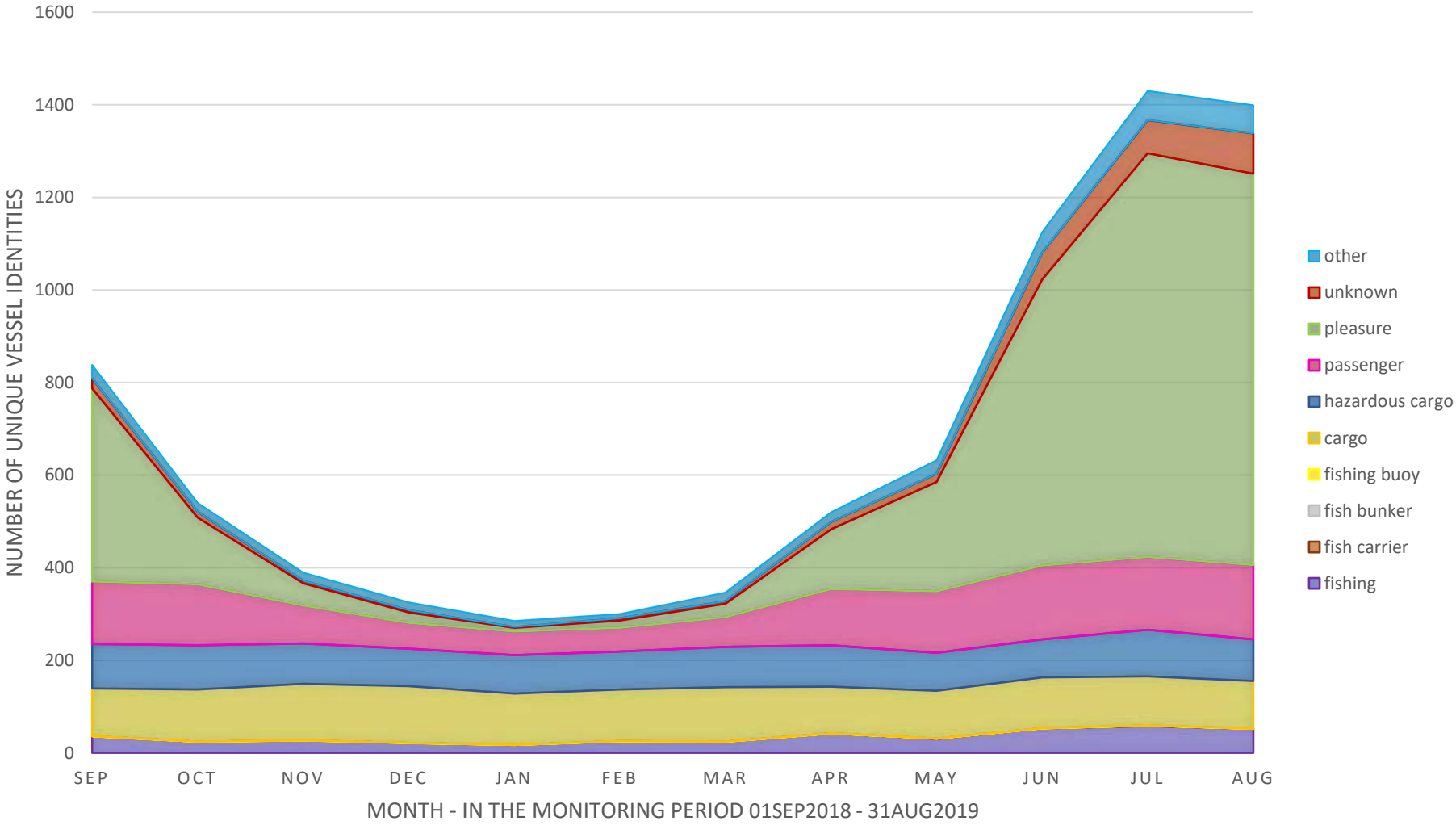


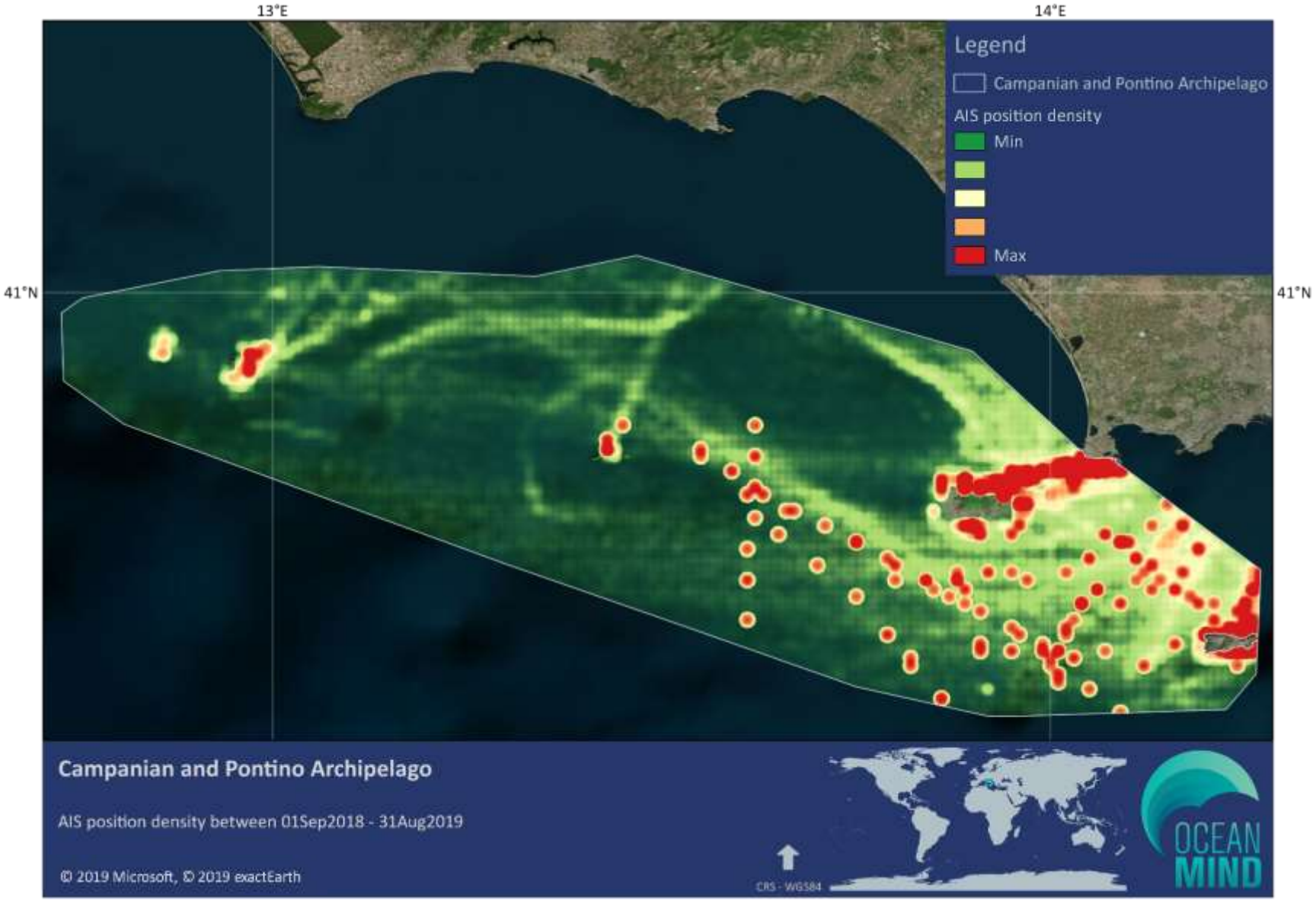


1.16 Campanian and Pontino Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	36	24	27	21	17	25	24	42	30	53	58	52	99
Fish carrier	0	0	0	0	0	0	0	0	1	0	1	0	2
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	103	113	122	123	111	112	118	101	103	110	106	103	583
Hazardous cargo	96	95	87	81	83	82	87	89	82	82	101	90	336
Passenger	135	132	82	56	51	51	64	122	133	160	157	161	278
Pleasure	417	144	48	22	8	16	29	129	236	618	872	845	2096
Unknown	22	13	6	5	2	5	6	16	18	58	72	87	191
Other	29	19	17	17	13	9	18	21	29	44	63	61	152
Total	838	540	389	325	285	300	346	520	632	1125	1430	1399	3737

NUMBER OF VESSELS AGGREGATED BY CATEGORY - CAMPANIAN AND PONTINO ARCHIPELAGO

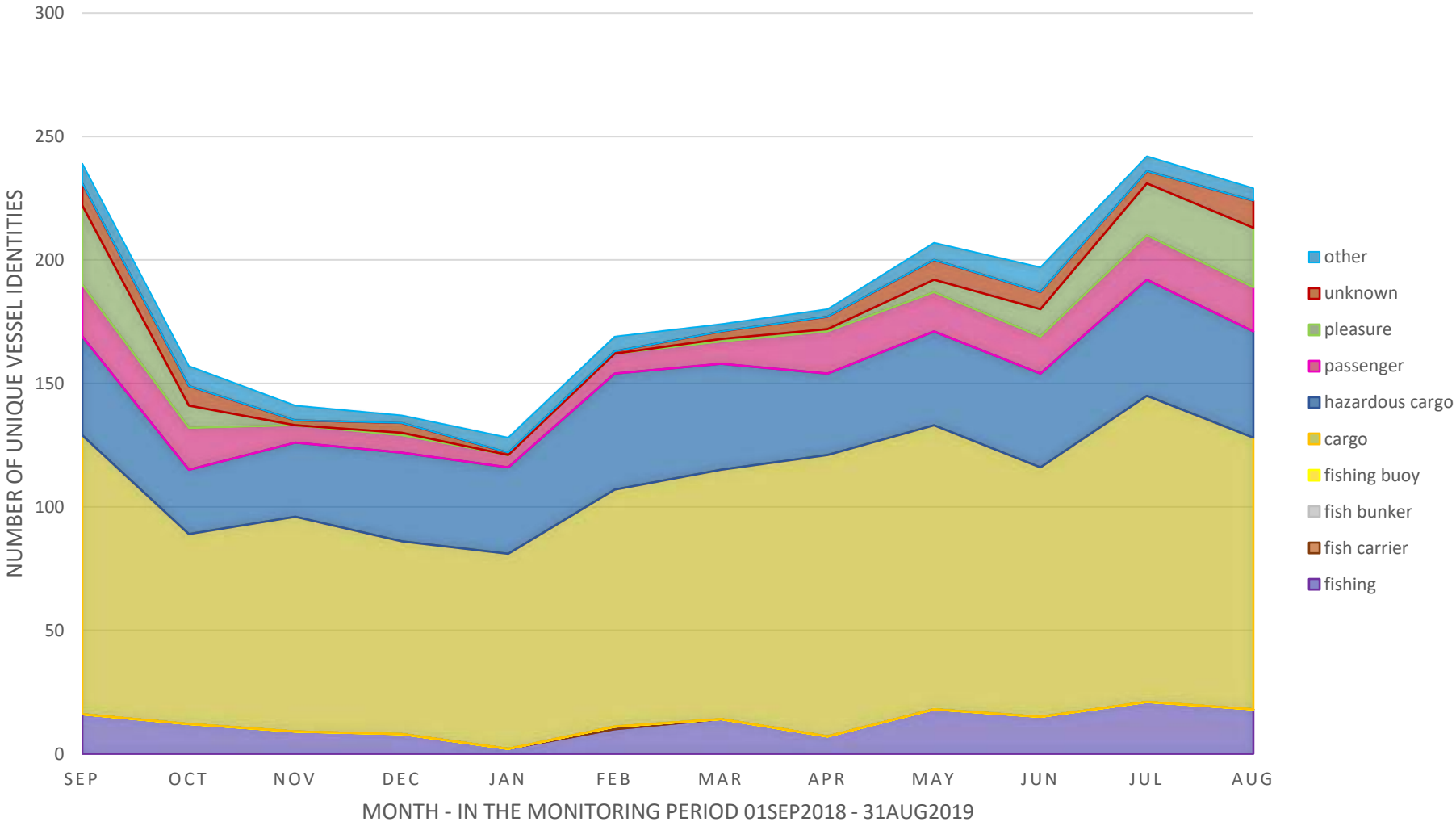




1.17 Northern Sporades IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	16	12	9	8	2	10	14	7	18	15	21	18	61
Fish carrier	0	0	0	0	0	1	0	0	0	0	0	0	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	113	77	87	78	79	96	101	114	115	101	124	110	603
Hazardous cargo	40	26	30	36	35	47	43	33	38	38	47	43	218
Passenger	21	17	7	7	5	8	9	17	16	15	18	18	50
Pleasure	32	9	0	1	0	0	1	1	5	11	21	24	84
Unknown	9	8	2	4	1	1	3	5	8	7	5	11	26
Other	8	8	6	3	6	6	3	3	7	10	6	5	35
Total	239	157	141	137	128	169	174	180	207	197	242	229	1078

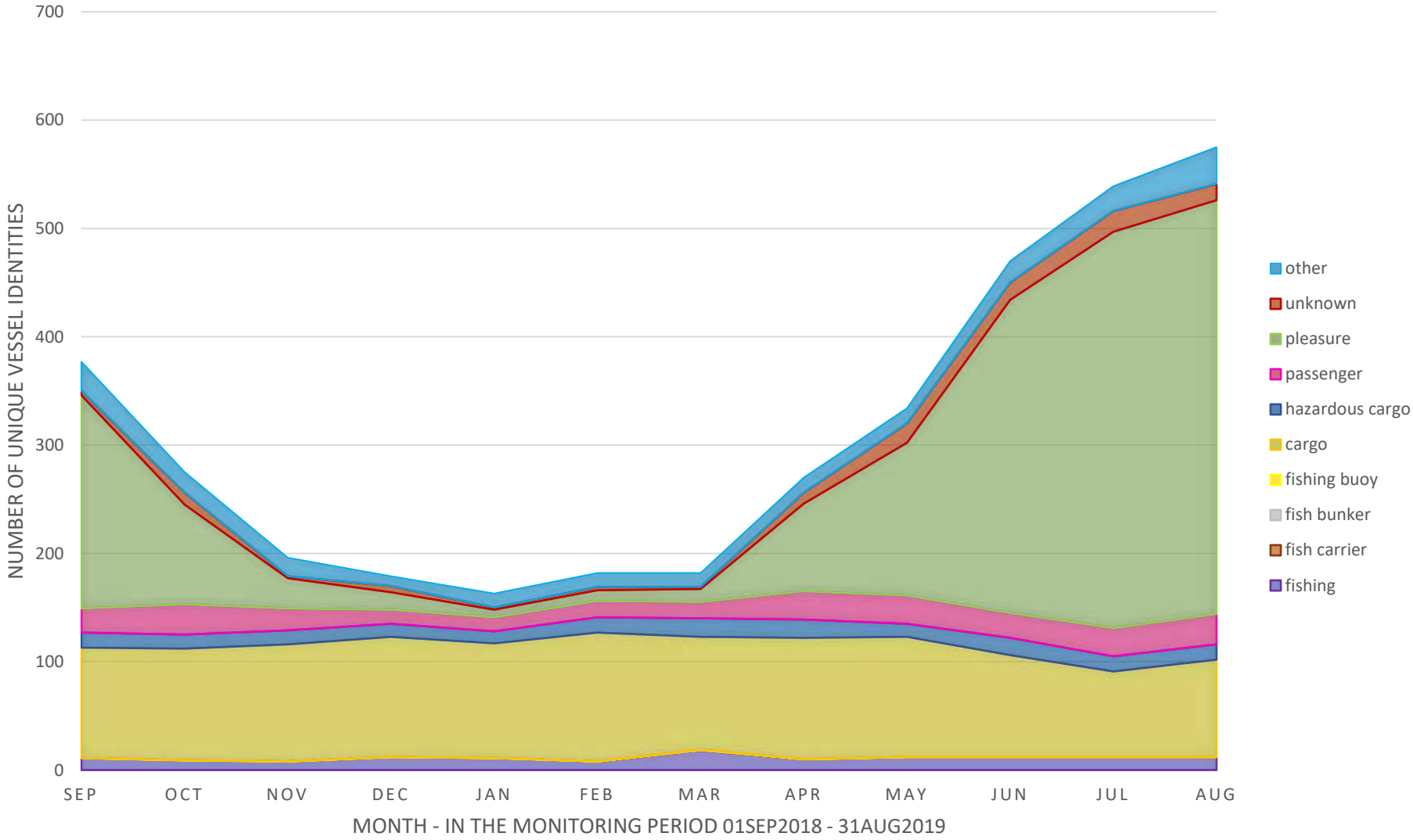
NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHERN SPORADES

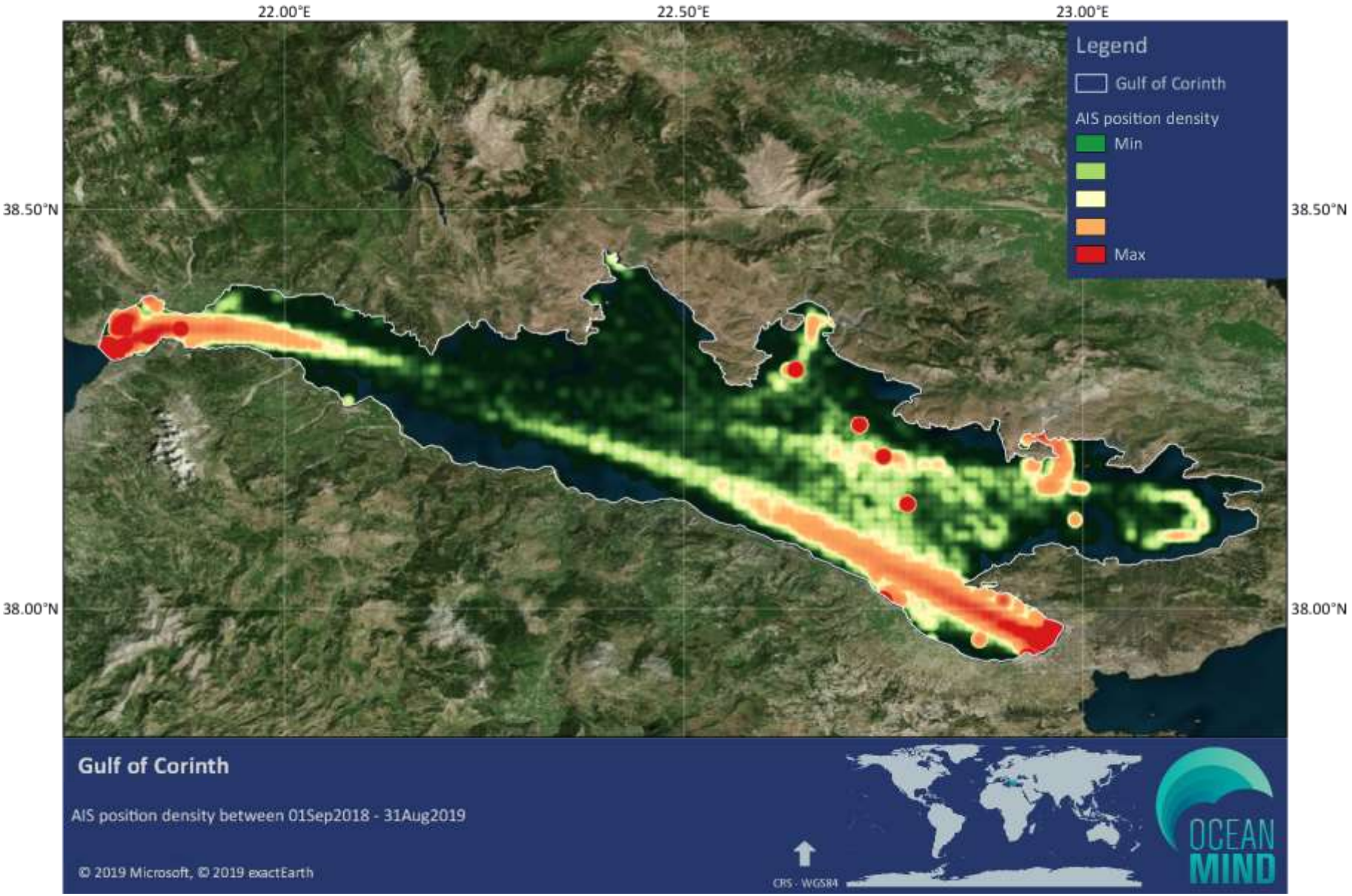


1.18 Gulf of Corinth IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	11	9	8	12	11	8	18	10	12	12	12	12	56
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	1	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	102	103	108	111	106	119	104	112	111	94	79	90	599
Hazardous cargo	14	13	13	12	11	14	17	17	12	16	14	14	70
Passenger	22	28	20	13	13	15	15	26	26	23	26	28	81
Pleasure	197	92	28	16	7	10	12	81	141	289	366	382	1204
Unknown	4	11	2	6	2	3	2	10	18	16	19	15	80
Other	27	19	17	9	13	13	13	14	14	20	23	34	106
Total	377	275	196	179	163	182	182	270	334	470	539	575	2197

NUMBER OF VESSELS AGGREGATED BY CATEGORY - GULF OF CORINTH

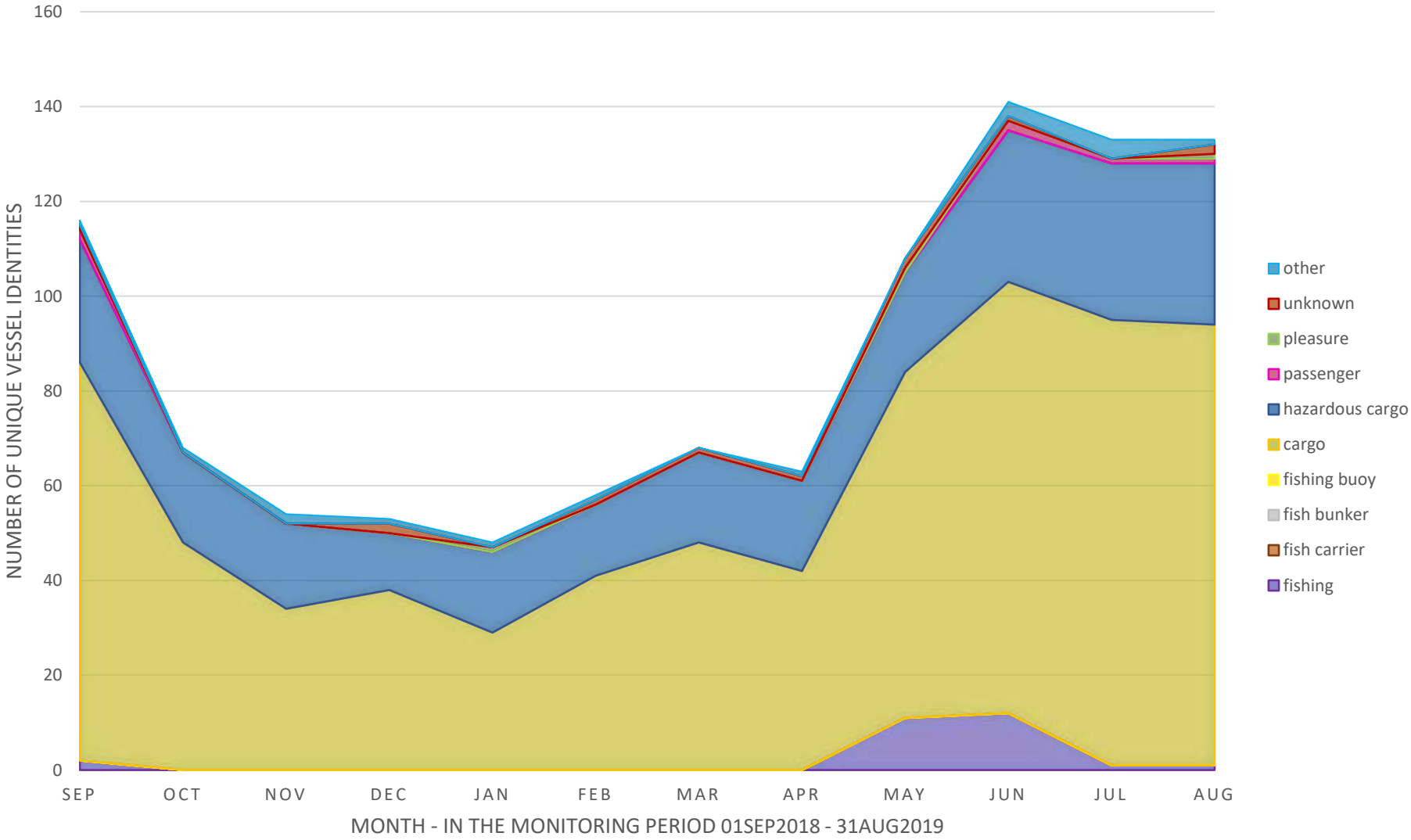


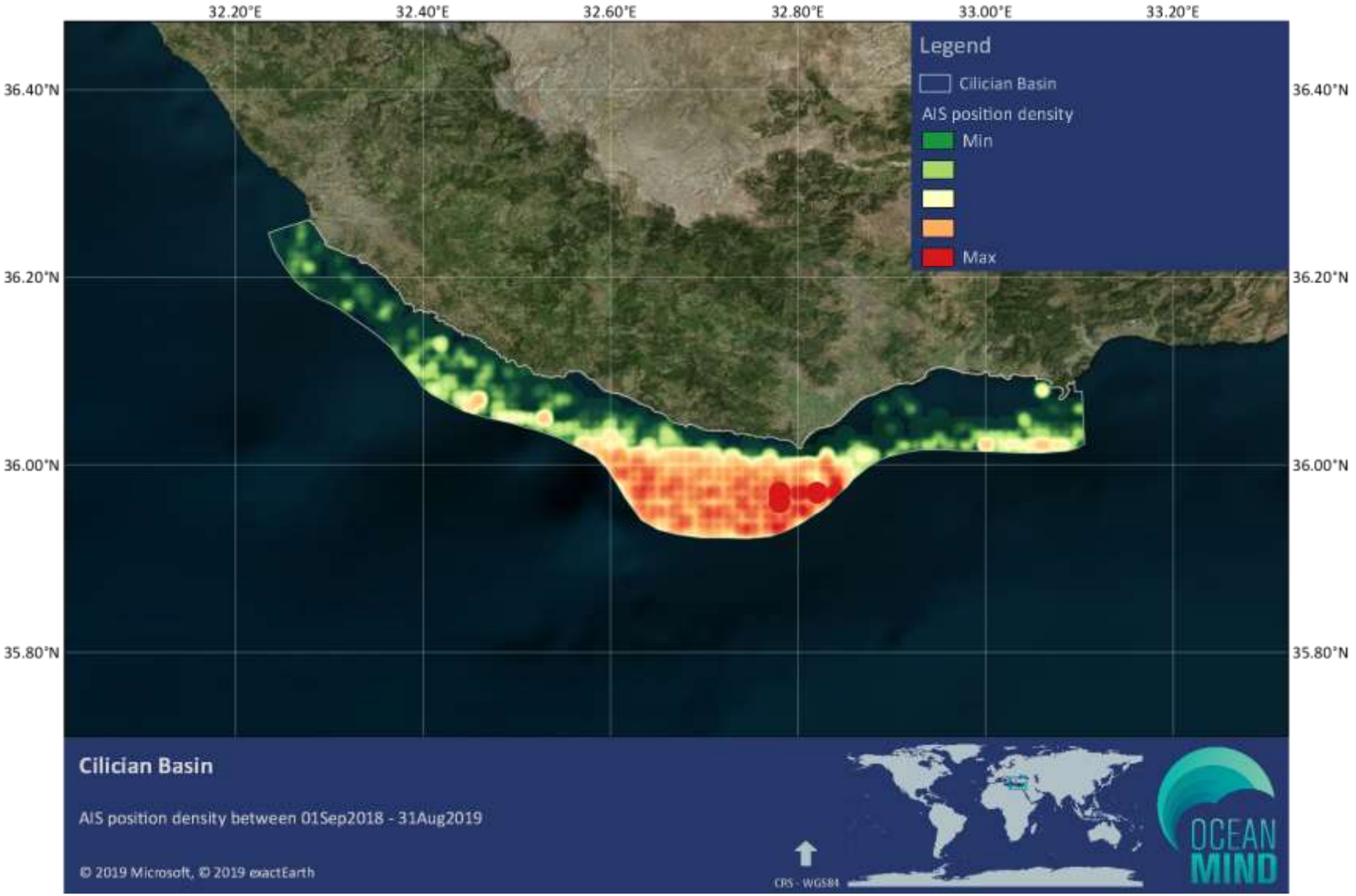


1.19 Cilician Basin IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	0	0	0	0	0	0	0	11	12	1	1	22
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	84	48	34	38	29	41	48	42	73	91	94	93	440
Hazardous cargo	26	19	18	12	17	15	19	19	21	32	33	34	106
Passenger	2	0	0	0	0	0	0	0	0	2	1	1	4
Pleasure	0	0	0	0	1	0	0	0	1	0	0	1	2
Unknown	1	0	0	2	0	1	1	1	2	1	0	2	4
Other	1	1	2	1	1	1	0	1	0	3	4	1	15
Total	116	68	54	53	48	58	68	63	108	141	133	133	593

NUMBER OF VESSELS AGGREGATED BY CATEGORY - CILICIAN BASIN

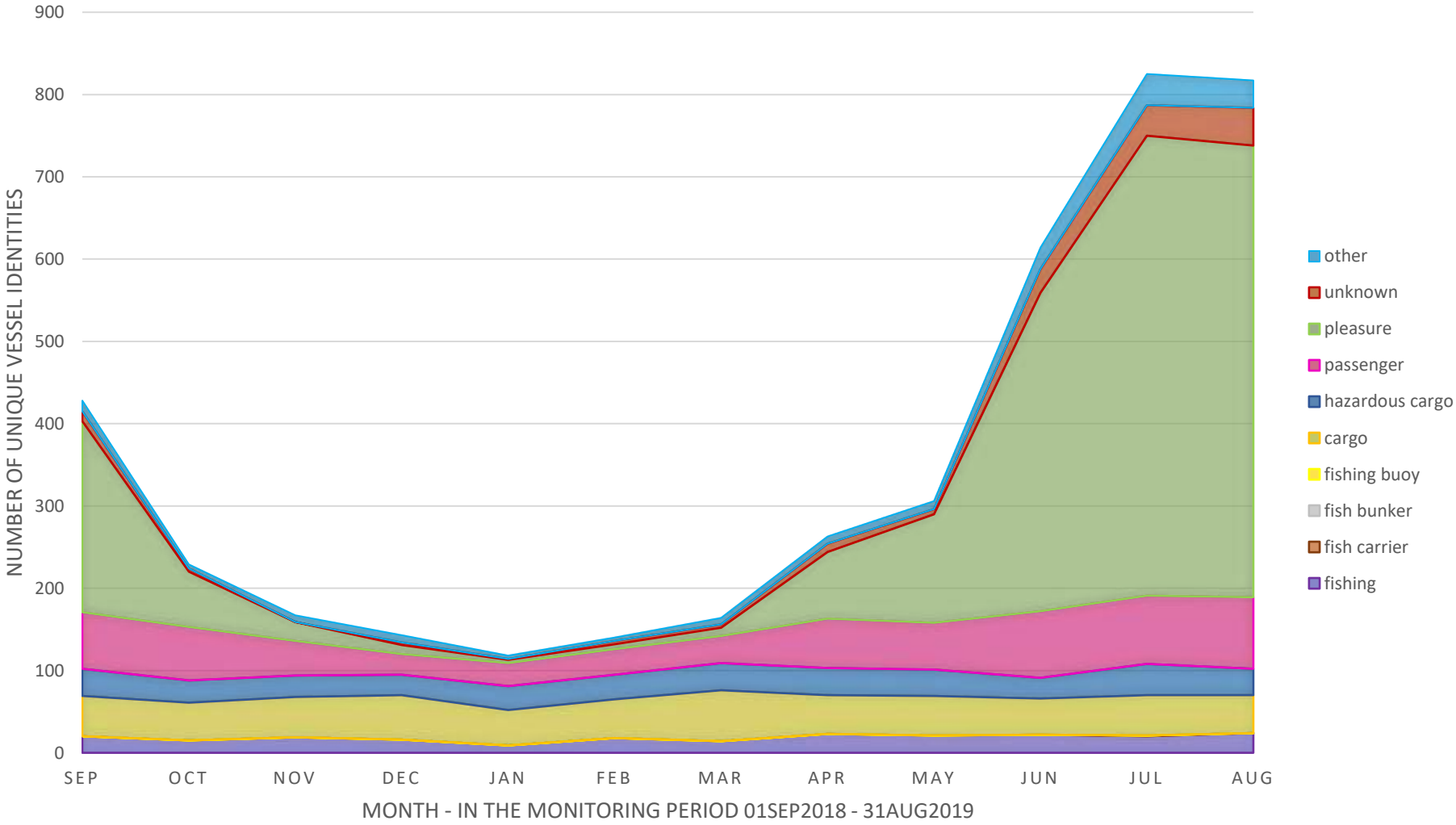


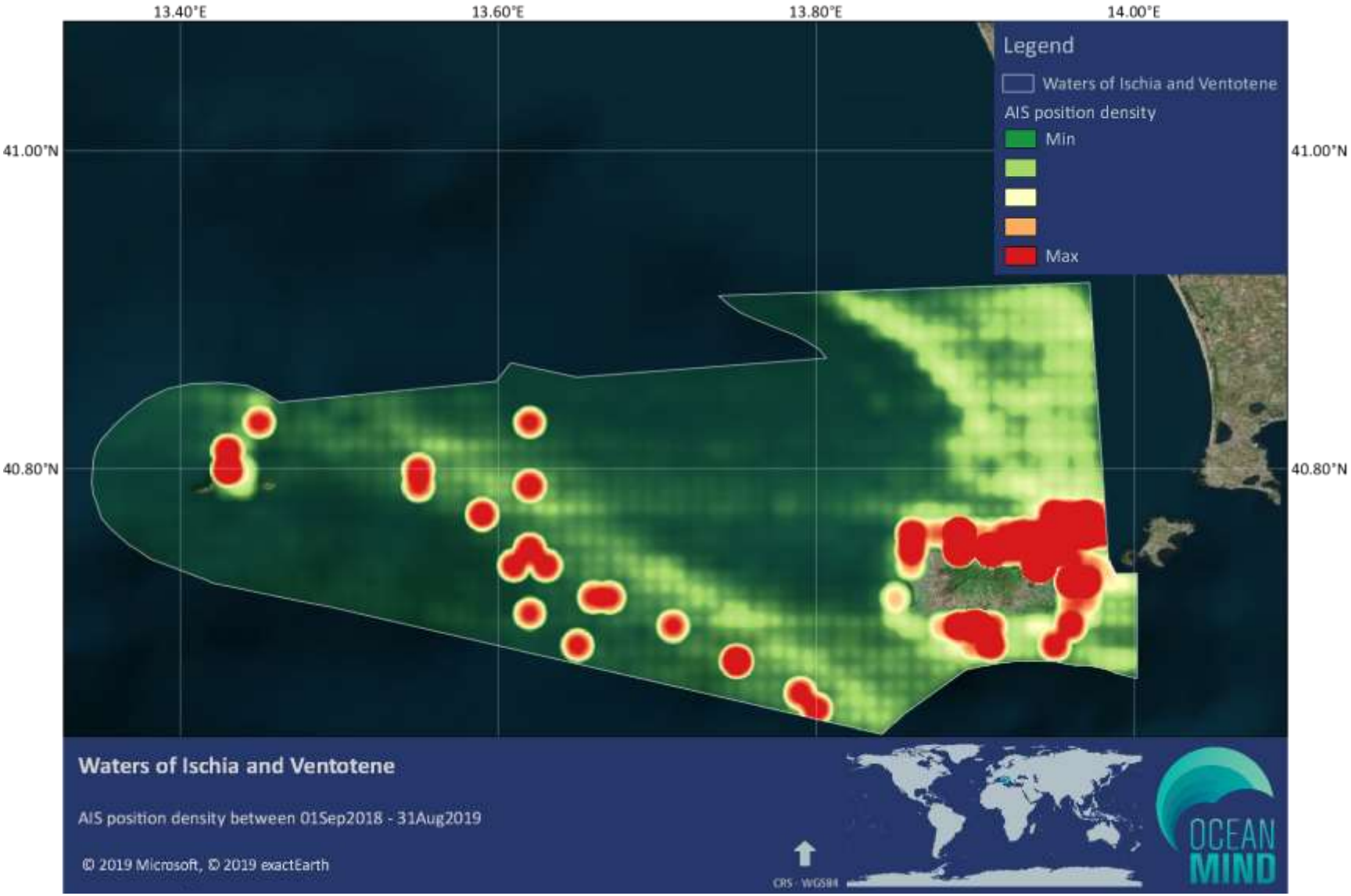


1.20 Waters of Ischia and Ventotene IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	20	15	19	16	9	18	14	23	21	22	20	24	63
Fish carrier	0	0	0	0	0	0	0	0	0	0	1	0	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	49	46	49	54	43	47	62	47	48	44	49	46	251
Hazardous cargo	33	27	26	25	29	30	33	33	32	25	38	32	120
Passenger	69	65	42	25	28	31	33	60	57	81	83	87	182
Pleasure	232	67	23	11	4	6	10	81	132	387	559	549	1442
Unknown	12	4	0	3	1	4	4	10	6	29	37	46	110
Other	13	5	8	9	4	4	8	9	10	26	38	33	89
Total	428	229	167	143	118	140	164	263	306	614	825	817	2258

NUMBER OF VESSELS AGGREGATED BY CATEGORY - WATERS OF ISCHIA AND VENTOTENE

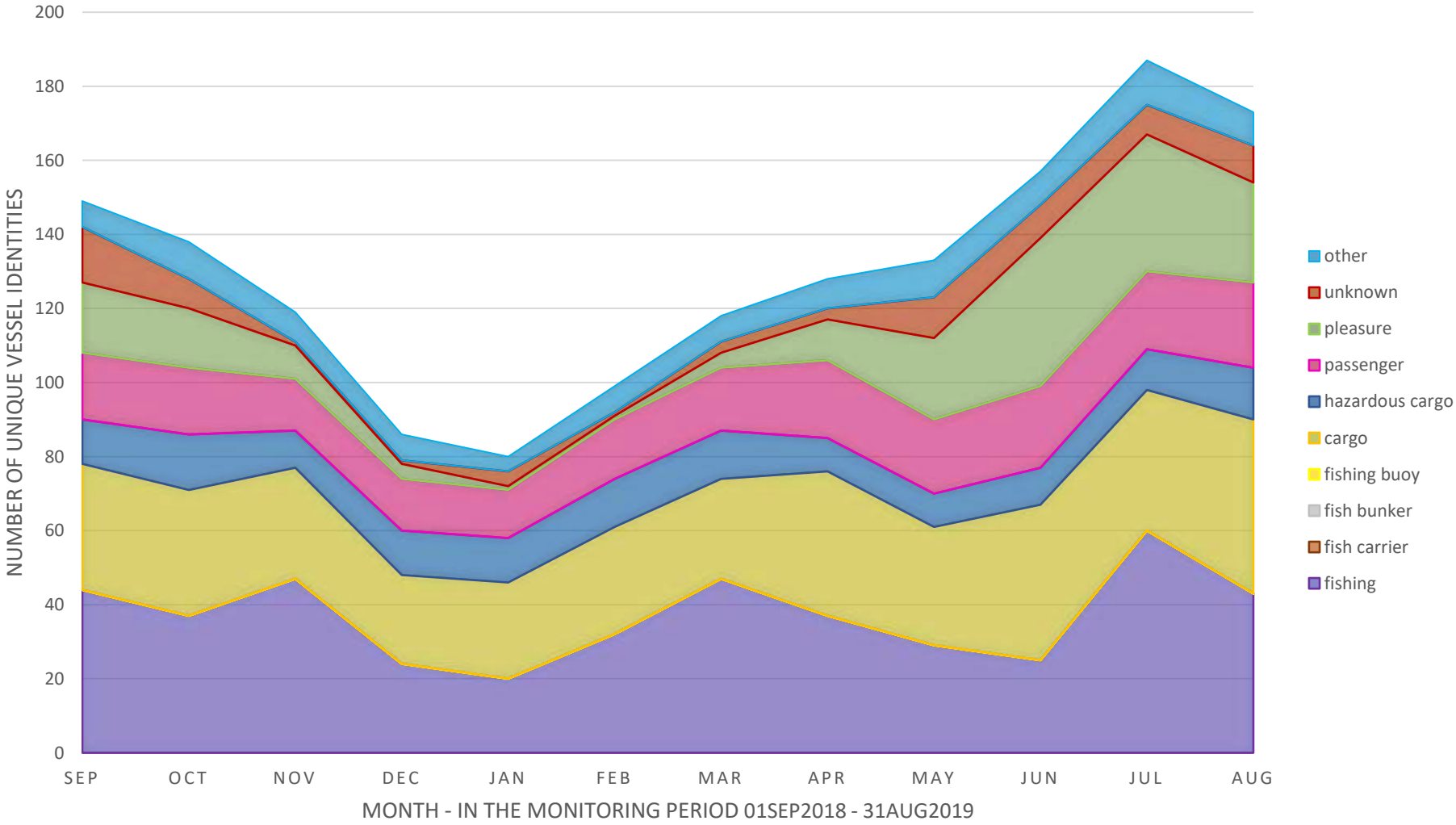




1.21 Northern Coast and Islands of the Thracian Sea IMMA

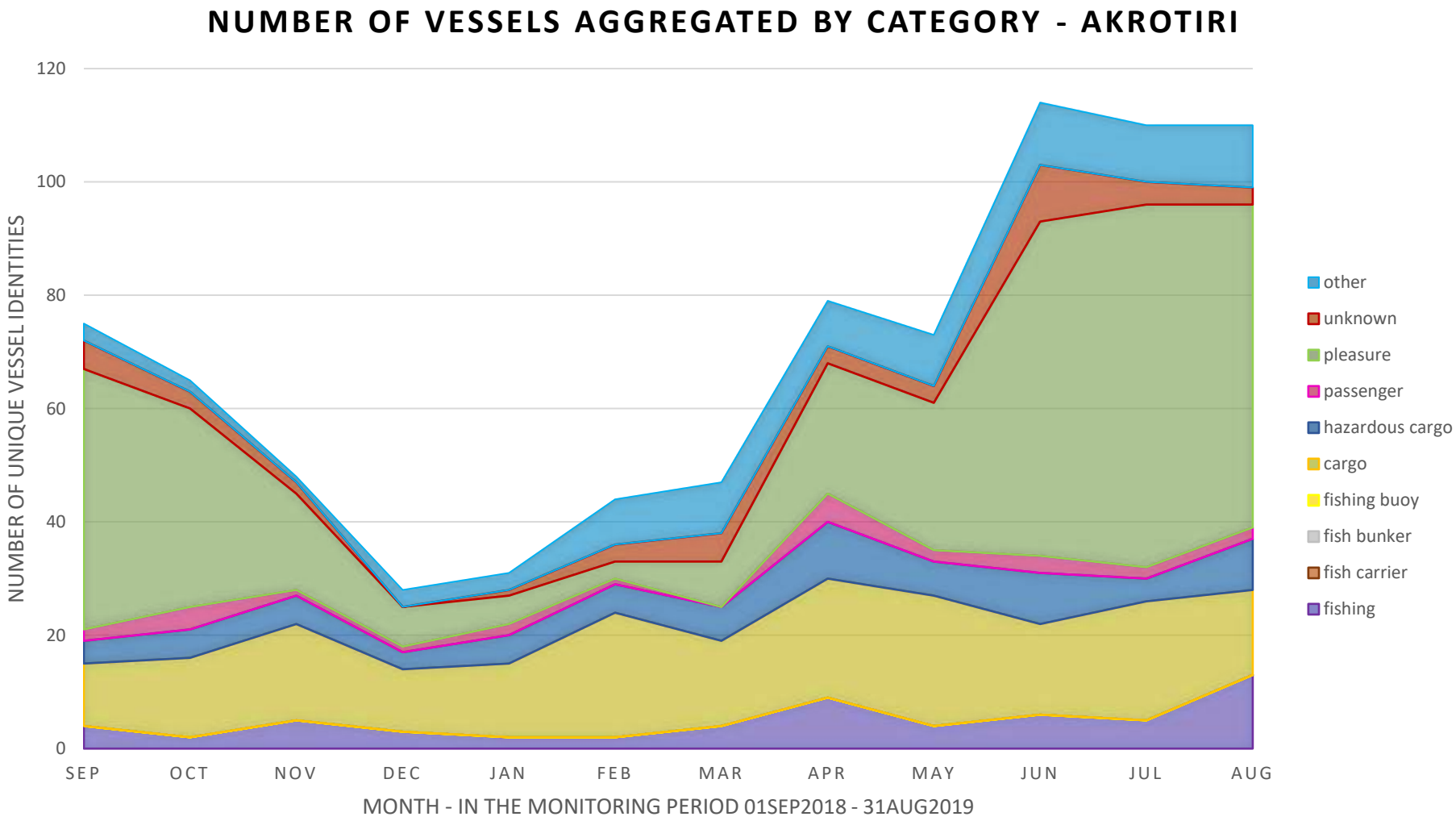
Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	44	37	47	24	20	32	47	37	29	25	60	43	137
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	34	34	30	24	26	29	27	39	32	42	38	47	222
Hazardous cargo	12	15	10	12	12	13	13	9	9	10	11	14	42
Passenger	18	18	14	14	13	16	17	21	20	22	21	23	33
Pleasure	19	16	9	4	1	1	4	11	22	40	37	27	93
Unknown	15	8	1	1	4	1	3	3	11	9	8	10	35
Other	7	10	8	7	4	7	7	8	10	9	12	9	24
Total	149	138	119	86	80	99	118	128	133	157	187	173	586

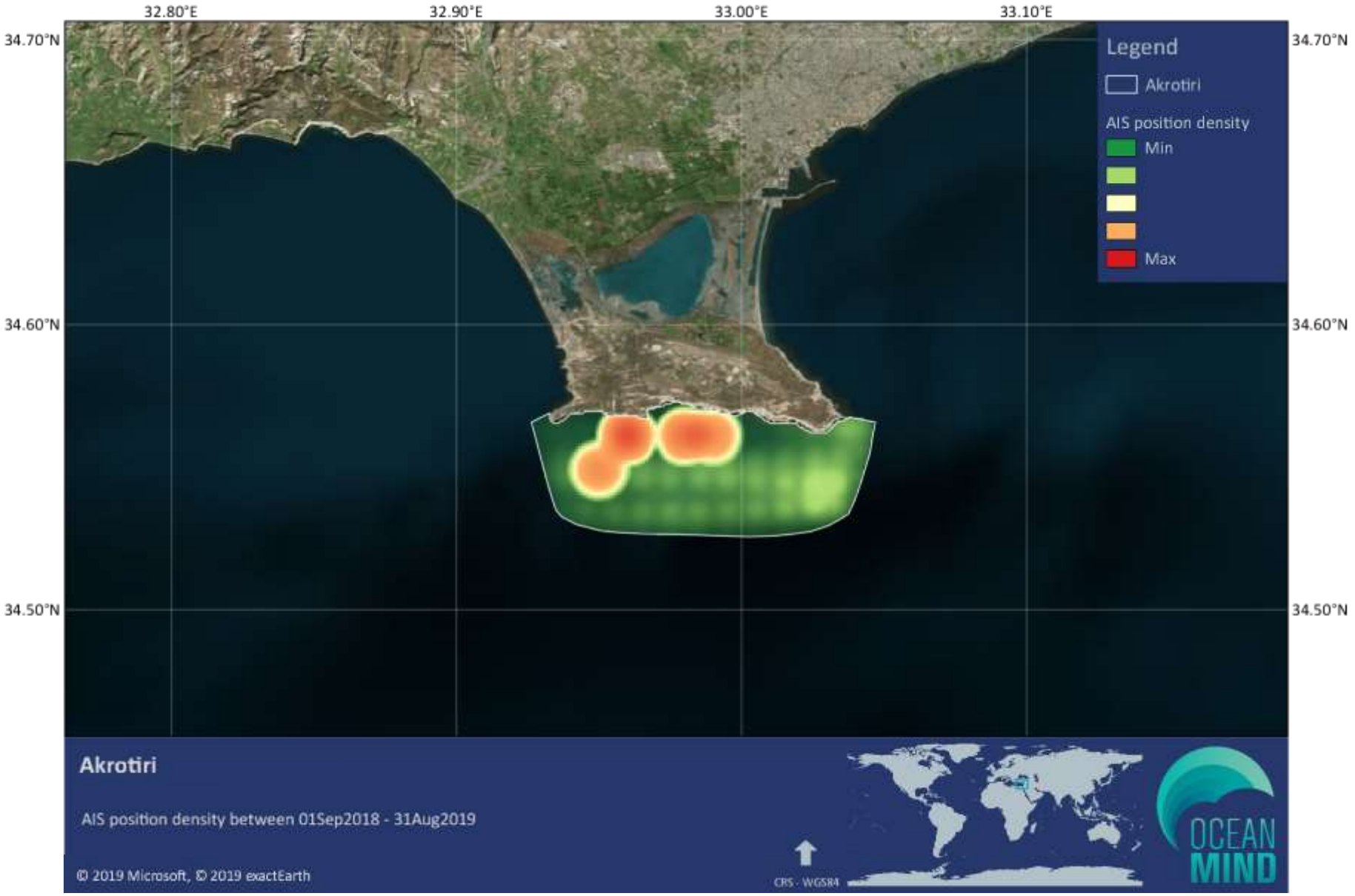
NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHERN COAST AND ISLANDS OF THE THRACIAN SEA



1.22 Akrotiri IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	4	2	5	3	2	2	4	9	4	6	5	13	20
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	11	14	17	11	13	22	15	21	23	16	21	15	114
Hazardous cargo	4	5	5	3	5	5	6	10	6	9	4	9	21
Passenger	2	4	1	1	2	1	0	5	2	3	2	2	13
Pleasure	46	35	17	7	5	3	8	23	26	59	64	57	235
Unknown	5	3	2	0	1	3	5	3	3	10	4	3	33
Other	3	2	1	3	3	8	9	8	9	11	10	11	41
Total	75	65	48	28	31	44	47	79	73	114	110	110	477

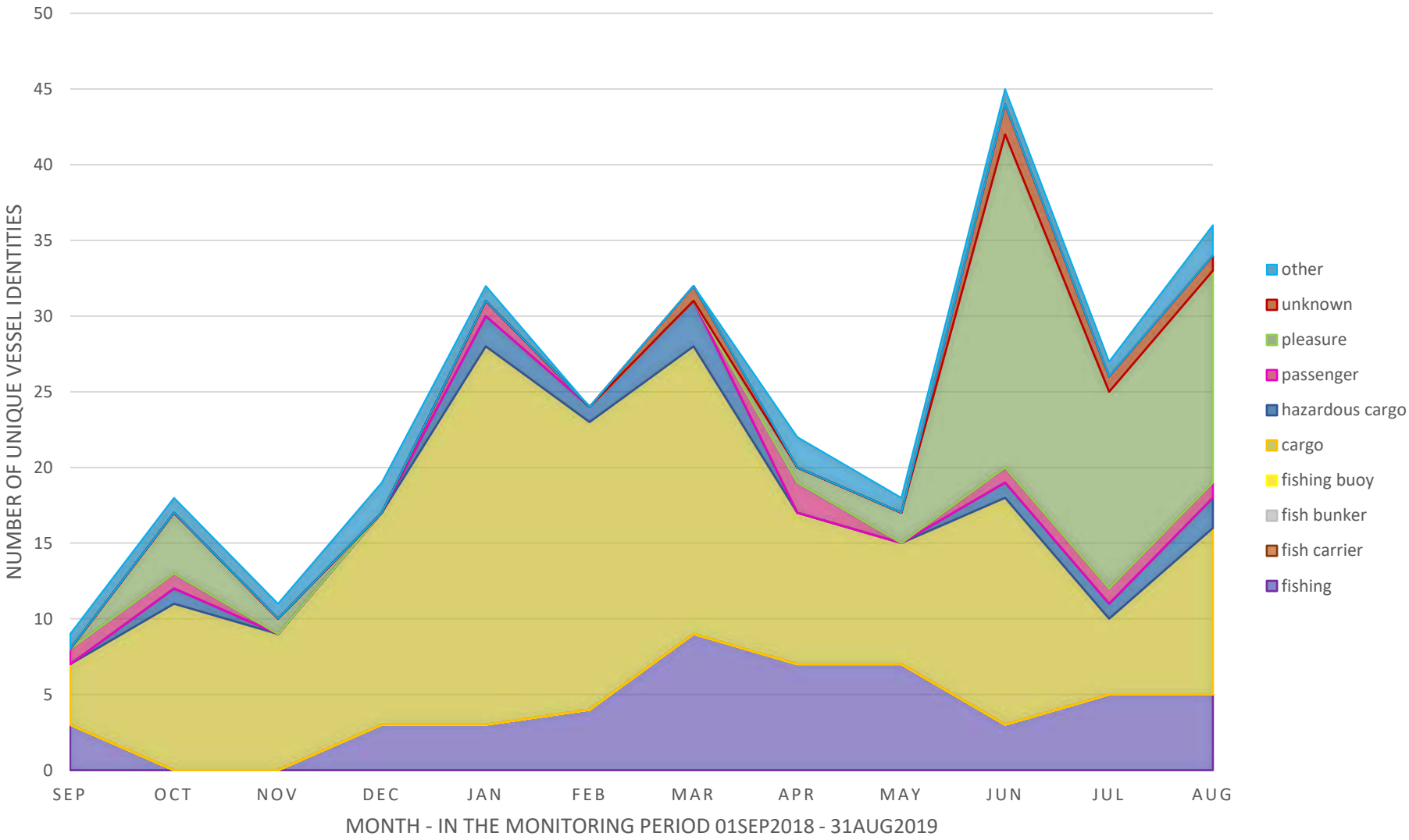


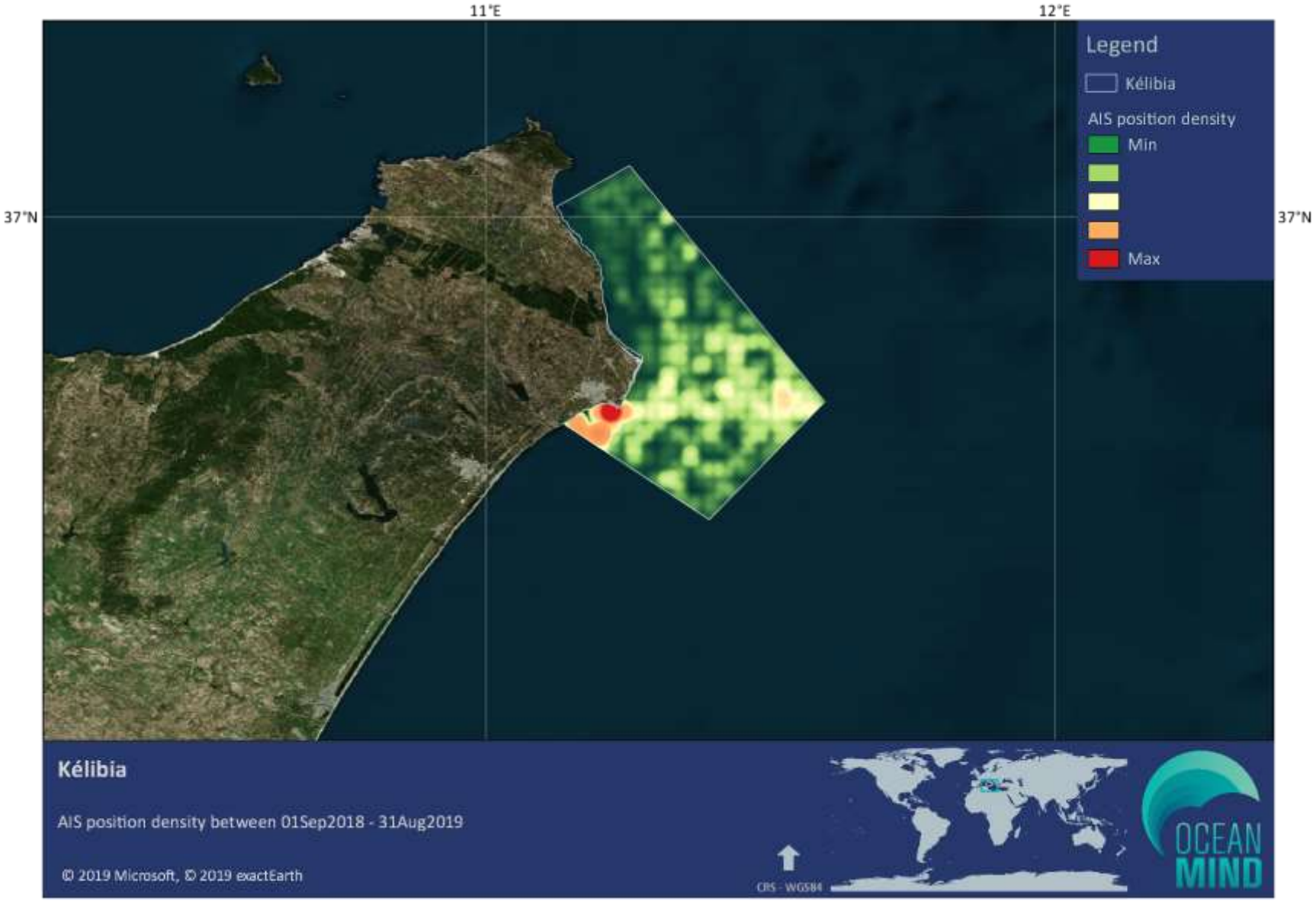


1.23 Kélibia IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	3	0	0	3	3	4	9	7	7	3	5	5	20
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	4	11	9	14	25	19	19	10	8	15	5	11	118
Hazardous cargo	0	1	0	0	2	1	3	0	0	1	1	2	9
Passenger	1	1	0	0	1	0	0	2	0	1	1	1	3
Pleasure	0	4	1	0	0	0	0	1	2	22	13	14	47
Unknown	0	0	0	0	0	0	1	0	0	2	1	1	4
Other	1	1	1	2	1	0	0	2	1	1	1	2	9
Total	9	18	11	19	32	24	32	22	18	45	27	36	210

NUMBER OF VESSELS AGGREGATED BY CATEGORY - KÉLIBIA

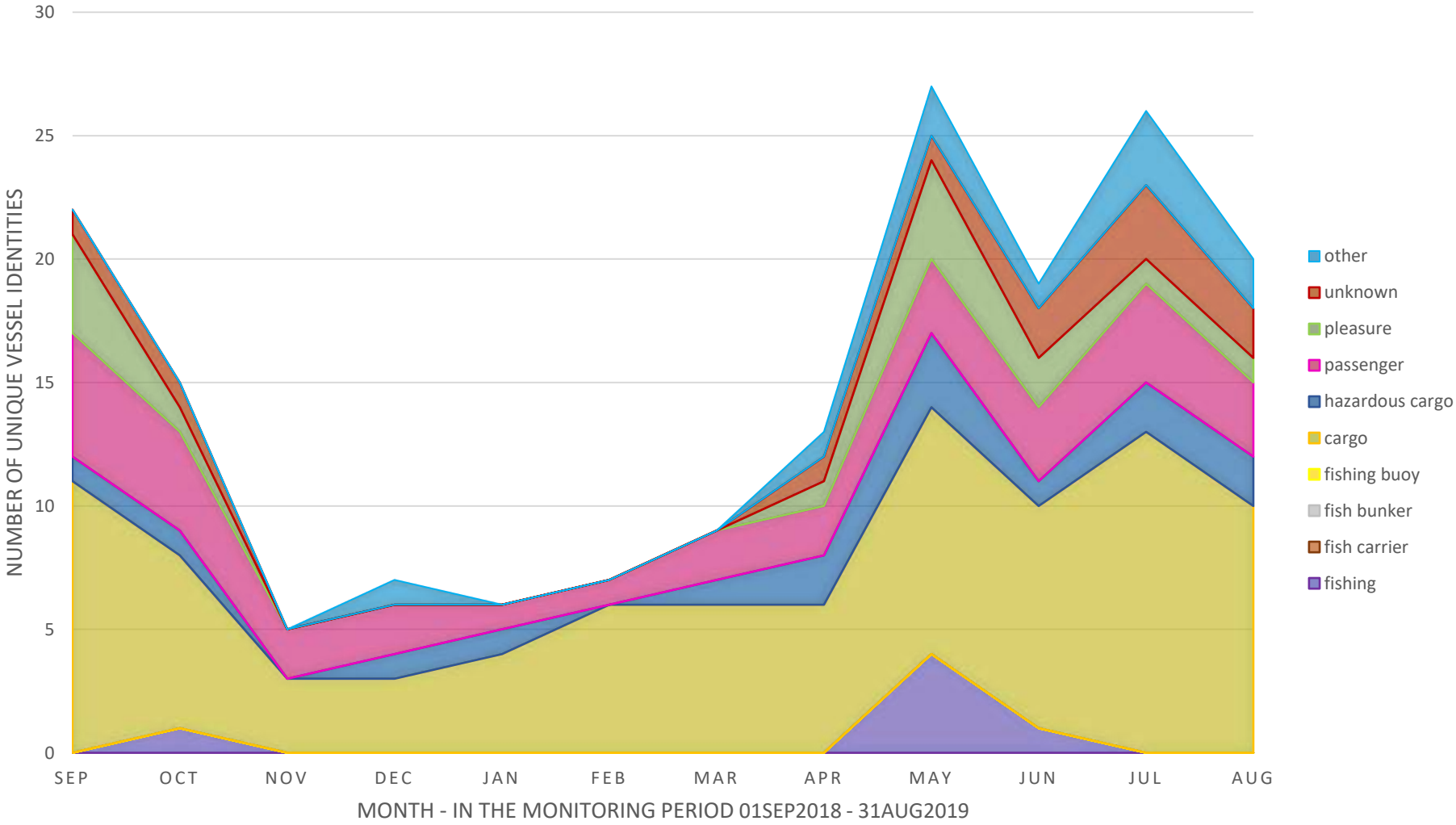




1.24 Northern Coast of Cyprus IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	0	0	0	0	0	0	4	1	0	0	6
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	11	7	3	3	4	6	6	6	10	9	13	10	31
Hazardous cargo	1	1	0	1	1	0	1	2	3	1	2	2	6
Passenger	5	4	2	2	1	1	2	2	3	3	4	3	7
Pleasure	4	1	0	0	0	0	0	1	4	2	1	1	7
Unknown	1	1	0	0	0	0	0	1	1	2	3	2	4
Other	0	0	0	1	0	0	0	1	2	1	3	2	4
Total	22	15	5	7	6	7	9	13	27	19	26	20	65

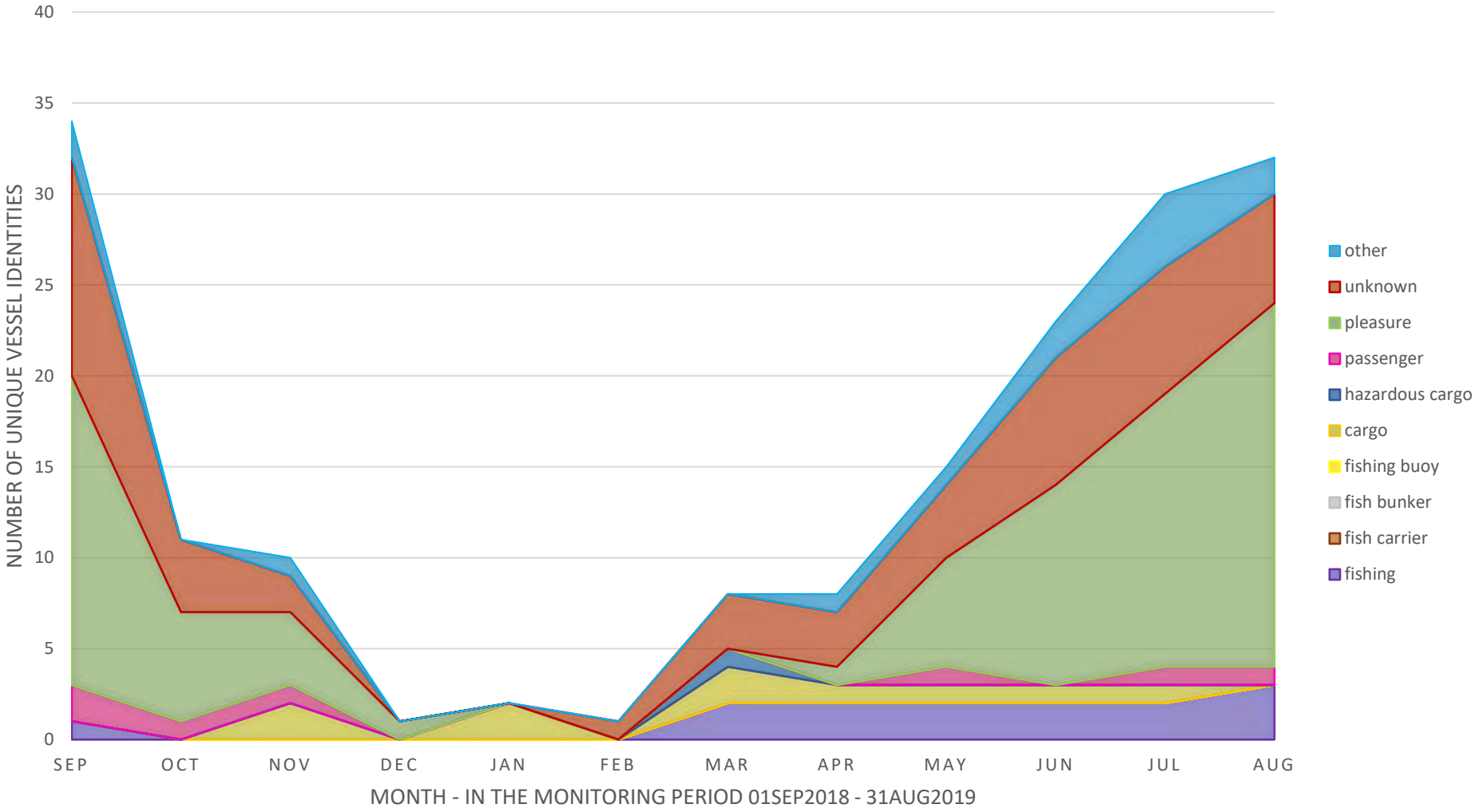
NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHERN COAST OF CYPRUS

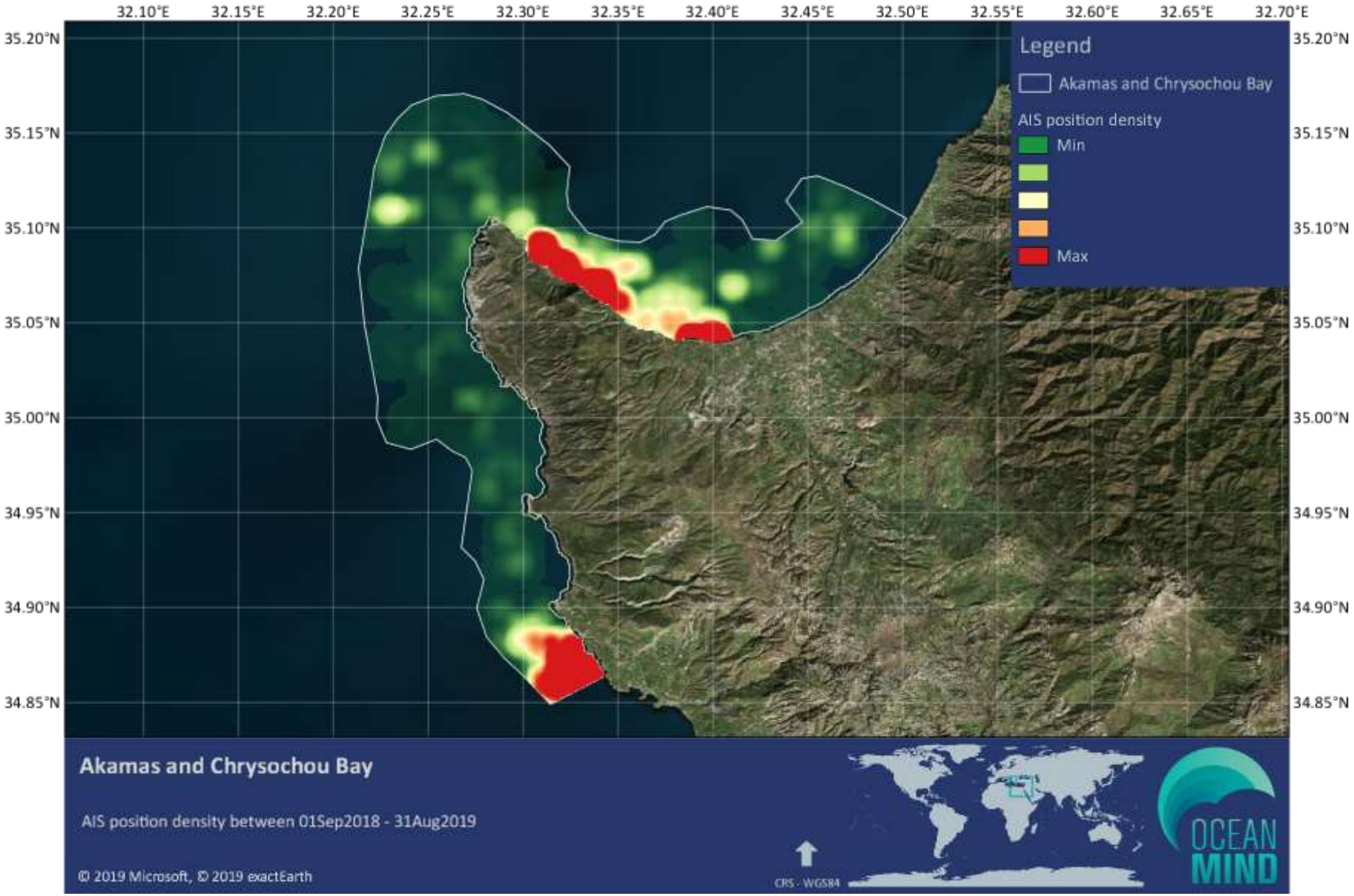


1.25 Akamas and Chrysochou Bay IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	0	0	0	0	0	2	2	2	2	2	3	10
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	2	0	2	0	2	1	1	1	1	0	9
Hazardous cargo	0	0	0	0	0	0	1	0	0	0	0	0	1
Passenger	2	1	1	0	0	0	0	0	1	0	1	1	4
Pleasure	17	6	4	1	0	0	0	1	6	11	15	20	51
Unknown	12	4	2	0	0	1	3	3	4	7	7	6	17
Other	2	0	1	0	0	0	0	1	1	2	4	2	4
Total	34	11	10	1	2	1	8	8	15	23	30	32	96

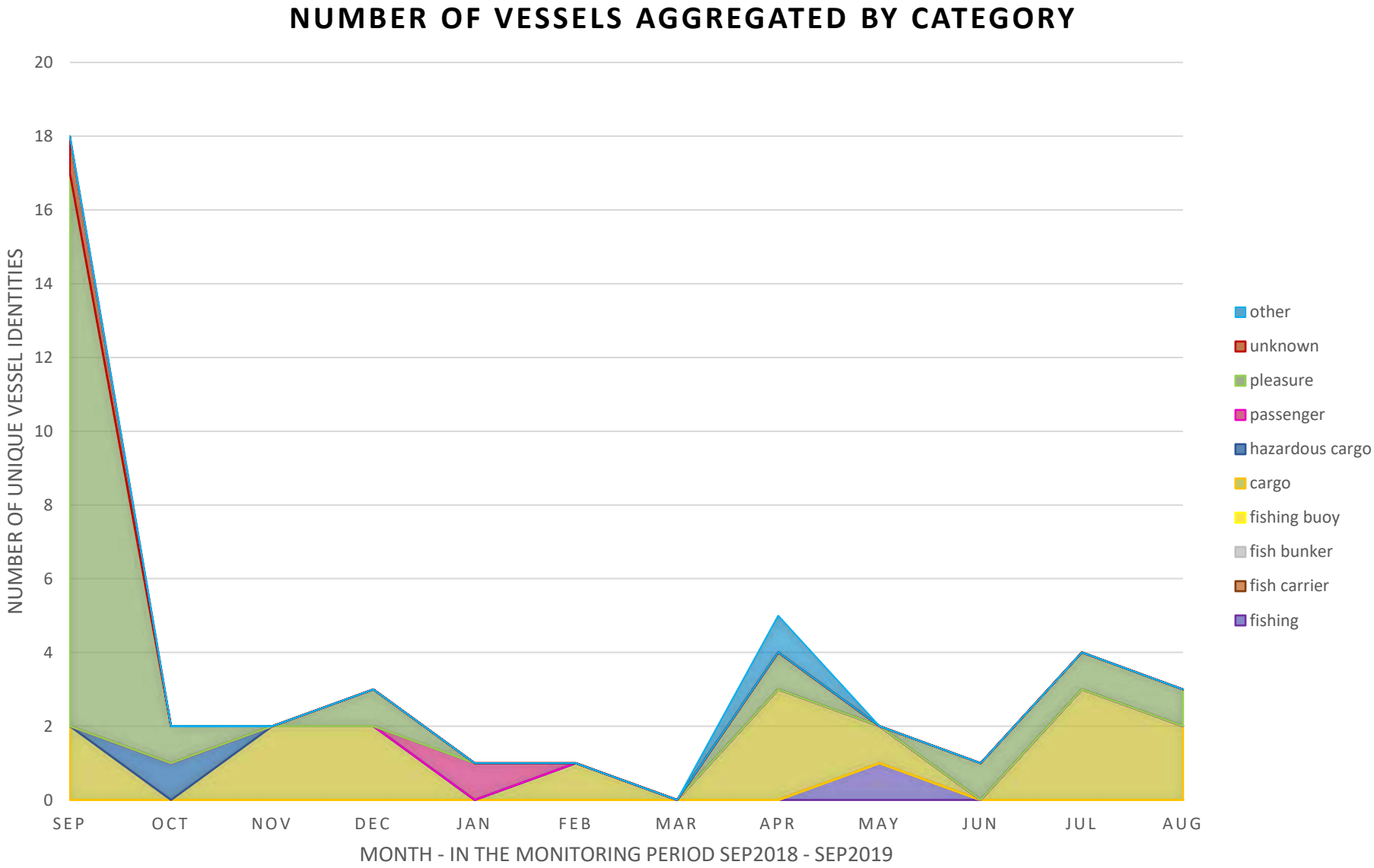
NUMBER OF VESSELS AGGREGATED BY CATEGORY - AKAMAS AND CHRYSOCHOU BAY

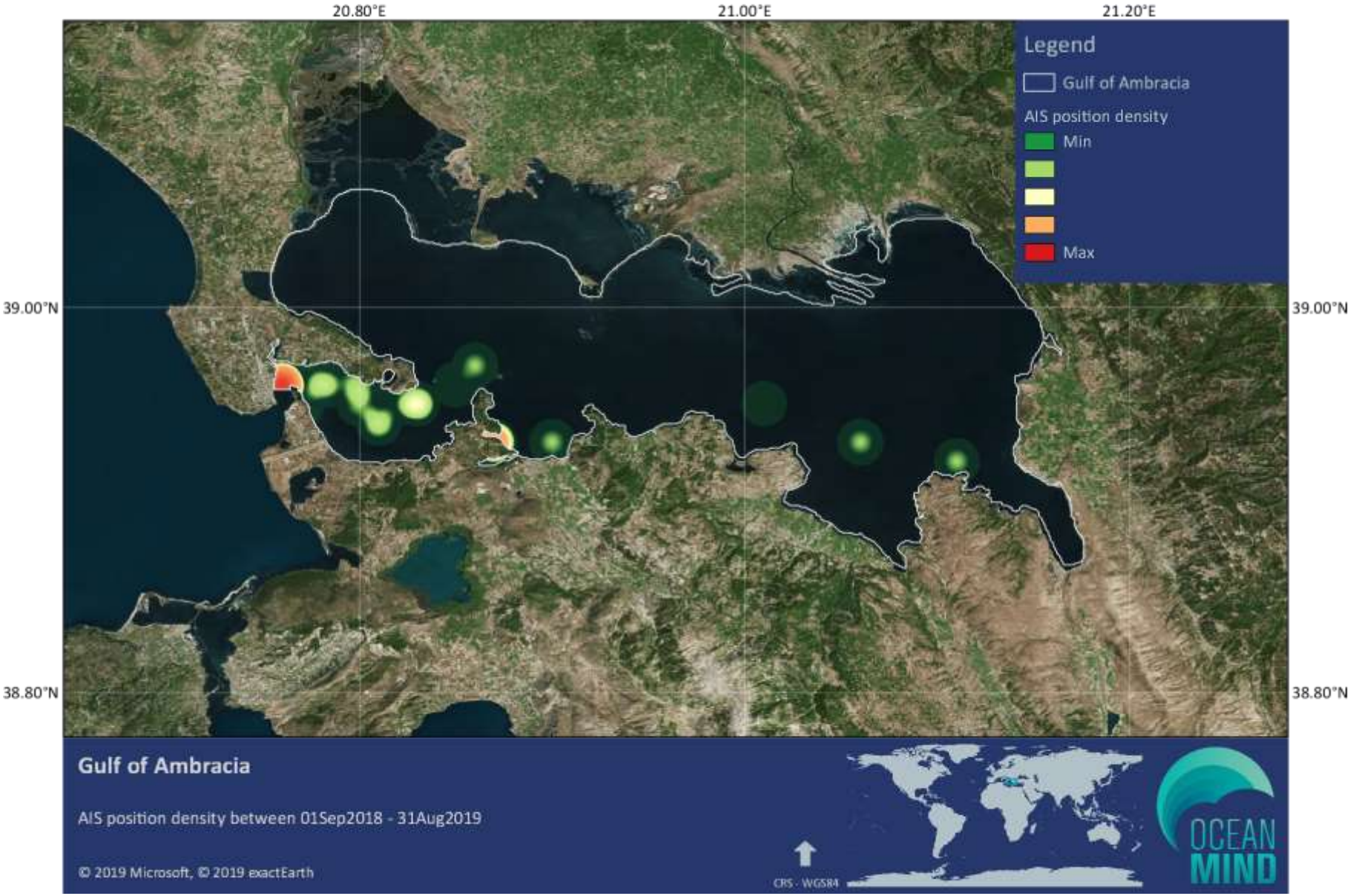




1.26 Gulf of Ambracia IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	1	0	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	2	0	2	2	0	1	0	3	1	0	3	2	14
Hazardous cargo	0	1	0	0	0	0	0	0	0	0	0	0	1
Passenger	0	0	0	0	1	0	0	0	0	0	0	0	1
Pleasure	15	1	0	1	0	0	0	1	0	1	1	1	20
Unknown	1	0	0	0	0	0	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	18	2	2	3	1	1	0	5	2	1	4	3	39



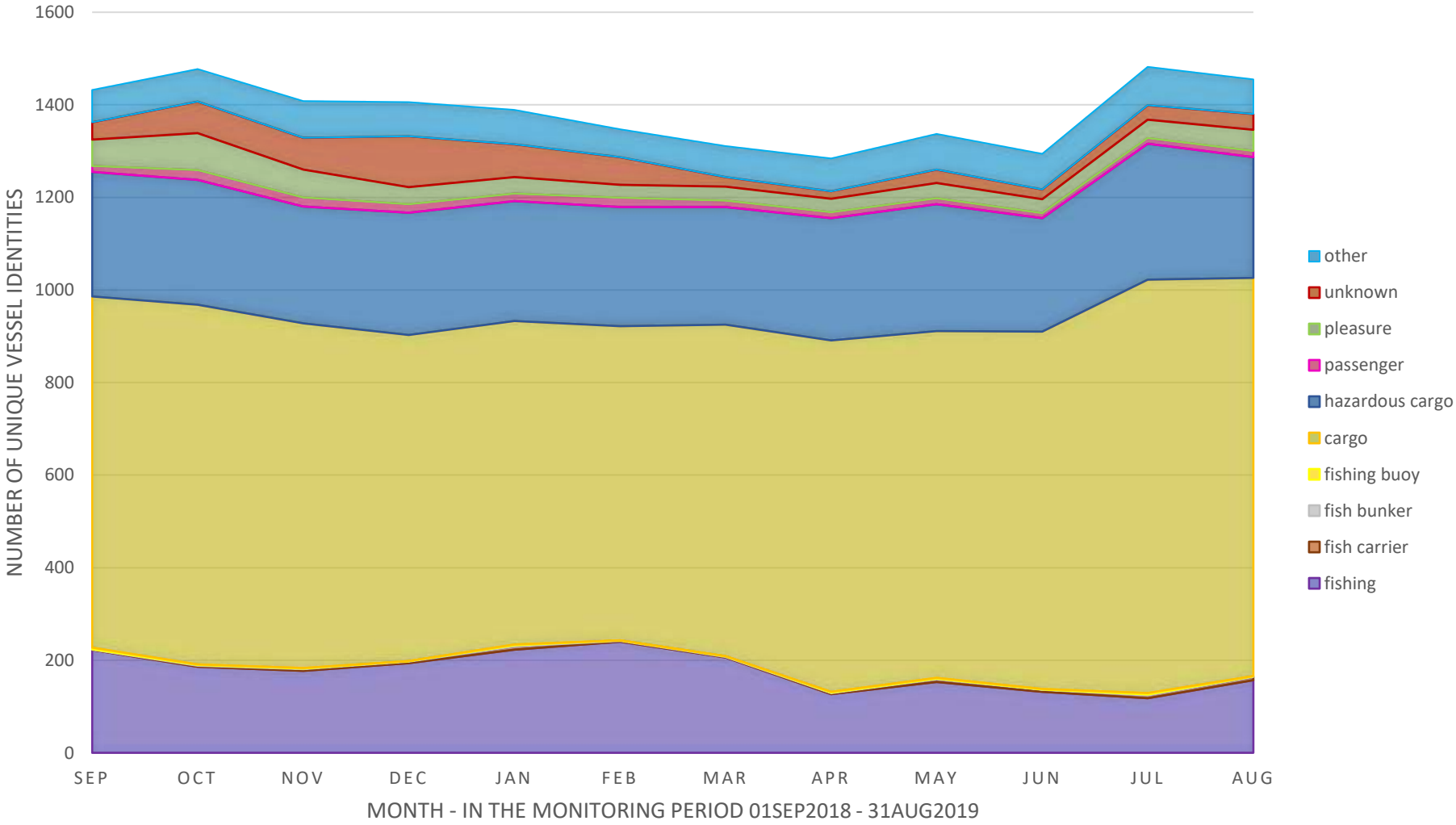


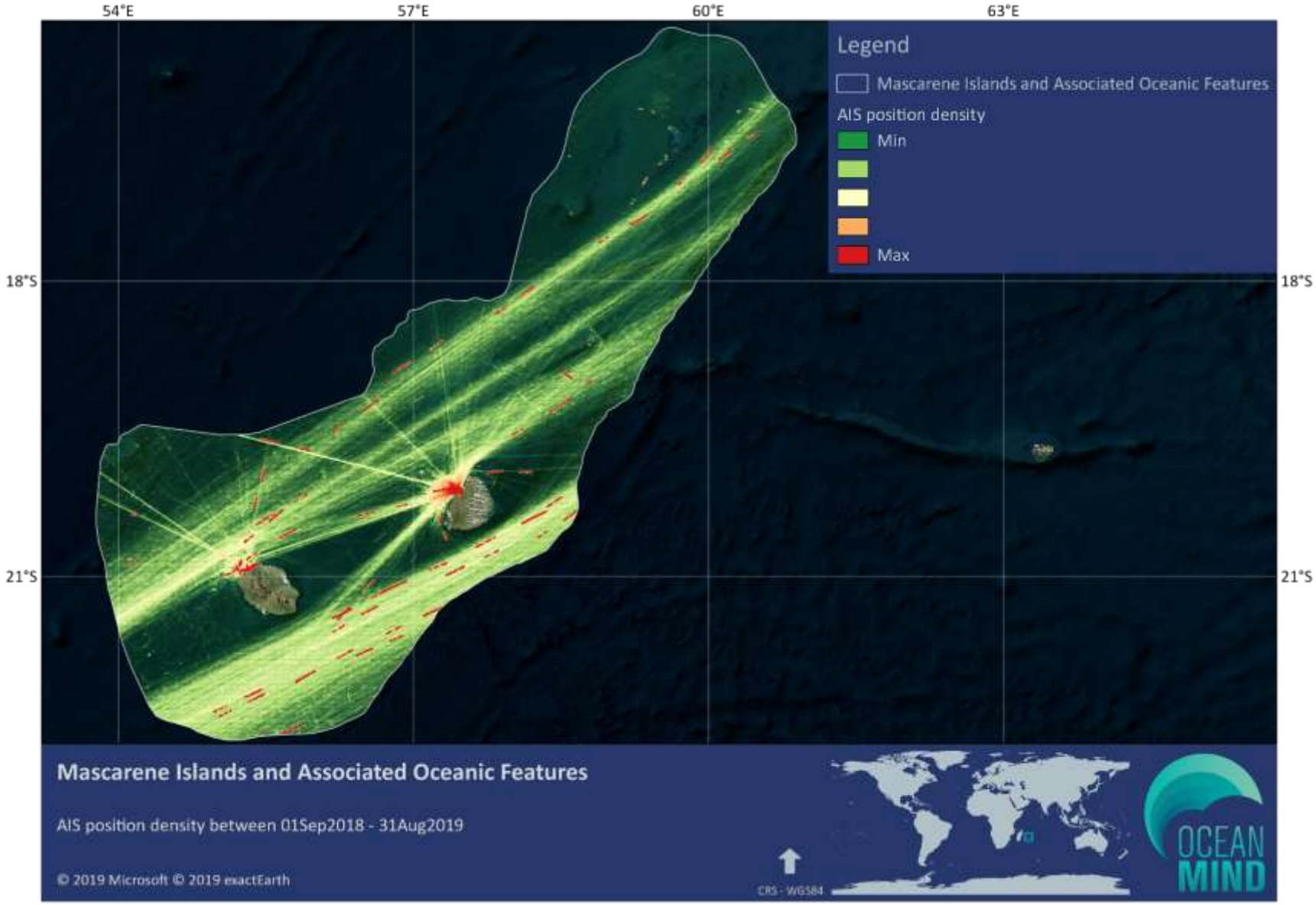
2 West Indian Ocean

2.1 Mascarene Islands and Associated Oceanic Features IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	222	186	177	194	223	240	206	127	153	132	118	157	596
Fish carrier	1	2	4	3	7	2	1	2	6	4	6	7	20
Fish bunker	1	2	1	1	2	1	2	1	1	1	2	1	4
Fishing buoy	3	1	1	0	2	0	0	2	2	1	3	1	10
Cargo	759	777	745	705	699	679	716	759	749	772	893	860	4378
Hazardous cargo	269	270	252	264	259	257	254	264	274	245	294	261	1454
Passenger	13	21	20	18	16	20	14	13	13	11	12	13	79
Pleasure	57	80	60	37	36	28	30	29	33	30	40	46	152
Unknown	37	68	69	110	71	60	21	16	29	21	31	34	314
Other	70	70	79	74	74	60	67	71	77	77	83	75	241
Total	1432	1477	1408	1406	1389	1347	1311	1284	1337	1294	1482	1455	7248

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MASCARENE ISLANDS AND ASSOCIATED OCEANIC FEATURES

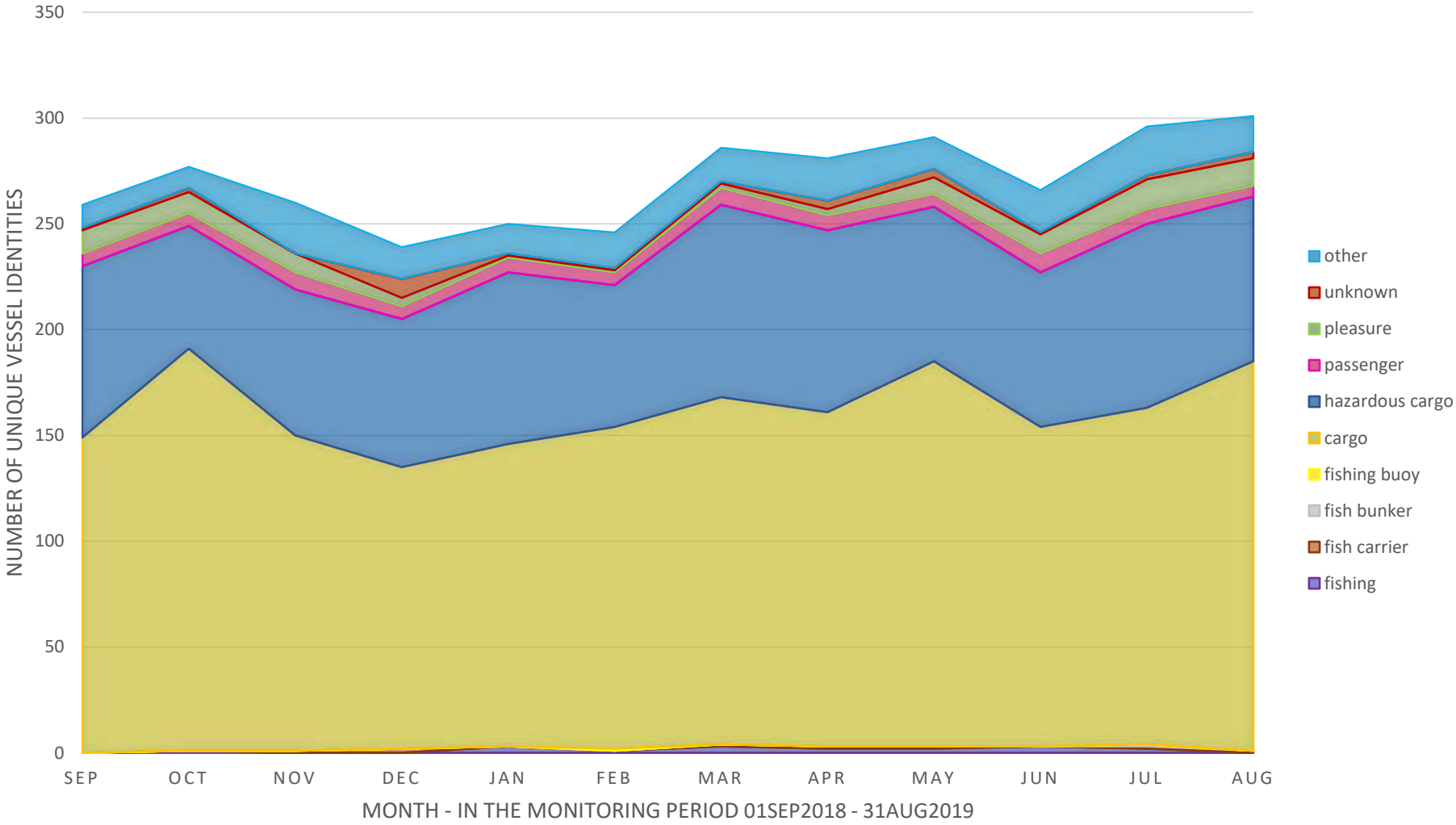




2.2 Comoros Island Chain and Adjacent Reef Banks IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	0	0	3	1	3	2	2	3	2	0	12
Fish carrier	0	0	1	2	0	0	1	1	1	0	1	1	6
Fish bunker	0	0	0	0	0	0	0	0	0	0	1	0	1
Fishing buoy	0	0	0	0	0	1	0	0	0	0	0	0	1
Cargo	149	190	149	133	143	152	164	158	182	151	159	184	1204
Hazardous cargo	81	58	69	70	81	67	91	86	73	73	87	78	554
Passenger	6	6	8	6	7	6	8	7	6	9	7	5	19
Pleasure	11	10	9	4	1	1	2	3	8	9	14	13	40
Unknown	1	2	0	9	1	1	1	4	4	1	2	3	25
Other	11	10	24	15	14	17	16	20	15	20	23	17	81
Total	259	277	260	239	250	246	286	281	291	266	296	301	1943

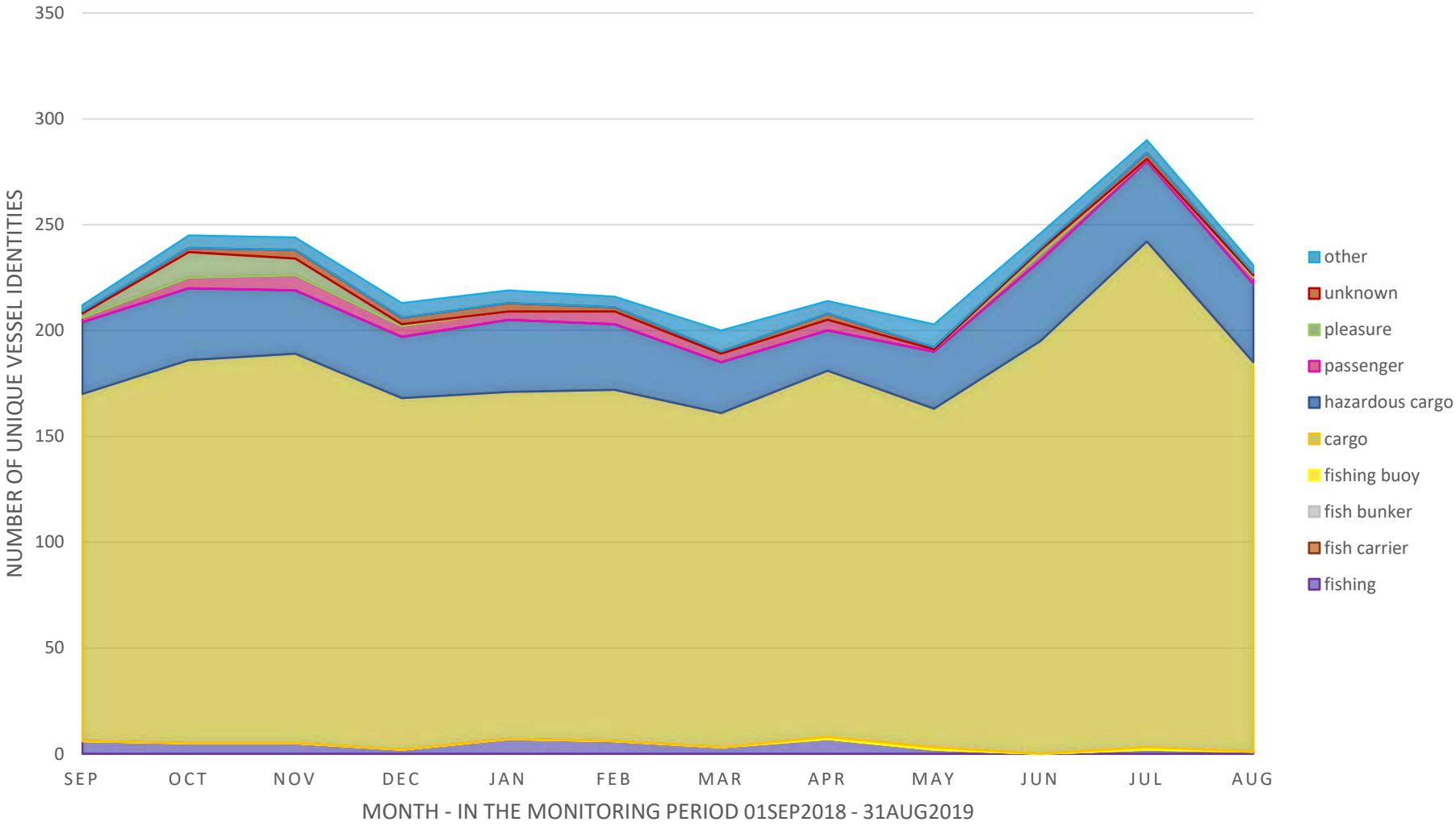
NUMBER OF VESSELS AGGREGATED BY CATEGORY - COMOROS ISLAND CHAIN AND ADJACENT REEF BANKS

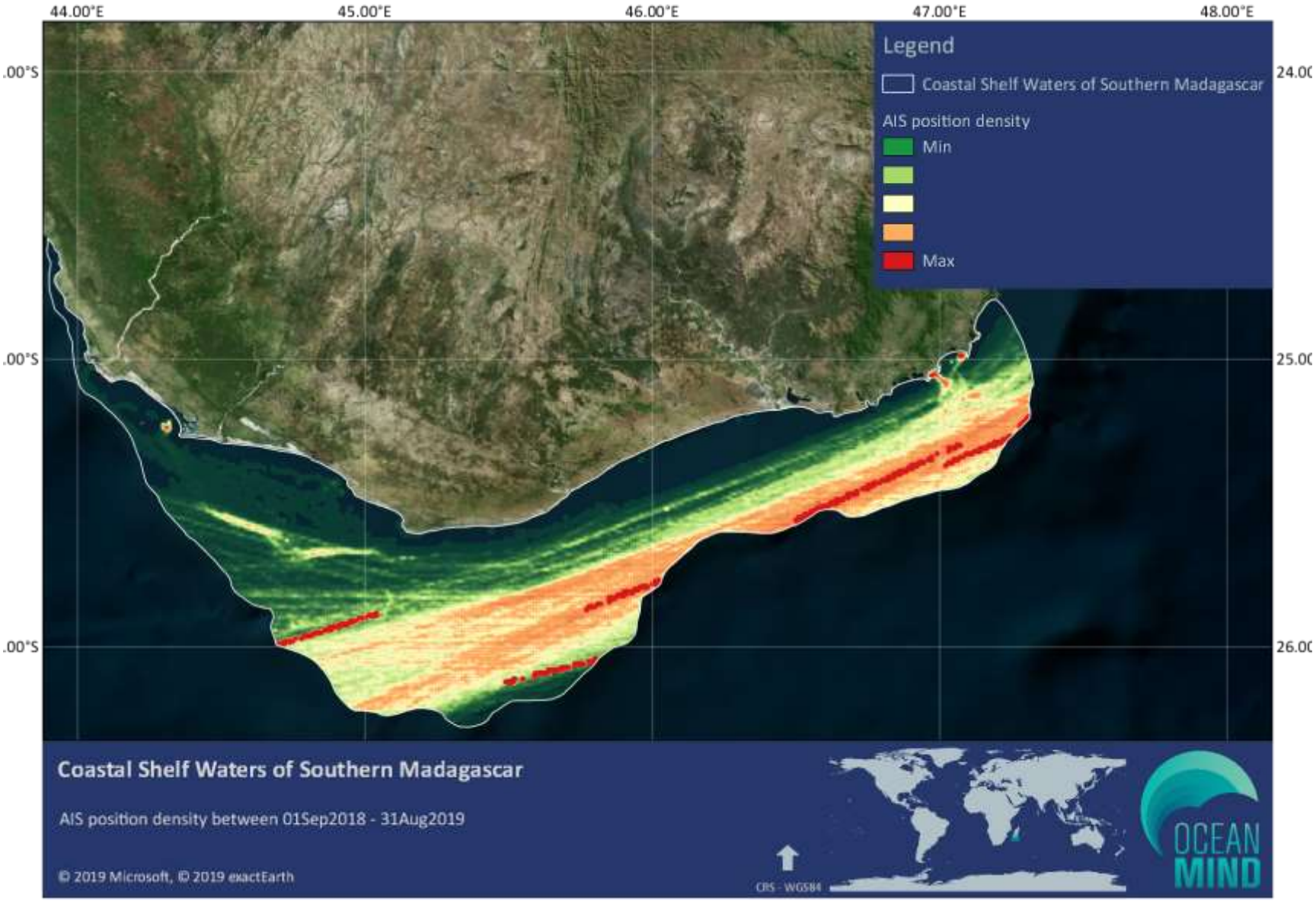


2.3 Coastal Shelf Waters of Southern Madagascar IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	6	5	5	2	7	6	3	7	2	0	2	1	26
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	1	1	0	1	0	1
Cargo	164	181	184	166	164	166	158	173	160	195	239	184	1464
Hazardous cargo	34	34	30	29	34	31	24	19	27	38	38	37	211
Passenger	2	5	7	5	4	6	4	5	1	3	1	3	29
Pleasure	2	12	8	1	0	0	0	0	0	2	0	1	25
Unknown	1	2	4	3	4	2	1	3	1	1	3	1	17
Other	3	6	6	7	6	5	10	6	11	7	6	4	40
Total	212	245	244	213	219	216	200	214	203	246	290	231	1813

NUMBER OF VESSELS AGGREGATED BY CATEGORY - COASTAL SHELF WATERS OF SOUTHERN MADAGASCAR

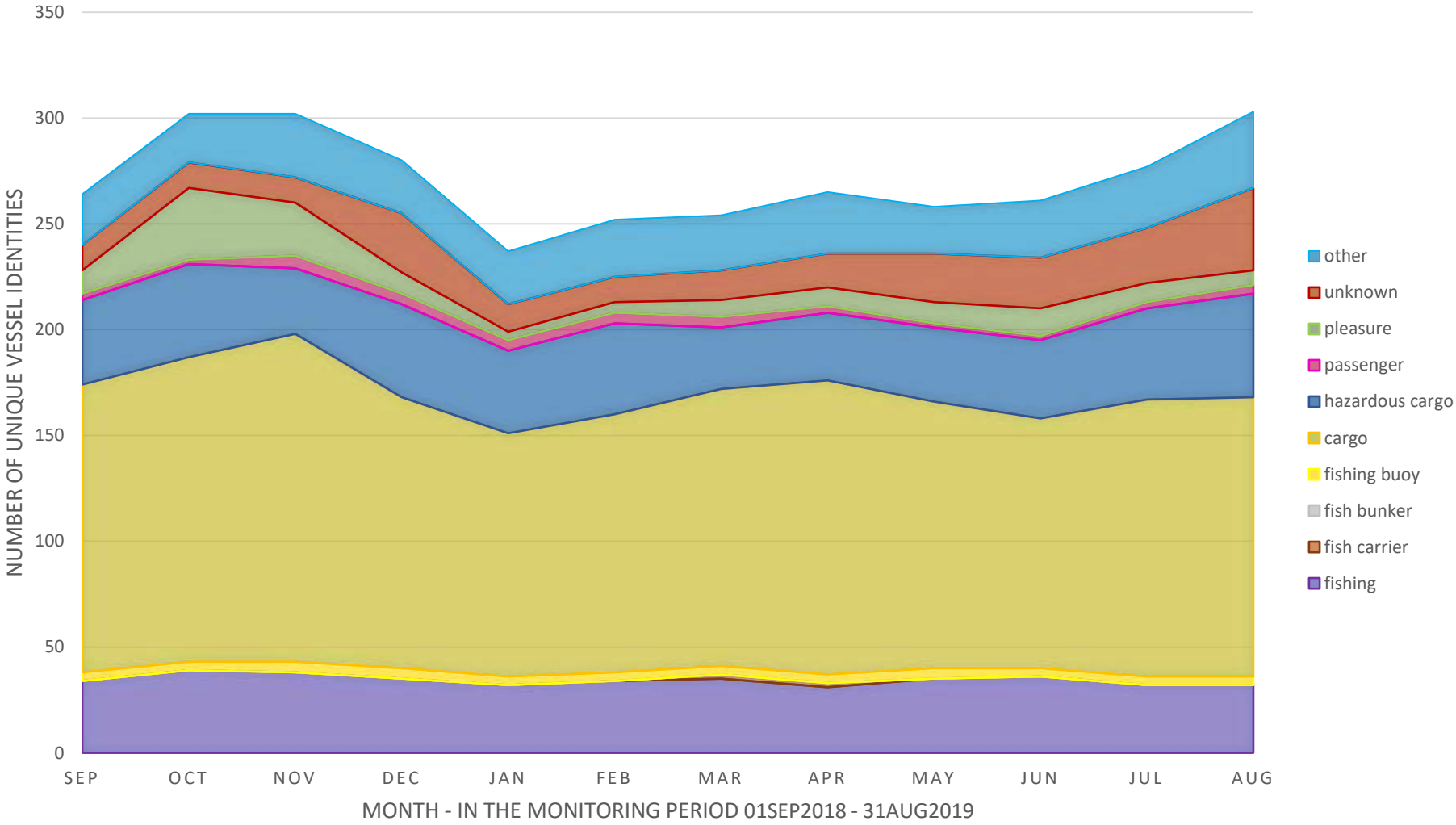




2.4 Mozambique Coastal Breeding Grounds IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	34	39	38	35	32	34	35	31	35	36	32	32	72
Fish carrier	0	0	0	0	0	0	2	2	0	0	0	0	2
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	4	4	5	5	4	4	4	4	5	4	4	4	5
Cargo	136	144	155	128	115	122	131	139	126	118	131	132	891
Hazardous cargo	40	44	31	44	39	43	29	32	35	37	43	49	225
Passenger	3	2	6	5	5	5	5	3	2	2	3	4	21
Pleasure	11	34	25	10	4	5	8	9	10	13	9	7	81
Unknown	12	12	12	28	13	12	14	16	23	24	26	39	80
Other	24	23	30	25	25	27	26	29	22	27	29	36	93
Total	264	302	302	280	237	252	254	265	258	261	277	303	1470

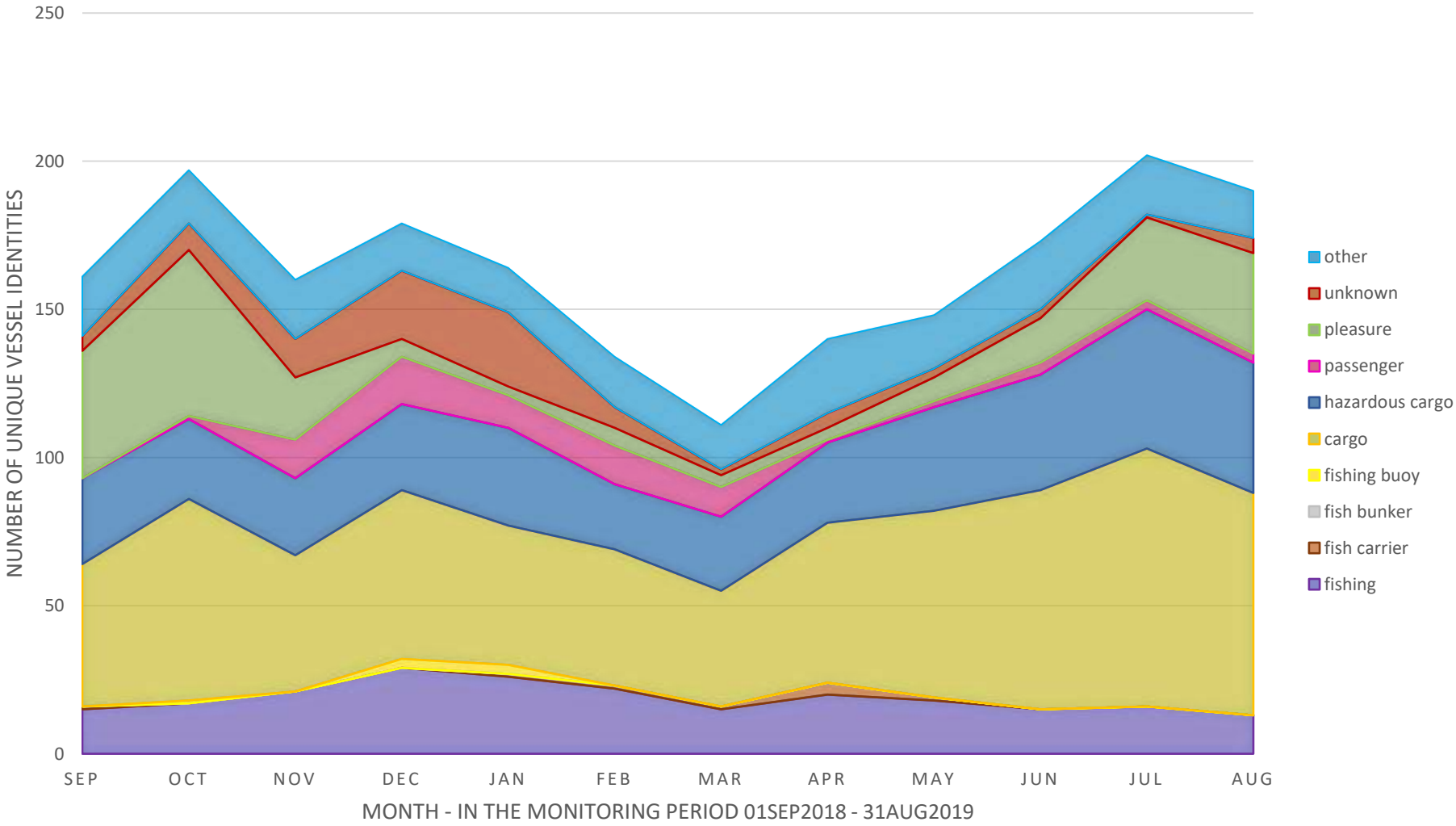
NUMBER OF VESSELS AGGREGATED BY CATEGORY - MOZAMBIQUE COASTAL BREEDING GROUNDS

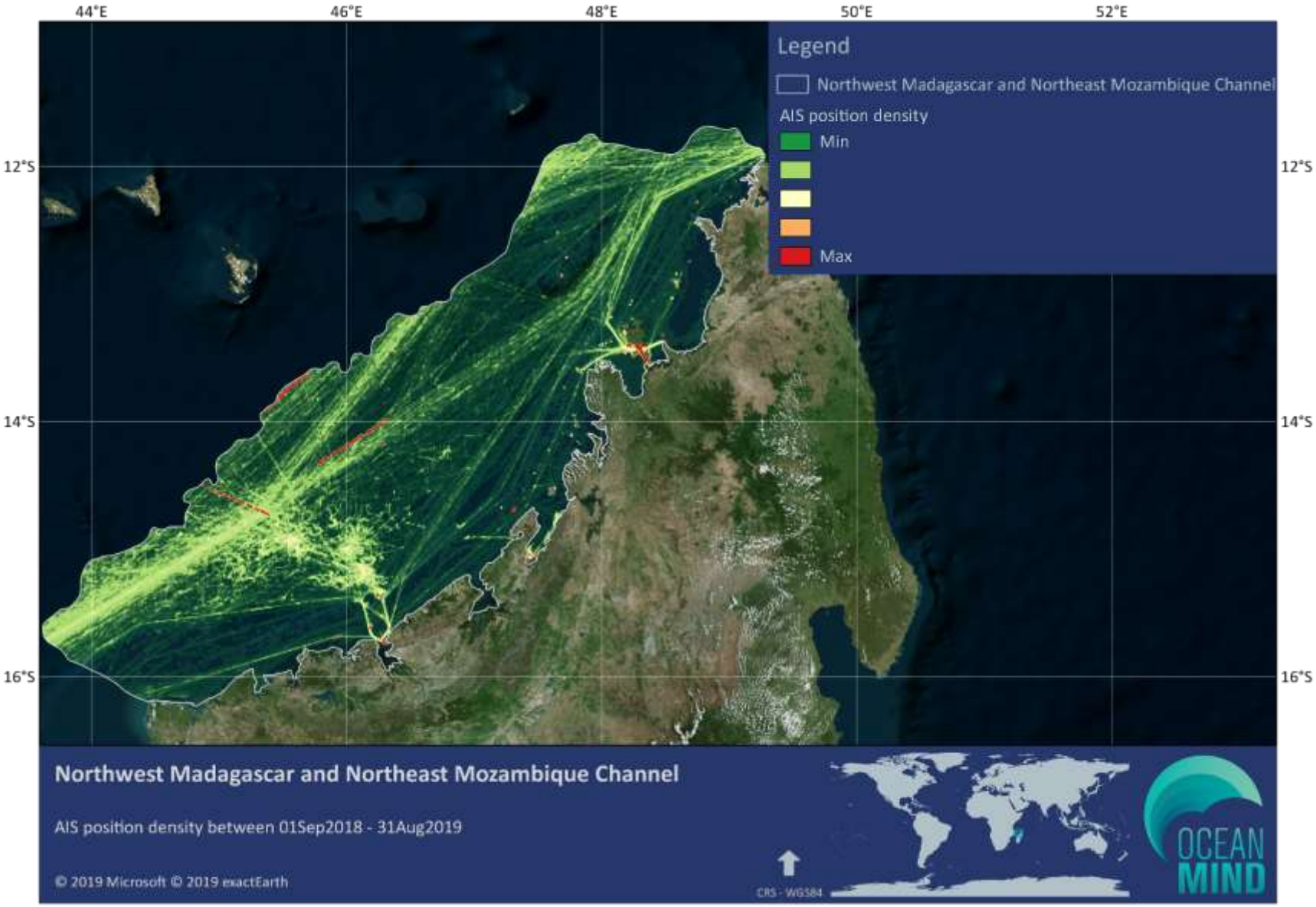


2.5 Northwest Madagascar and Northeast Mozambique Channel IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	15	17	21	29	26	22	15	20	18	15	16	13	64
Fish carrier	1	0	0	0	1	1	1	4	1	0	0	0	5
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	1	0	3	3	0	0	0	0	0	0	0	4
Cargo	48	68	46	57	47	46	39	54	63	74	87	75	475
Hazardous cargo	29	27	26	29	33	22	25	27	35	39	47	44	229
Passenger	0	1	13	16	11	13	10	1	2	4	3	3	29
Pleasure	43	56	21	6	3	6	4	4	8	15	28	34	117
Unknown	5	9	13	23	25	7	2	5	3	3	1	5	60
Other	20	18	20	16	15	17	15	25	18	23	20	16	69
Total	161	197	160	179	164	134	111	140	148	173	202	190	1052

NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHWEST MADAGASCAR AND NORTHEAST MOZAMBIQUE CHANNEL

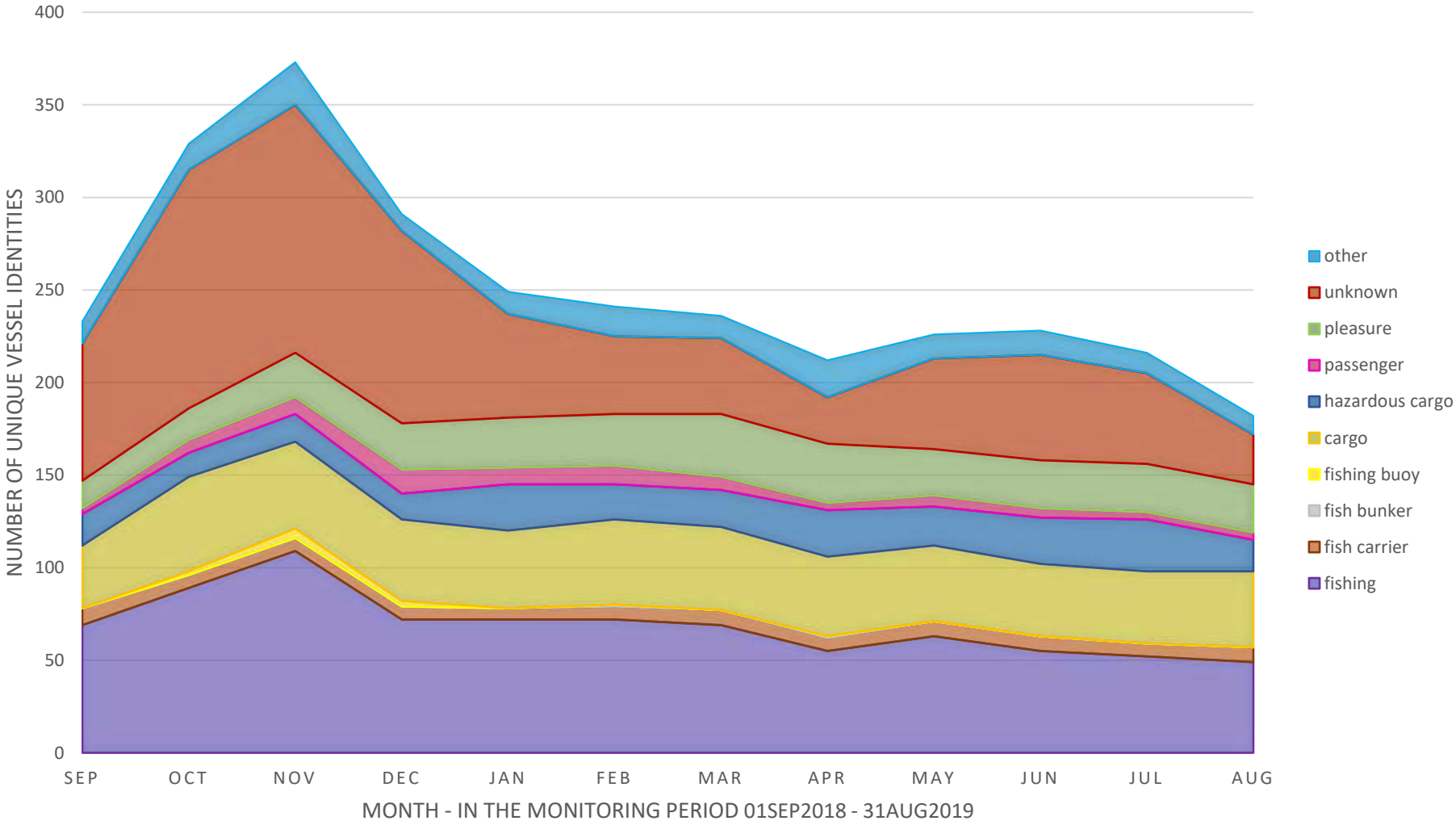




2.6 Seychelles Plateau and Adjacent Oceanic Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	69	89	109	72	72	72	69	55	63	55	52	49	192
Fish carrier	9	7	7	7	6	7	8	7	8	8	7	8	14
Fish bunker	0	0	0	0	0	1	0	1	0	0	0	0	1
Fishing buoy	0	2	5	3	0	0	0	0	0	0	0	0	8
Cargo	34	51	47	44	42	46	45	43	41	39	39	41	223
Hazardous cargo	17	13	15	14	25	19	20	25	21	25	28	17	104
Passenger	3	7	9	13	9	10	7	4	6	5	4	4	28
Pleasure	15	17	24	25	27	28	34	32	25	26	26	26	89
Unknown	74	129	134	104	56	42	41	25	49	57	49	27	338
Other	12	14	23	9	12	16	12	20	13	13	11	10	64
Total	233	329	373	291	249	241	236	212	226	228	216	182	1061

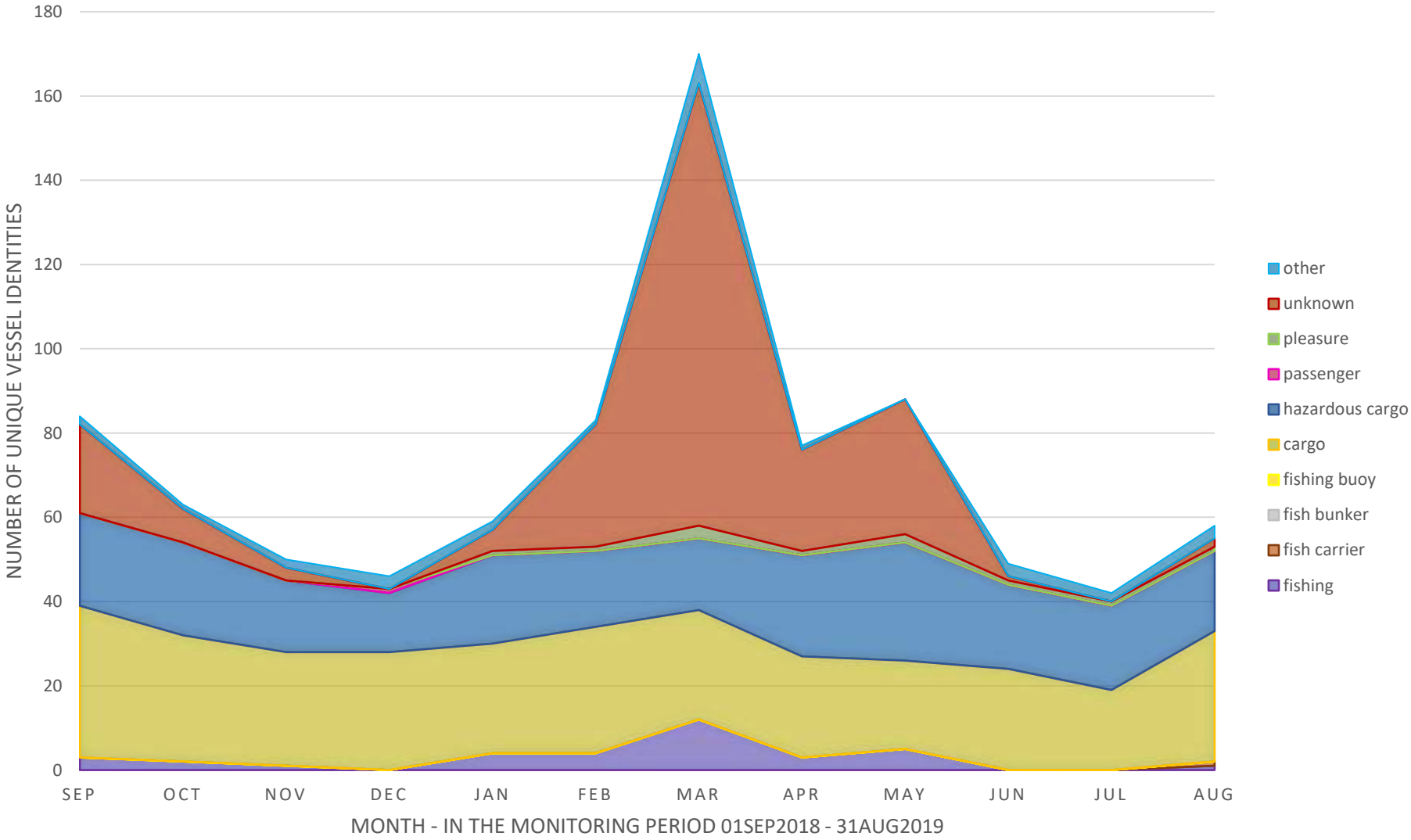
NUMBER OF VESSELS AGGREGATED BY CATEGORY - SEYCHELLES PLATEAU AND ADJACENT OCEANIC WATERS

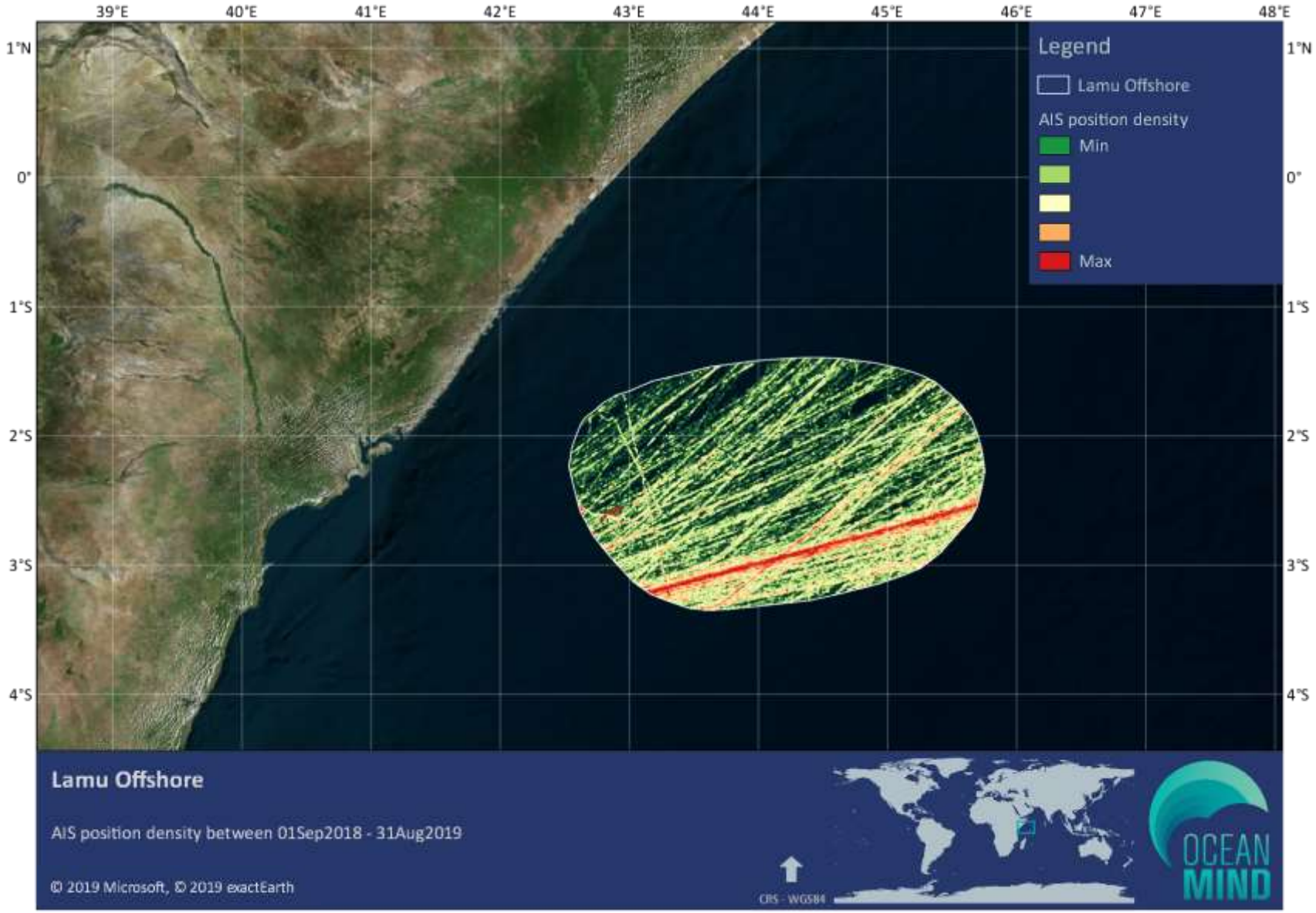


2.7 Lamu Offshore IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	3	2	1	0	4	4	12	3	5	0	0	1	21
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	1	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	36	30	27	28	26	30	26	24	21	24	19	31	177
Hazardous cargo	22	22	17	14	21	18	17	24	28	20	20	19	107
Passenger	0	0	0	1	0	0	0	0	0	0	0	0	1
Pleasure	0	0	0	0	1	1	3	1	2	1	1	1	4
Unknown	21	8	3	0	5	29	105	24	32	1	0	2	148
Other	2	1	2	3	2	1	7	1	0	3	2	3	18
Total	84	63	50	46	59	83	170	77	88	49	42	58	477

NUMBER OF VESSELS AGGREGATED BY CATEGORY - LAMU OFFSHORE

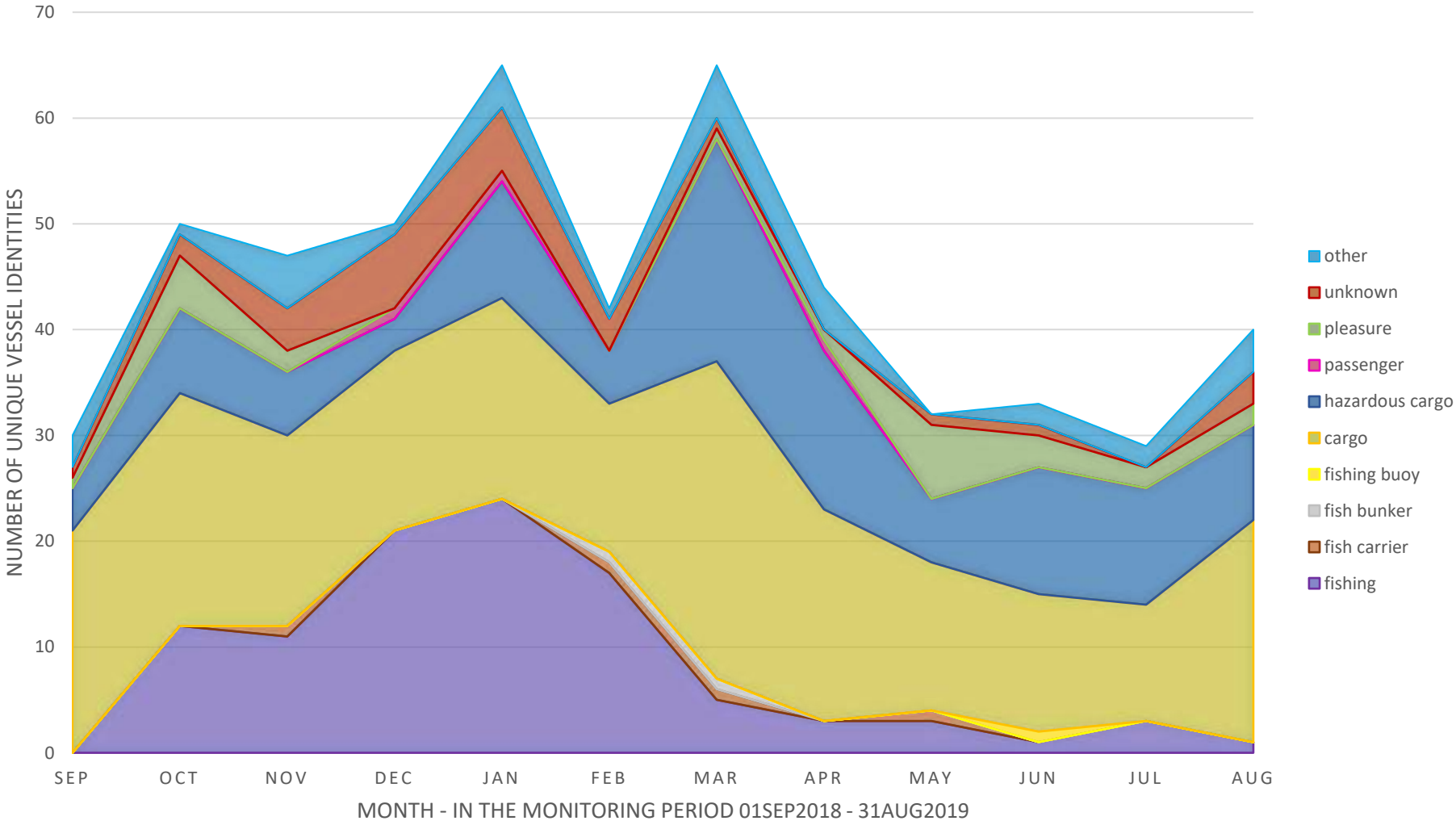


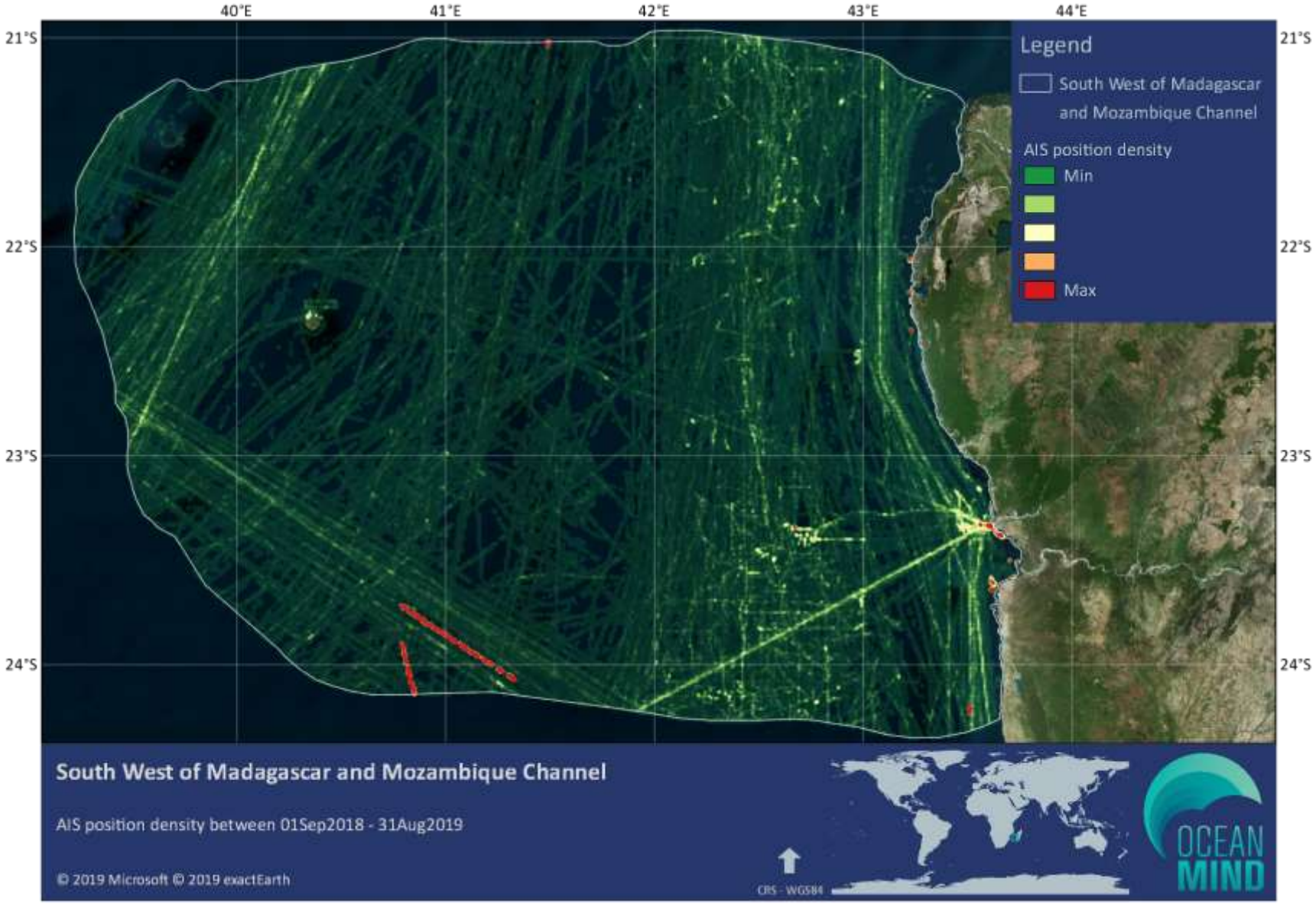


2.8 South West of Madagascar and Mozambique Channel IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	6	12	11	21	24	17	5	3	3	1	3	1	41
Fish carrier	0	0	1	0	0	1	1	0	1	0	0	0	4
Fish bunker	0	0	0	0	0	1	1	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	0	0	0	0	1	0	0	1
Cargo	21	22	18	17	19	14	30	20	14	13	11	21	175
Hazardous cargo	4	8	6	3	11	5	21	15	6	12	11	9	87
Passenger	0	0	0	1	1	0	0	1	0	0	0	0	3
Pleasure	1	5	2	0	0	0	1	1	7	3	2	2	20
Unknown	1	2	4	7	6	3	1	0	1	1	0	3	24
Other	3	1	5	1	4	1	5	4	0	2	2	4	25
Total	30	50	47	50	65	42	65	44	32	33	29	40	381

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTH WEST OF MADAGASCAR AND MOZAMBIQUE CHANNEL

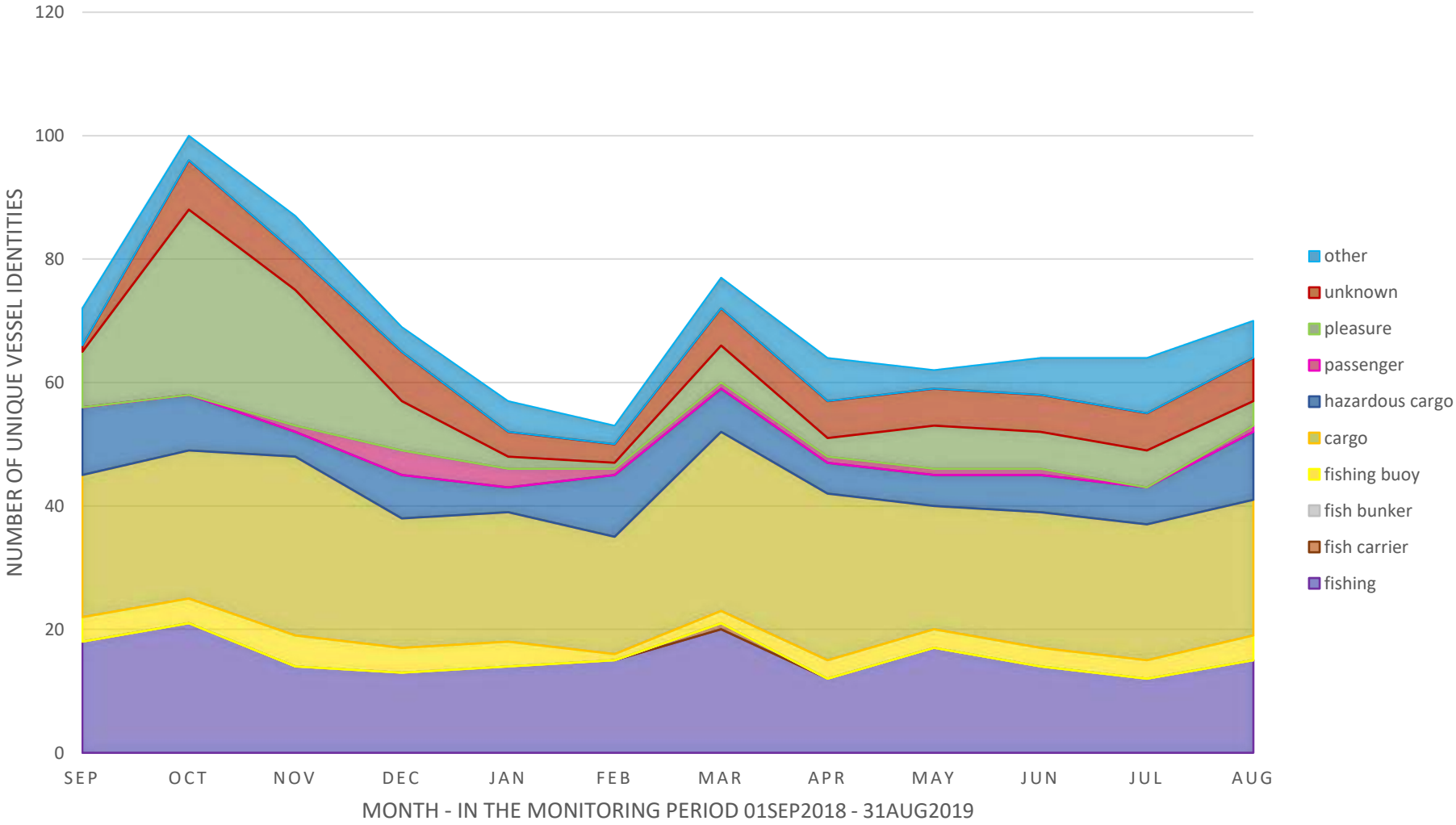


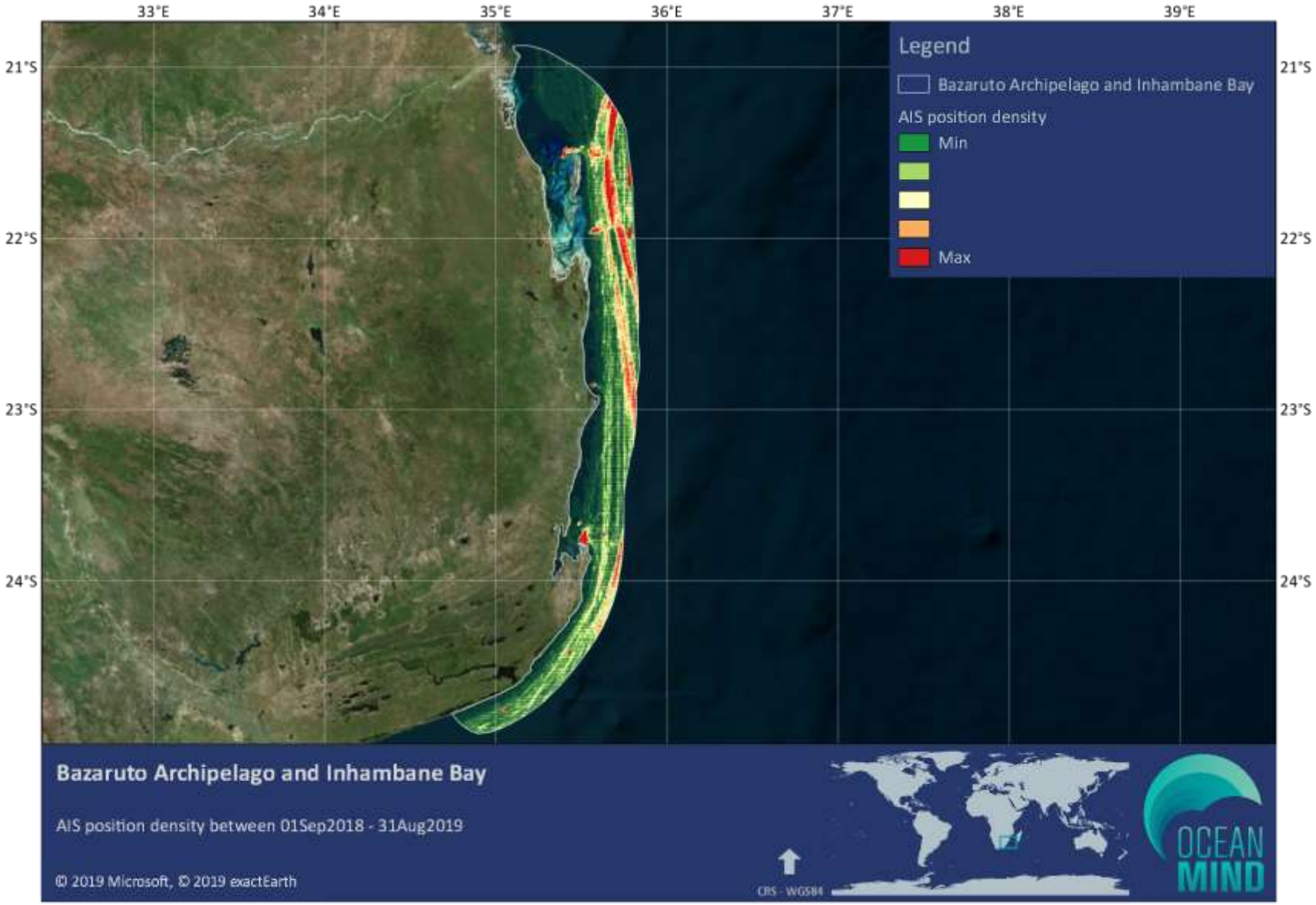


2.9 Bazaruto Archipelago and Inhambane Bay IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	18	21	14	13	14	15	20	12	17	14	12	15	45
Fish carrier	0	0	0	0	0	0	1	0	0	0	0	0	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	4	4	5	4	4	1	2	3	3	3	3	4	5
Cargo	23	24	29	21	21	19	29	27	20	22	22	22	154
Hazardous cargo	11	9	4	7	4	10	7	5	5	6	6	11	42
Passenger	0	0	1	4	3	1	1	1	1	1	0	1	6
Pleasure	9	30	22	8	2	1	6	3	7	6	6	4	66
Unknown	1	8	6	8	4	3	6	6	6	6	6	7	31
Other	6	4	6	4	5	3	5	7	3	6	9	6	27
Total	72	100	87	69	57	53	77	64	62	64	64	70	377

NUMBER OF VESSELS AGGREGATED BY CATEGORY - BAZARUTO ARCHIPELAGO AND INHAMBANE BAY

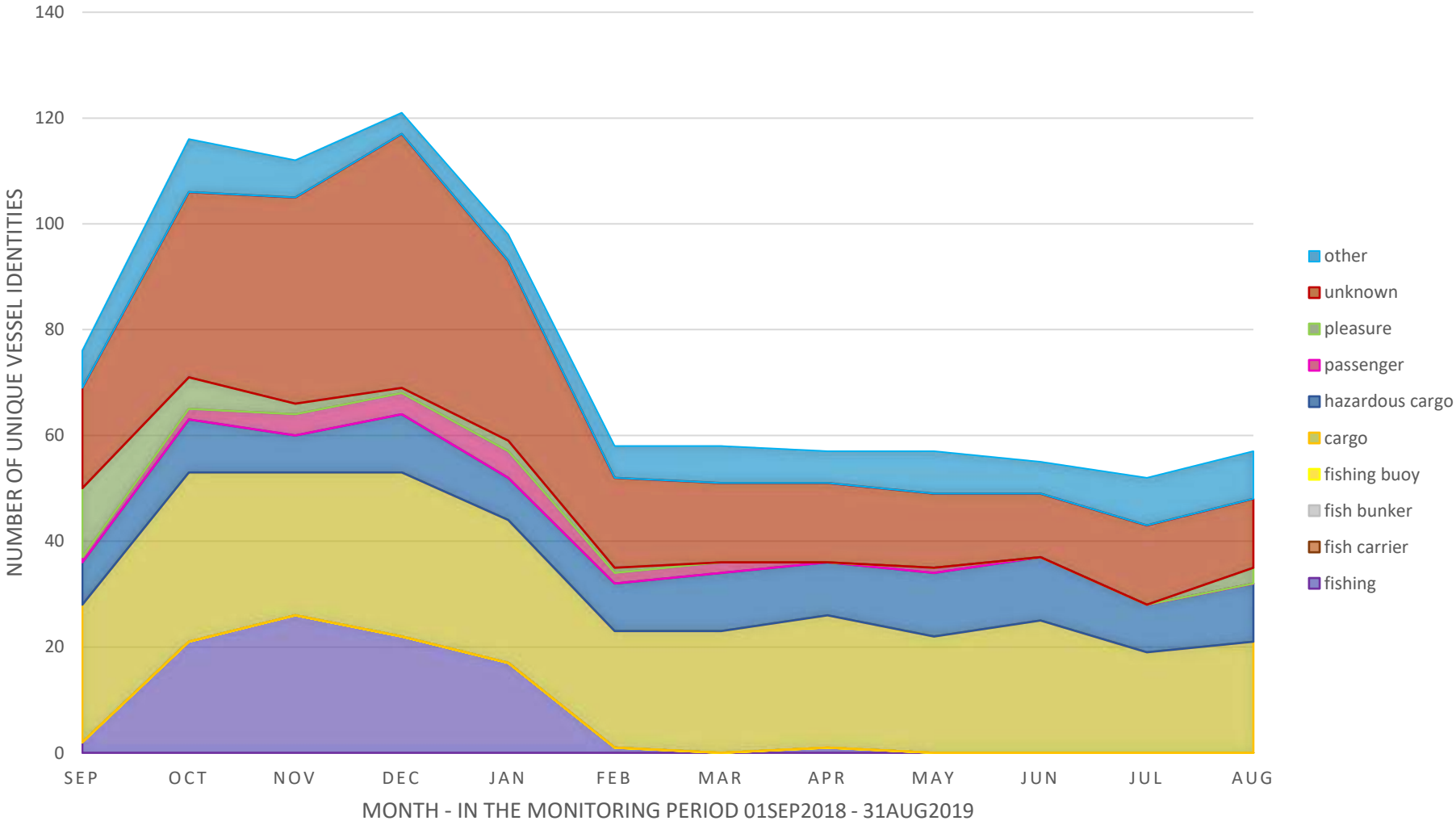


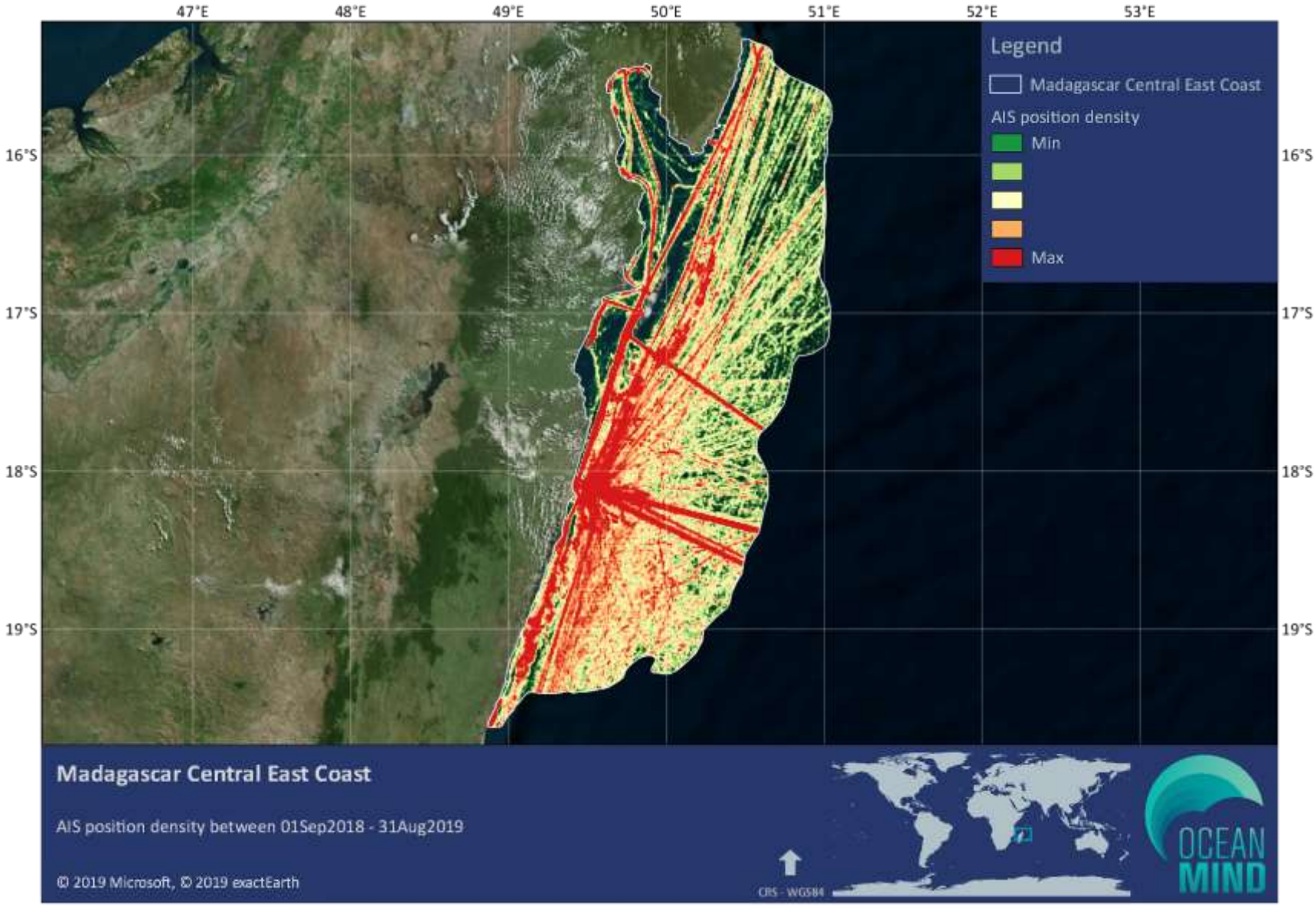


2.10 Madagascar Central East Coast IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	21	26	22	17	1	0	1	0	0	0	0	46
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	26	32	27	31	27	22	23	25	22	25	19	21	140
Hazardous cargo	8	10	7	11	8	9	11	10	12	12	9	11	52
Passenger	1	2	4	4	5	2	2	0	1	0	0	0	6
Pleasure	13	6	2	1	2	1	0	0	0	0	0	3	23
Unknown	19	35	39	48	34	17	15	15	14	12	15	13	80
Other	7	10	7	4	5	6	7	6	8	6	9	9	18
Total	76	116	112	121	98	58	58	57	57	55	52	57	365

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MADAGASCAR CENTRAL EAST COAST

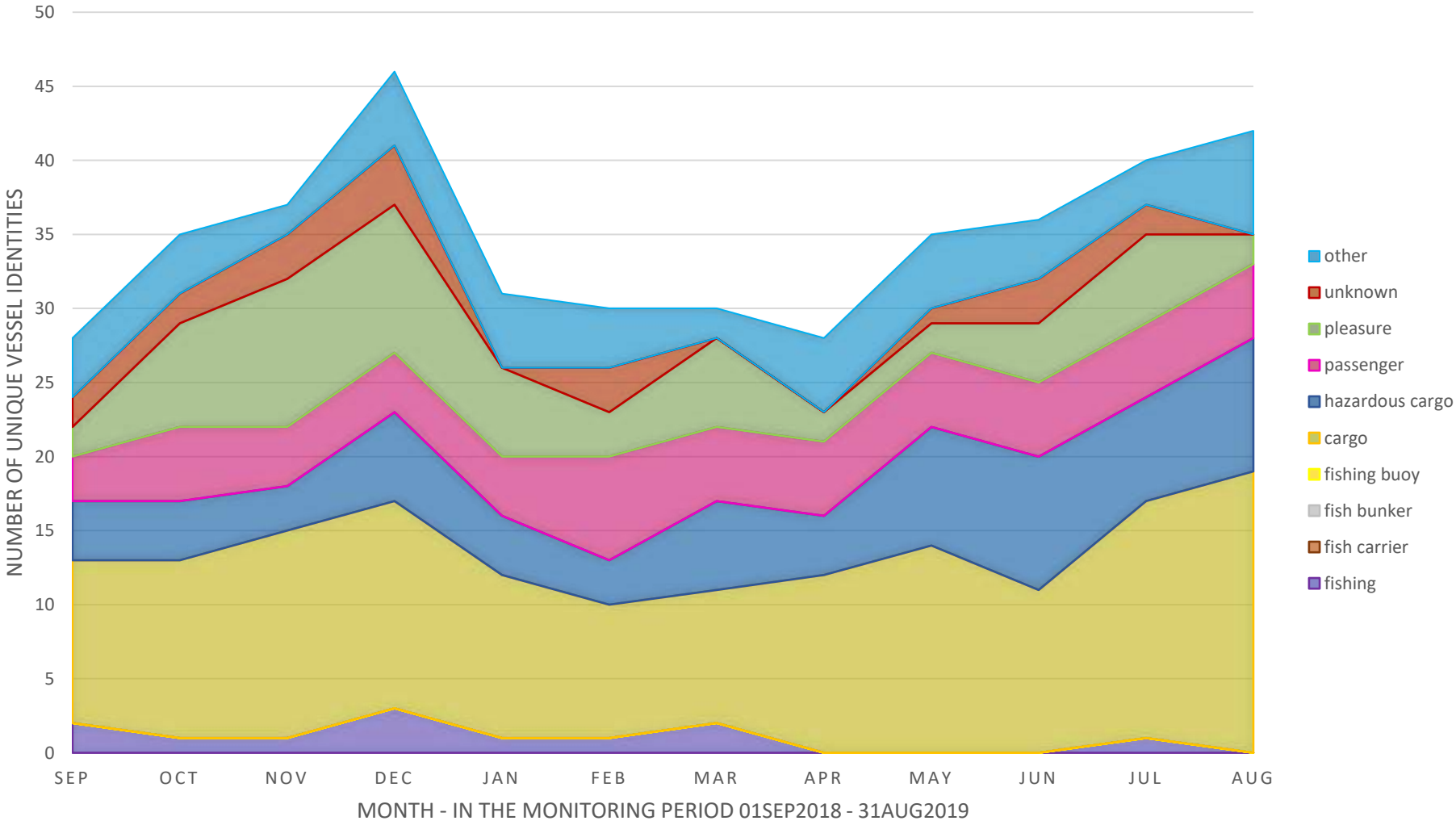


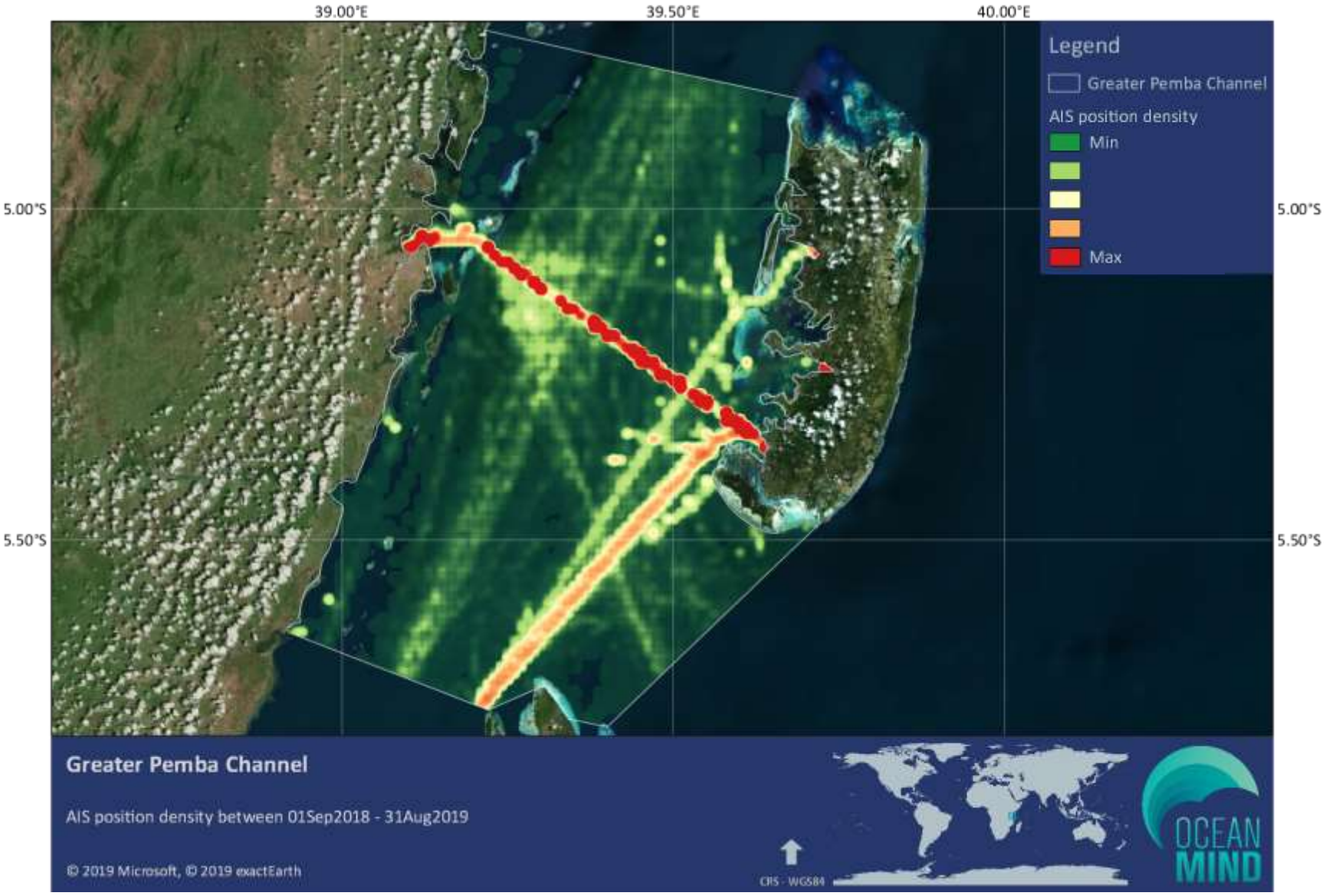


2.11 Greater Pemba Channel IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	1	1	3	1	1	2	0	0	0	1	0	8
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	11	12	14	14	11	9	9	12	14	11	16	19	73
Hazardous cargo	4	4	3	6	4	3	6	4	8	9	7	9	27
Passenger	3	5	4	4	4	7	5	5	5	5	5	5	7
Pleasure	2	7	10	10	6	3	6	2	2	4	6	2	30
Unknown	2	2	3	4	0	3	0	0	1	3	2	0	13
Other	4	4	2	5	5	4	2	5	5	4	3	7	18
Total	28	35	37	46	31	30	30	28	35	36	40	42	176

NUMBER OF VESSELS AGGREGATED BY CATEGORY - GREATER PEMBA CHANNEL

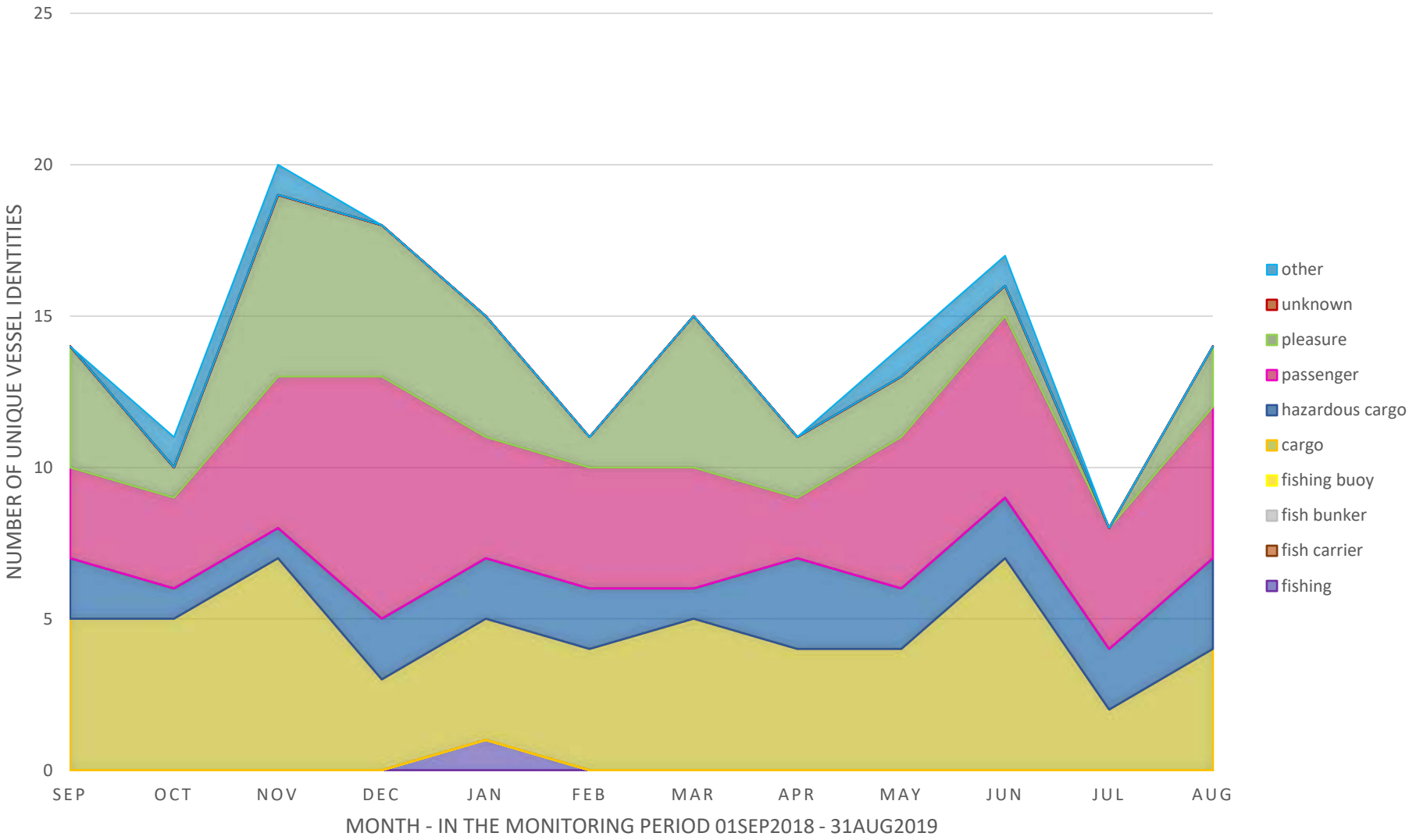


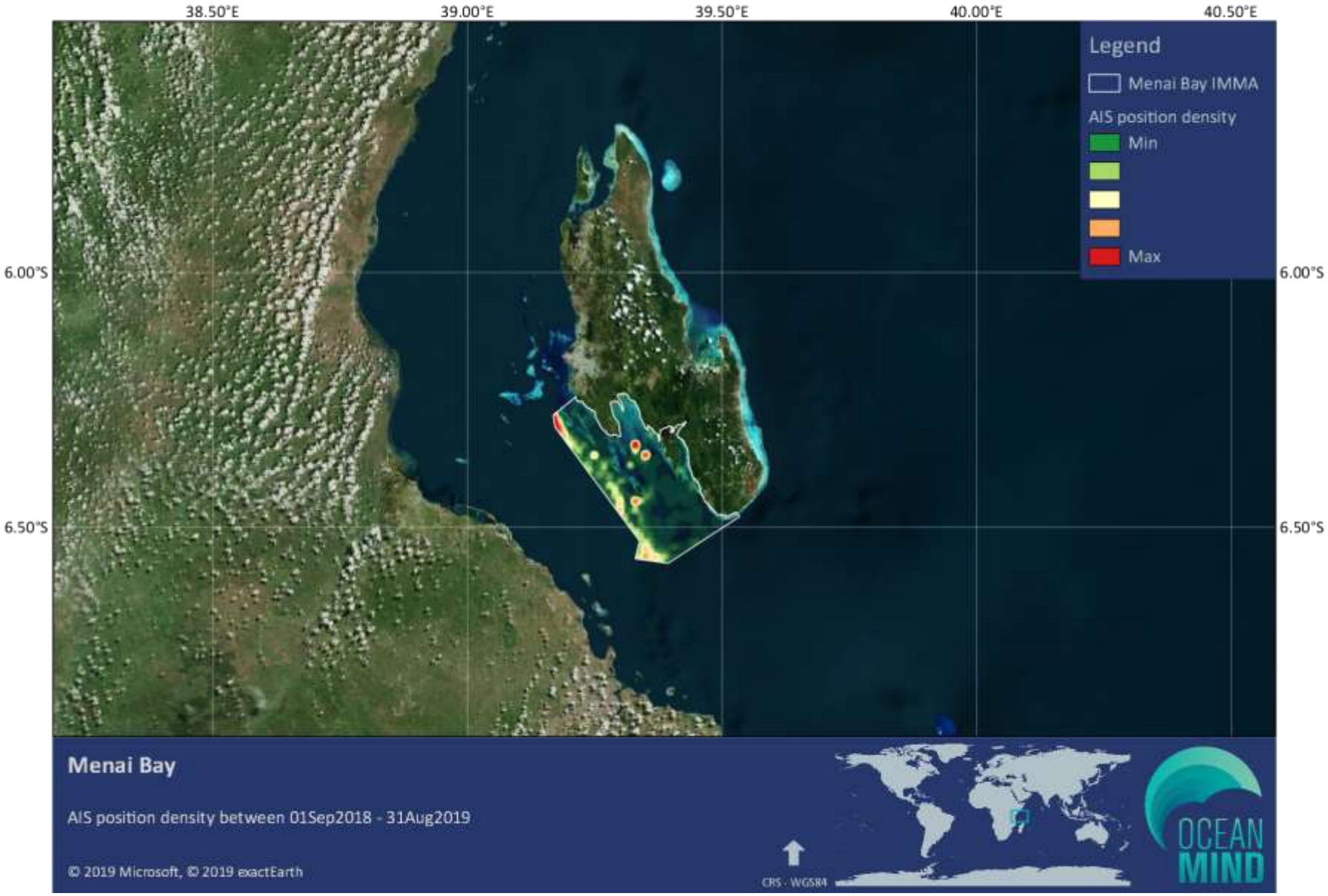


2.12 Menai Bay IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	1	0	0	0	0	0	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	5	5	7	3	4	4	5	4	4	7	2	4	24
Hazardous cargo	2	1	1	2	2	2	1	3	2	2	2	3	4
Passenger	3	3	5	8	4	4	4	2	5	6	4	5	10
Pleasure	4	1	6	5	4	1	5	2	2	1	0	2	16
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	1	1	0	0	0	0	0	1	1	0	0	3
Total	14	11	20	18	15	11	15	11	14	17	8	14	58

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MENAI BAY

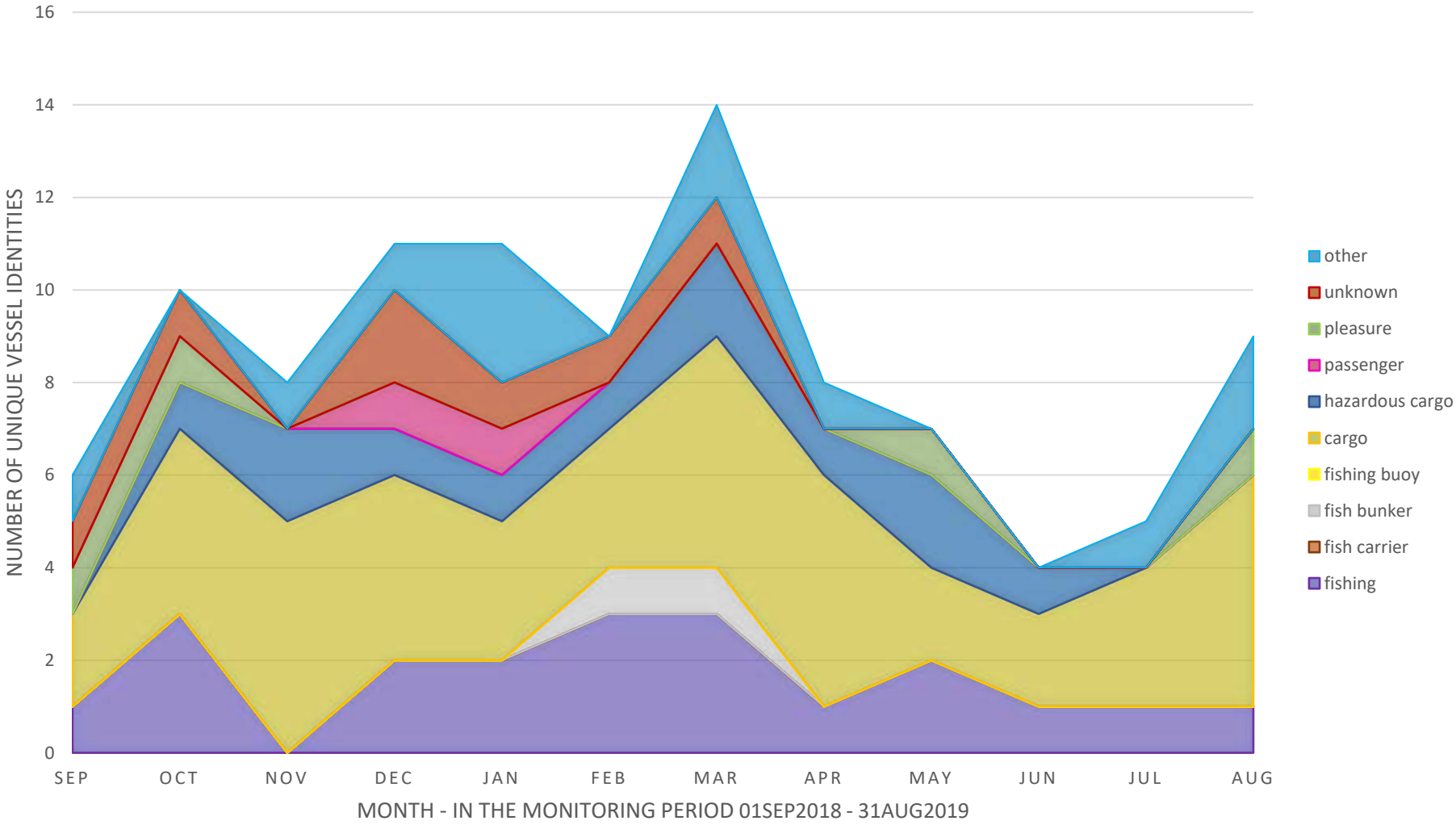


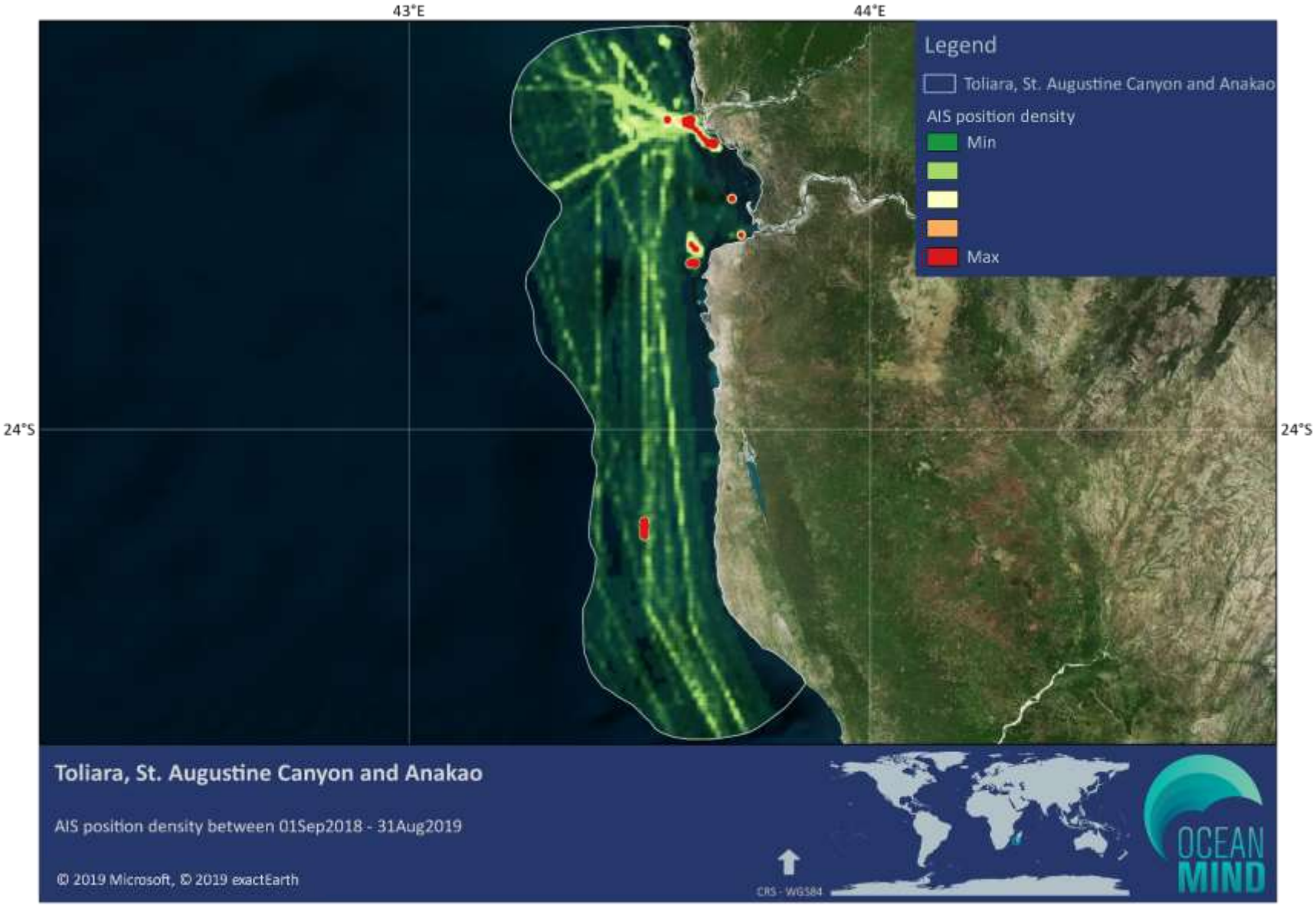


2.13 Toliara, St. Augustine Canyon and Anakao IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	3	0	2	2	3	3	1	2	1	1	1	5
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	1	1	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	2	4	5	4	3	3	5	5	2	2	3	5	19
Hazardous cargo	0	1	2	1	1	1	2	1	2	1	0	0	4
Passenger	0	0	0	1	1	0	0	0	0	0	0	0	2
Pleasure	1	1	0	0	0	0	0	0	1	0	0	1	4
Unknown	1	1	0	2	1	1	1	0	0	0	0	0	2
Other	1	0	1	1	3	0	2	1	0	0	1	2	7
Total	6	10	8	11	11	9	14	8	7	4	5	9	44

NUMBER OF VESSELS AGGREGATED BY CATEGORY - TOLIARA, ST. AUGUSTINE CANYON AND ANAKAO

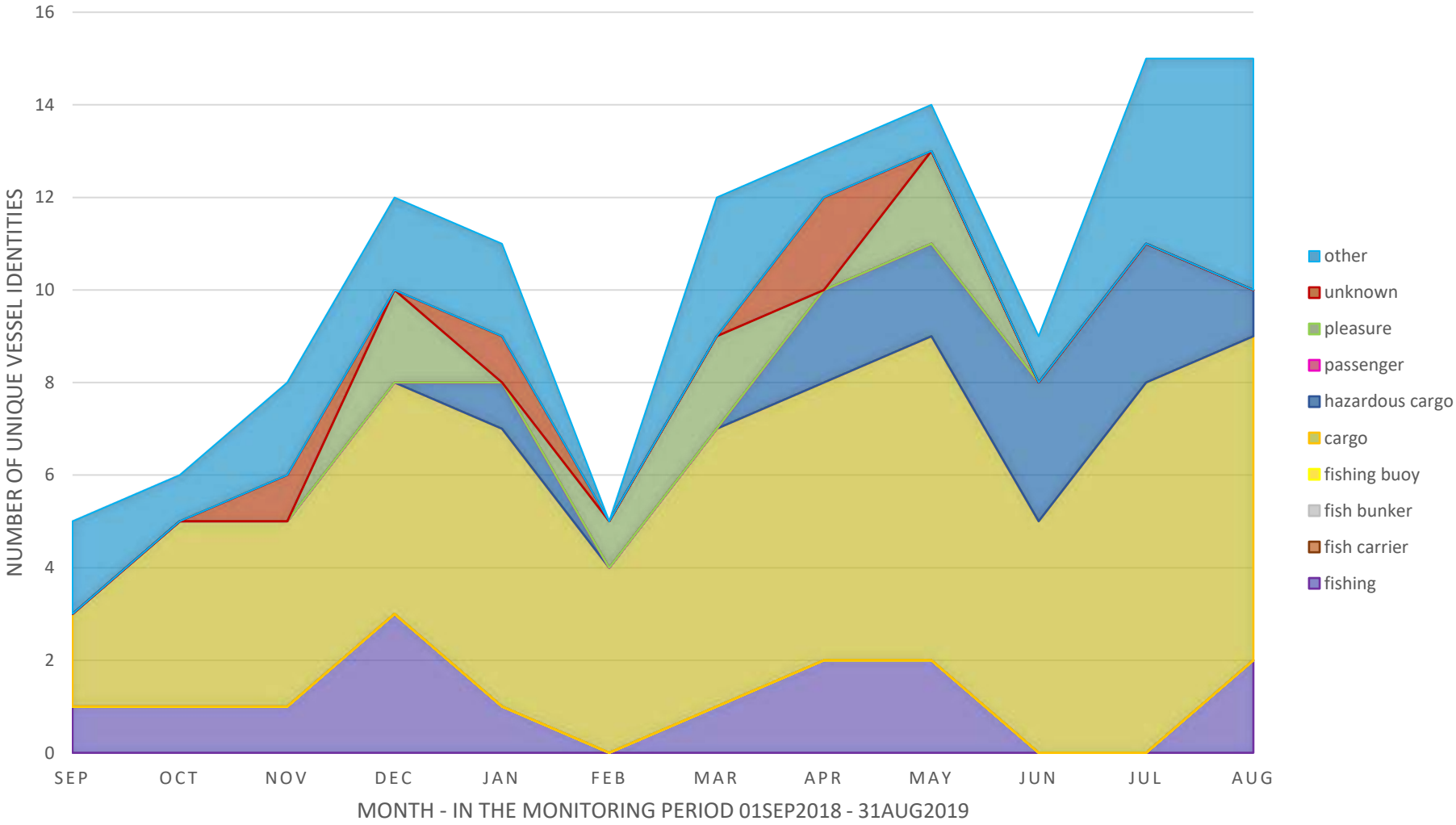


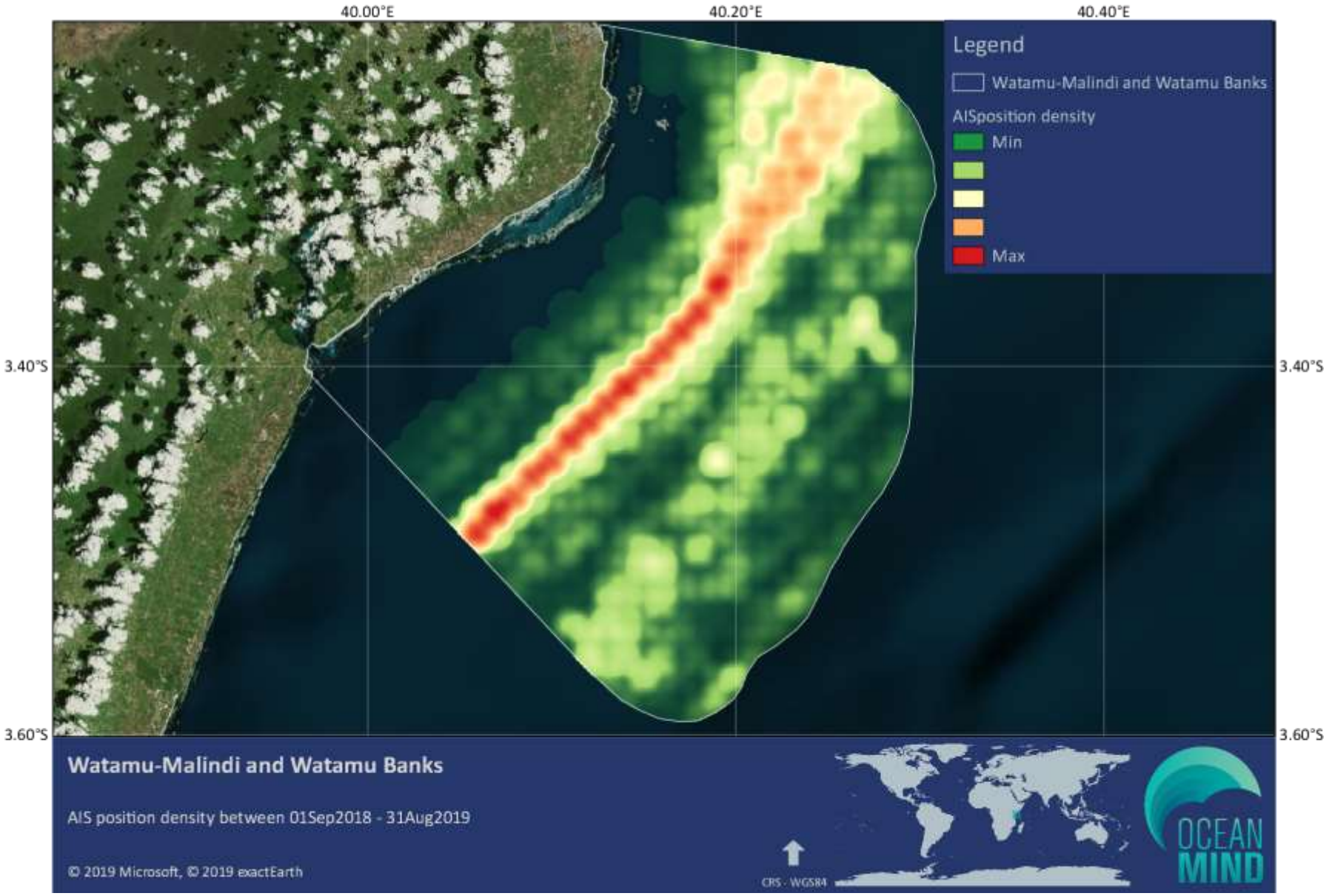


2.14 Watamu-Malindi and Watamu Banks IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	1	1	3	1	0	1	2	2	0	0	2	5
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	2	4	4	5	6	4	6	6	7	5	8	7	13
Hazardous cargo	0	0	0	0	1	0	0	2	2	3	3	1	8
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	2	0	1	2	0	2	0	0	0	7
Unknown	0	0	1	0	1	0	0	2	0	0	0	0	2
Other	2	1	2	2	2	0	3	1	1	1	4	5	10
Total	5	6	8	12	11	5	12	13	14	9	15	15	45

NUMBER OF VESSELS AGGREGATED BY CATEGORY - WATAMU-MALINDI AND WATAMU BANKS

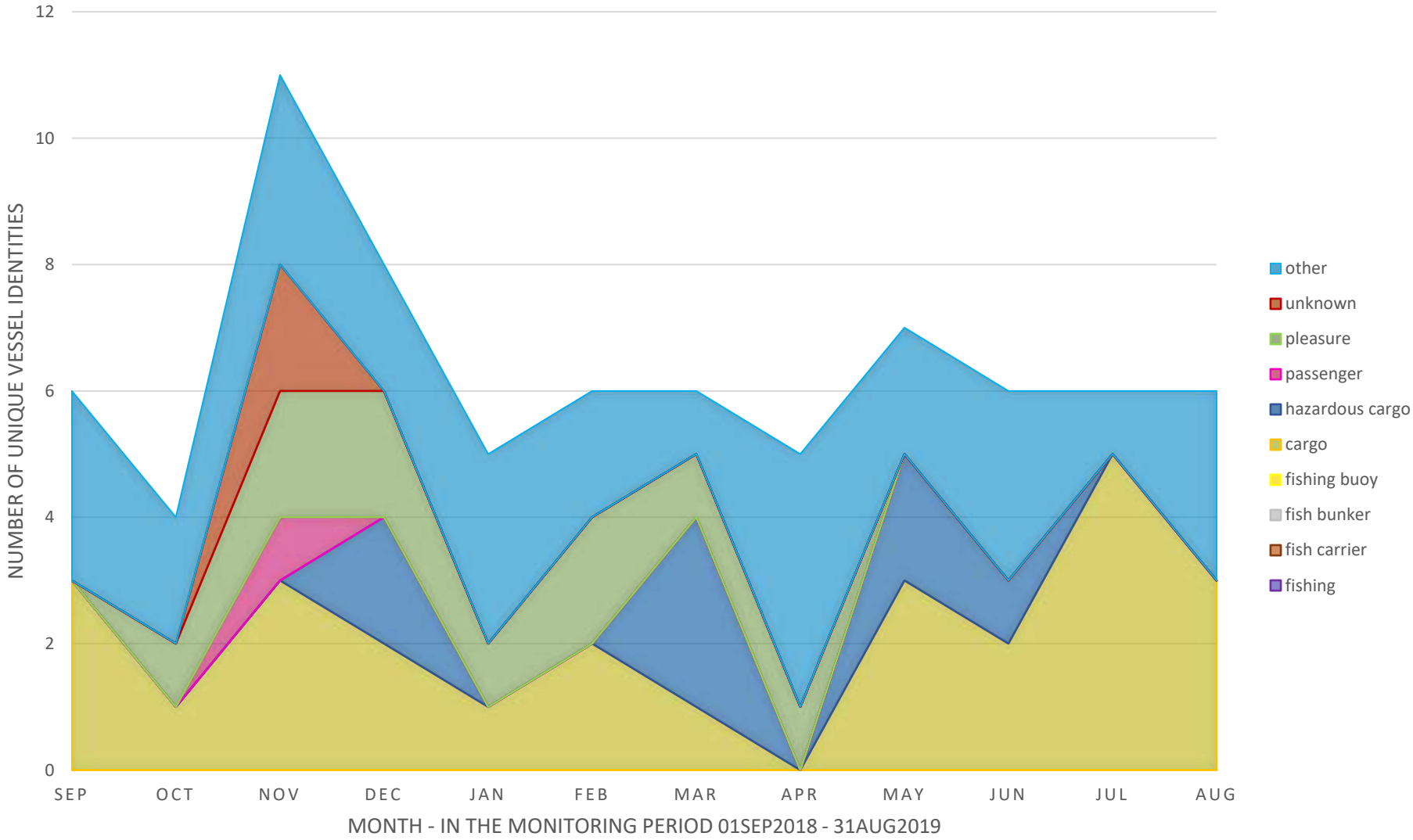


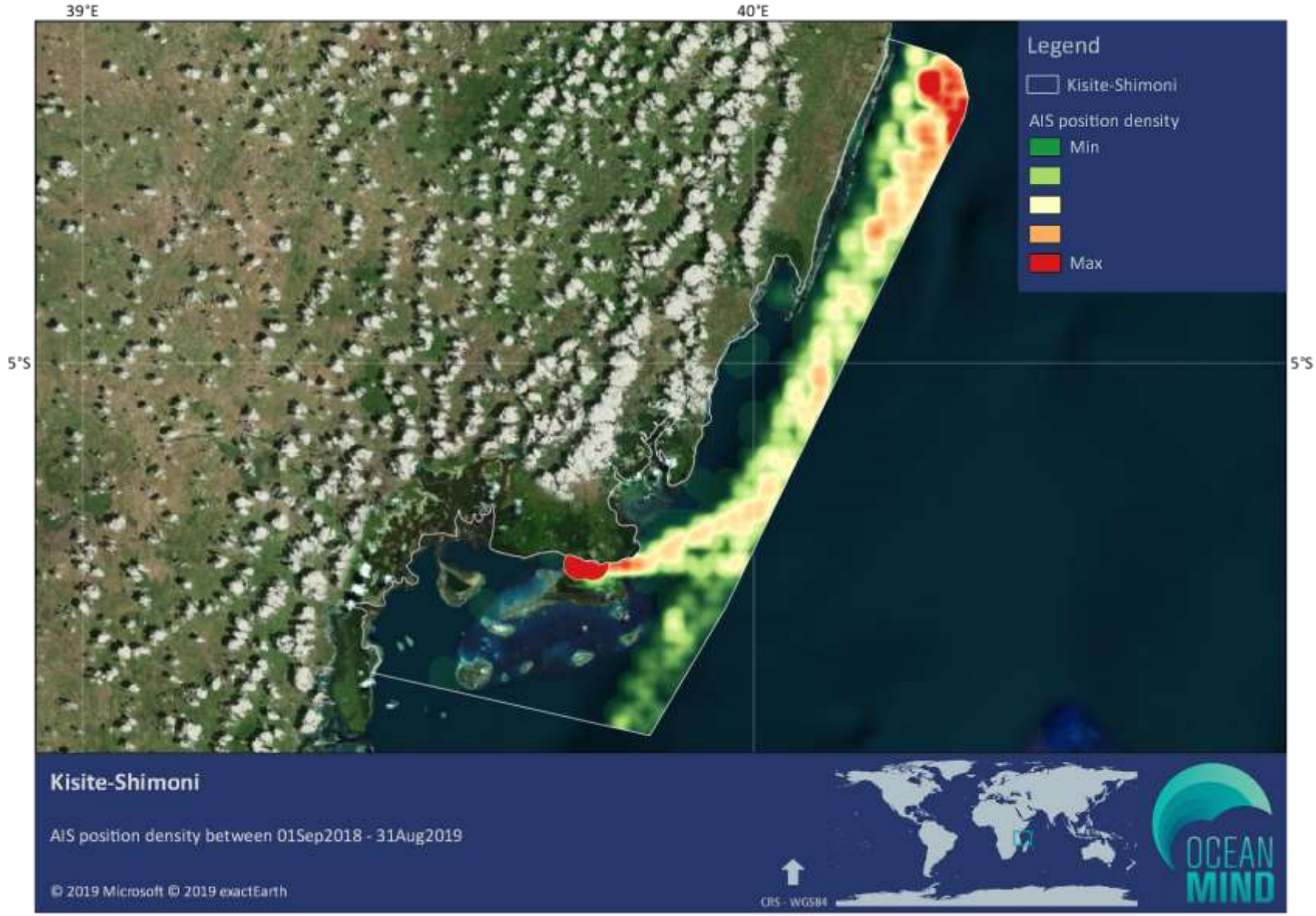


2.15 Kisite-Shimoni IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	3	1	3	2	1	2	1	0	3	2	5	3	9
Hazardous cargo	0	0	0	2	0	0	3	0	2	1	0	0	6
Passenger	0	0	1	0	0	0	0	0	0	0	0	0	1
Pleasure	0	1	2	2	1	2	1	1	0	0	0	0	8
Unknown	0	0	2	0	0	0	0	0	0	0	0	0	2
Other	3	2	3	2	3	2	1	4	2	3	1	3	9
Total	6	4	11	8	5	6	6	5	7	6	6	6	35

NUMBER OF VESSELS AGGREGATED BY CATEGORY - KISITE-SHIMONI

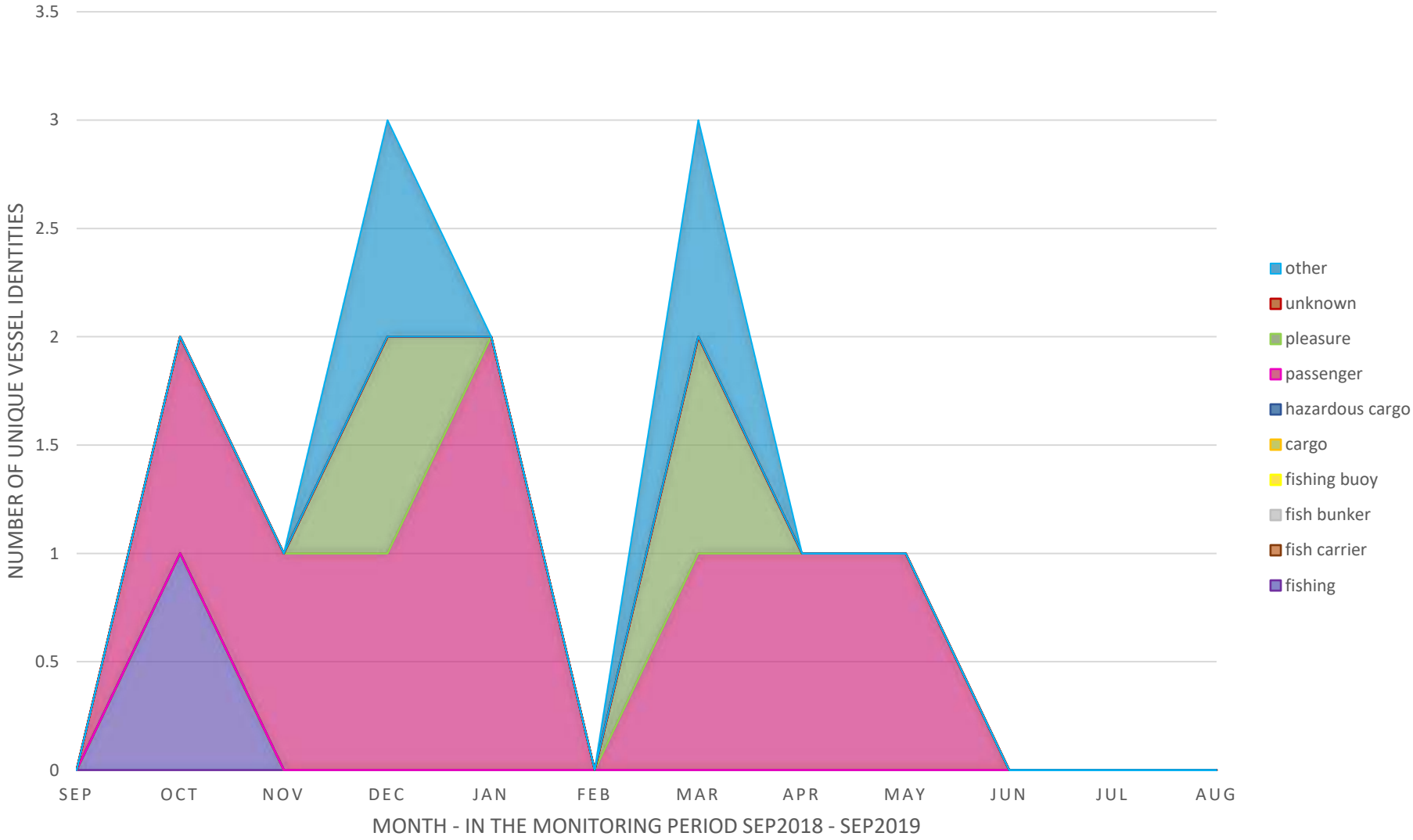




2.16 Aldabra Atoll IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	0	0	0	0	0	0	0	0	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger	0	1	1	1	2	0	1	1	1	0	0	0	5
Pleasure	0	0	0	1	0	0	1	0	0	0	0	0	2
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	1	0	0	1	0	0	0	0	0	2
Total	0	2	1	3	2	0	3	1	1	0	0	0	10

NUMBER OF VESSELS AGGREGATED BY CATEGORY - ALDABRA ATOLL

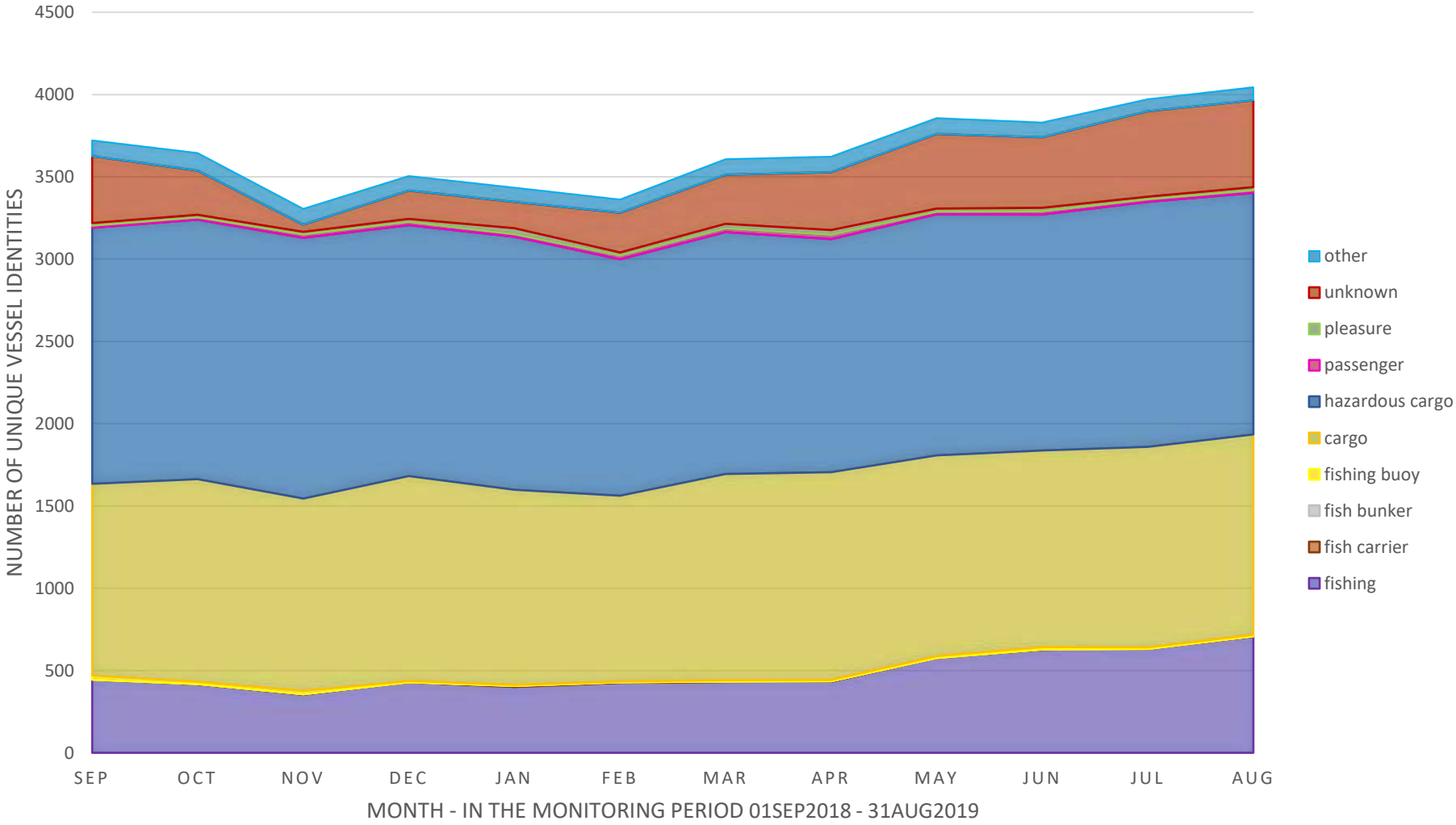


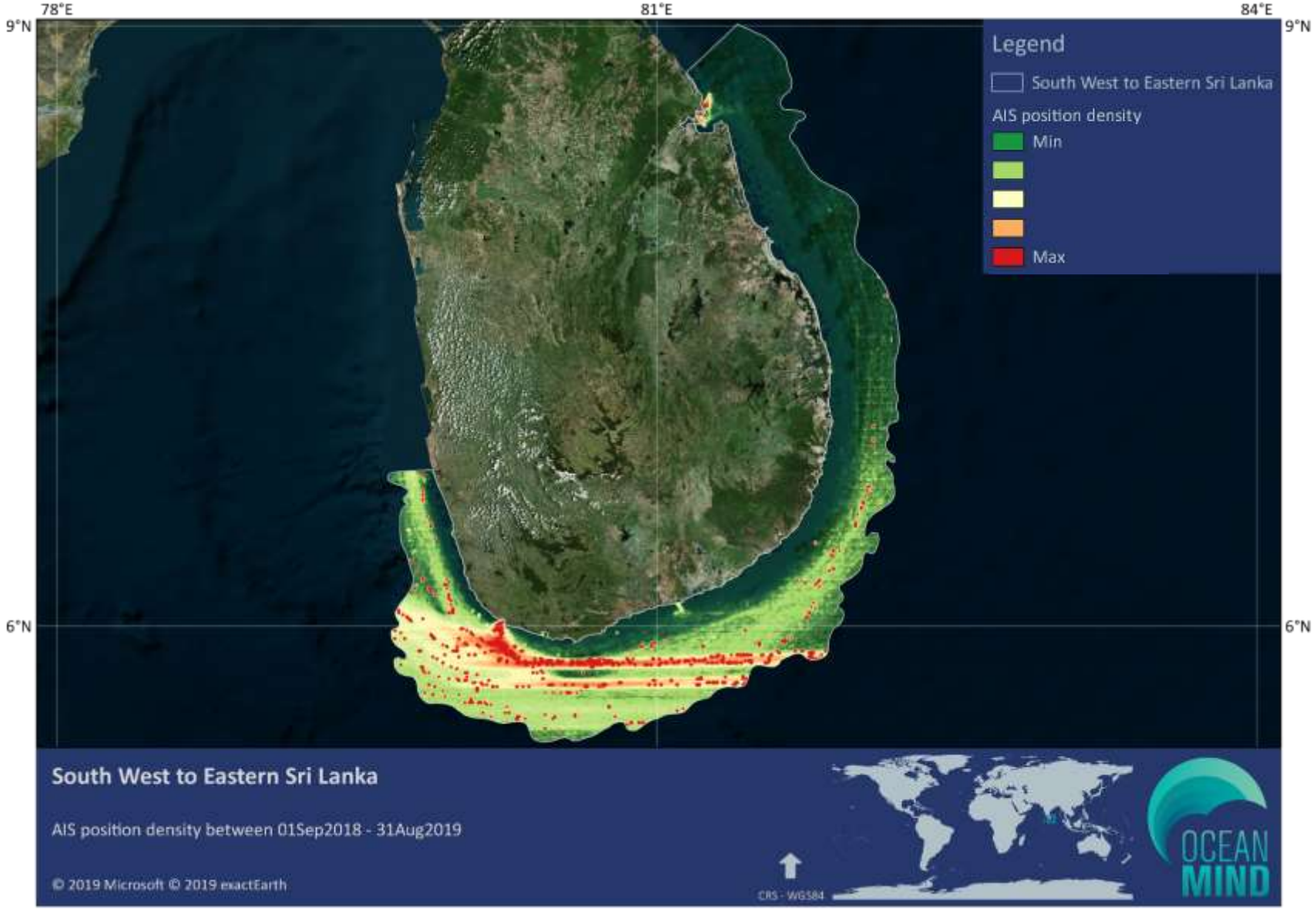
3 Northwest Indian Ocean

3.1 South West to Eastern Sri Lanka IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	444	416	354	428	401	425	431	432	576	627	631	706	1475
Fish carrier	1	1	2	0	5	3	3	3	1	1	1	2	8
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	24	15	20	9	7	5	7	8	10	15	9	9	53
Cargo	1166	1231	1169	1244	1185	1129	1254	1263	1220	1194	1218	1218	5816
Hazardous cargo	1555	1576	1585	1526	1537	1437	1469	1415	1466	1434	1489	1467	4652
Passenger	13	15	20	19	17	23	24	28	15	20	15	16	106
Pleasure	16	15	15	18	36	18	26	28	19	21	16	19	115
Unknown	407	268	44	172	159	241	298	351	453	428	520	528	1647
Other	95	107	96	88	87	81	94	94	96	89	72	79	516
Total	3721	3644	3305	3504	3434	3362	3606	3622	3856	3829	3971	4044	14388

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTH WEST TO EASTERN SRI LANKA

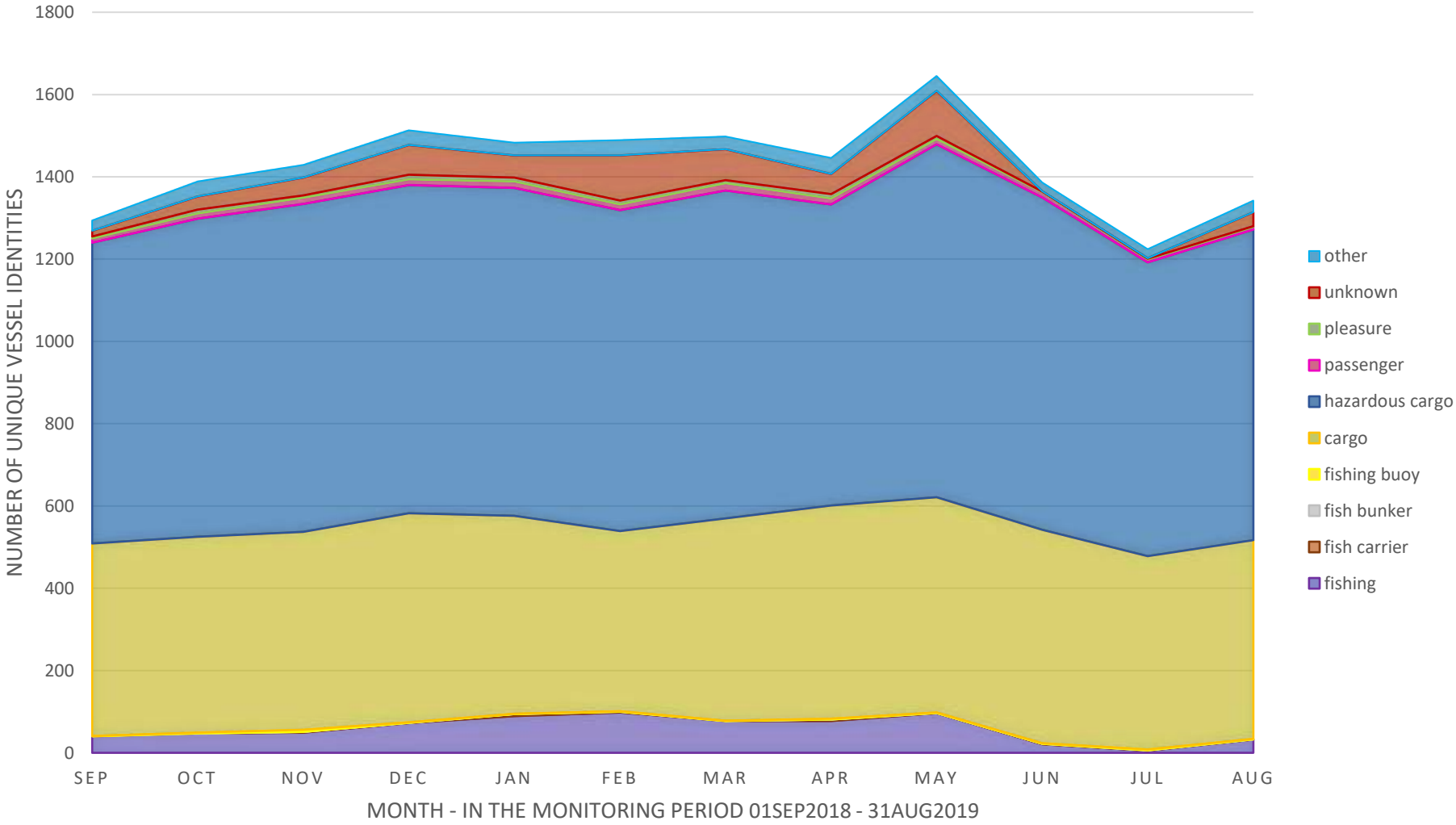


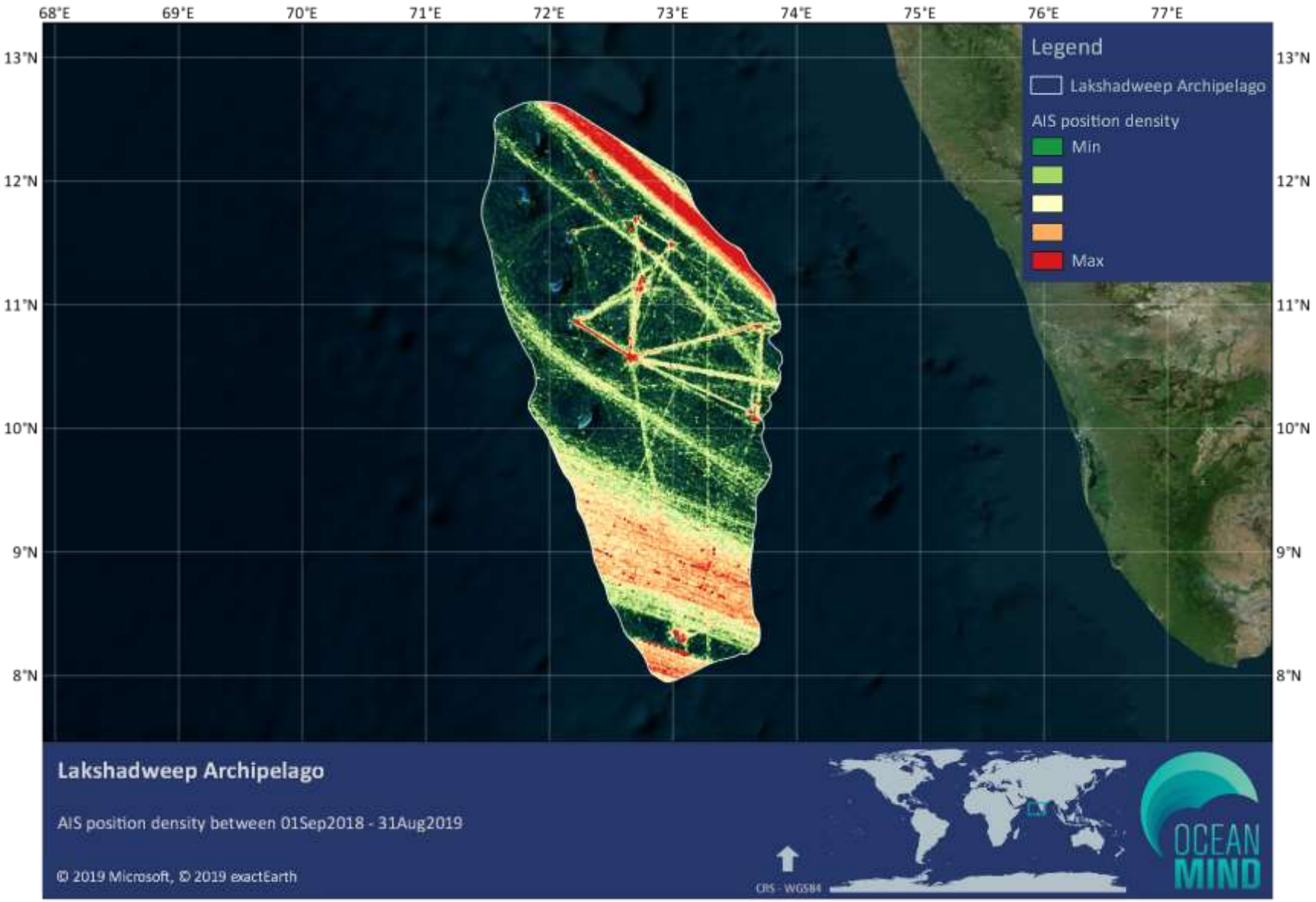


3.2 Lakshadweep Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	40	47	49	72	89	98	77	77	96	21	5	32	313
Fish carrier	0	0	2	1	5	2	0	4	1	1	1	1	9
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	1	2	5	1	1	1	1	2	1	1	2	1	8
Cargo	468	476	481	508	481	438	492	518	523	519	470	483	3117
Hazardous cargo	731	773	797	798	797	780	797	732	858	808	714	755	3093
Passenger	10	13	15	14	16	14	17	14	13	12	7	6	45
Pleasure	5	9	6	11	9	9	8	11	7	2	2	2	30
Unknown	14	32	43	72	54	110	75	49	110	1	1	34	355
Other	25	37	31	36	31	37	31	39	36	21	22	28	192
Total	1294	1389	1429	1513	1483	1489	1498	1446	1645	1386	1224	1342	7162

NUMBER OF VESSELS AGGREGATED BY CATEGORY - LAKSHADWEEP ARCHIPELAGO

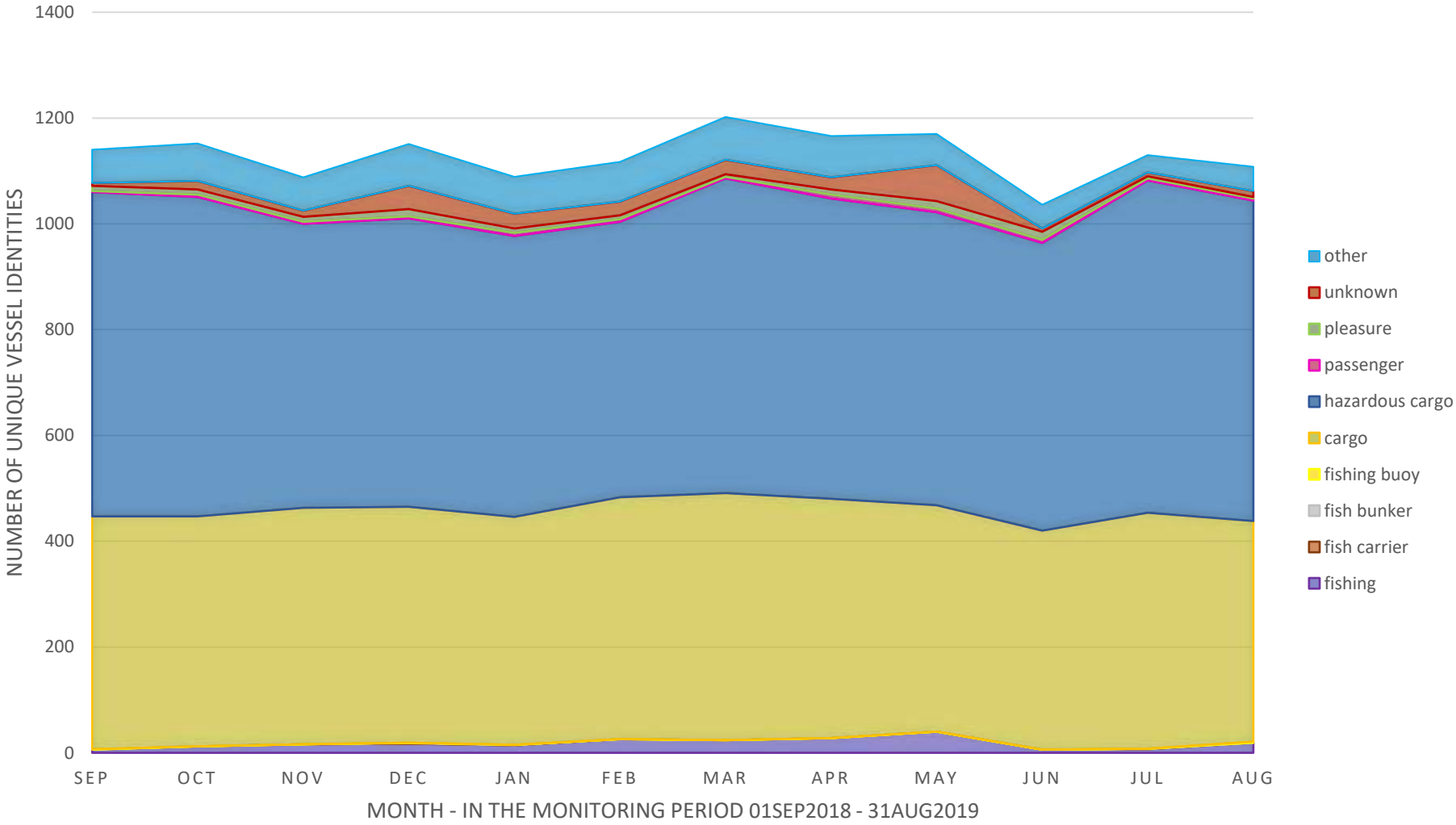


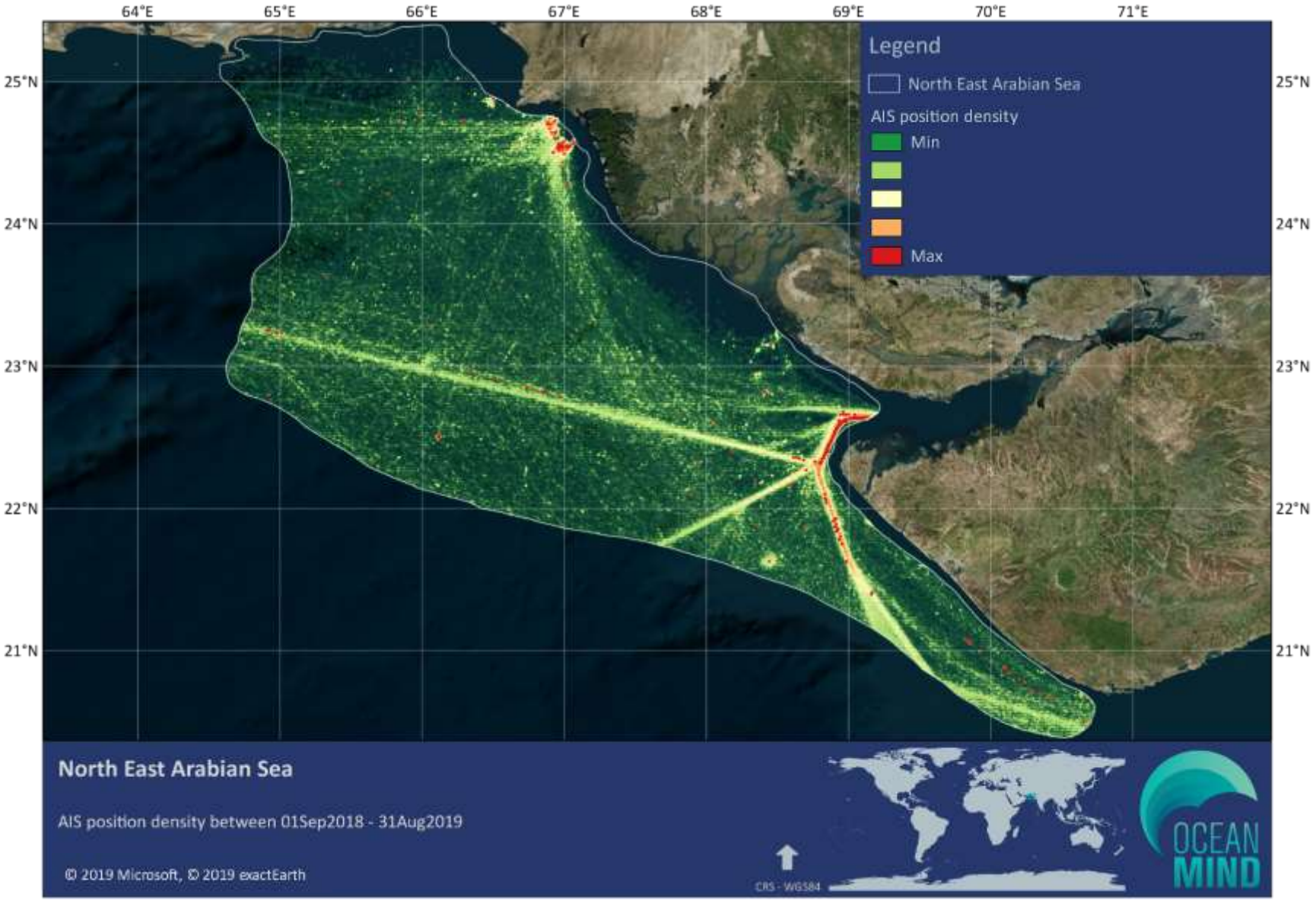


3.3 North East Arabian Sea IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	6	12	16	17	14	26	24	28	40	6	7	19	99
Fish carrier	0	0	0	1	0	0	0	0	0	0	0	0	1
Fish bunker	0	0	0	1	1	0	0	0	0	0	1	0	2
Fishing buoy	1	0	0	0	0	0	0	0	0	0	0	2	2
Cargo	440	435	447	446	431	457	467	452	428	414	446	417	2597
Hazardous cargo	613	604	537	545	531	521	595	568	554	544	628	606	2521
Passenger	2	4	4	4	6	5	3	7	7	6	4	4	28
Pleasure	10	10	9	14	8	7	5	10	14	15	4	3	36
Unknown	5	16	12	44	28	26	27	23	68	6	7	11	187
Other	63	71	63	79	70	75	81	78	59	45	33	46	343
Total	1140	1152	1088	1151	1089	1117	1202	1166	1170	1036	1130	1108	5816

NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTH EAST ARABIAN SEA

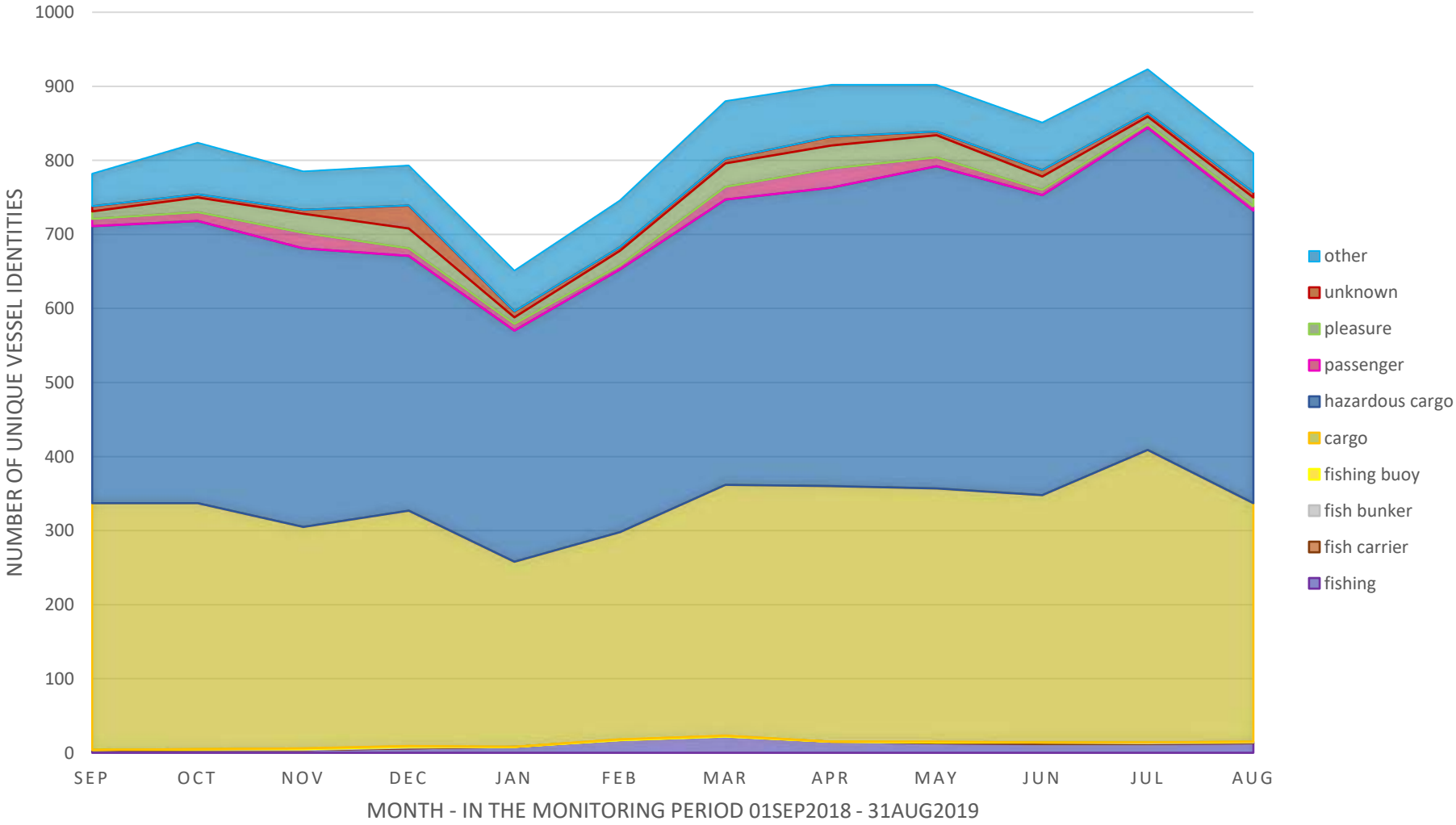


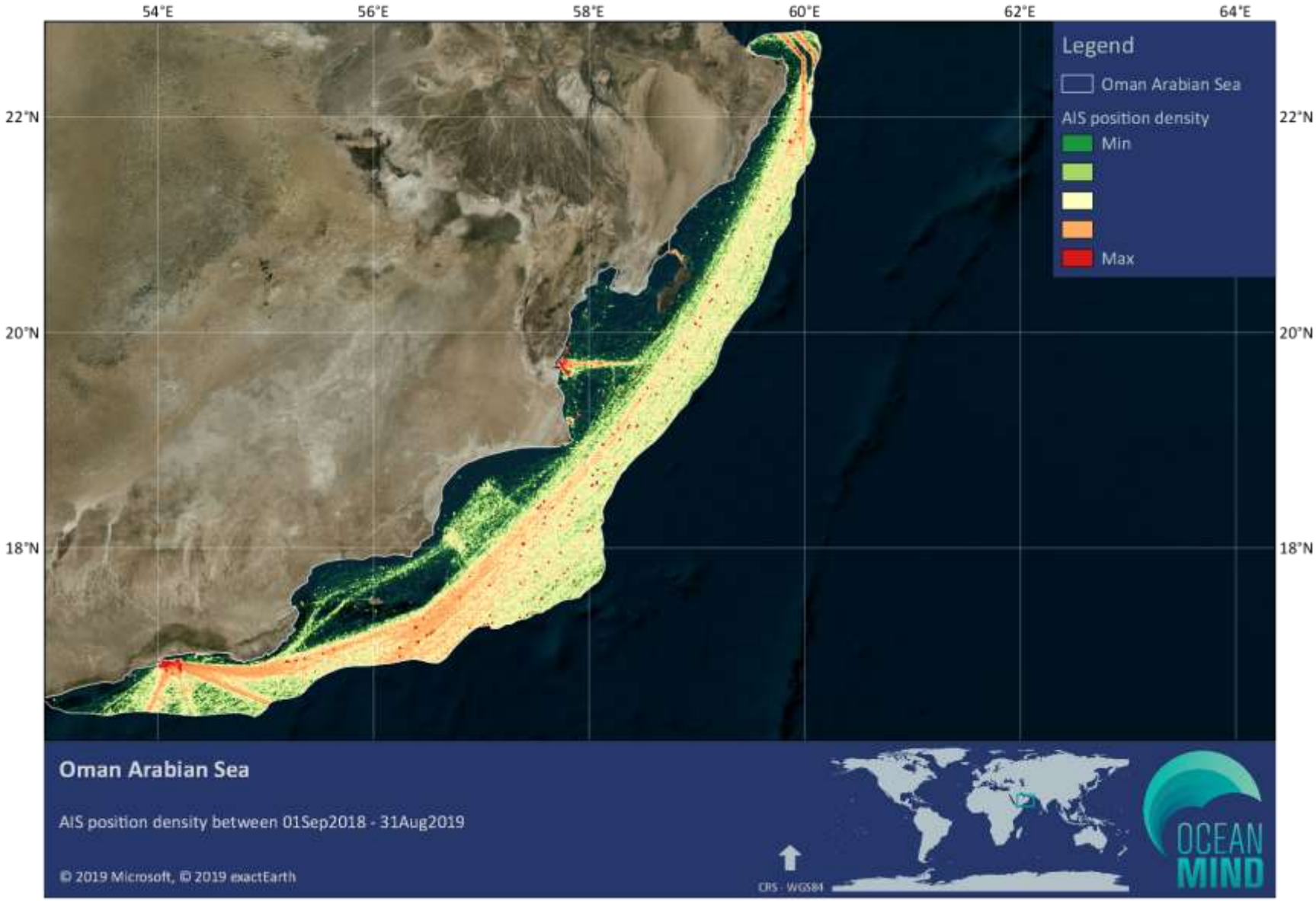


3.4 Oman Arabian Sea IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	3	4	4	6	8	17	22	15	13	12	12	13	42
Fish carrier	1	0	0	1	0	0	0	0	1	2	1	1	3
Fish bunker	0	1	1	1	0	0	0	0	0	0	1	1	3
Fishing buoy	0	0	1	1	0	1	1	0	1	0	0	0	3
Cargo	333	332	299	318	250	280	339	345	342	334	395	322	1991
Hazardous cargo	374	381	376	344	312	355	385	403	435	405	435	395	1871
Passenger	10	12	21	10	9	5	17	26	12	7	5	6	72
Pleasure	10	20	26	27	9	20	32	31	30	18	10	12	94
Unknown	7	4	5	31	8	5	6	12	5	9	5	7	77
Other	44	70	52	54	55	63	78	70	63	64	59	53	293
Total	782	824	785	793	651	746	880	902	902	851	923	810	4449

NUMBER OF VESSELS AGGREGATED BY CATEGORY - OMAN ARABIAN SEA

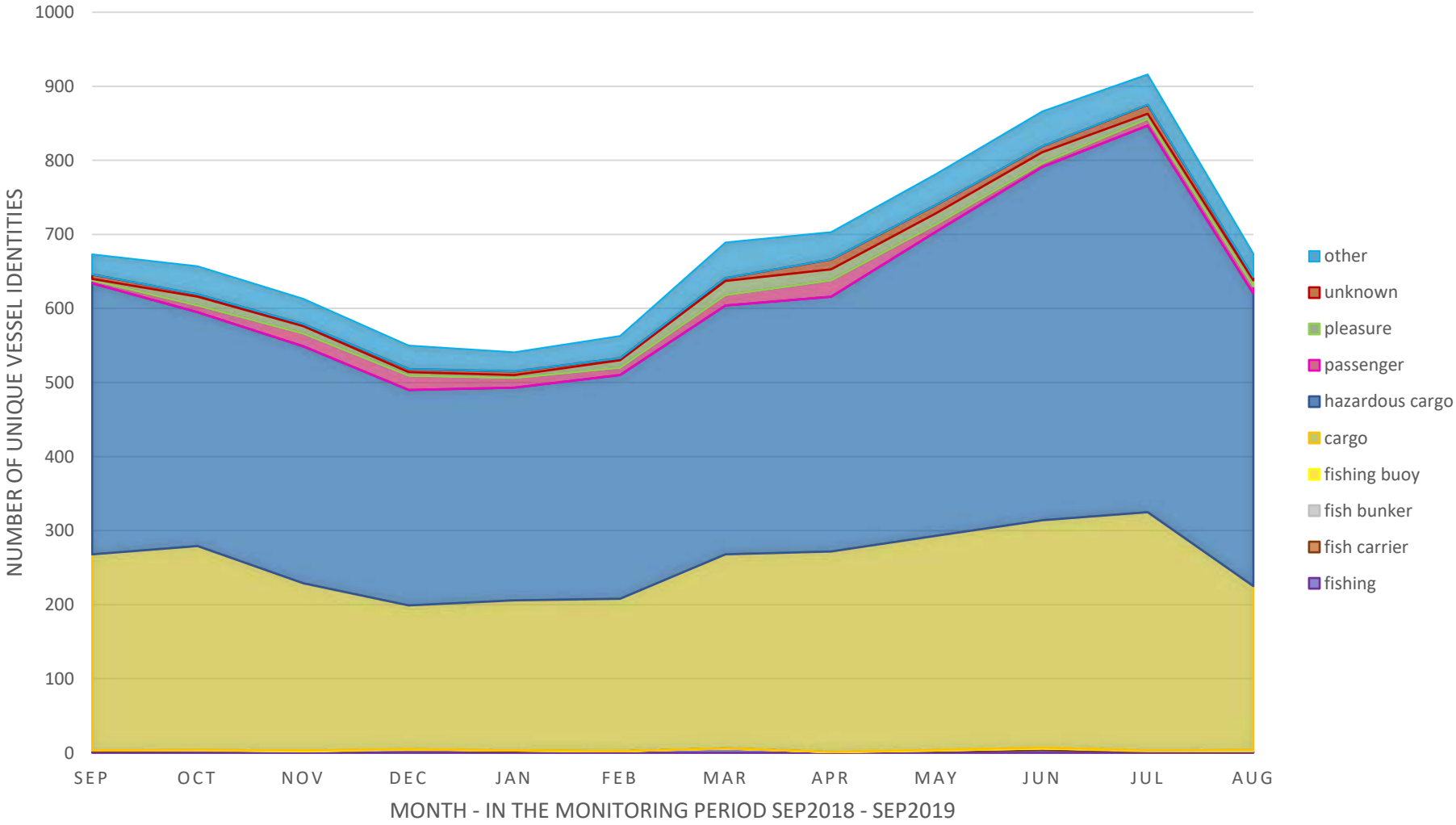


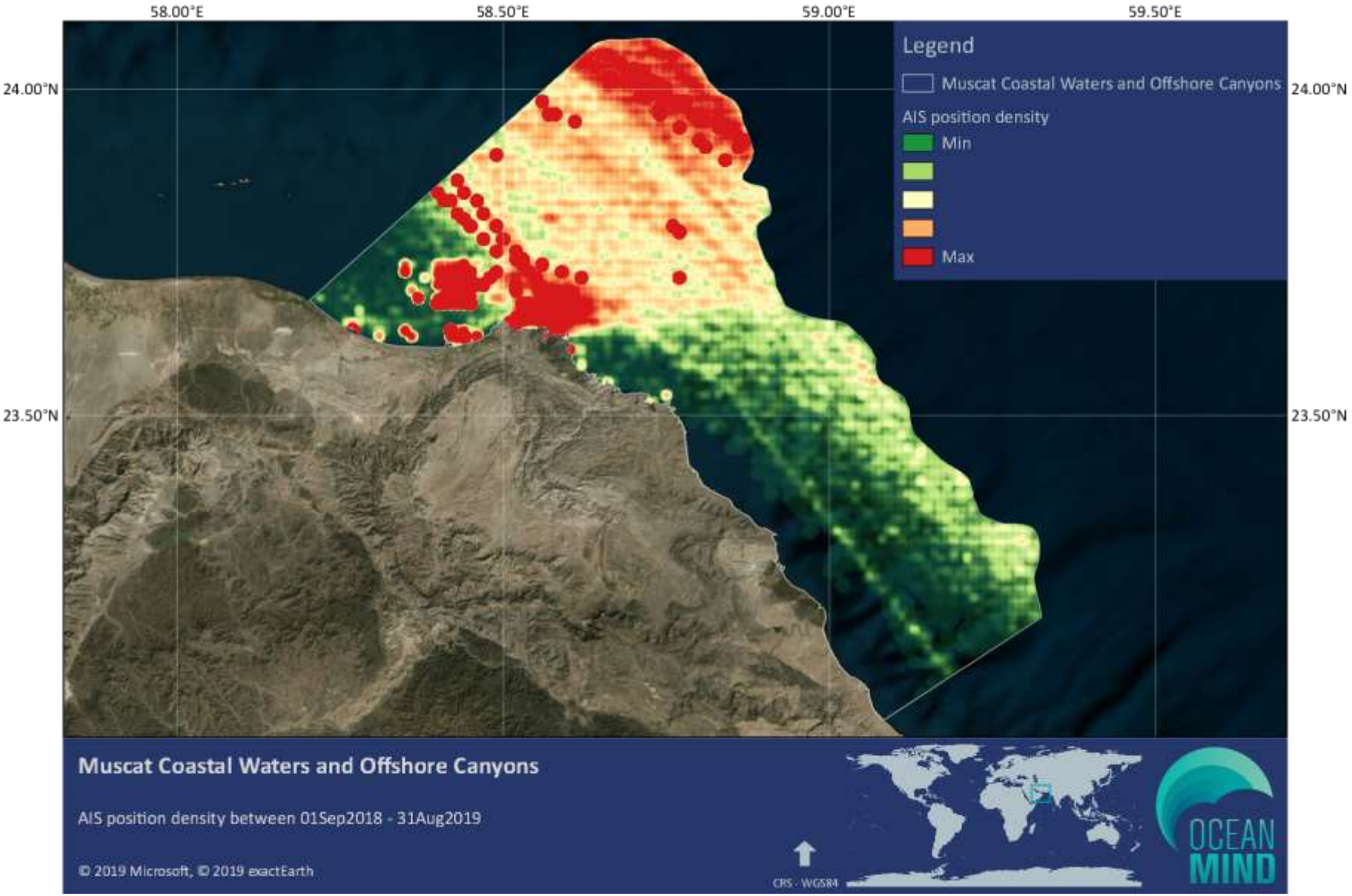


3.5 Muscat Coastal Waters and Offshore Canyons IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	3	2	3	2	2	6	1	2	4	1	1	17
Fish carrier	1	0	0	1	1	0	0	0	1	2	1	1	3
Fish bunker	0	1	0	1	0	0	0	0	0	0	1	2	3
Fishing buoy	0	0	1	0	0	0	0	0	1	1	0	0	2
Cargo	265	275	226	194	203	206	262	271	289	307	322	221	1802
Hazardous cargo	366	316	320	291	287	302	336	344	411	477	522	395	1989
Passenger	4	9	17	19	13	10	14	22	10	5	9	10	59
Pleasure	2	12	10	5	4	10	19	15	15	15	7	8	53
Unknown	6	3	3	4	5	3	4	13	11	8	12	4	36
Other	27	38	34	32	26	30	48	37	42	47	41	32	234
Total	673	657	613	550	541	563	689	703	782	866	916	674	4198

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MUSCAT COASTAL WATERS AND OFFSHORE CANYONS

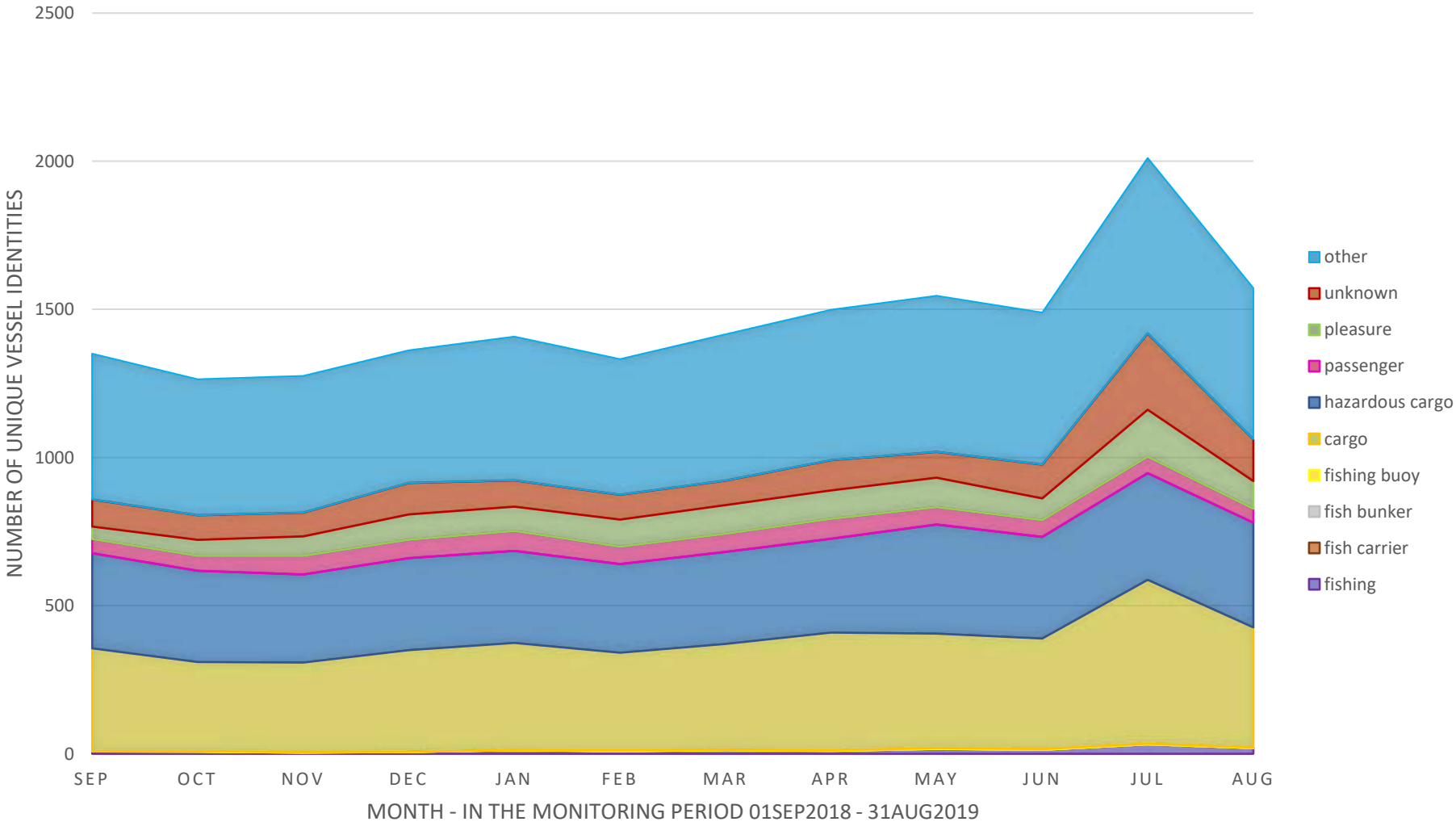


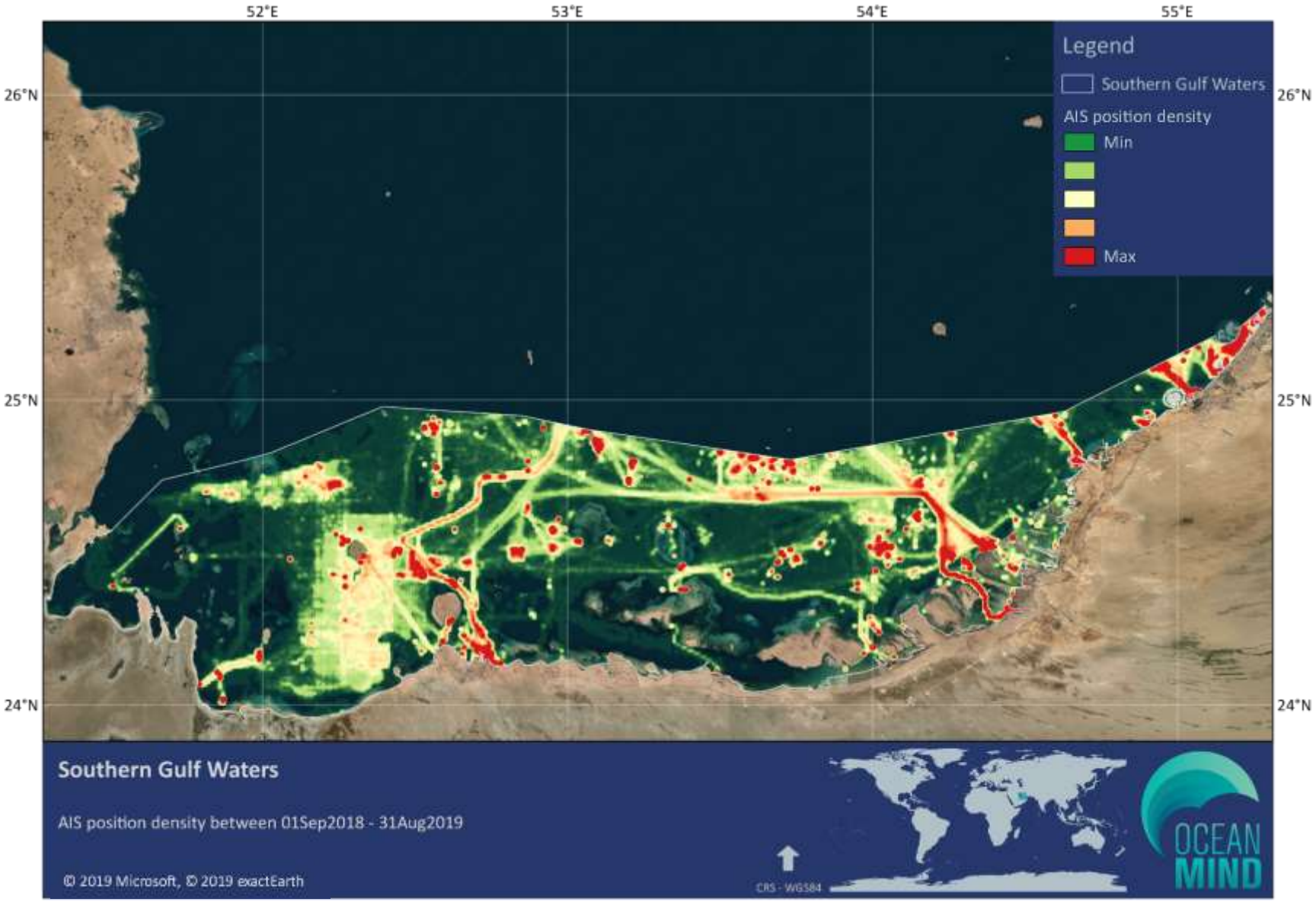


3.6 Southern Gulf Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	7	7	4	6	11	8	12	10	16	13	31	18	65
Fish carrier	1	0	0	0	0	0	0	0	0	0	0	0	1
Fish bunker	0	0	0	0	1	1	0	0	1	0	1	1	2
Fishing buoy	1	1	1	0	0	2	1	1	2	3	2	2	5
Cargo	347	302	303	344	362	330	358	398	387	373	553	406	1898
Hazardous cargo	321	308	297	310	311	299	310	317	368	343	360	353	1667
Passenger	48	50	63	62	67	59	61	67	58	57	55	47	131
Pleasure	42	54	66	86	82	91	97	96	100	73	159	93	290
Unknown	91	83	80	106	89	84	83	102	87	114	258	142	472
Other	492	459	461	448	485	458	494	508	527	513	592	510	1124
Total	1350	1264	1275	1362	1408	1332	1416	1499	1546	1489	2011	1572	5655

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTHERN GULF WATERS



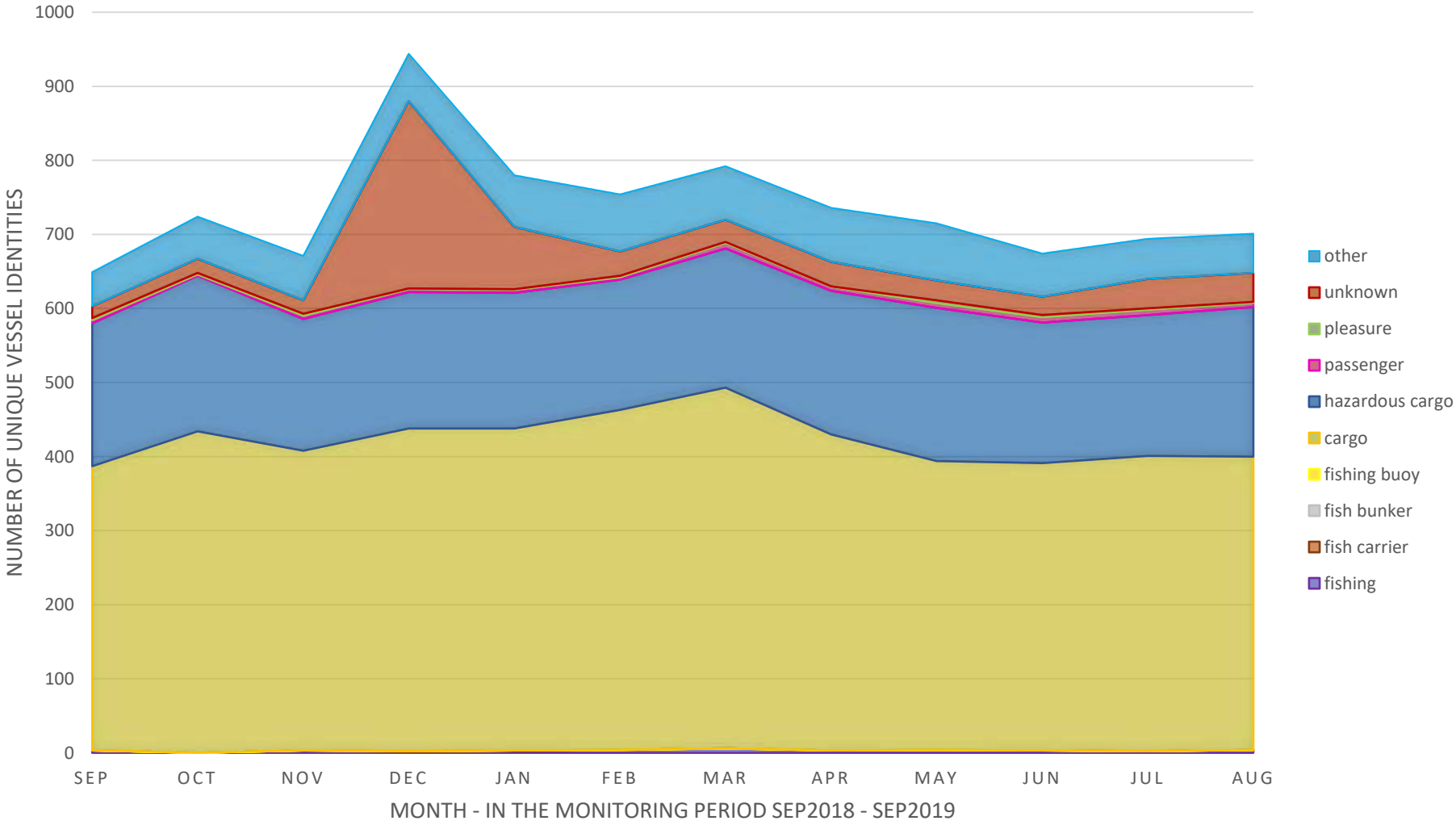


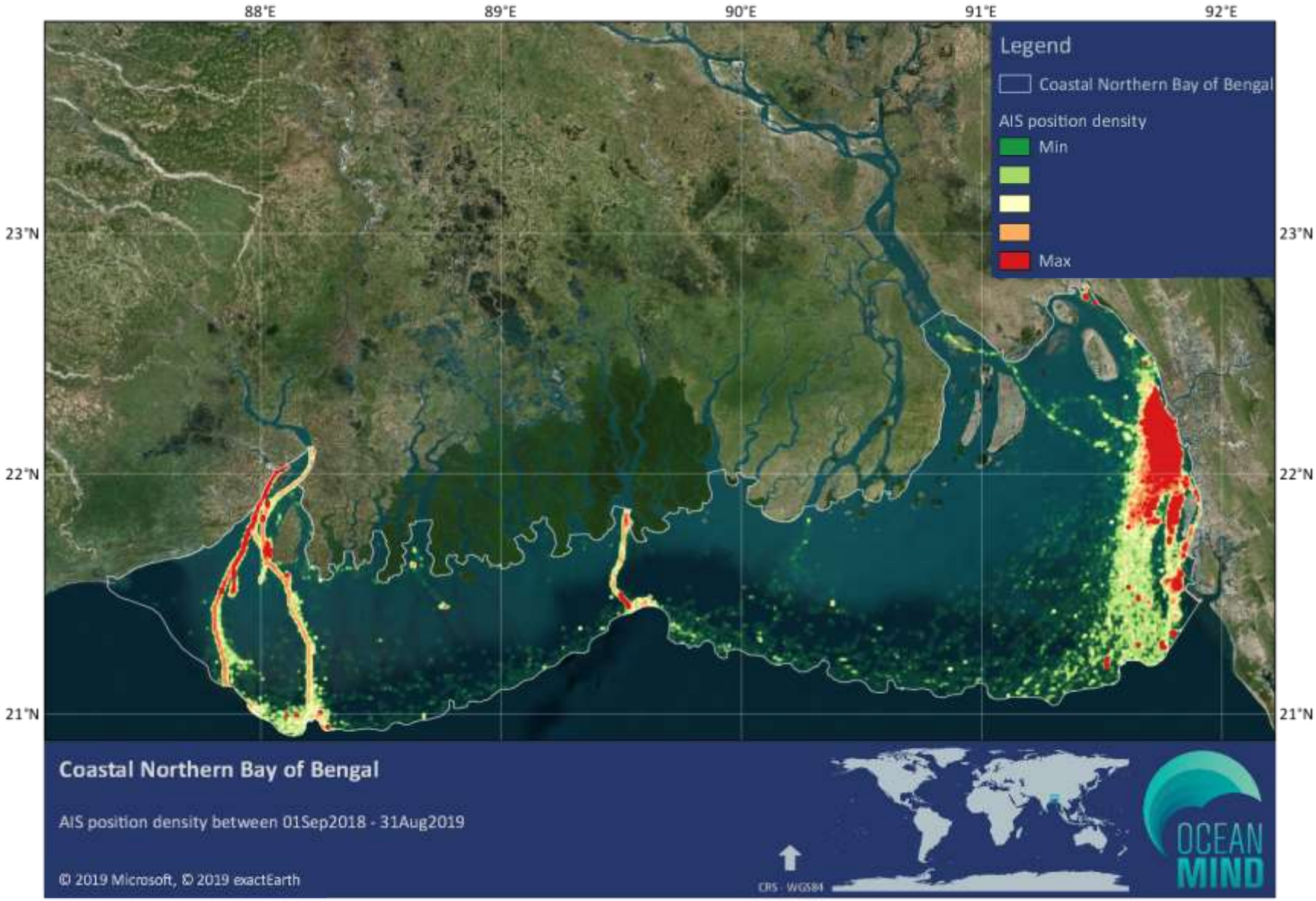
3.7 Coastal Northern Bay of Bengal IMMA

OceanMind could not assess the vessel activity for Coastal Northern Bay of Bengal for July 2019 and could therefore not run an accurate spatial analysis for the IMMA.

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	3	0	3	1	2	4	6	3	3	3	2	4	13
Fish carrier	0	0	0	1	1	0	0	0	1	0	0	0	3
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	384	434	405	436	435	459	487	427	390	388	399	396	2005
Hazardous cargo	193	210	178	184	183	176	188	194	207	190	190	202	879
Passenger	4	2	4	4	4	3	7	5	6	7	7	5	29
Pleasure	3	2	3	1	1	2	2	1	4	3	2	2	8
Unknown	16	19	18	253	84	33	30	33	27	25	40	39	490
Other	46	57	60	64	70	77	72	73	77	58	54	53	200
Total	649	724	671	944	780	754	792	736	715	674	694	701	3627

NUMBER OF VESSELS AGGREGATED BY CATEGORY - COASTAL NORTHERN BAY OF BENGAL

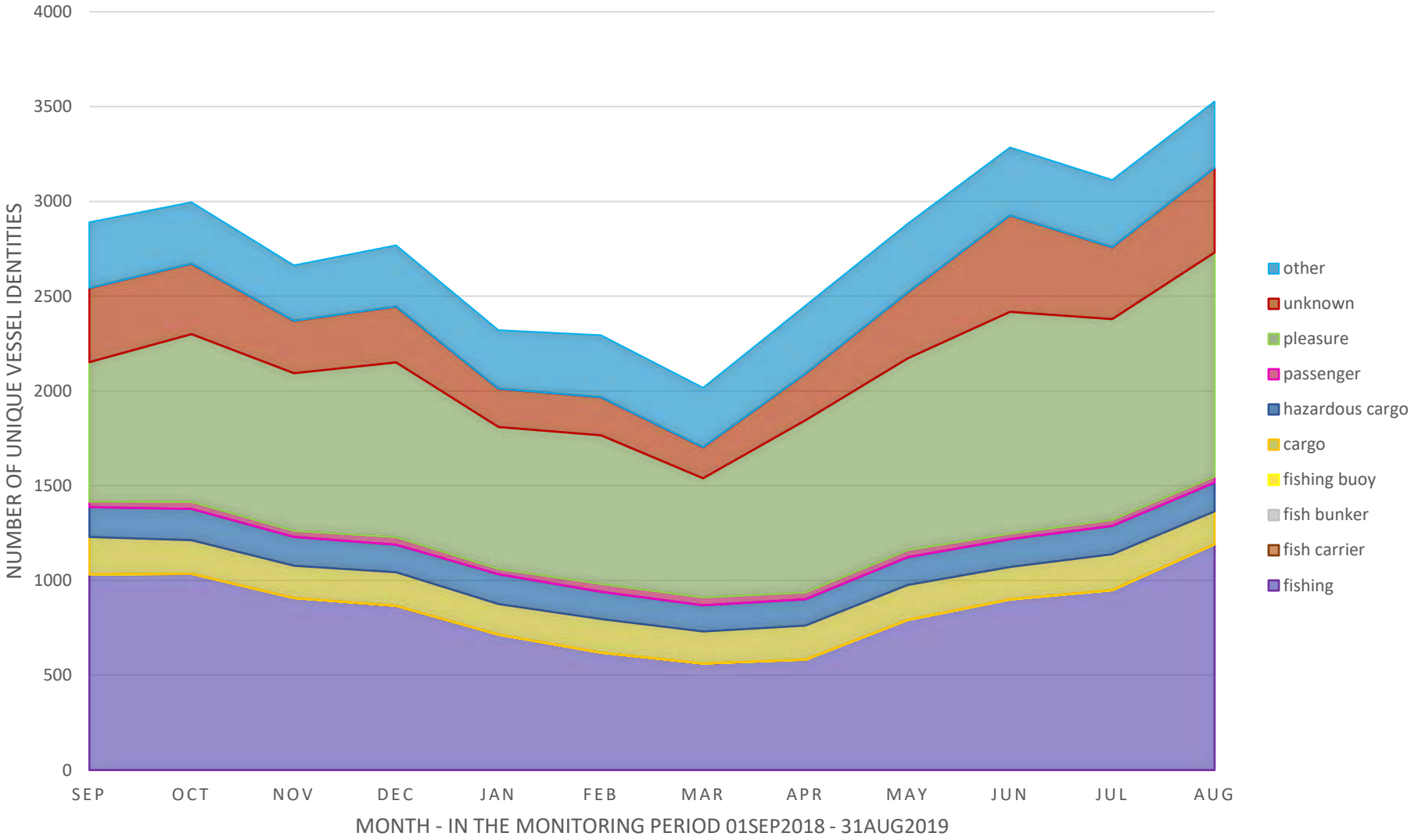


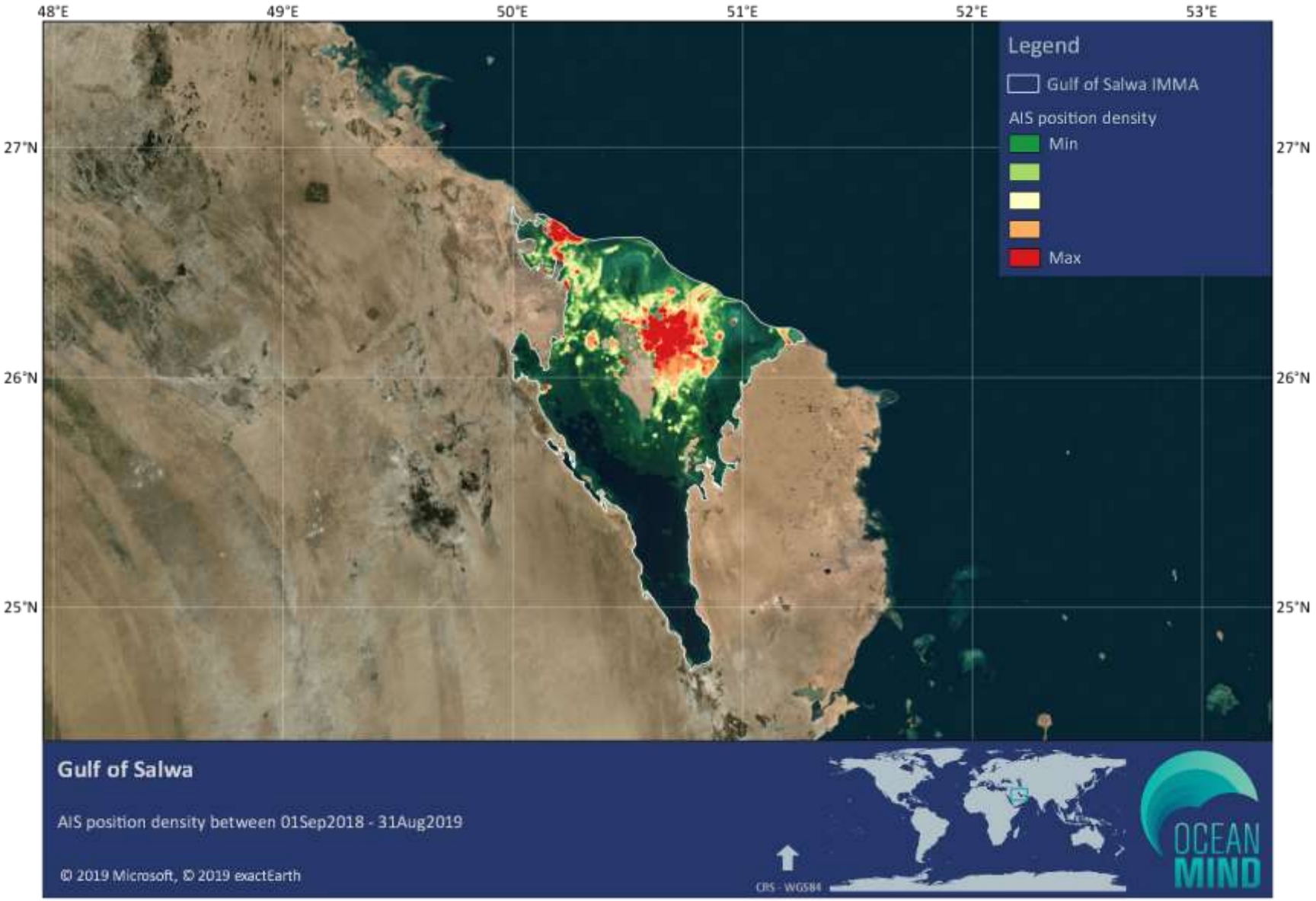


3.8 Gulf of Salwa IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1031	1035	907	865	715	620	561	582	791	900	948	1191	1637
Fish carrier	1	0	0	1	0	0	1	0	0	0	0	0	3
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	1	0	0	0	0	0	0	0	1	1	1	1	3
Cargo	196	177	171	177	161	176	169	180	184	170	190	172	1044
Hazardous cargo	158	165	152	146	157	145	138	139	147	147	149	152	917
Passenger	29	37	31	39	27	41	41	36	37	29	31	32	85
Pleasure	736	886	832	922	749	784	629	908	1011	1170	1060	1182	1909
Unknown	390	370	276	295	202	200	164	246	348	509	379	447	1284
Other	348	325	294	323	309	328	314	359	363	359	355	350	773
Total	2890	2995	2663	2768	2320	2294	2017	2450	2882	3285	3113	3527	7655

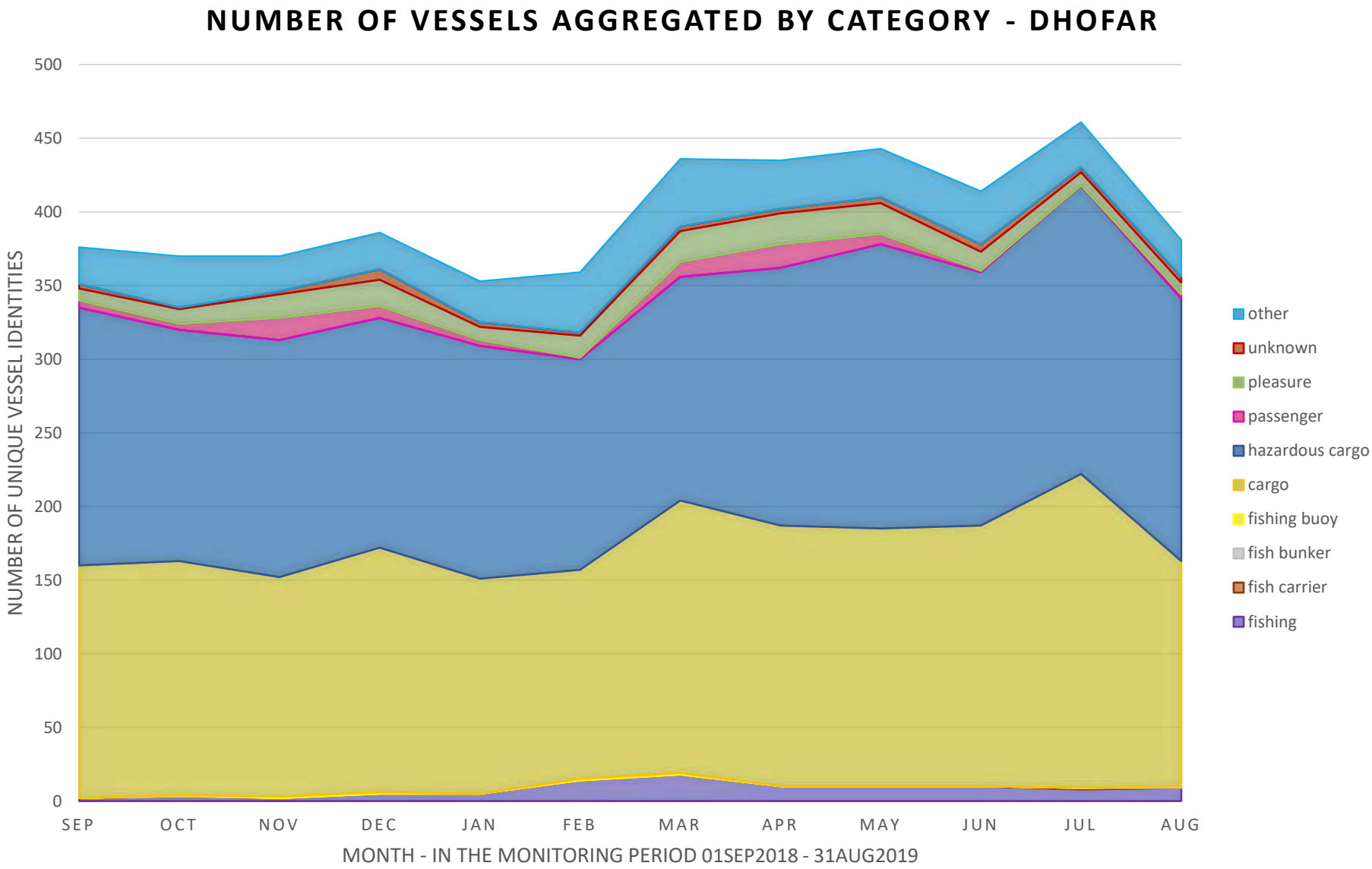
NUMBER OF VESSELS AGGREGATED BY CATEGORY - GULF OF SALWA

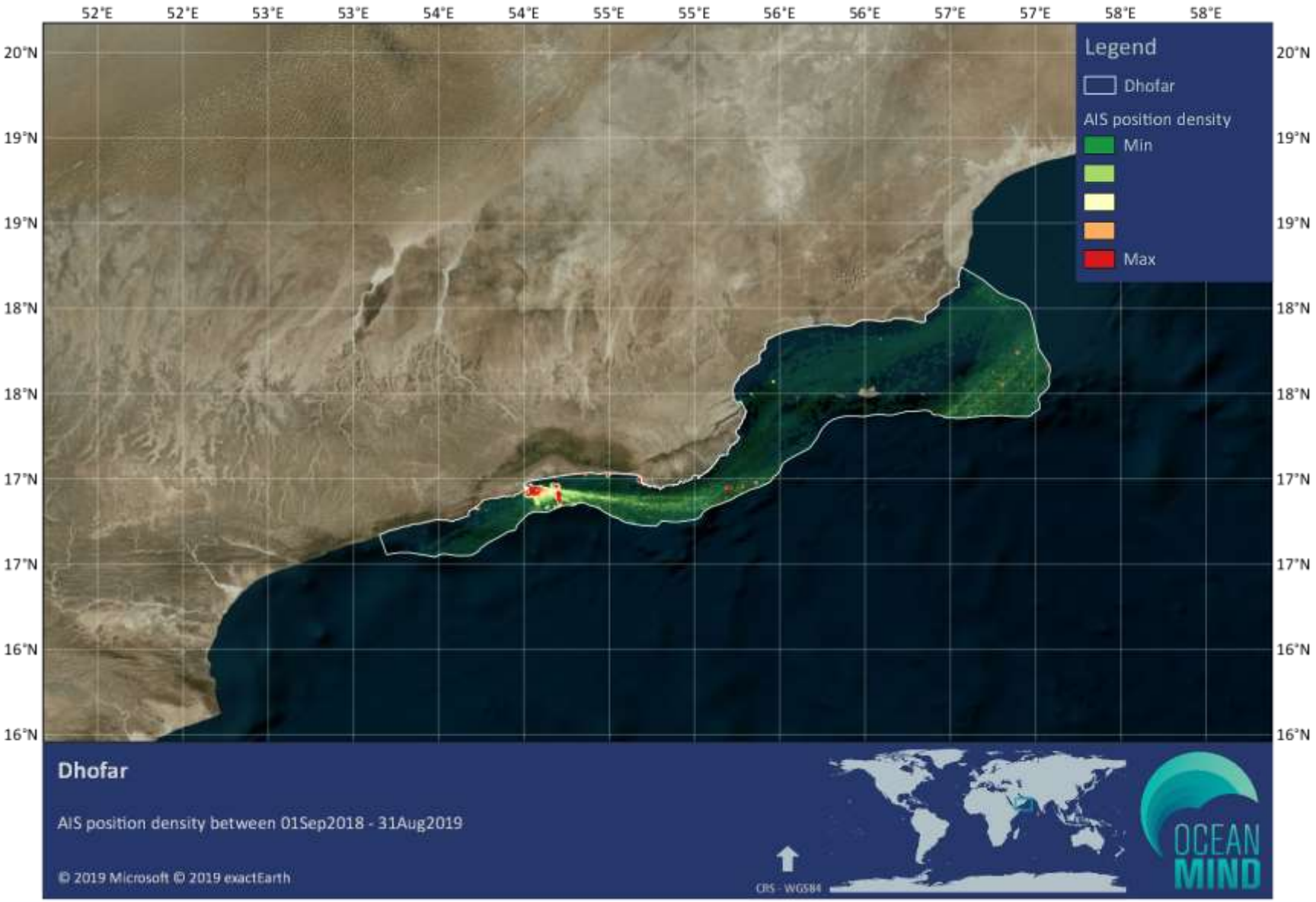




3.9 Dhofar IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	3	2	5	5	14	18	10	10	10	8	9	27
Fish carrier	0	0	0	0	0	0	0	0	0	0	1	0	1
Fish bunker	0	1	0	0	0	0	0	0	0	0	0	1	2
Fishing buoy	0	0	1	1	0	1	1	0	0	0	0	0	2
Cargo	158	159	149	166	146	142	185	177	175	177	213	153	1066
Hazardous cargo	175	157	161	156	158	143	152	175	193	172	196	178	790
Passenger	5	4	15	8	4	1	10	16	7	1	0	3	53
Pleasure	8	10	16	18	9	15	21	21	21	13	9	8	73
Unknown	3	1	2	7	3	2	3	3	4	5	3	4	28
Other	25	35	24	25	28	41	46	33	33	36	31	25	181
Total	376	370	370	386	353	359	436	435	443	414	461	381	2223

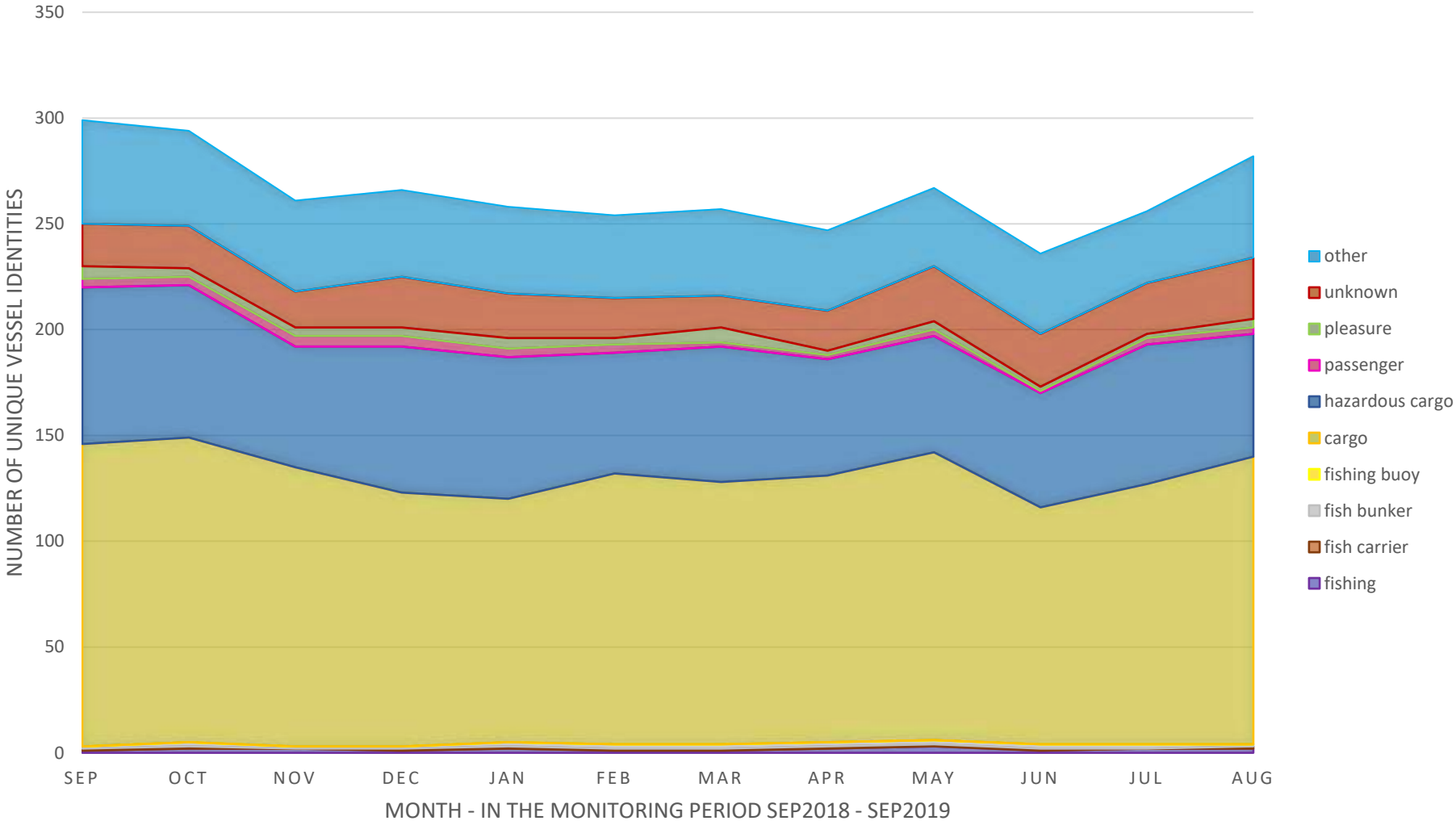


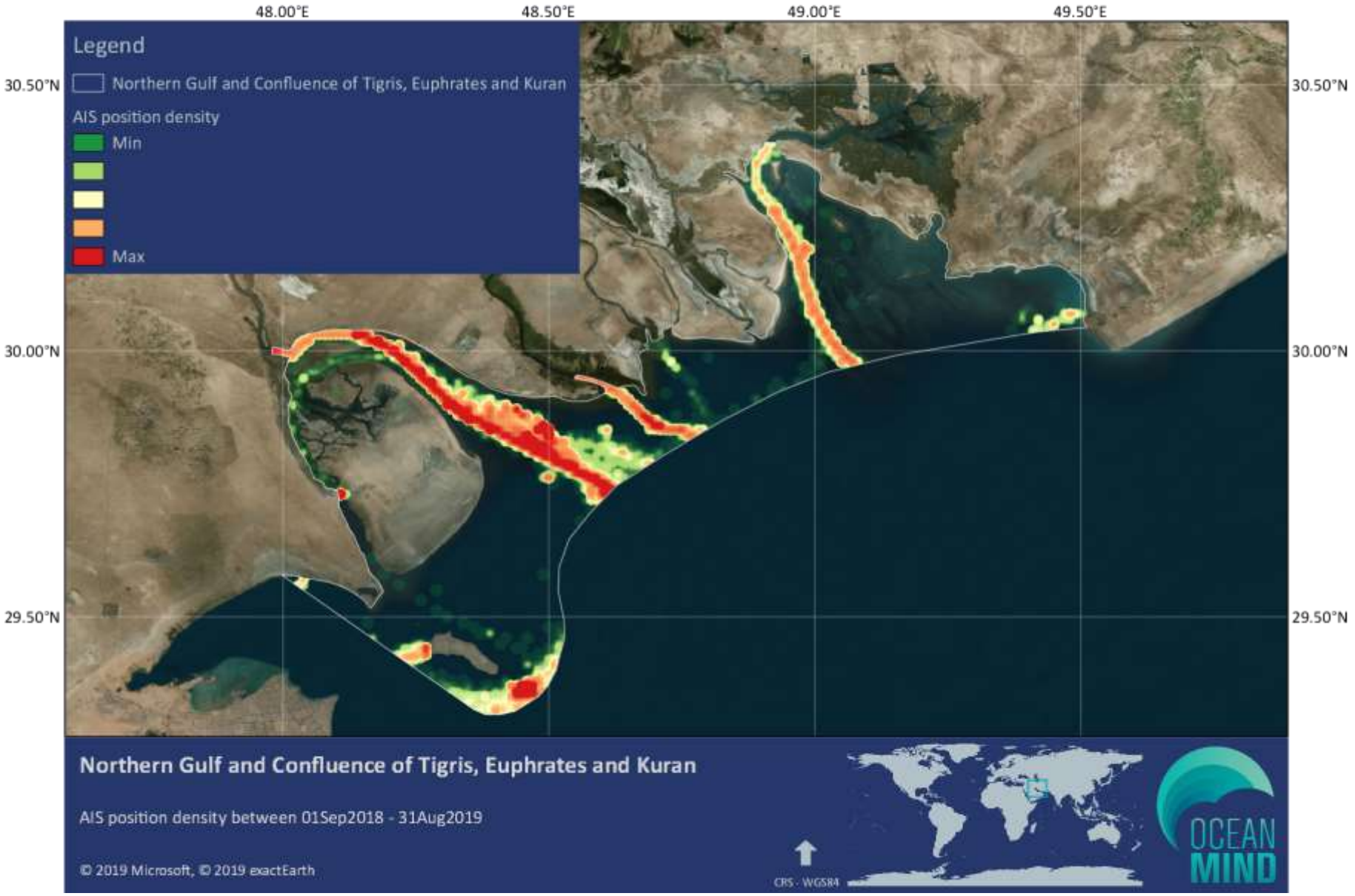


3.10 Northern Gulf and Confluence of Tigris, Euphrates and Kuran IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	2	2	1	2	1	1	2	3	1	2	2	5
Fish carrier	1	1	0	1	1	1	1	1	1	1	0	1	2
Fish bunker	1	2	1	1	2	2	2	2	2	2	2	1	2
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	143	144	132	120	115	128	124	126	136	112	123	136	609
Hazardous cargo	74	72	57	69	67	57	64	55	55	54	66	58	264
Passenger	4	4	5	5	4	4	2	2	3	1	3	3	6
Pleasure	6	4	4	4	5	3	7	2	4	2	2	4	22
Unknown	20	20	17	24	21	19	15	19	26	25	24	29	75
Other	49	45	43	41	41	39	41	38	37	38	34	48	118
Total	299	294	261	266	258	254	257	247	267	236	256	282	1103

NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHERN GULF AND CONFLUENCE OF TIGRIS, EUPHRATES AND KURAN

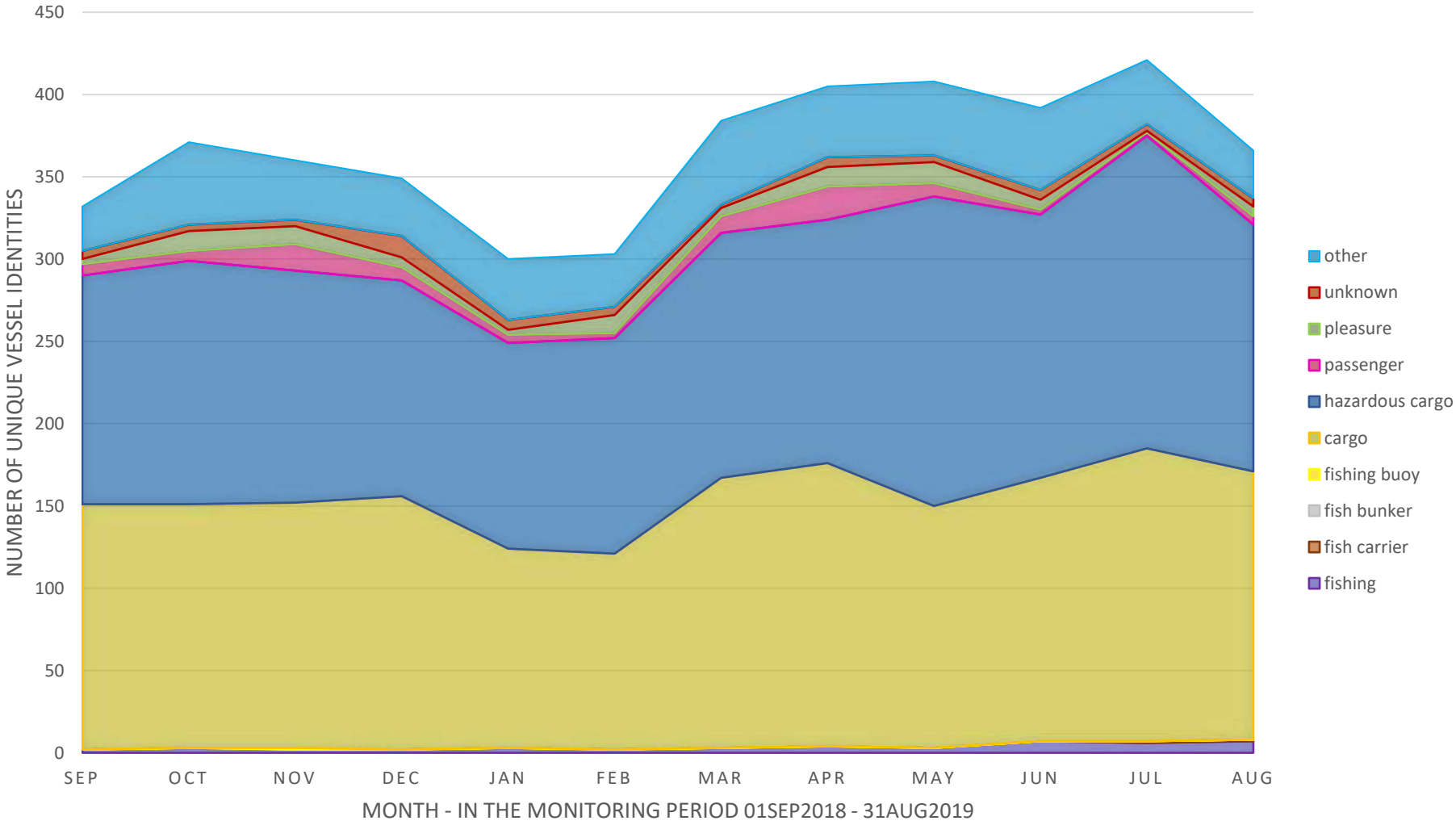




3.11 Gulf of Masirah and Offshore Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	3	2	2	3	2	3	4	3	7	6	7	13
Fish carrier	0	0	0	0	0	0	0	0	0	0	1	1	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	1	0	0	0	0	0	0	0	0	0	1
Cargo	149	148	149	154	121	119	164	172	147	160	178	163	1053
Hazardous cargo	139	148	141	131	125	131	149	148	188	160	190	150	716
Passenger	7	6	16	8	5	3	10	20	8	3	2	5	50
Pleasure	3	12	11	6	3	11	5	12	13	6	1	6	41
Unknown	5	4	4	13	6	5	2	6	4	6	4	5	28
Other	27	50	36	35	37	32	51	43	45	50	39	29	200
Total	332	371	360	349	300	303	384	405	408	392	421	366	2103

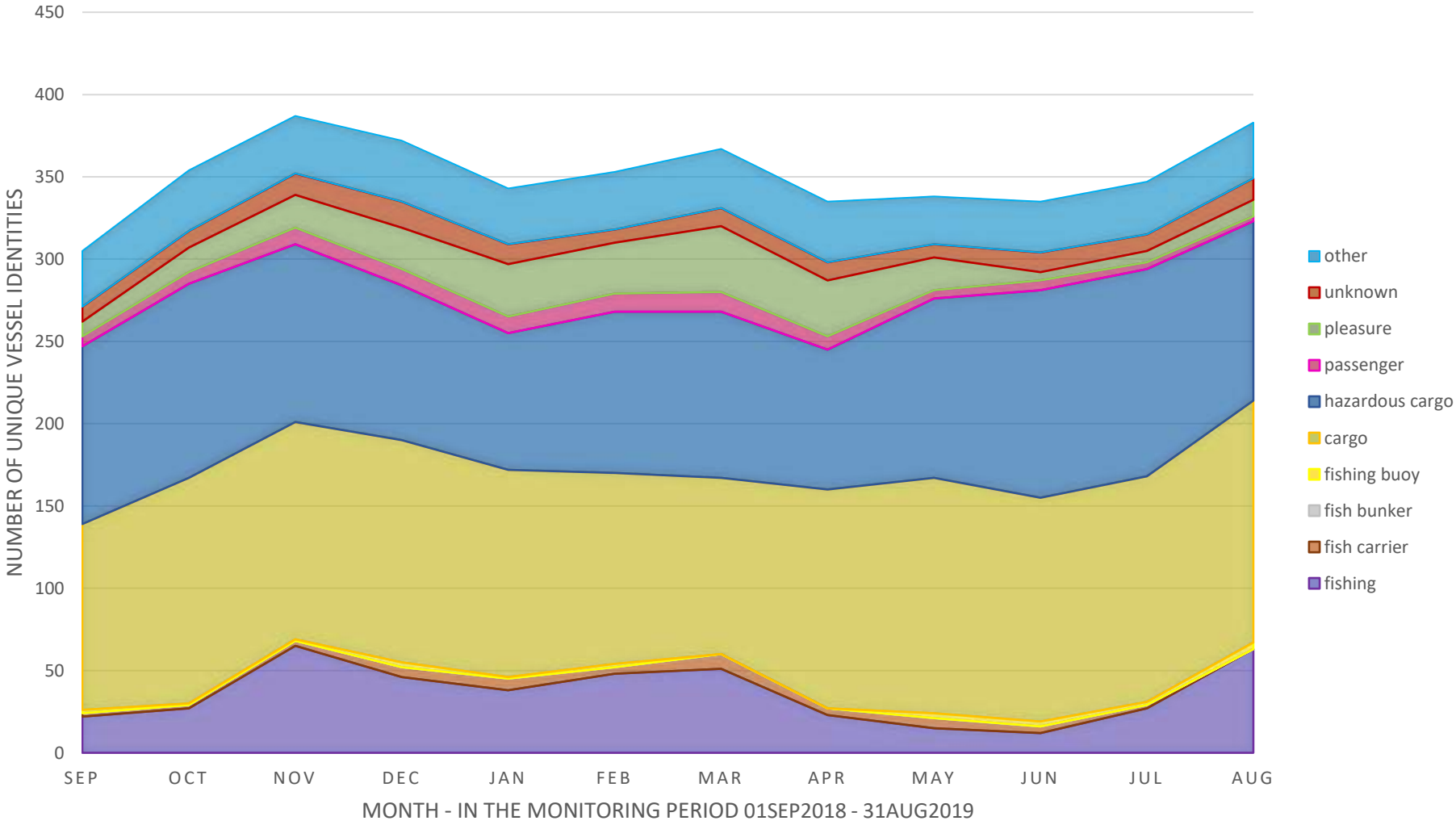
NUMBER OF VESSELS AGGREGATED BY CATEGORY - GULF OF MASIRAH AND OFFSHORE WATERS

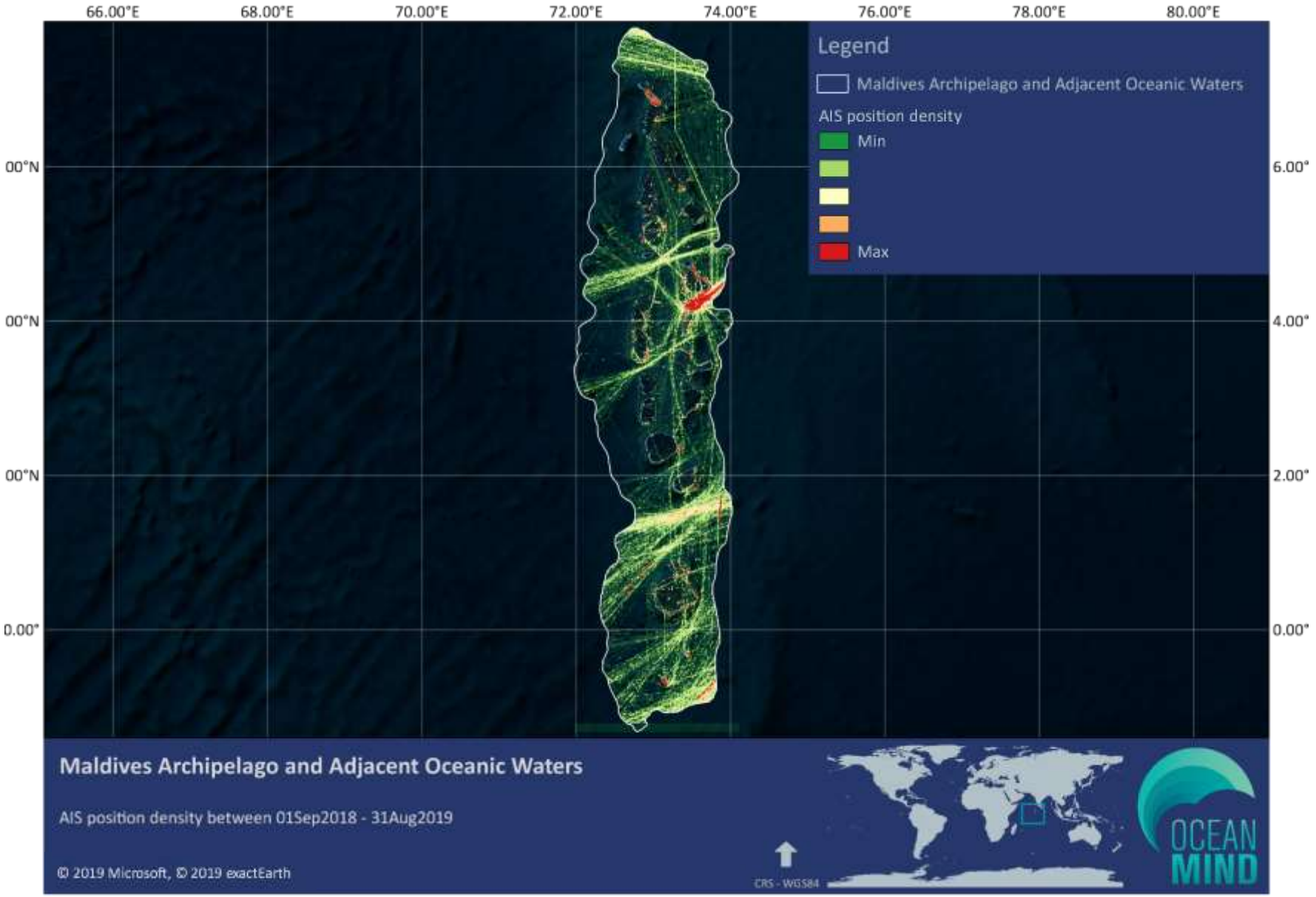


3.12 Maldives Archipelago and Adjacent Oceanic Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	22	27	65	46	38	48	51	23	15	12	27	63	292
Fish carrier	2	2	3	6	7	4	9	4	6	4	2	0	13
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	2	1	1	3	1	2	0	0	3	3	2	4	7
Cargo	113	137	132	135	126	116	107	133	143	136	137	147	933
Hazardous cargo	108	118	108	94	83	98	101	85	109	126	126	109	626
Passenger	6	7	10	10	10	11	12	8	5	6	4	3	35
Pleasure	9	15	20	25	32	31	40	34	20	5	7	10	85
Unknown	9	10	13	16	12	8	11	11	8	12	10	13	54
Other	34	37	35	37	34	35	36	37	29	31	32	34	125
Total	305	354	387	372	343	353	367	335	338	335	347	383	2170

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MALDIVES ARCHIPELAGO AND ADJACENT OCEANIC WATERS

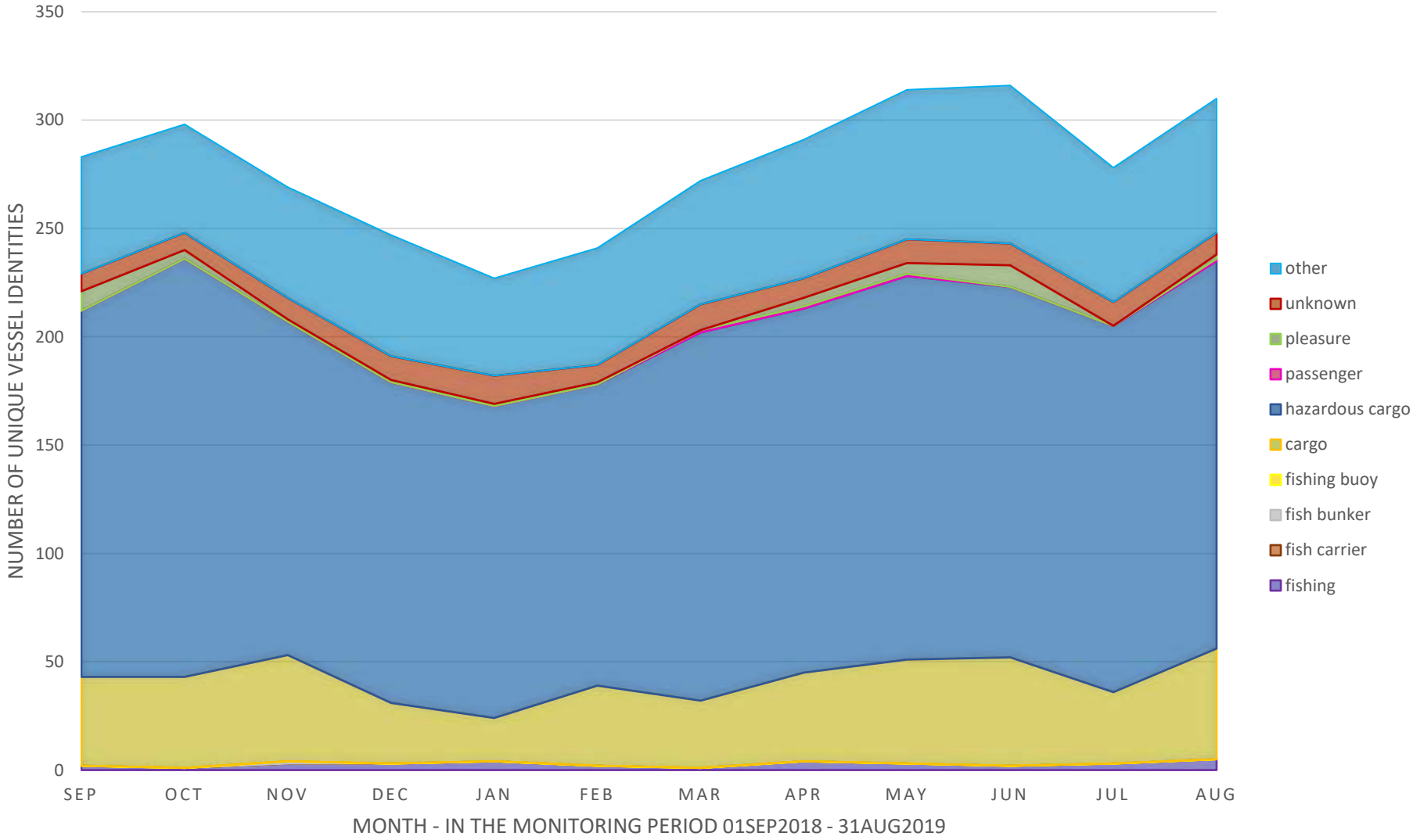


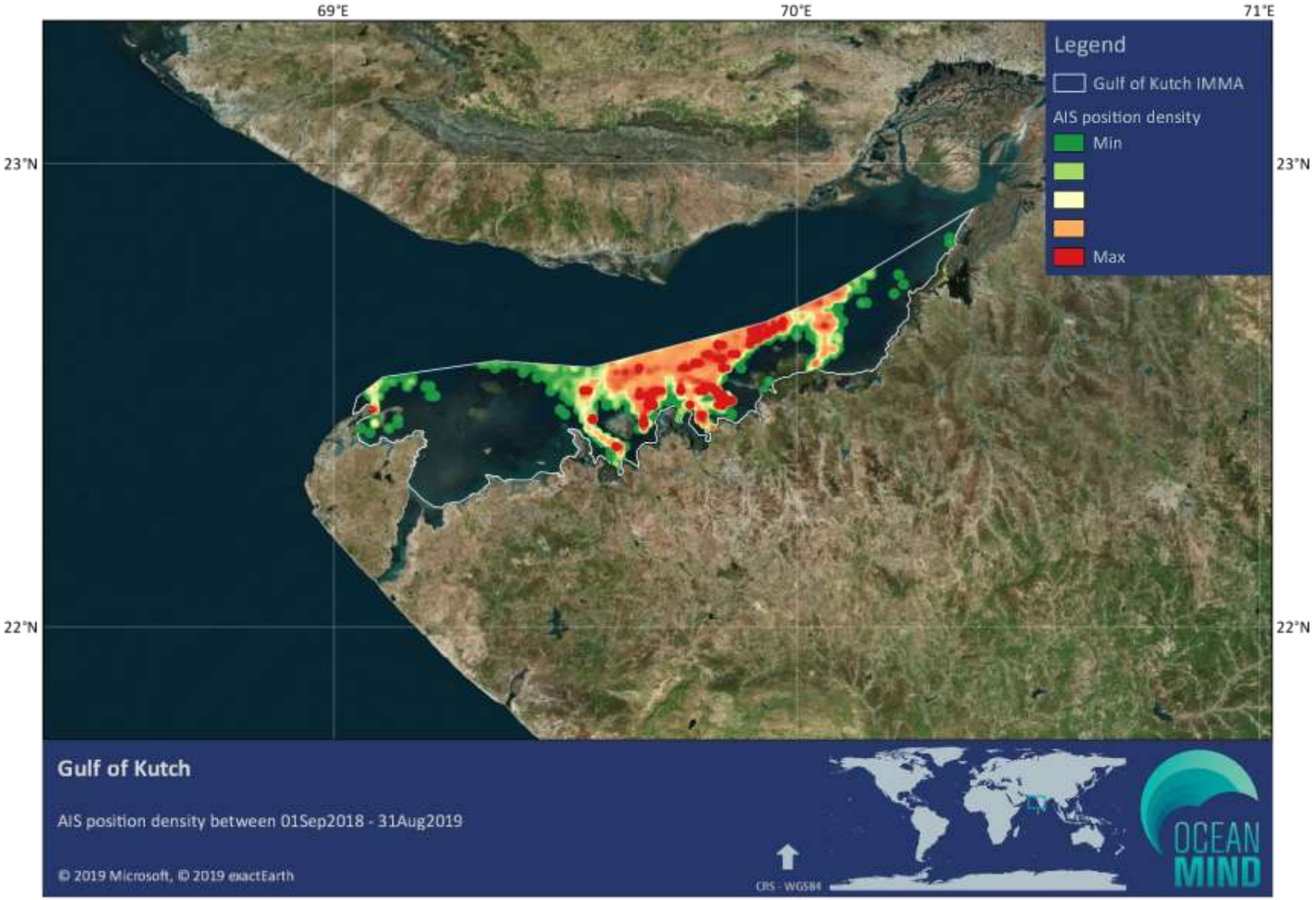


3.13 Gulf of Kutch IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	1	3	3	4	2	1	4	3	2	3	5	8
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	1	0	0	0	0	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	41	42	49	28	20	37	31	41	48	50	33	51	310
Hazardous cargo	169	193	154	148	144	139	170	168	177	171	169	179	1013
Passenger	0	0	0	0	0	0	1	1	1	0	0	1	3
Pleasure	9	4	1	1	1	1	0	4	5	10	0	2	21
Unknown	8	8	10	11	13	8	12	9	11	10	11	10	37
Other	54	50	51	56	45	54	57	64	69	73	62	62	137
Total	283	298	269	247	227	241	272	291	314	316	278	310	1530

NUMBER OF VESSELS AGGREGATED BY CATEGORY - GULF OF KUTCH

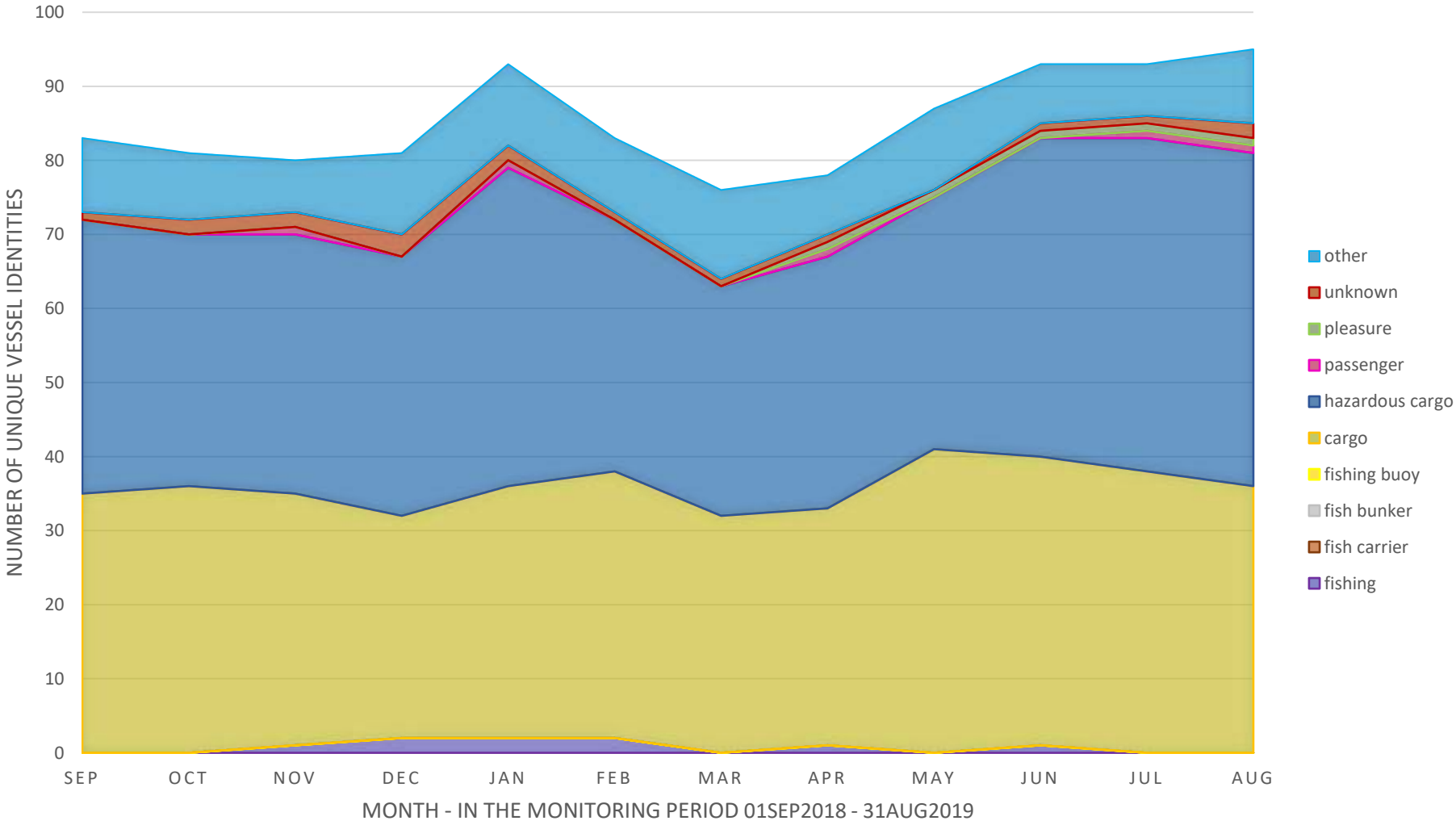




3.14 Indus Estuary and Creeks IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	1	2	2	2	0	1	0	1	0	0	5
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	35	36	34	30	34	36	32	32	41	39	38	36	288
Hazardous cargo	37	34	35	35	43	34	31	34	34	43	45	45	289
Passenger	0	0	1	0	1	0	0	1	0	0	1	1	4
Pleasure	0	0	0	0	0	0	0	1	1	1	1	1	1
Unknown	1	2	2	3	2	1	1	1	0	1	1	2	6
Other	10	9	7	11	11	10	12	8	11	8	7	10	23
Total	83	81	80	81	93	83	76	78	87	93	93	95	616

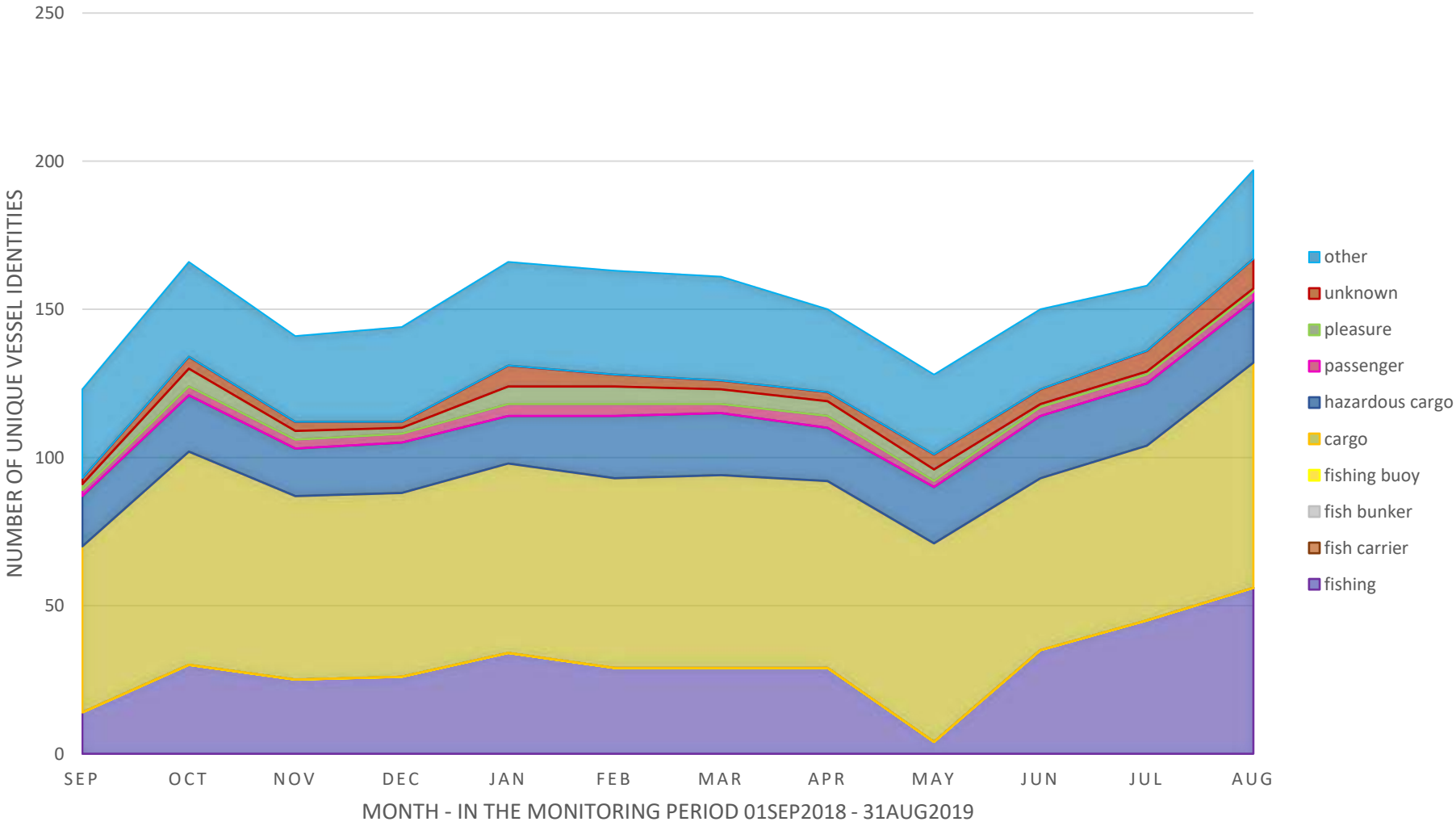
NUMBER OF VESSELS AGGREGATED BY CATEGORY - INDUS ESTUARY AND CREEKS



3.15 Gulf of Mannar and Palk Bay IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	14	30	25	26	34	29	29	29	4	35	45	56	112
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	56	72	62	62	64	64	65	63	67	58	59	76	385
Hazardous cargo	17	19	16	17	16	21	21	18	19	21	21	21	111
Passenger	2	3	3	3	4	4	3	4	2	3	3	3	9
Pleasure	2	6	3	2	6	6	5	5	4	1	1	1	11
Unknown	2	4	3	2	7	4	3	3	5	5	7	10	28
Other	30	32	29	32	35	35	35	28	27	27	22	30	90
Total	123	166	141	144	166	163	161	150	128	150	158	197	746

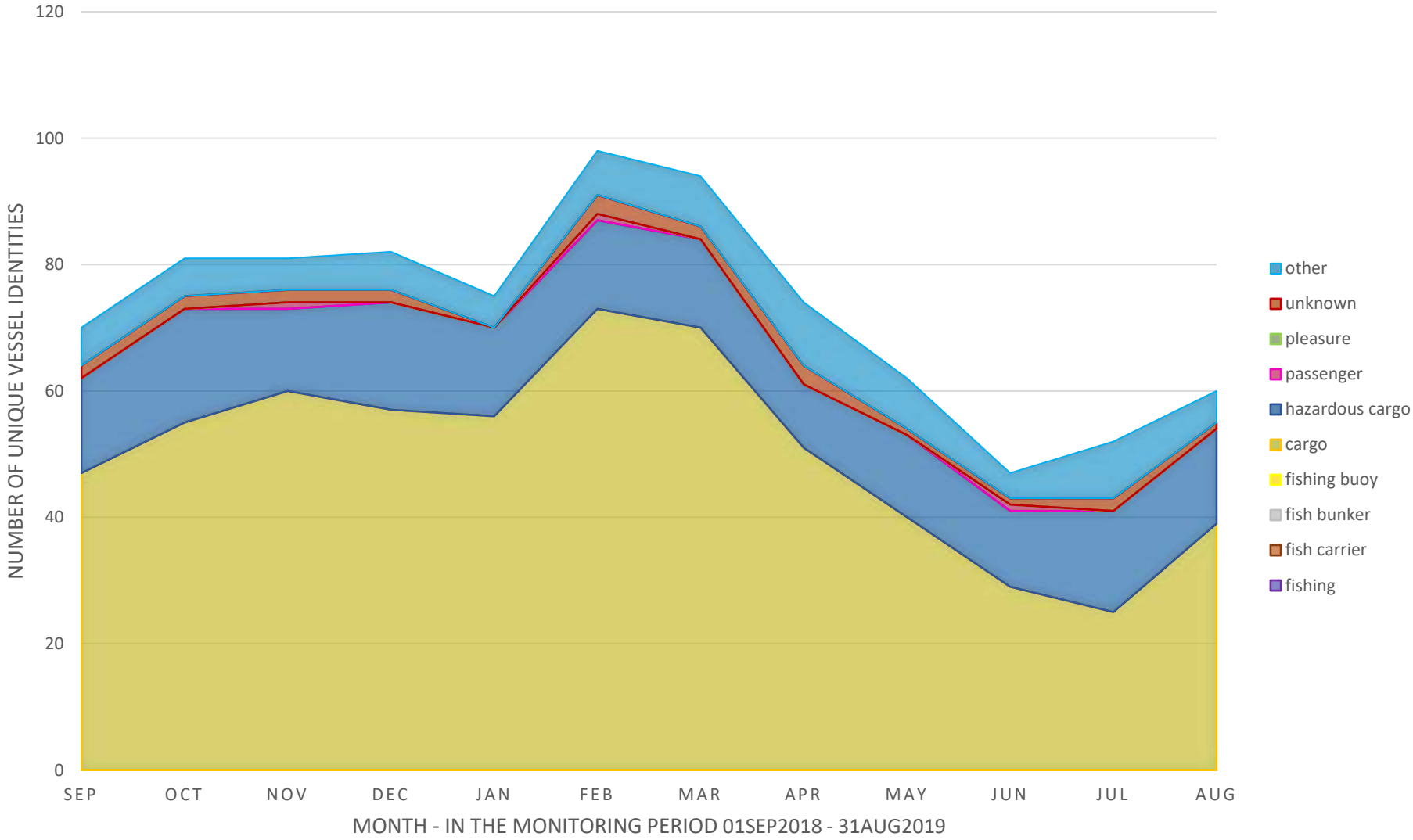
NUMBER OF VESSELS AGGREGATED BY CATEGORY - GULF OF MANNAR AND PALK BAY



3.16 Sundarbans IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	47	55	60	57	56	73	70	51	40	29	25	39	363
Hazardous cargo	15	18	13	17	14	14	14	10	13	12	16	15	58
Passenger	0	0	1	0	0	1	0	0	0	1	0	0	3
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	2	2	2	2	0	3	2	3	1	1	2	1	8
Other	6	6	5	6	5	7	8	10	8	4	9	5	25
Total	70	81	81	82	75	98	94	74	62	47	52	60	457

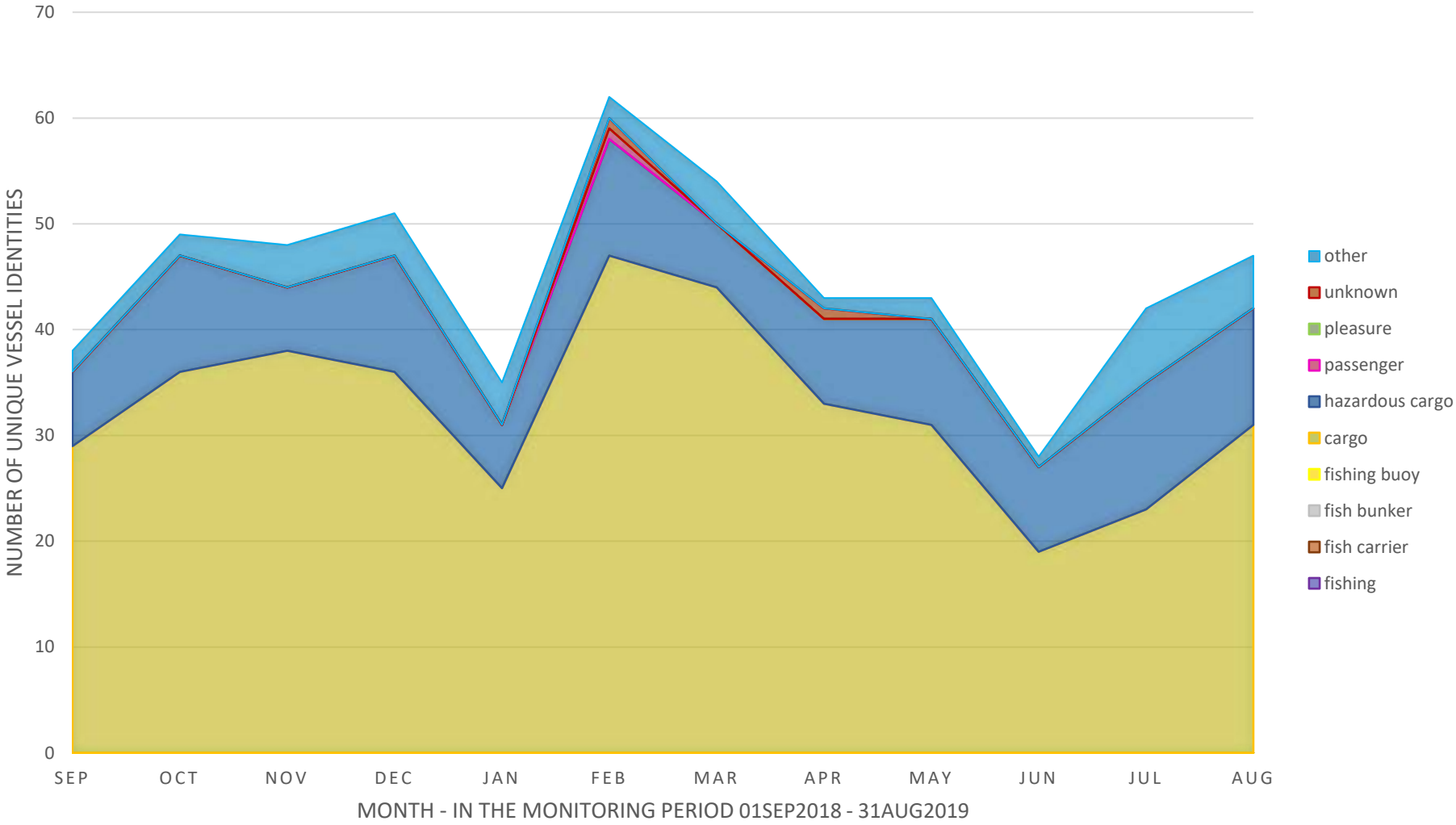
NUMBER OF VESSELS AGGREGATED BY CATEGORY - SUNDARBANS

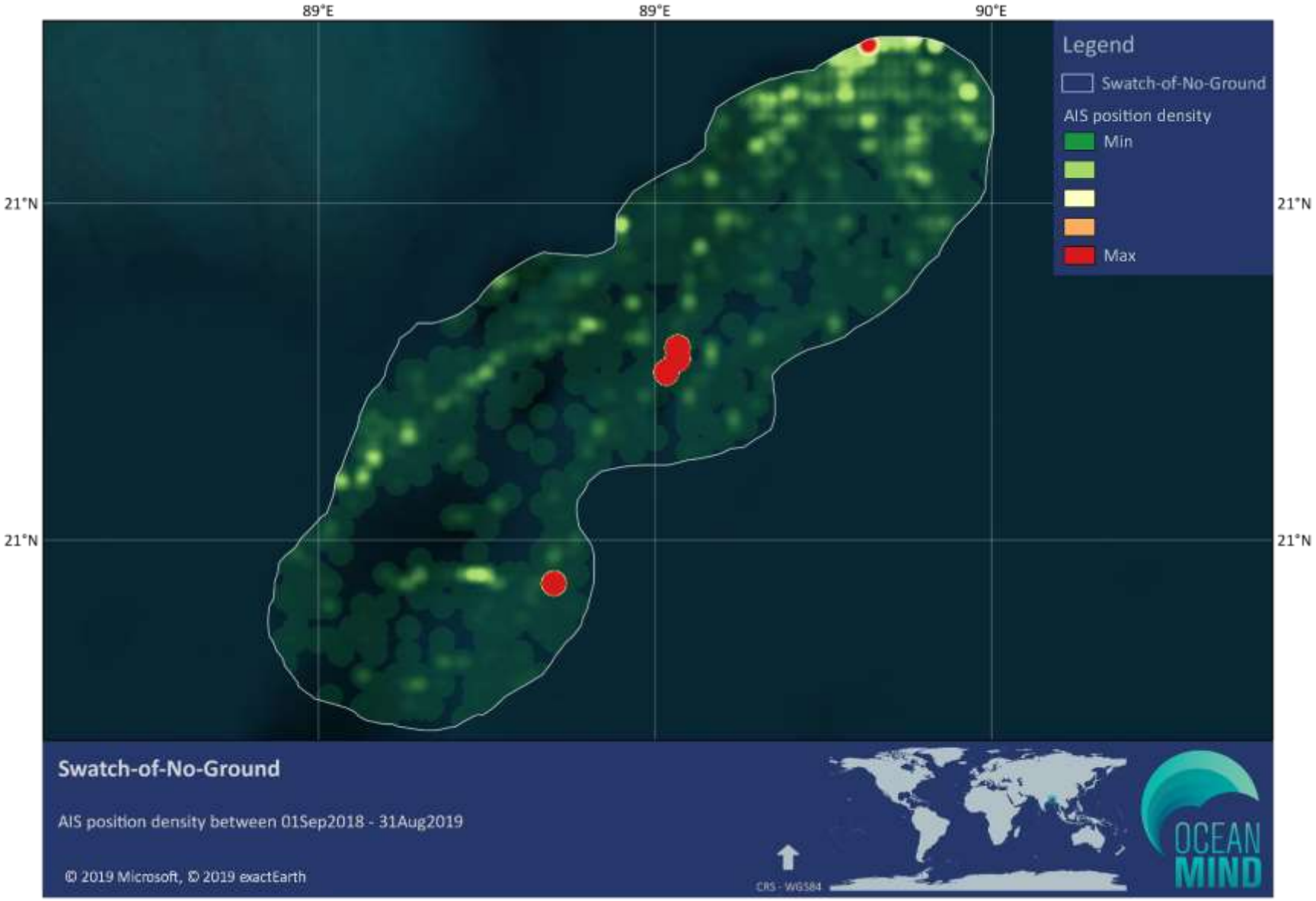


3.17 Swatch-of-No-Ground IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	29	36	38	36	25	47	44	33	31	19	23	31	258
Hazardous cargo	7	11	6	11	6	11	6	8	10	8	12	11	50
Passenger	0	0	0	0	0	1	0	0	0	0	0	0	1
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	1	0	1	0	0	0	0	2
Other	2	2	4	4	4	2	4	1	2	1	7	5	17
Total	38	49	48	51	35	62	54	43	43	28	42	47	328

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SWATCH-OF-NO-GROUND

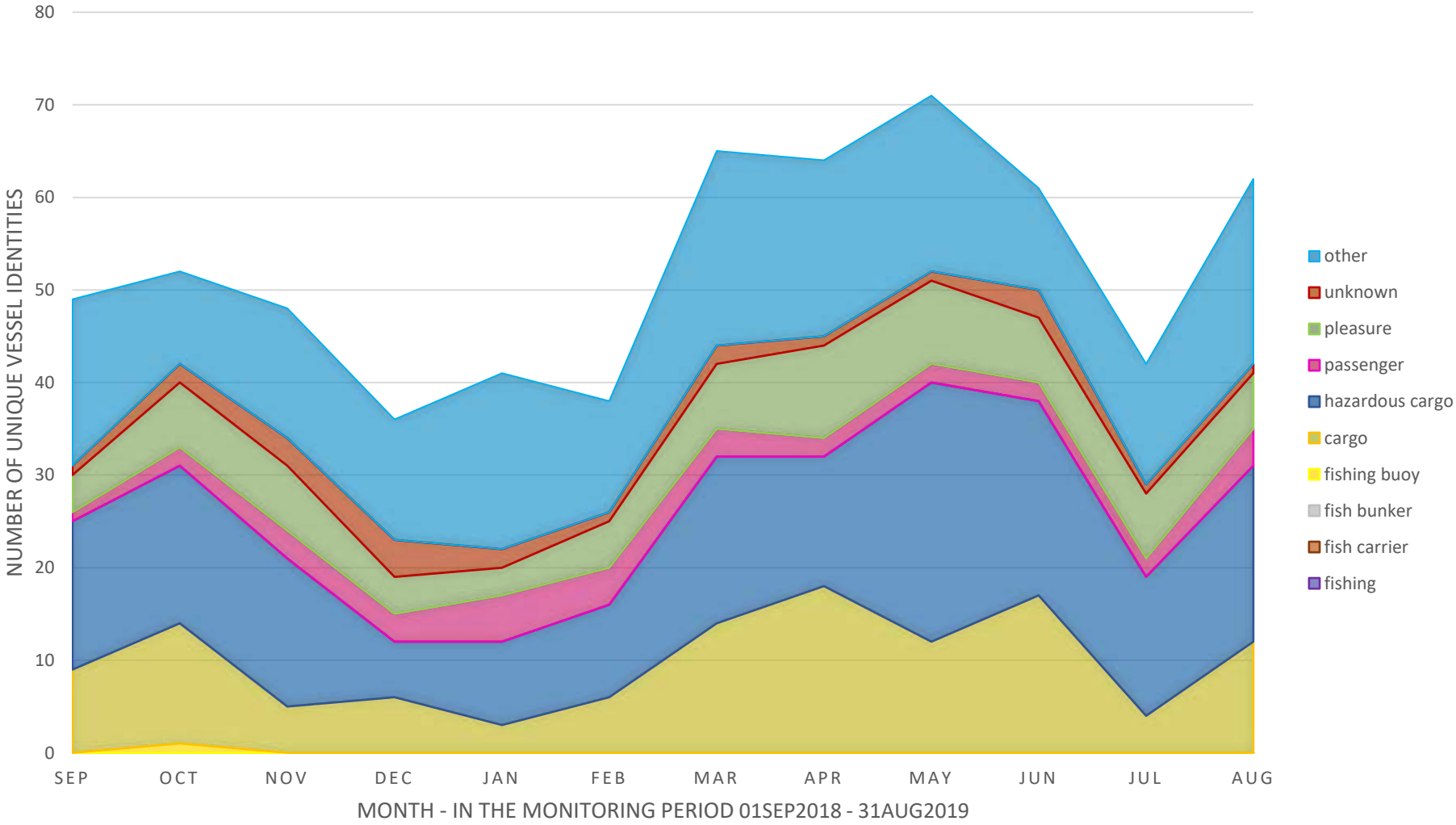




3.18 Northern Red Sea Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	1	0	0	0	0	0	0	0	0	0	0	1
Cargo	9	13	5	6	3	6	14	18	12	17	4	12	116
Hazardous cargo	16	17	16	6	9	10	18	14	28	21	15	19	167
Passenger	1	2	3	3	5	4	3	2	2	2	2	4	11
Pleasure	4	7	7	4	3	5	7	10	9	7	7	6	31
Unknown	1	2	3	4	2	1	2	1	1	3	1	1	13
Other	18	10	14	13	19	12	21	19	19	11	13	20	49
Total	49	52	48	36	41	38	65	64	71	61	42	62	388

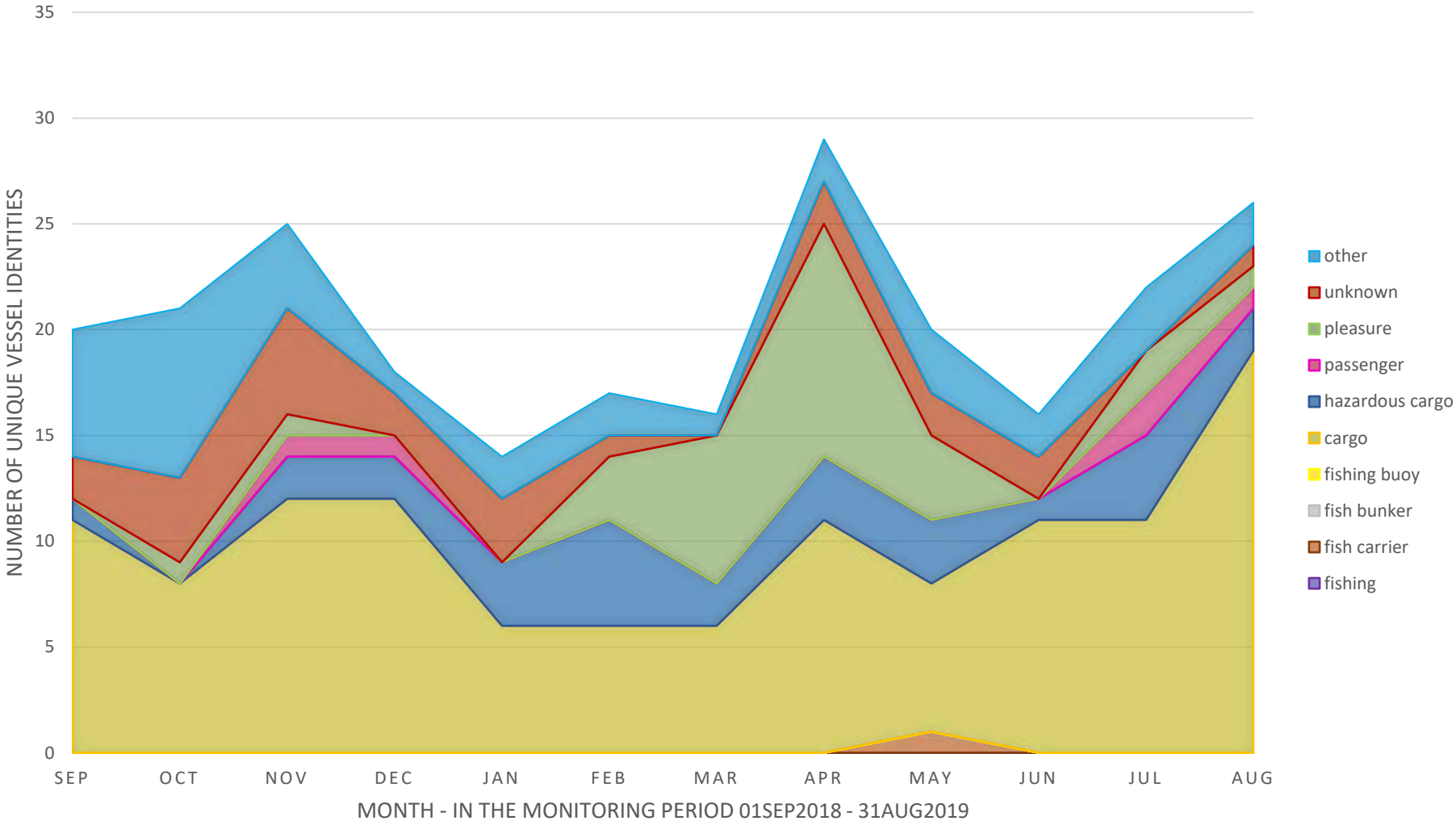
NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTHERN RED SEA ISLANDS



3.19 Southern Egyptian Red Sea Bays, Offshore Reefs and Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	1	0	0	0	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	11	8	12	12	6	6	6	11	7	11	11	19	95
Hazardous cargo	1	0	2	2	3	5	2	3	3	1	4	2	23
Passenger	0	0	1	1	0	0	0	0	0	0	2	1	5
Pleasure	0	1	1	0	0	3	7	11	4	0	2	1	28
Unknown	2	4	5	2	3	1	0	2	2	2	0	1	11
Other	6	8	4	1	2	2	1	2	3	2	3	2	23
Total	20	21	25	18	14	17	16	29	20	16	22	26	186

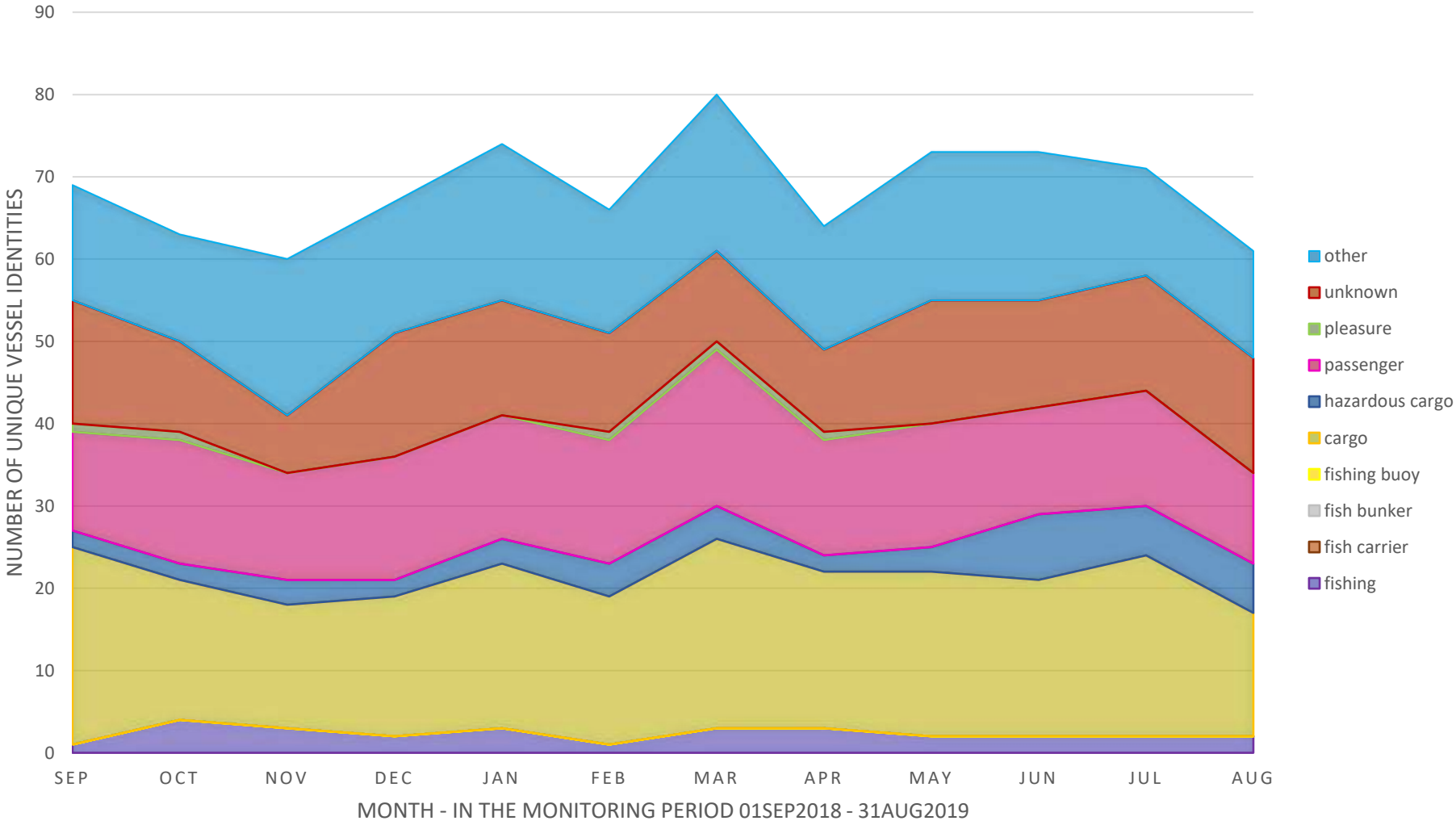
NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTHERN EGYPTIAN RED SEA BAYS, OFFSHORE REEFS AND ISLANDS

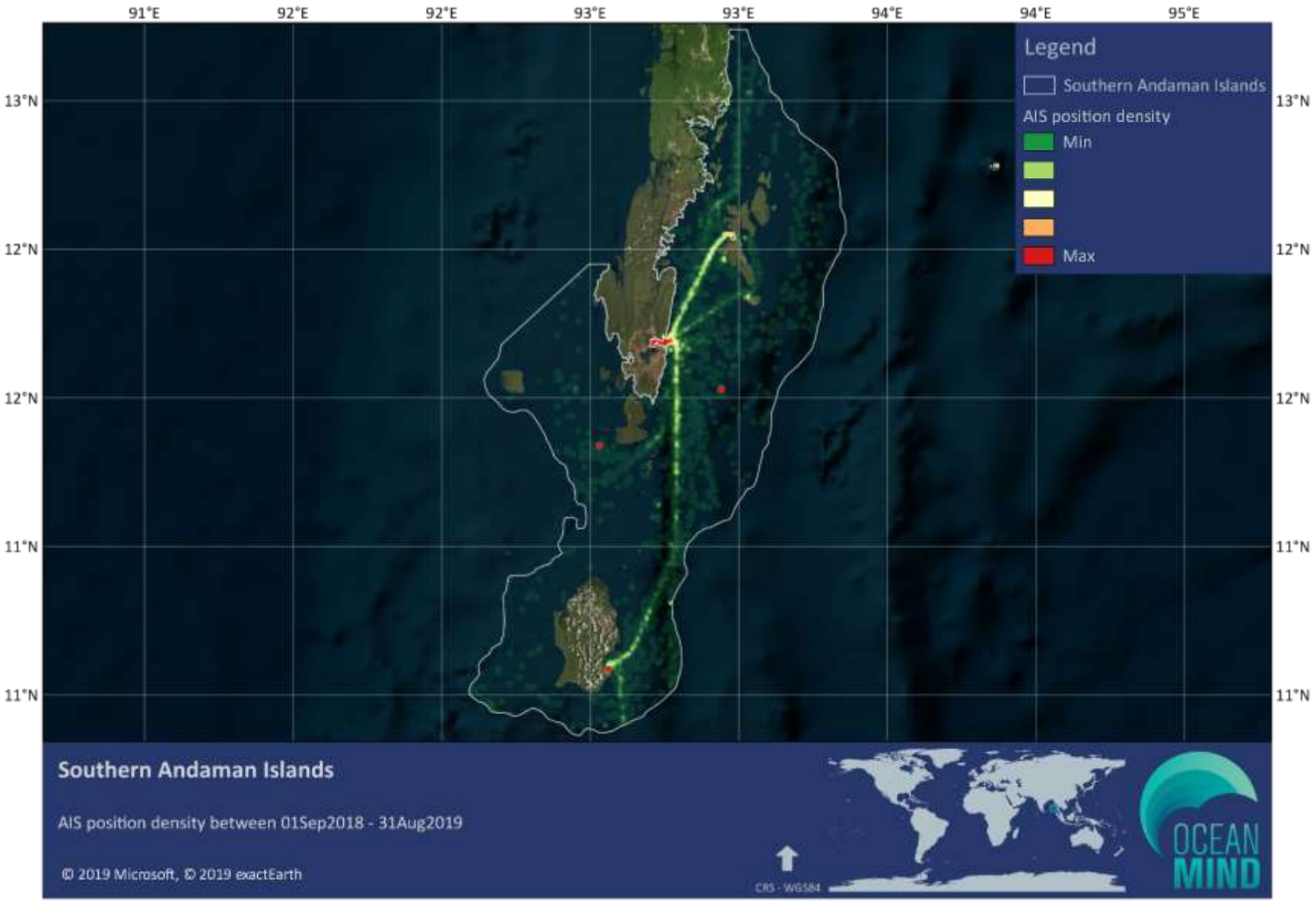


3.20 Southern Andaman Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	4	3	2	3	1	3	3	2	2	2	2	8
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	24	17	15	17	20	18	23	19	20	19	22	15	54
Hazardous cargo	2	2	3	2	3	4	4	2	3	8	6	6	26
Passenger	12	15	13	15	15	15	19	14	15	13	14	11	27
Pleasure	1	1	0	0	0	1	1	1	0	0	0	0	2
Unknown	15	11	7	15	14	12	11	10	15	13	14	14	32
Other	14	13	19	16	19	15	19	15	18	18	13	14	44
Total	69	63	60	67	74	66	80	64	73	73	71	62	193

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTHERN ANDAMAN ISLANDS

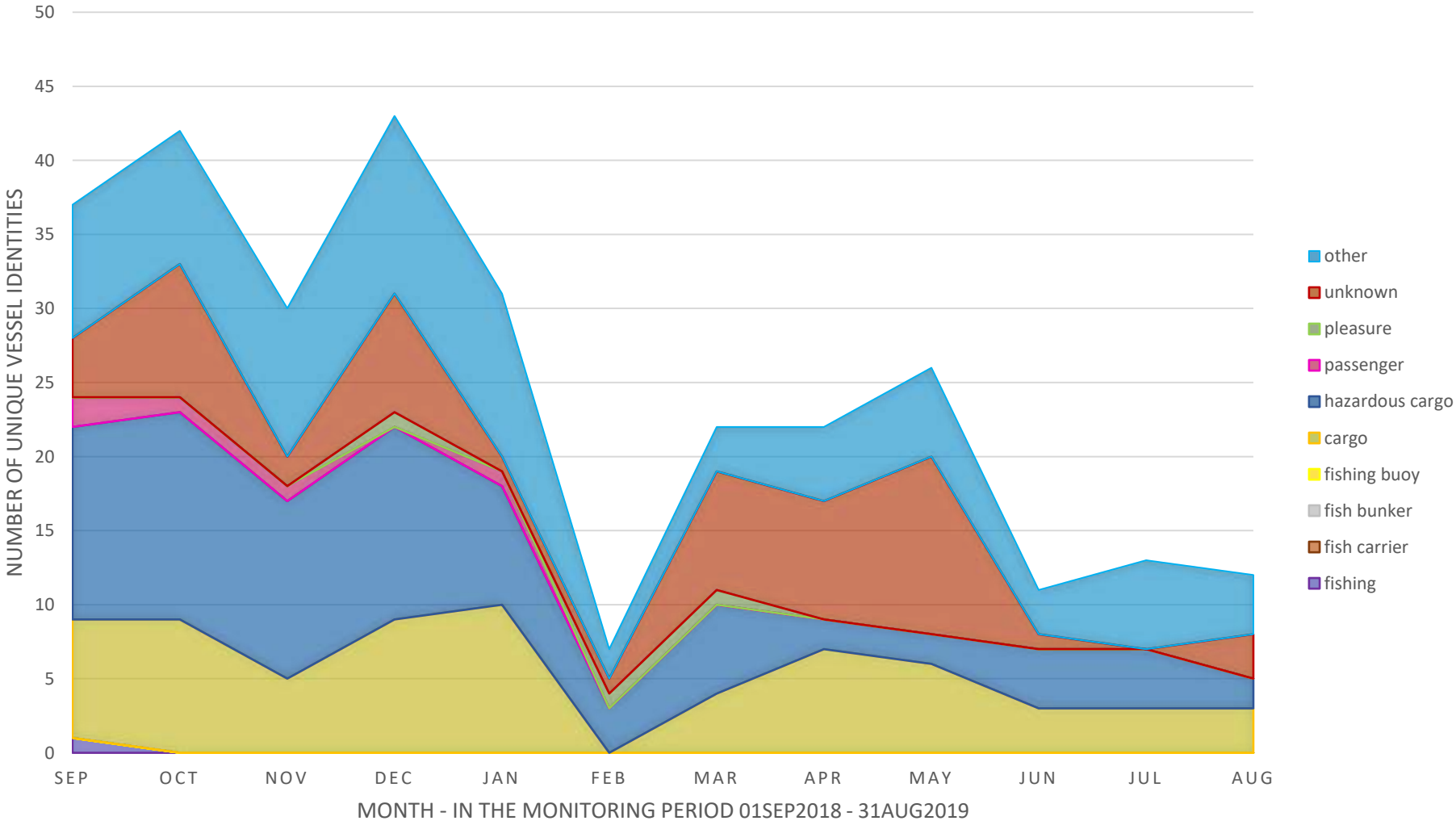


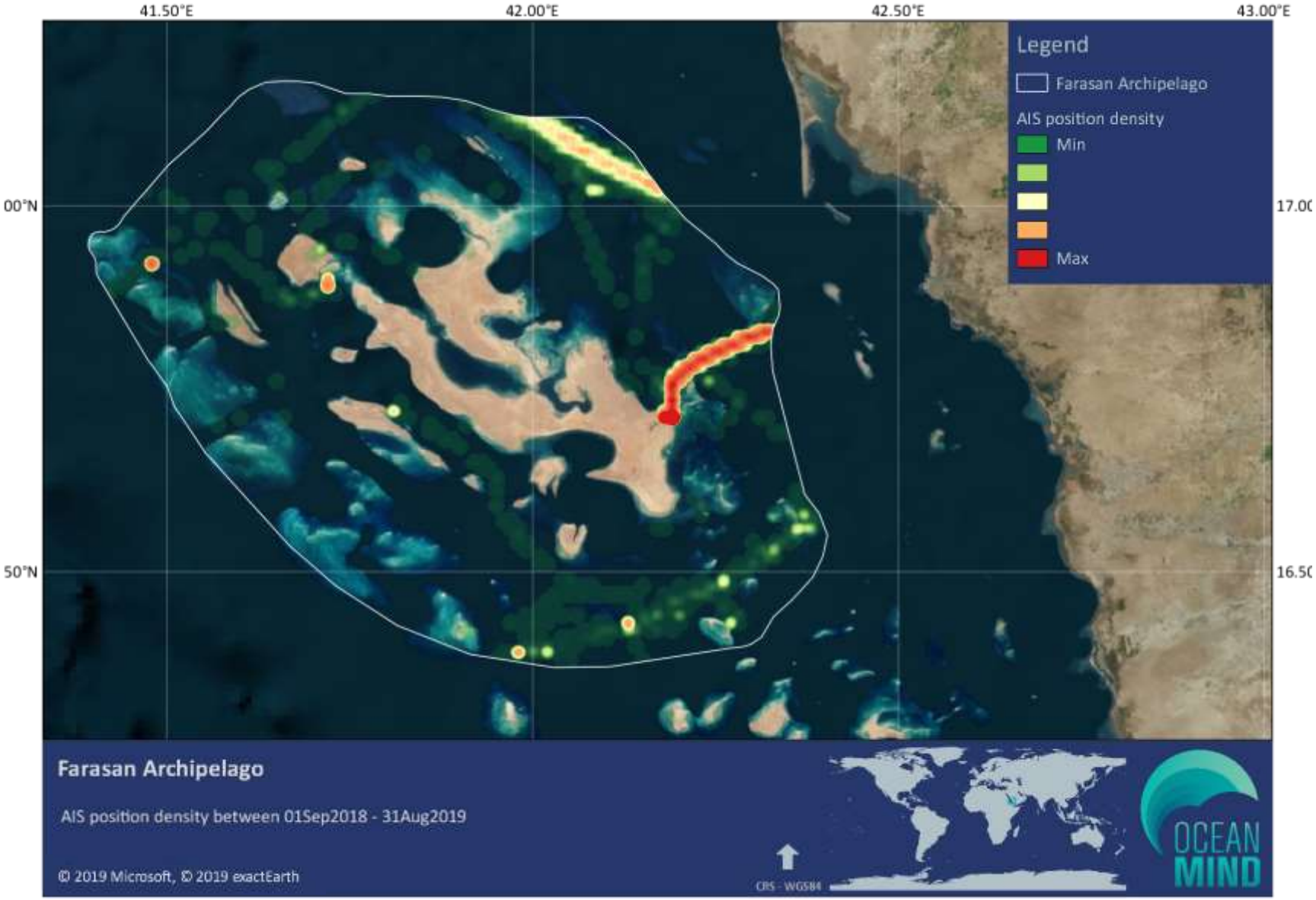


3.21 Farasan Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	0	0	0	0	0	0	0	0	0	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	8	9	5	9	10	0	4	7	6	3	3	3	40
Hazardous cargo	13	14	12	13	8	3	6	2	2	4	4	2	39
Passenger	2	1	1	0	1	0	0	0	0	0	0	0	2
Pleasure	0	0	0	1	0	1	1	0	0	0	0	0	3
Unknown	4	9	2	8	1	1	8	8	12	1	0	3	44
Other	9	9	10	12	11	2	3	5	6	3	6	4	34
Total	37	42	30	43	31	7	22	22	26	11	13	12	163

NUMBER OF VESSELS AGGREGATED BY CATEGORY - FARASAN ARCHIPELAGO

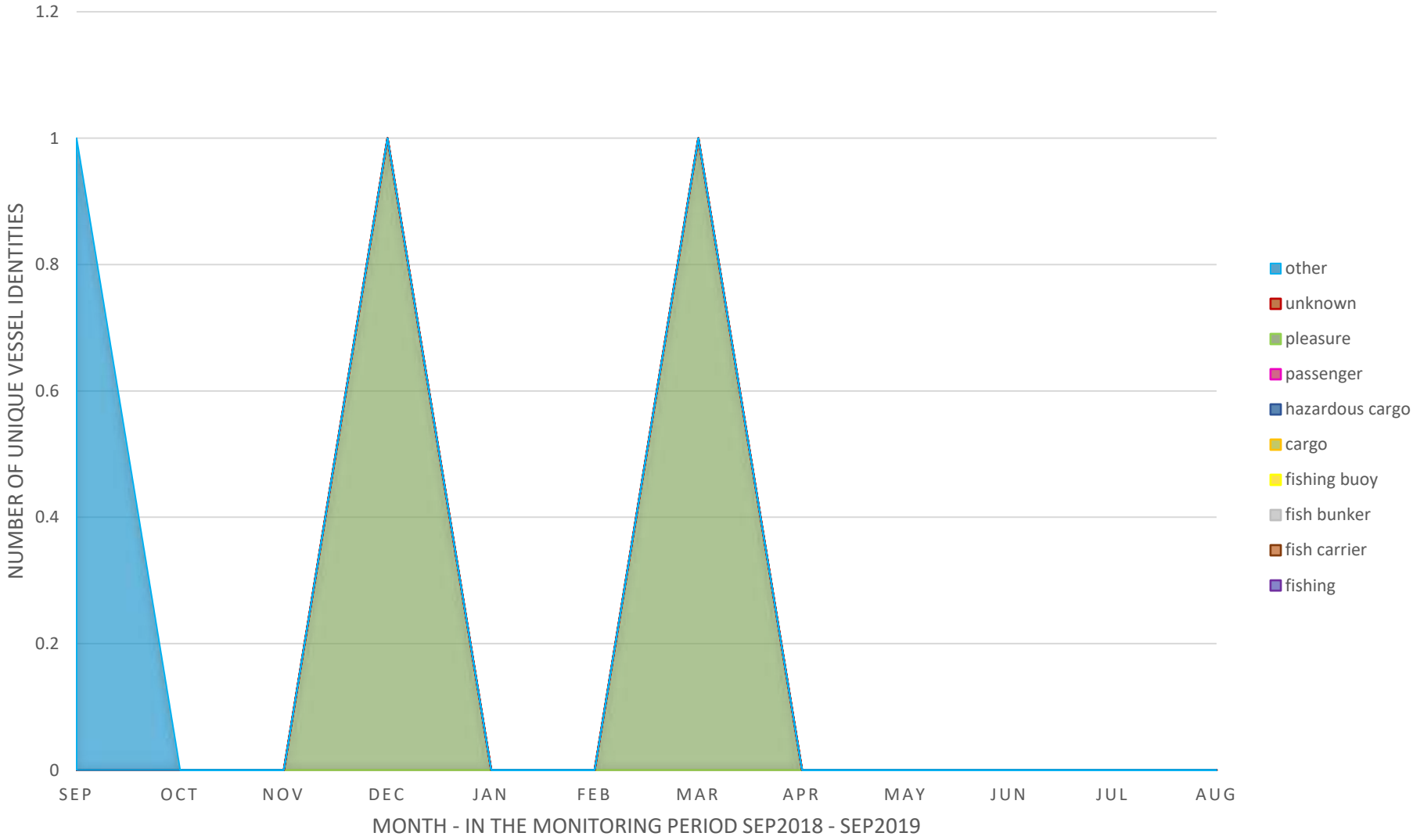


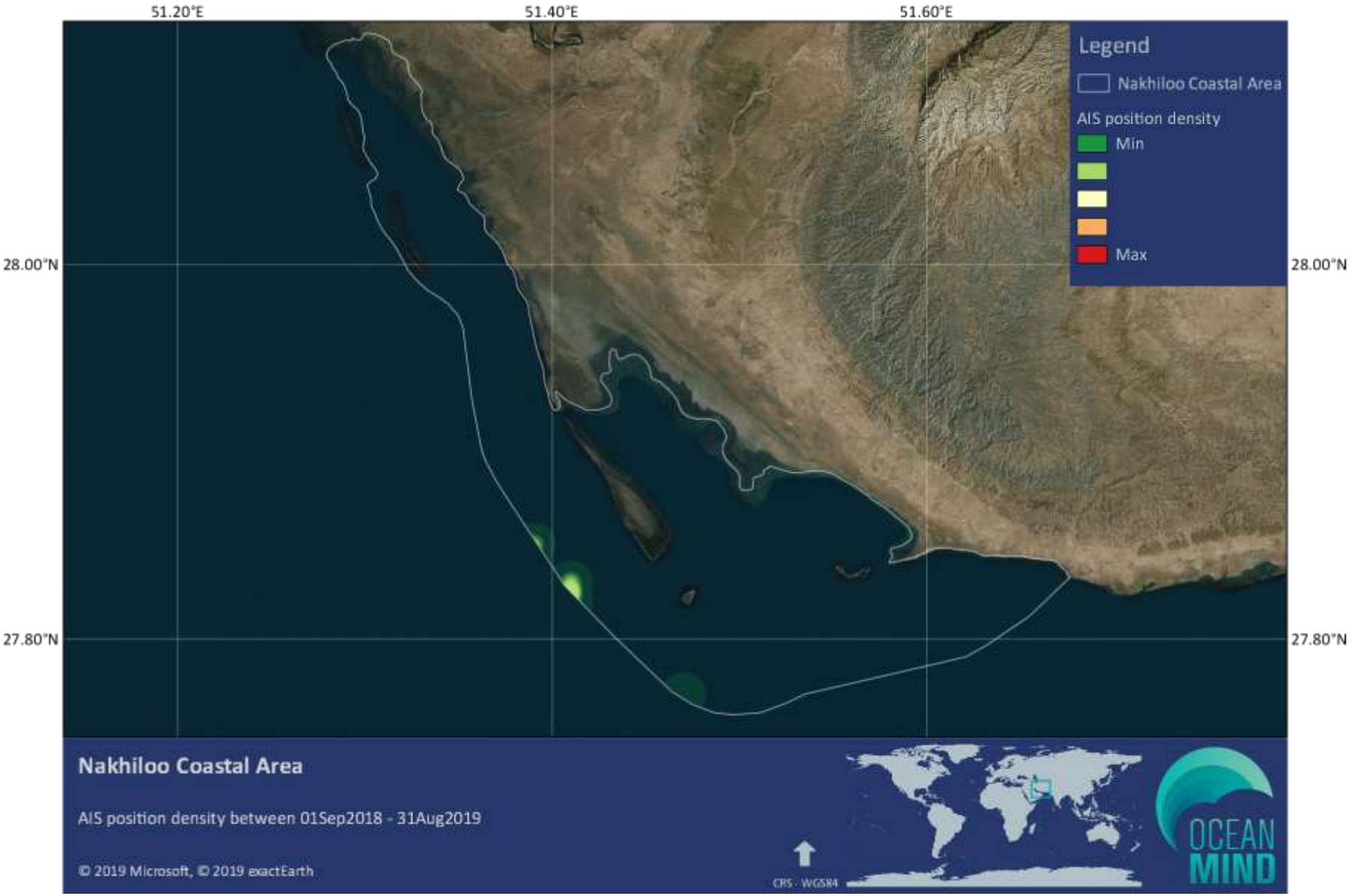


3.22 Nakhiloo Coastal Area IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	1	0	0	1	0	0	0	0	0	1
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	1	0	0	1	0	0	1	0	0	0	0	0	2

NUMBER OF VESSELS AGGREGATED BY CATEGORY





3.23 Chilika Lagoon IMMA

There were no AIS transmissions detected within the Chilika Lagoon in the assessment period 01Sep2018 and 01Sep2019. The IMMA can therefore not be assessed for its vessel activity without consolidating further detection methodologies.

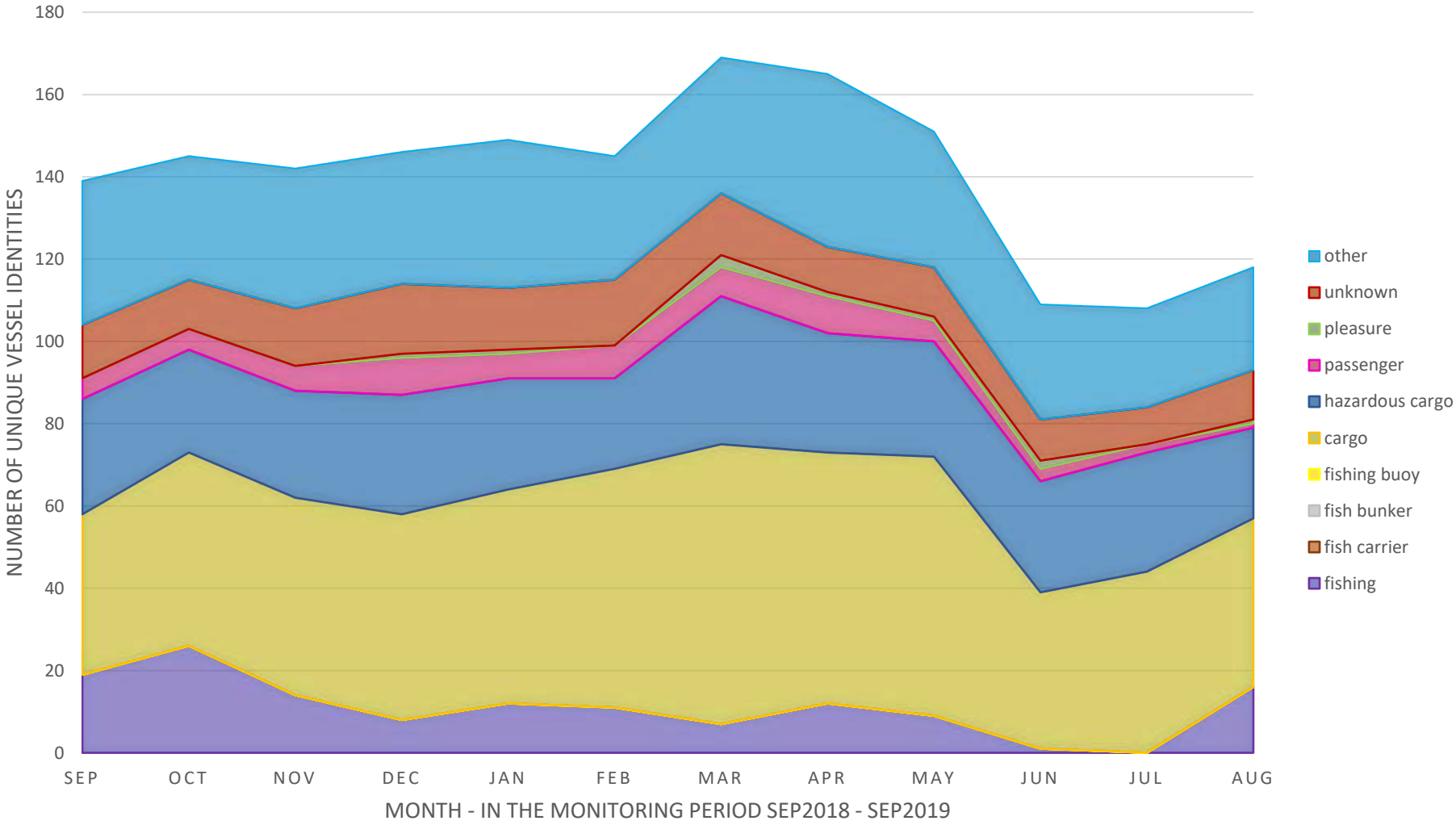
3.24 Miani Hor IMMA

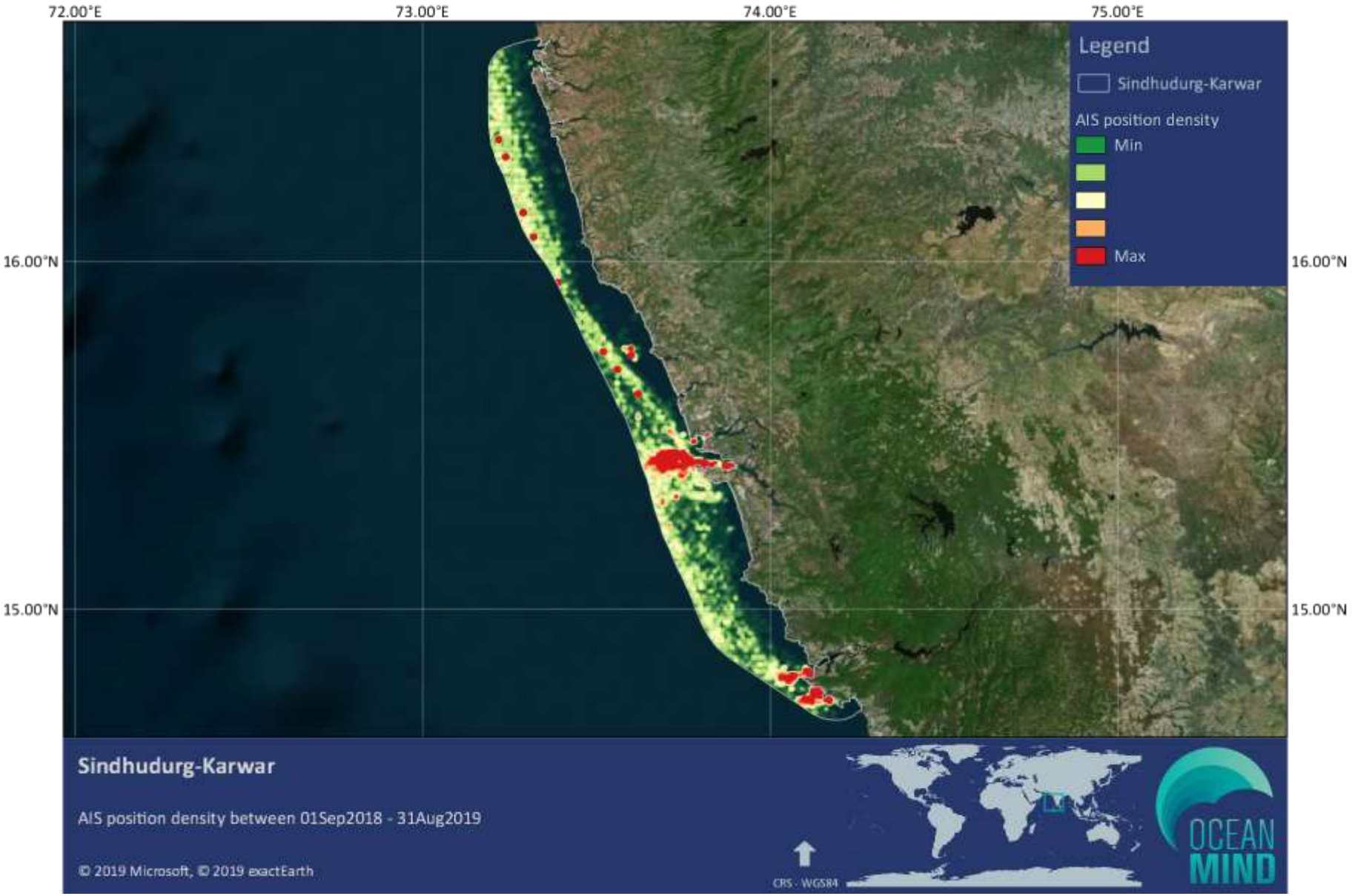
There were no AIS transmissions detected within the Miani Hor in the assessment period 01Sep2018 and 01Sep2019. The IMMA can therefore not be assessed for its vessel activity without consolidating further detection methodologies.

3.25 Sindhudurg-Karwar IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	19	26	14	8	12	11	7	12	9	1	0	16	77
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	39	47	48	50	52	58	68	61	63	38	44	41	373
Hazardous cargo	28	25	26	29	27	22	36	29	28	27	29	22	174
Passenger	5	5	6	9	6	8	7	9	5	3	2	1	28
Pleasure	0	0	0	1	1	0	3	1	1	2	0	1	5
Unknown	13	12	14	17	15	16	15	11	12	10	9	12	51
Other	35	30	34	32	36	30	33	42	33	28	24	25	134
Total	139	145	142	146	149	145	169	165	151	109	108	118	842

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SINDHUDURG-KARWAR



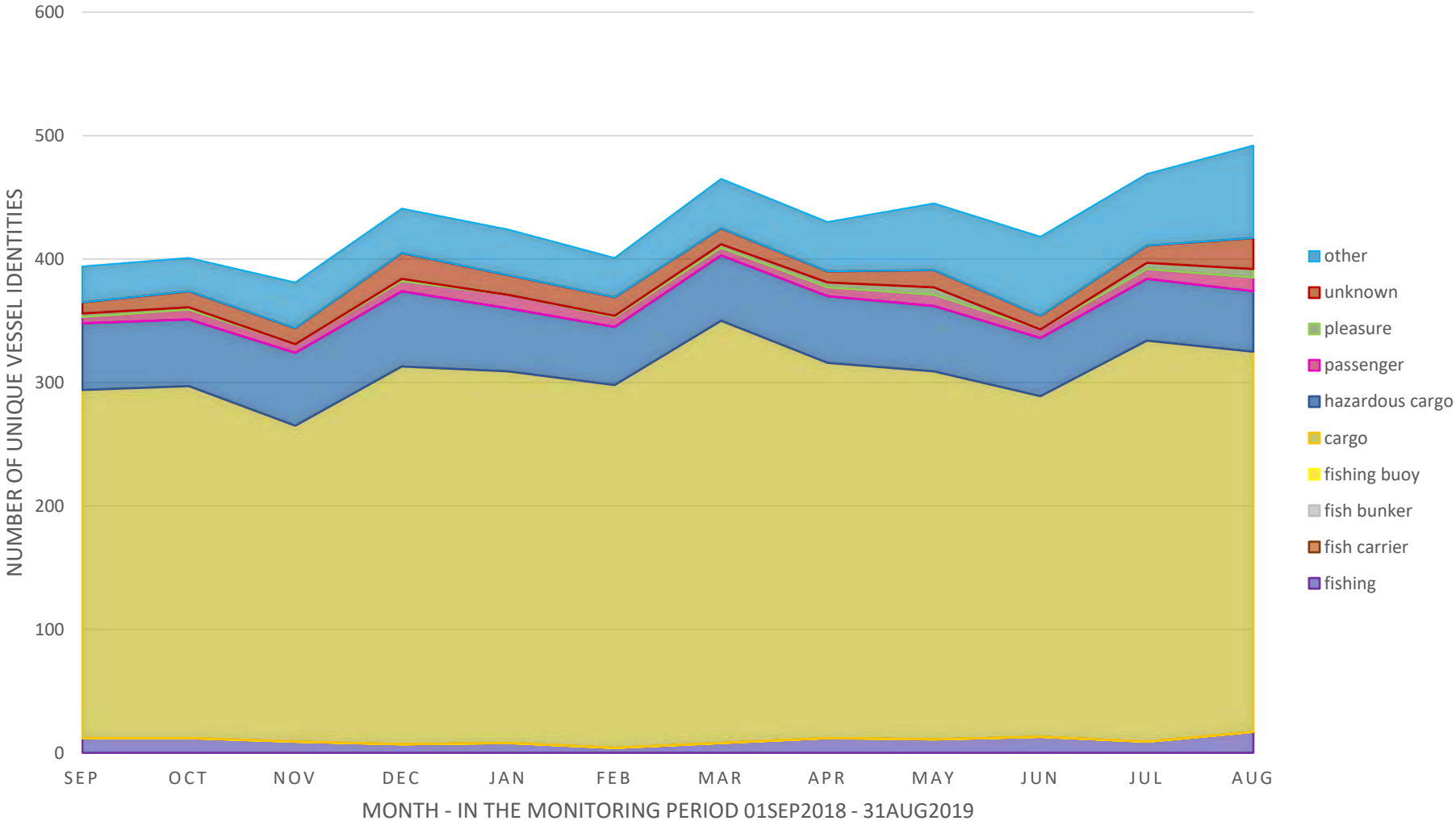


4 Southeast Asian Seas Region

4.1 Berau and East Kutai District, Kalimantan IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	12	12	9	7	8	4	8	12	11	13	9	17	85
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	282	285	256	306	301	294	342	304	298	276	325	308	1771
Hazardous cargo	54	54	59	61	51	47	53	54	53	47	50	49	217
Passenger	5	8	7	8	11	8	6	7	9	7	8	11	31
Pleasure	3	2	0	2	0	1	3	4	6	0	5	7	18
Unknown	9	13	13	21	16	15	13	9	14	11	14	25	74
Other	29	27	37	36	37	32	40	40	54	64	58	75	191
Total	394	401	381	441	424	401	465	430	445	418	469	492	2387

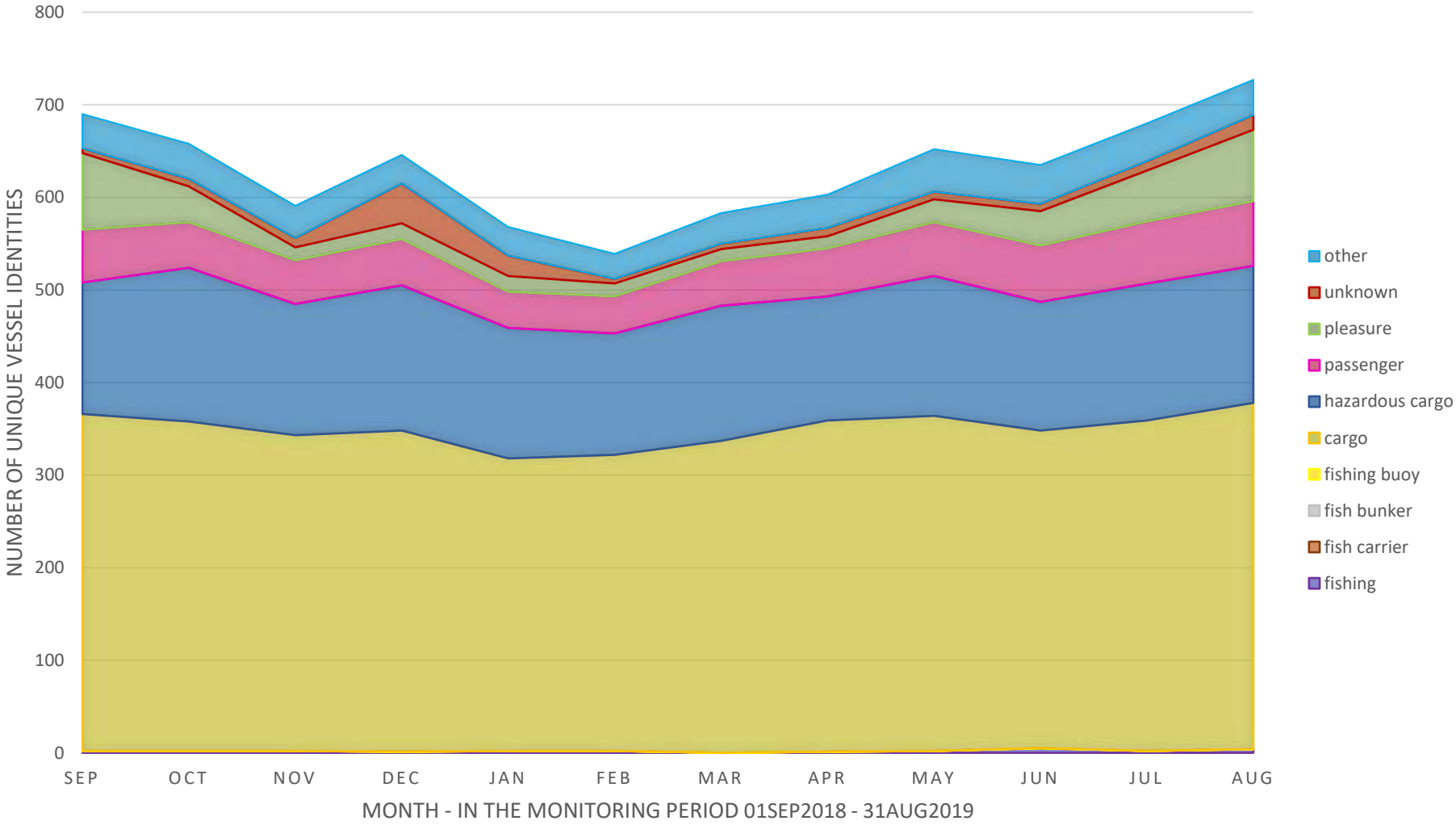
NUMBER OF VESSELS AGGREGATED BY CATEGORY - BERAU AND EAST KUTAI DISTRICT, KALIMANTAN

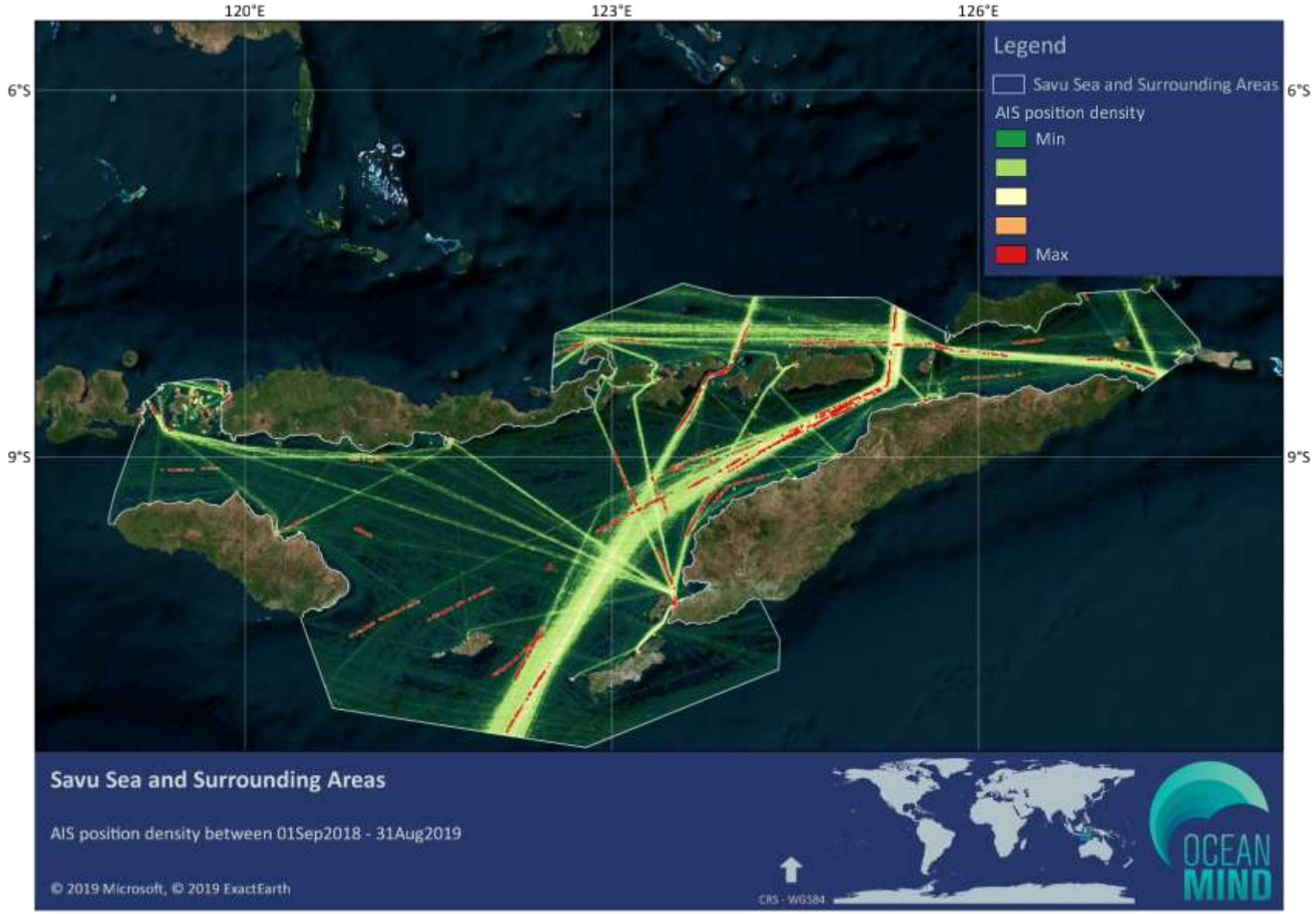


4.2 Savu Sea and Surrounding Areas IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	2	2	1	2	2	0	1	2	5	2	4	15
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	364	356	341	347	316	320	337	358	362	343	357	374	1463
Hazardous cargo	142	166	142	157	141	131	146	134	151	139	148	148	525
Passenger	57	49	47	50	39	40	48	52	58	61	67	70	135
Pleasure	83	39	14	17	17	14	13	13	25	37	55	77	232
Unknown	5	8	10	43	22	5	6	9	8	8	10	16	96
Other	37	38	35	31	31	27	33	36	46	42	41	38	165
Total	690	658	591	646	568	539	583	603	652	635	680	727	2631

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SAVU SEA AND SURROUNDING AREAS

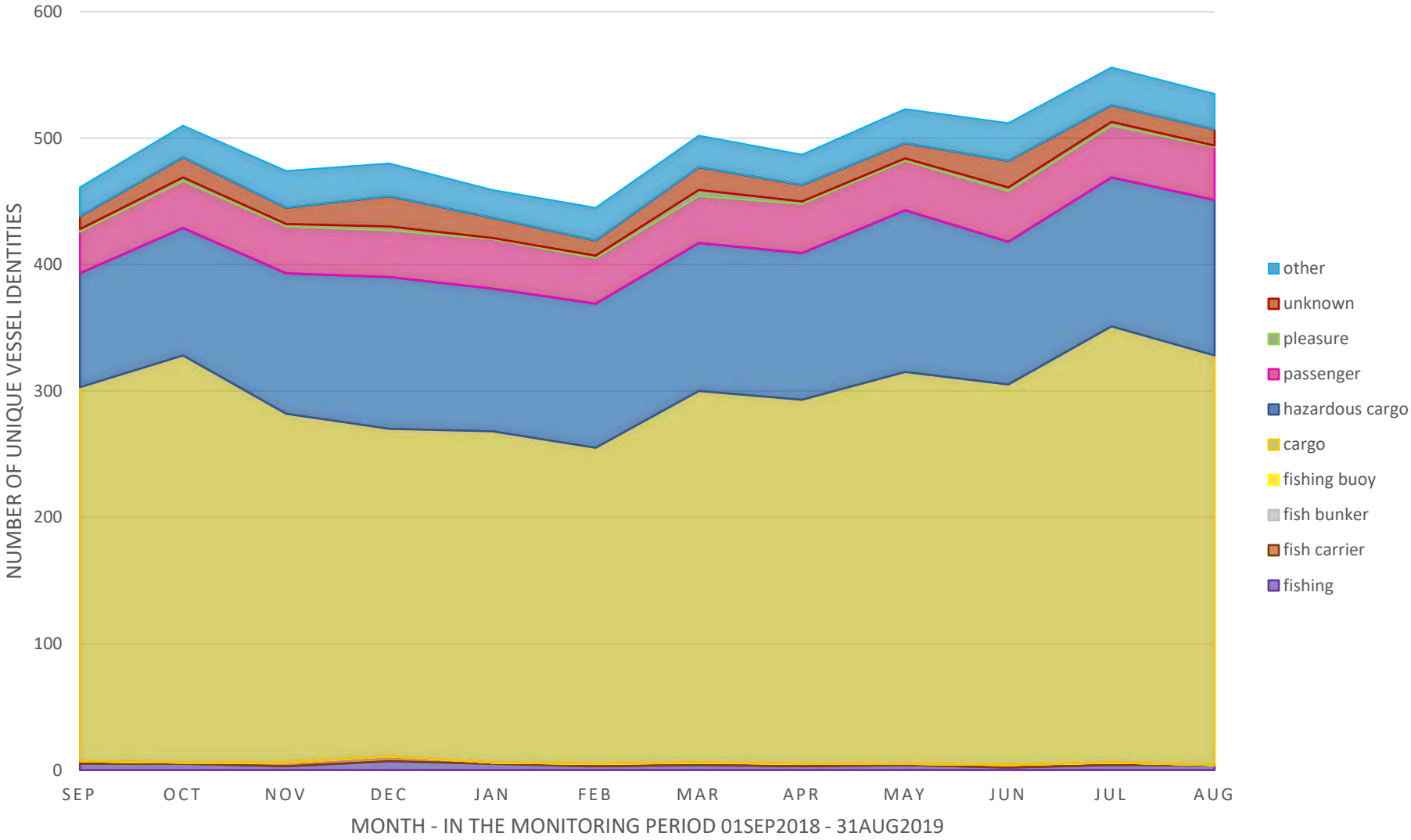


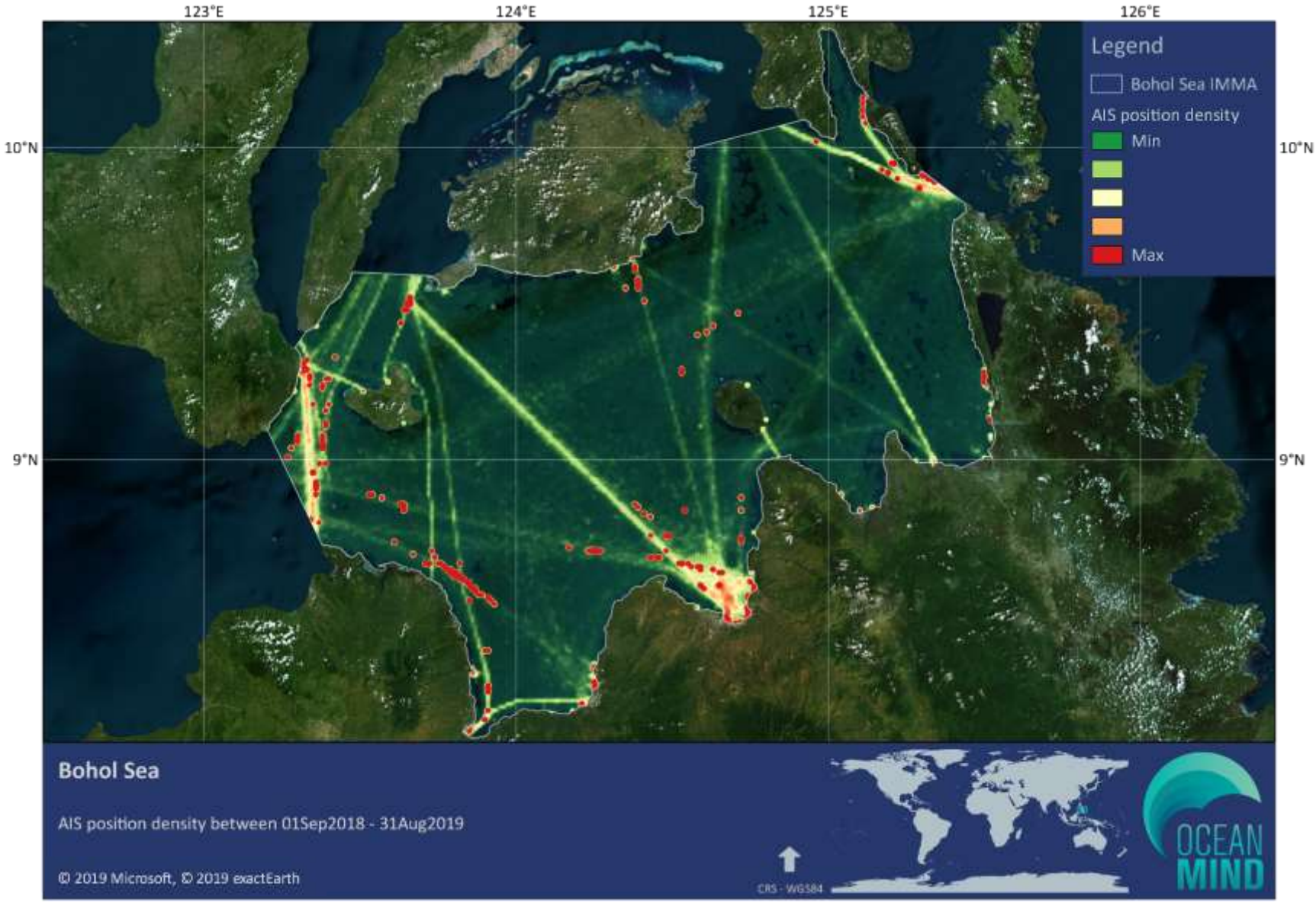


4.3 Bohol Sea IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	5	5	3	7	5	3	4	3	4	2	4	4	19
Fish carrier	2	1	3	4	1	2	2	2	1	2	2	0	10
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	296	322	276	259	262	250	294	288	310	301	345	324	1338
Hazardous cargo	90	101	111	120	113	114	117	116	128	113	118	123	457
Passenger	33	37	37	37	39	36	37	39	39	40	41	42	76
Pleasure	2	3	2	3	1	2	5	2	2	3	3	1	16
Unknown	10	16	13	24	16	12	18	13	12	21	13	13	59
Other	23	25	29	26	22	26	25	24	27	30	30	28	94
Total	461	510	474	480	459	445	502	487	523	512	556	535	2069

NUMBER OF VESSELS AGGREGATED BY CATEGORY - BOHOL SEA

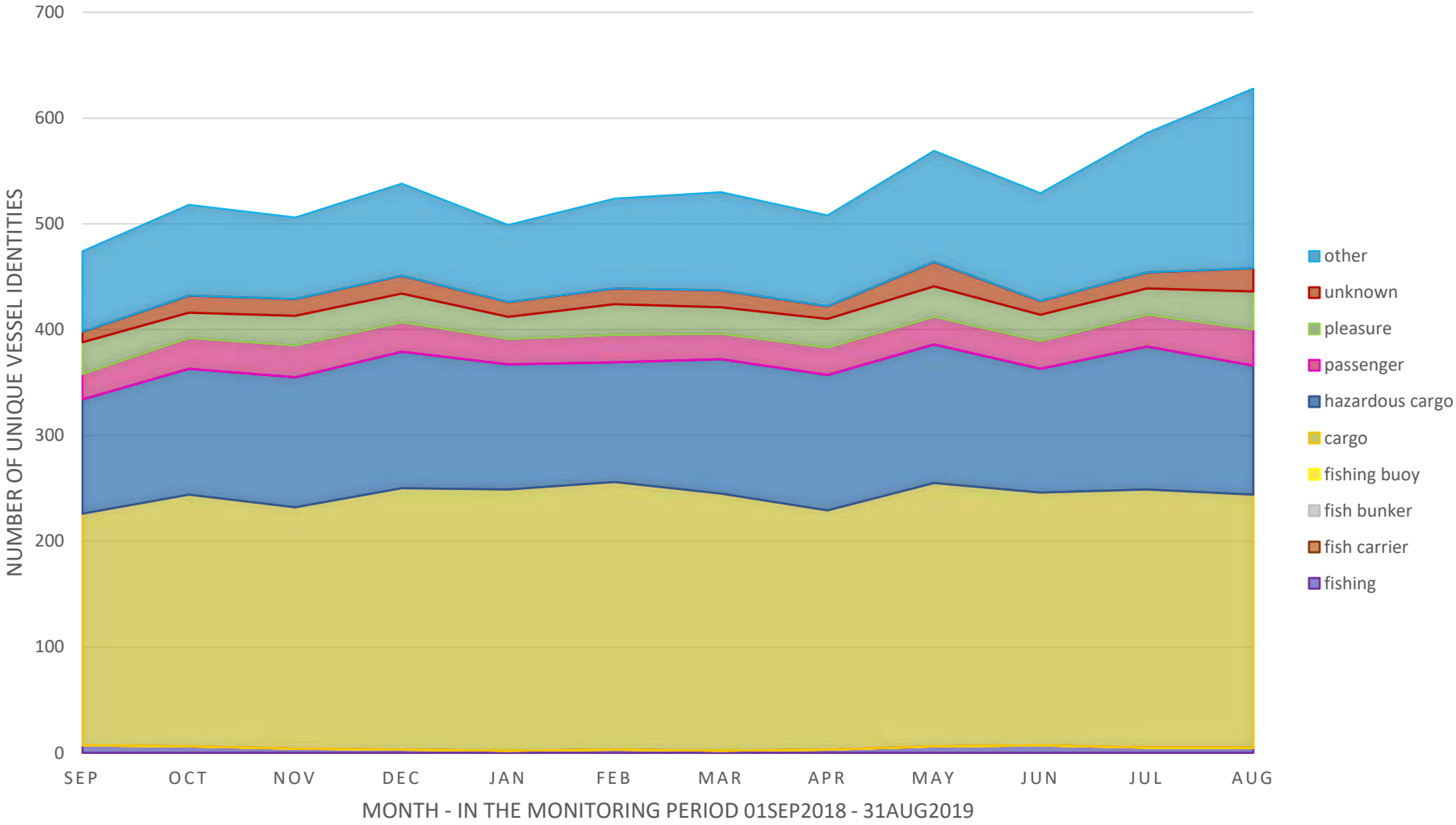


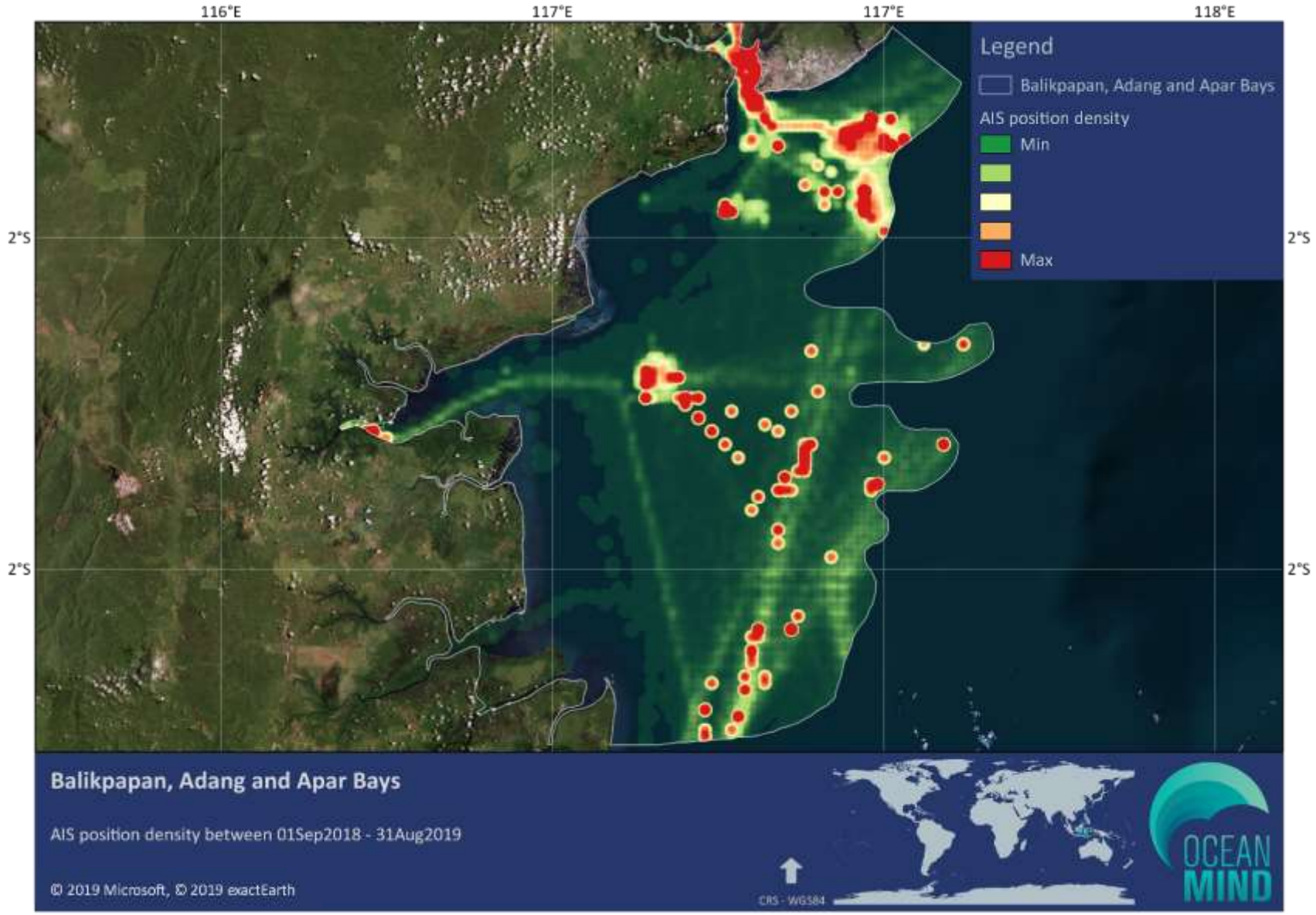


4.4 Balikpapan, Adang and Apar Bays IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	7	6	4	3	2	3	2	3	6	7	5	5	17
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	219	238	228	247	247	253	243	226	249	239	244	239	1260
Hazardous cargo	108	119	123	129	118	113	127	128	131	117	135	122	417
Passenger	24	29	30	28	24	26	24	26	26	26	30	34	69
Pleasure	30	24	28	27	21	29	25	27	29	25	25	36	76
Unknown	10	16	16	17	14	15	16	12	23	13	15	22	80
Other	76	86	77	87	73	85	93	86	105	102	132	170	416
Total	474	518	506	538	499	524	530	508	569	529	586	628	2335

NUMBER OF VESSELS AGGREGATED BY CATEGORY - BALIKPAPAN, ADANG AND APAR BAYS

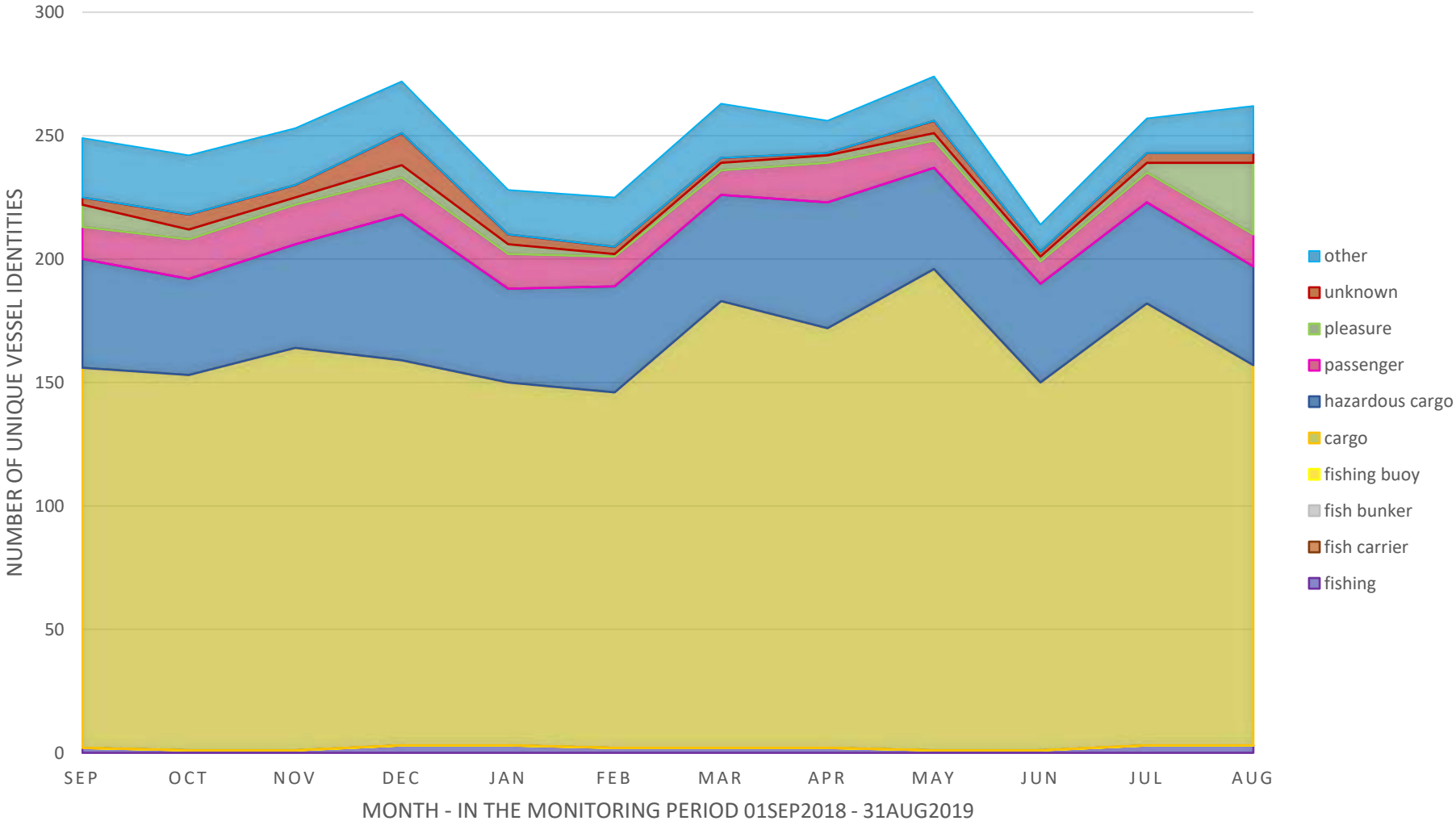


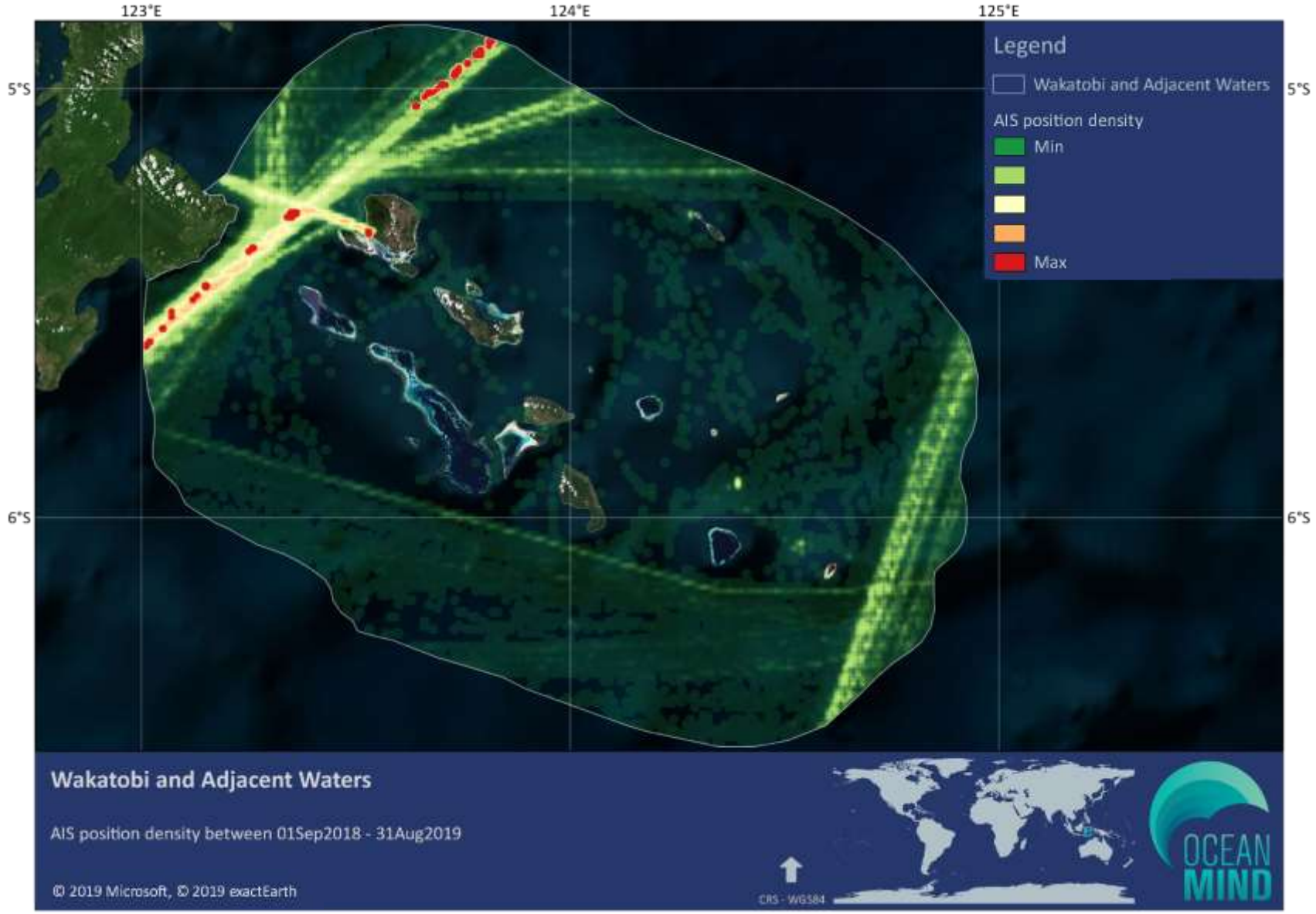


4.5 Wakatobi and Adjacent Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	1	1	3	3	2	2	2	1	1	3	3	16
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	154	152	163	156	147	144	181	170	195	149	179	154	717
Hazardous cargo	44	39	42	59	38	43	43	51	41	40	41	40	208
Passenger	13	16	16	15	14	12	10	16	11	9	12	13	46
Pleasure	9	4	3	5	4	1	3	3	3	2	4	29	59
Unknown	3	6	5	13	4	3	2	1	5	2	4	4	29
Other	24	24	23	21	18	20	22	13	18	11	14	19	104
Total	249	242	253	272	228	225	263	256	274	214	257	262	1179

NUMBER OF VESSELS AGGREGATED BY CATEGORY - WAKATOBI AND ADJACENT WATERS

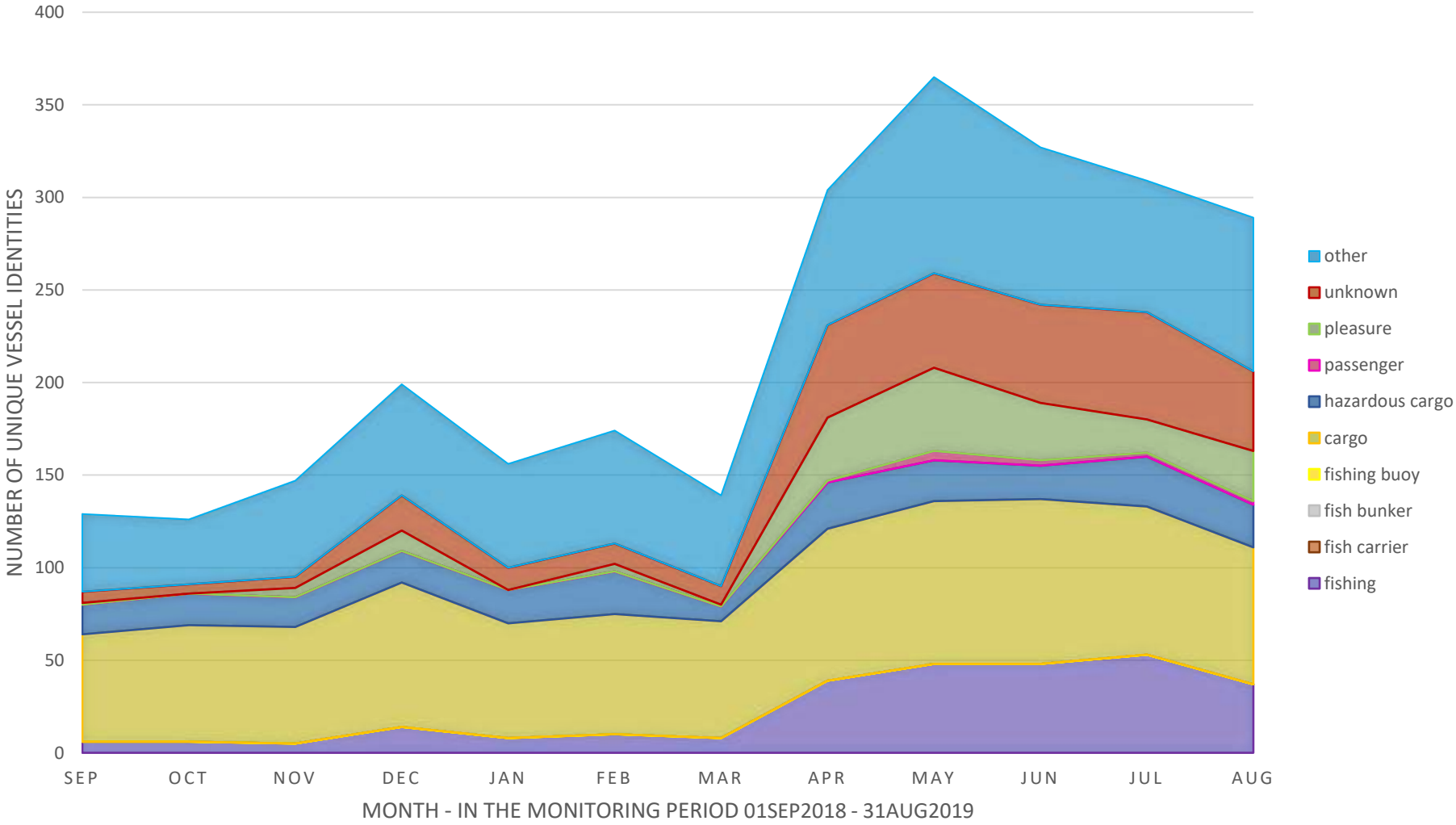


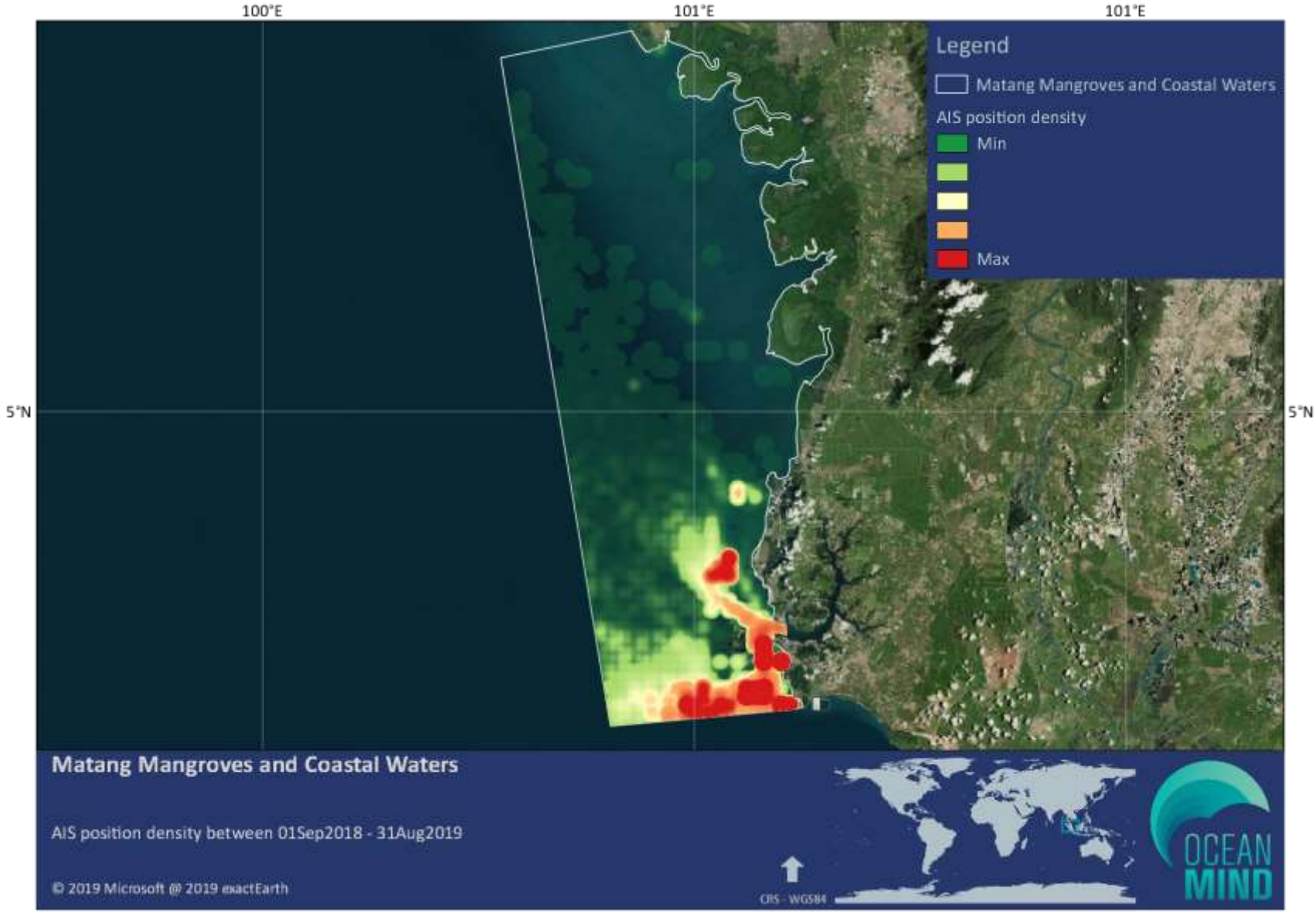


4.6 Matang Mangroves and Coastal Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	6	6	5	14	8	10	8	39	48	48	53	37	88
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	58	63	63	78	62	65	63	82	88	89	80	74	479
Hazardous cargo	16	17	16	17	18	23	8	25	22	18	27	23	112
Passenger	0	0	0	0	0	0	0	1	5	3	2	2	6
Pleasure	1	0	5	11	0	4	1	34	45	31	18	27	119
Unknown	6	5	6	19	12	11	10	50	51	53	58	43	155
Other	42	35	52	60	56	61	49	73	106	85	71	83	258
Total	129	126	147	199	156	174	139	304	365	327	309	289	1217

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MATANG MANGROVES AND COASTAL WATERS

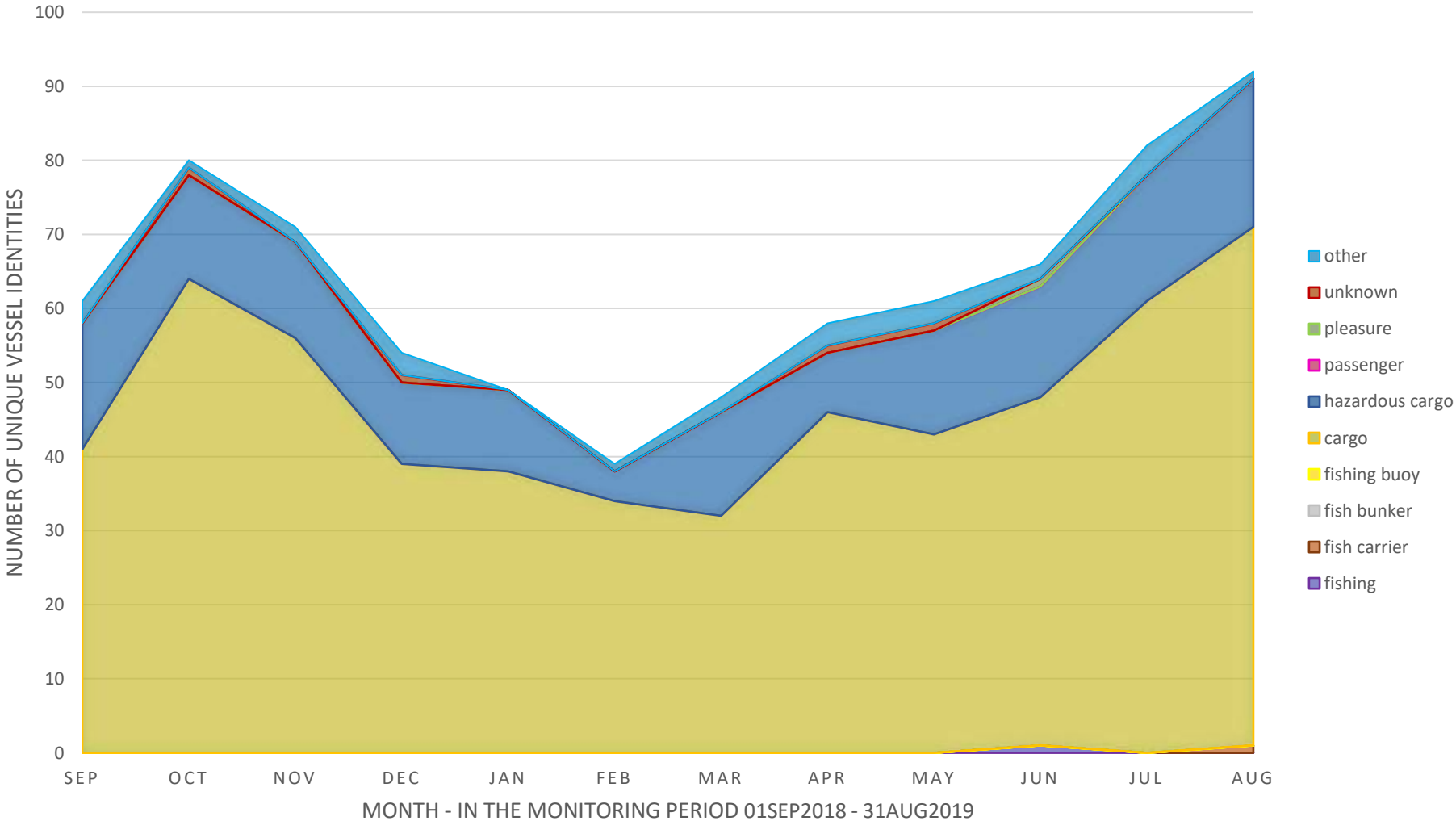


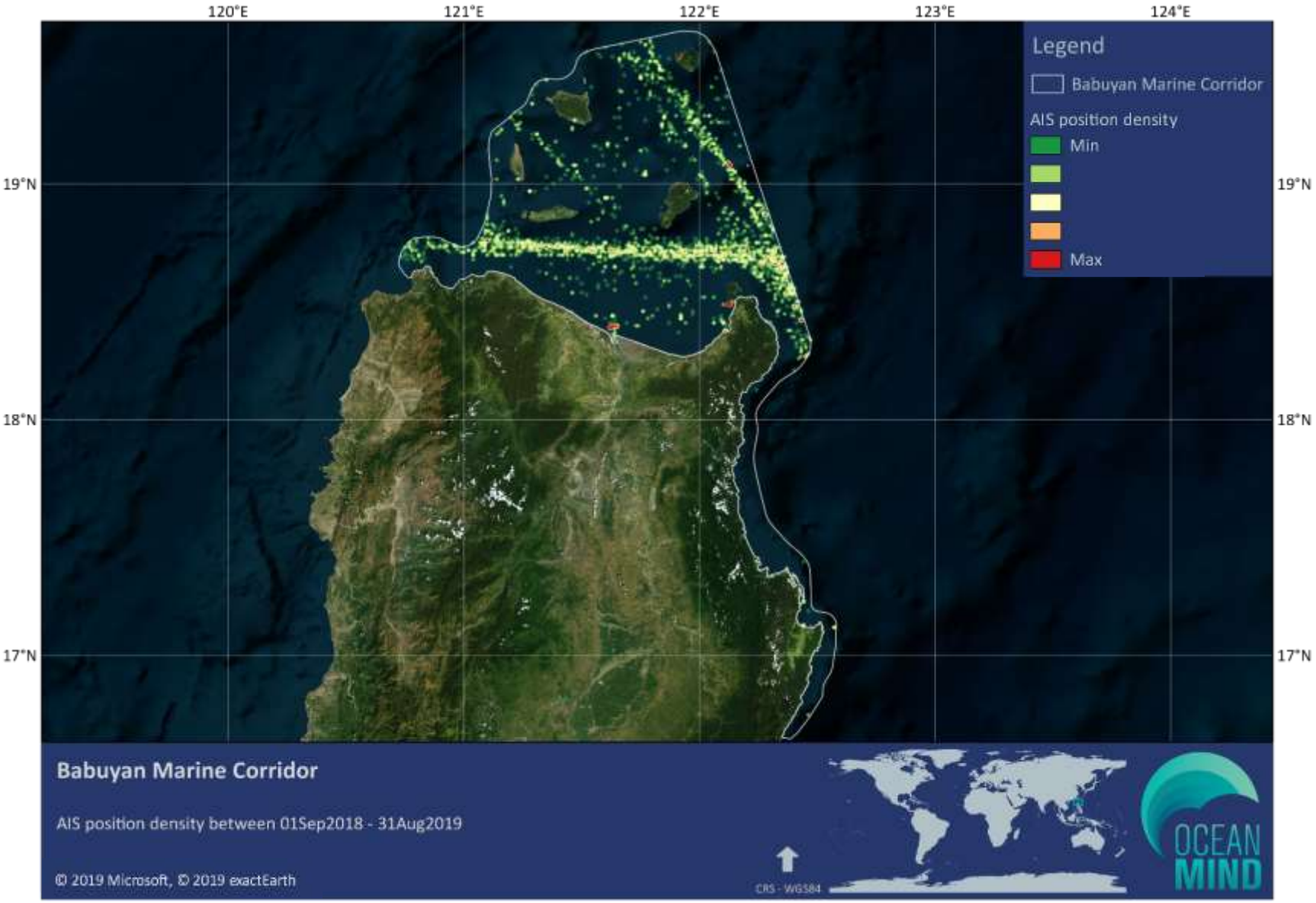


4.7 Babuyan Marine Corridor IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	1	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	1	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	41	64	56	39	38	34	32	46	43	47	61	70	436
Hazardous cargo	17	14	13	11	11	4	14	8	14	15	17	20	93
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	0	0	0	1	0	0	1
Unknown	0	1	0	1	0	0	0	1	1	0	0	0	4
Other	3	1	2	3	0	1	2	3	3	2	4	1	17
Total	61	80	71	54	49	39	48	58	61	66	82	92	553

NUMBER OF VESSELS AGGREGATED BY CATEGORY - BABUYAN MARINE CORRIDOR

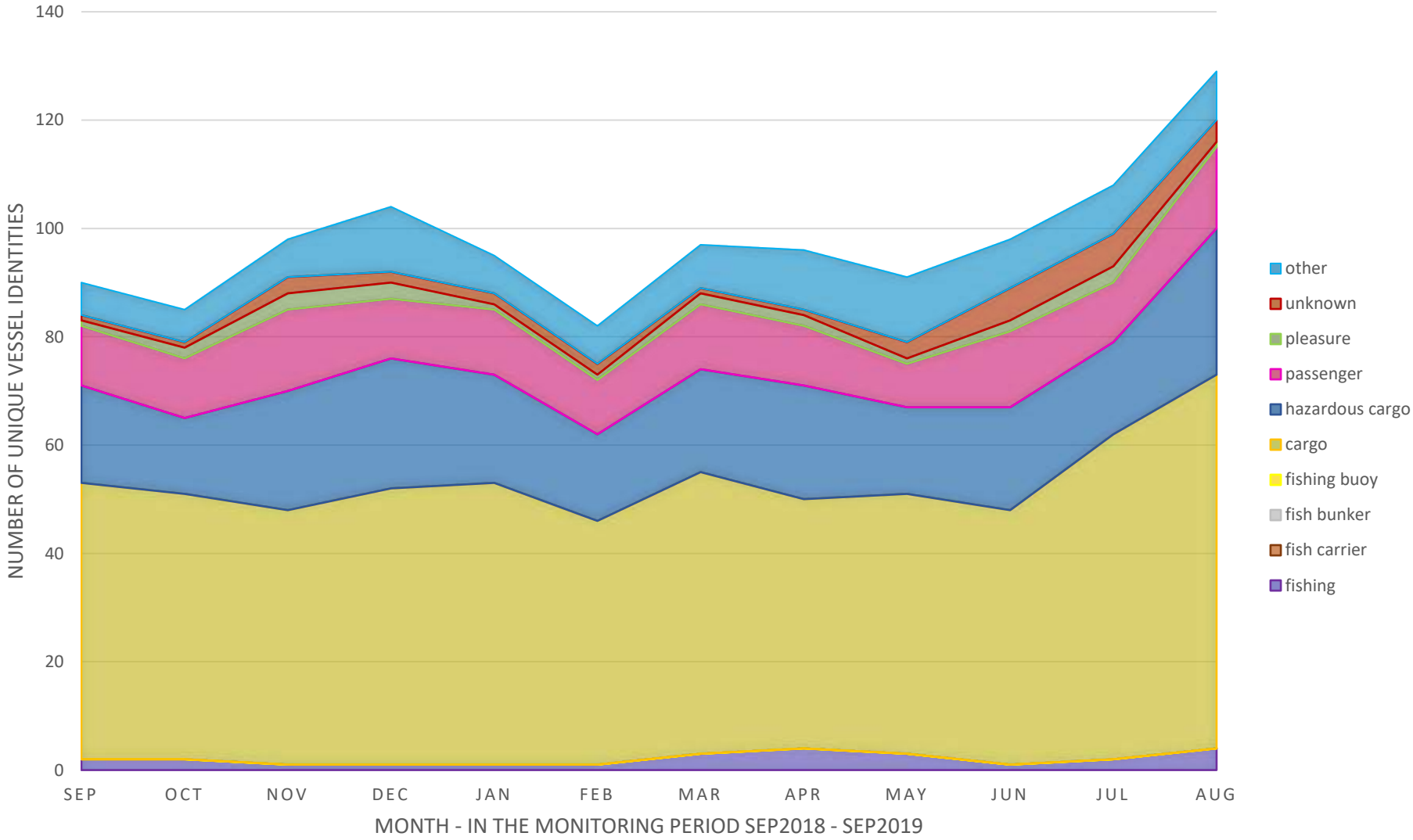




4.8 Tanon Strait IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	2	1	1	1	1	3	4	3	1	2	4	5
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	51	49	47	51	52	45	52	46	48	47	60	69	300
Hazardous cargo	18	14	22	24	20	16	19	21	16	19	17	27	95
Passenger	11	11	15	11	12	10	12	11	8	14	11	15	34
Pleasure	1	2	3	3	1	1	2	2	1	2	3	1	9
Unknown	1	1	3	2	2	2	1	1	3	6	6	4	15
Other	6	6	7	12	7	7	8	11	12	9	9	9	32
Total	90	85	98	104	95	82	97	96	91	98	108	129	490

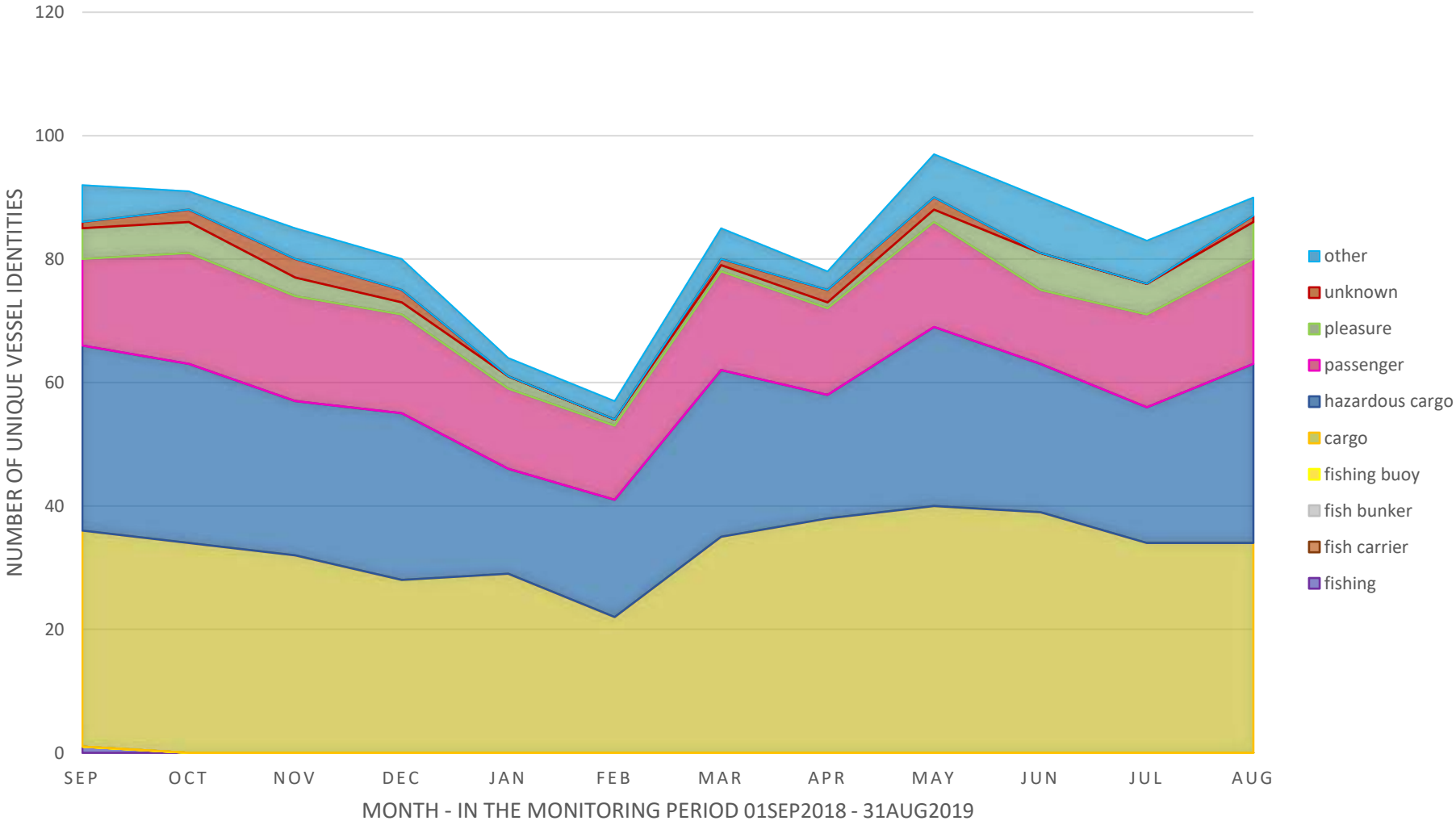
NUMBER OF VESSELS AGGREGATED BY CATEGORY - TANON STRAIT

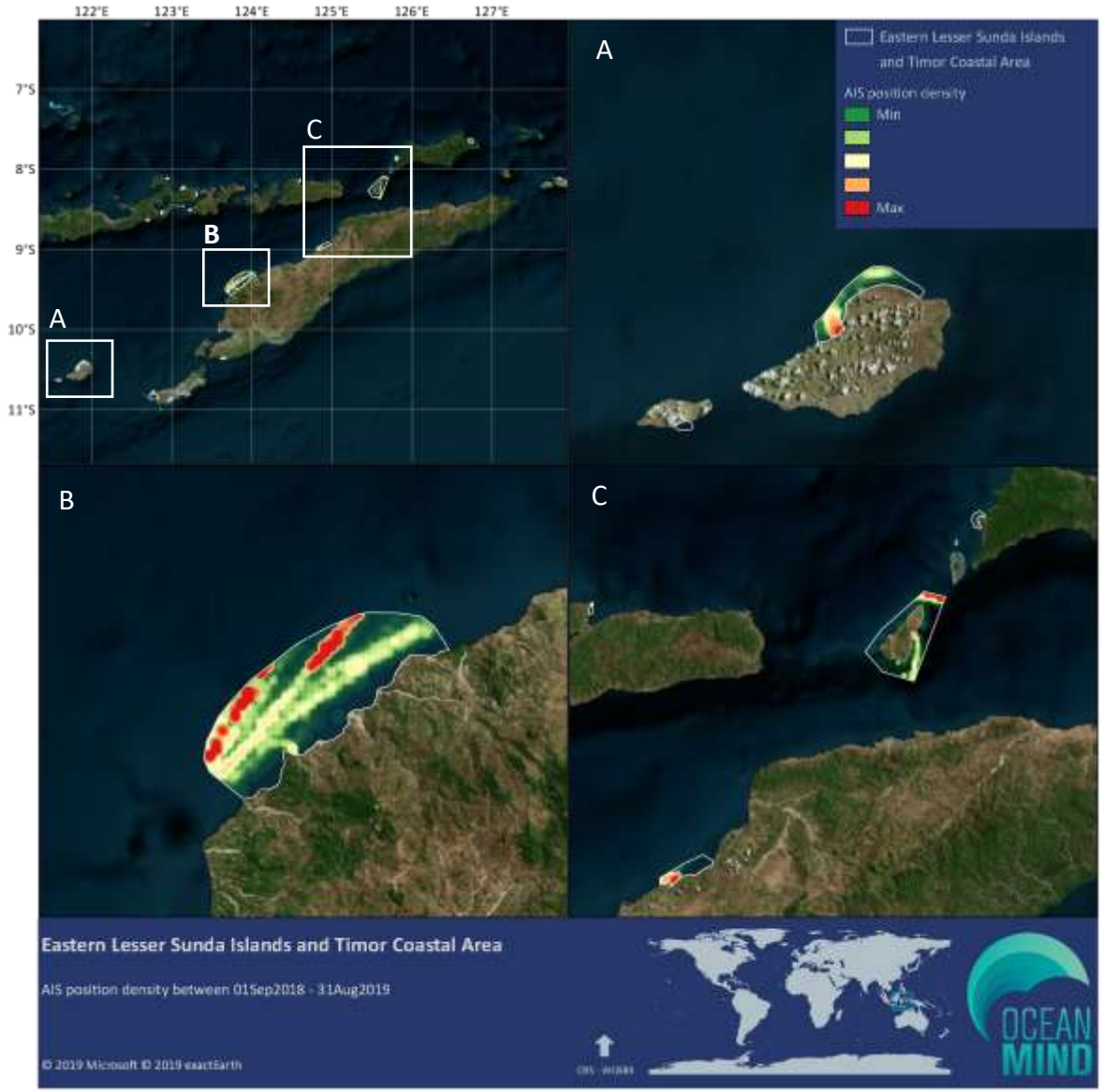


4.9 Eastern Lesser Sunda Islands and Timor Coastal Area IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	0	0	0	0	0	0	0	0	0	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	35	34	32	28	29	22	35	38	40	39	34	34	263
Hazardous cargo	30	29	25	27	17	19	27	20	29	24	22	29	124
Passenger	14	18	17	16	13	12	16	14	17	12	15	17	32
Pleasure	5	5	3	2	2	1	1	1	2	6	5	6	23
Unknown	1	2	3	2	0	0	1	2	2	0	0	1	6
Other	6	3	5	5	3	3	5	3	7	9	7	3	33
Total	92	91	85	80	64	57	85	78	97	90	83	90	482

NUMBER OF VESSELS AGGREGATED BY CATEGORY - EASTERN LESSER SUNDA ISLANDS AND TIMOR COASTAL AREA

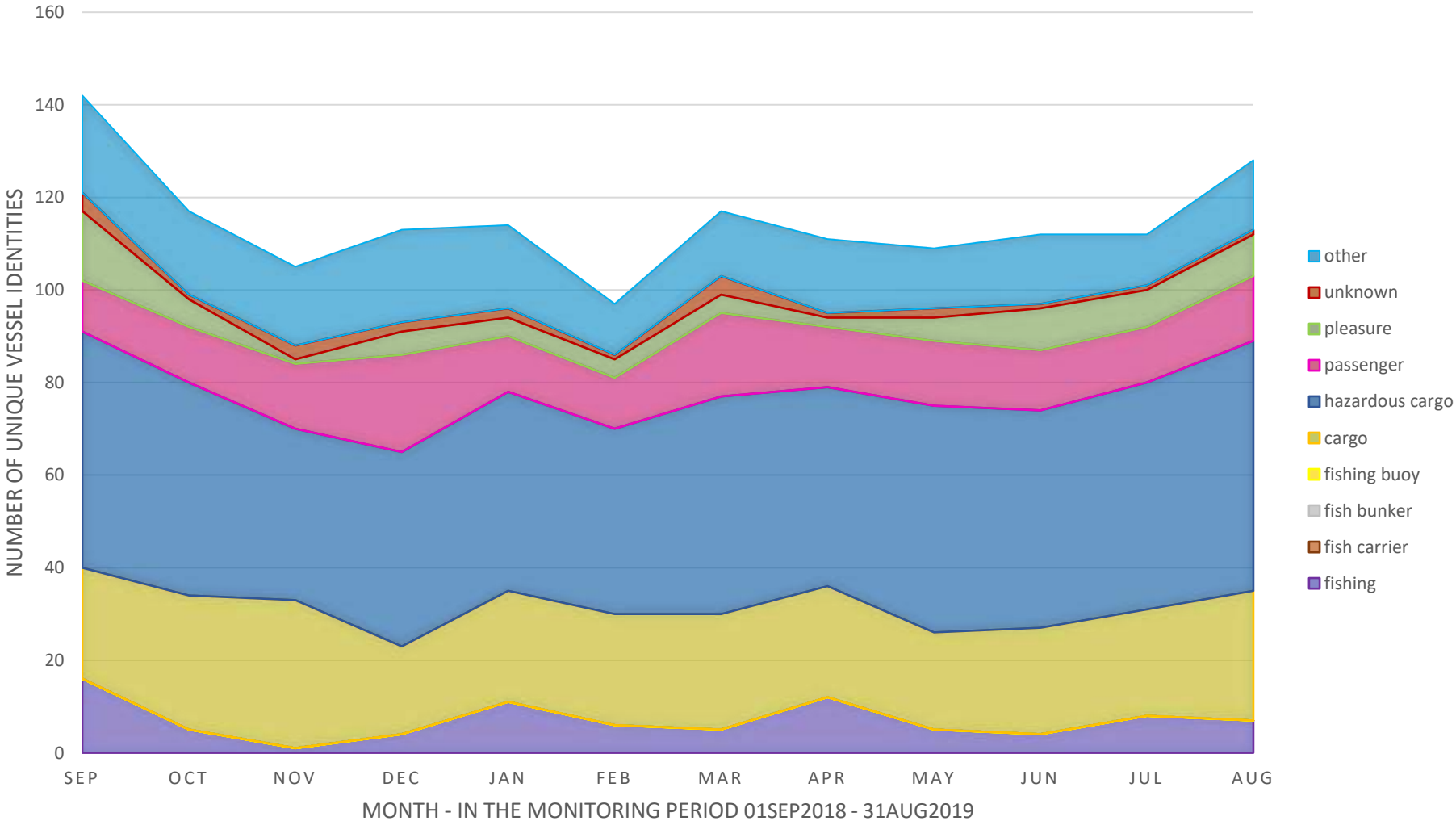


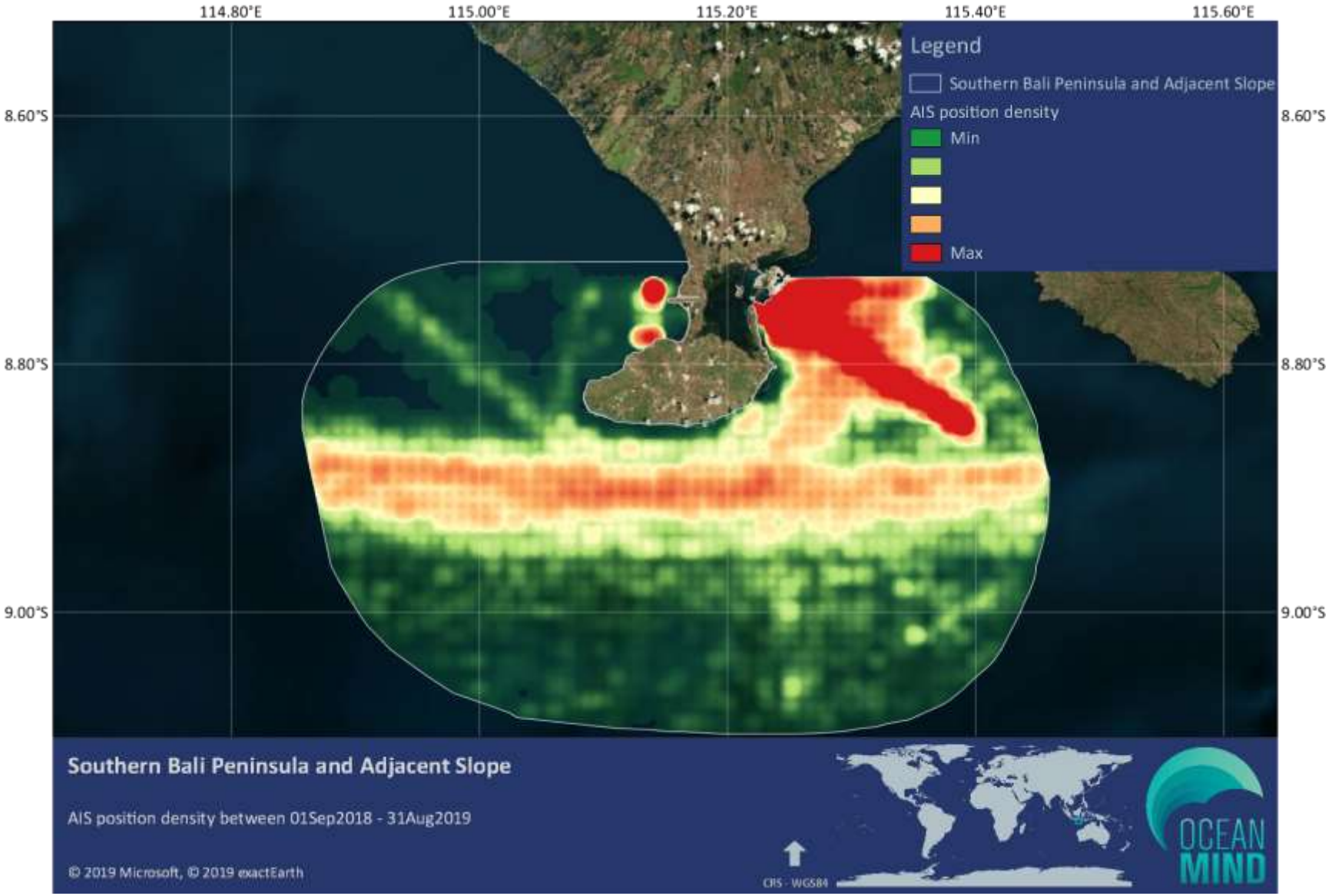


4.10 Southern Bali Peninsula and Adjacent Slope IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	16	5	1	4	11	6	5	12	5	4	8	7	32
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	24	29	32	19	24	24	25	24	21	23	23	28	126
Hazardous cargo	51	46	37	42	43	40	47	43	49	47	49	54	154
Passenger	11	12	14	21	12	11	18	13	14	13	12	14	55
Pleasure	15	6	1	5	4	4	4	2	5	9	8	9	49
Unknown	4	1	3	2	2	1	4	1	2	1	1	1	11
Other	21	18	17	20	18	11	14	16	13	15	11	15	62
Total	142	117	105	113	114	97	117	111	109	112	112	128	489

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTHERN BALI PENINSULA AND ADJACENT SLOPE

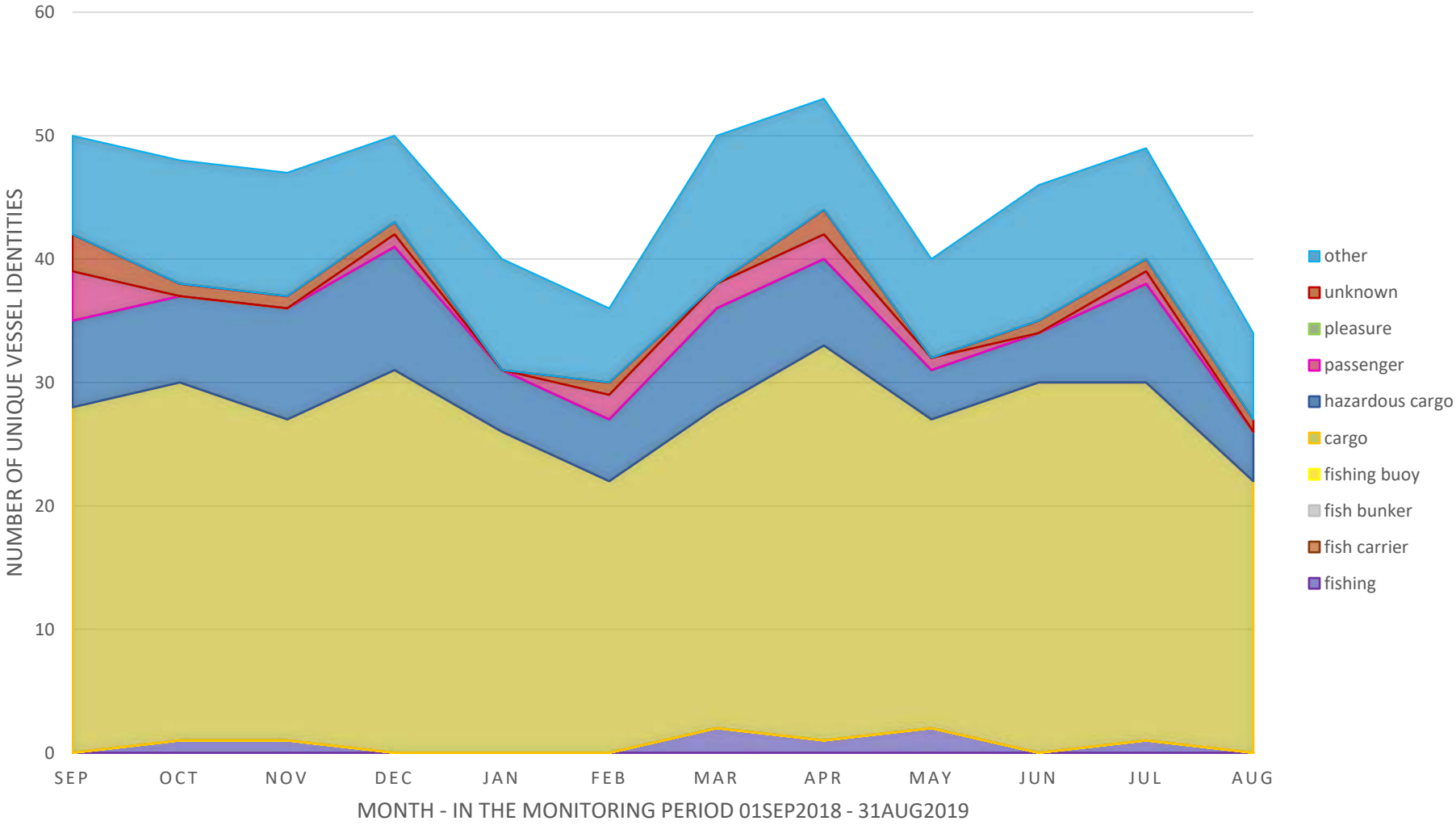


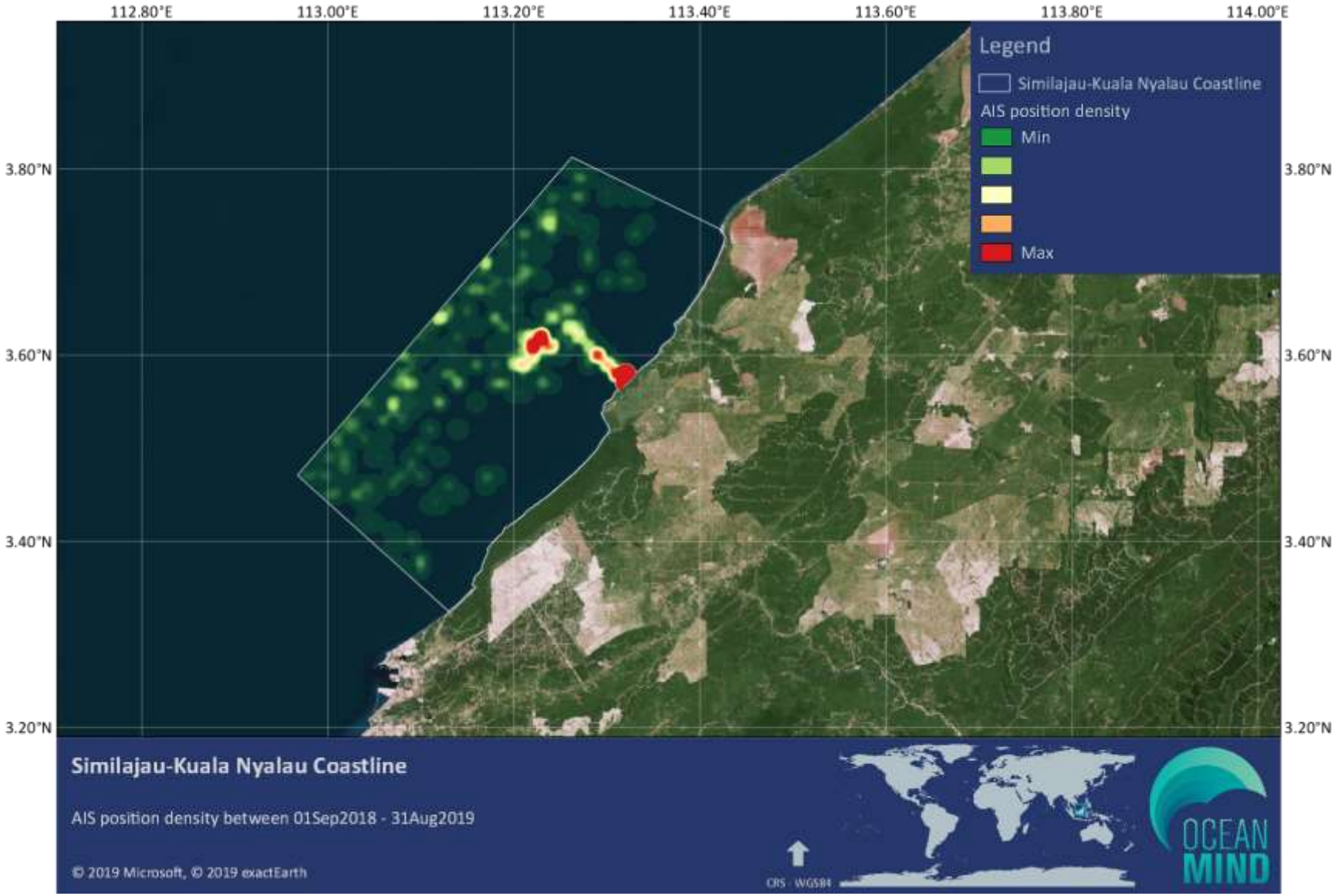


4.11 Similajau-Kuala Nyalau Coastline IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	1	0	0	0	2	1	2	0	1	0	3
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	28	29	26	31	26	22	26	32	25	30	29	22	223
Hazardous cargo	7	7	9	10	5	5	8	7	4	4	8	4	37
Passenger	4	0	0	1	0	2	2	2	1	0	1	0	13
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	3	1	1	1	0	1	0	2	0	1	1	1	9
Other	8	10	10	7	9	6	12	9	8	11	9	7	46
Total	50	48	47	50	40	36	50	53	40	46	49	34	331

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SIMILAJAU-KUALA NYALAU COASTLINE

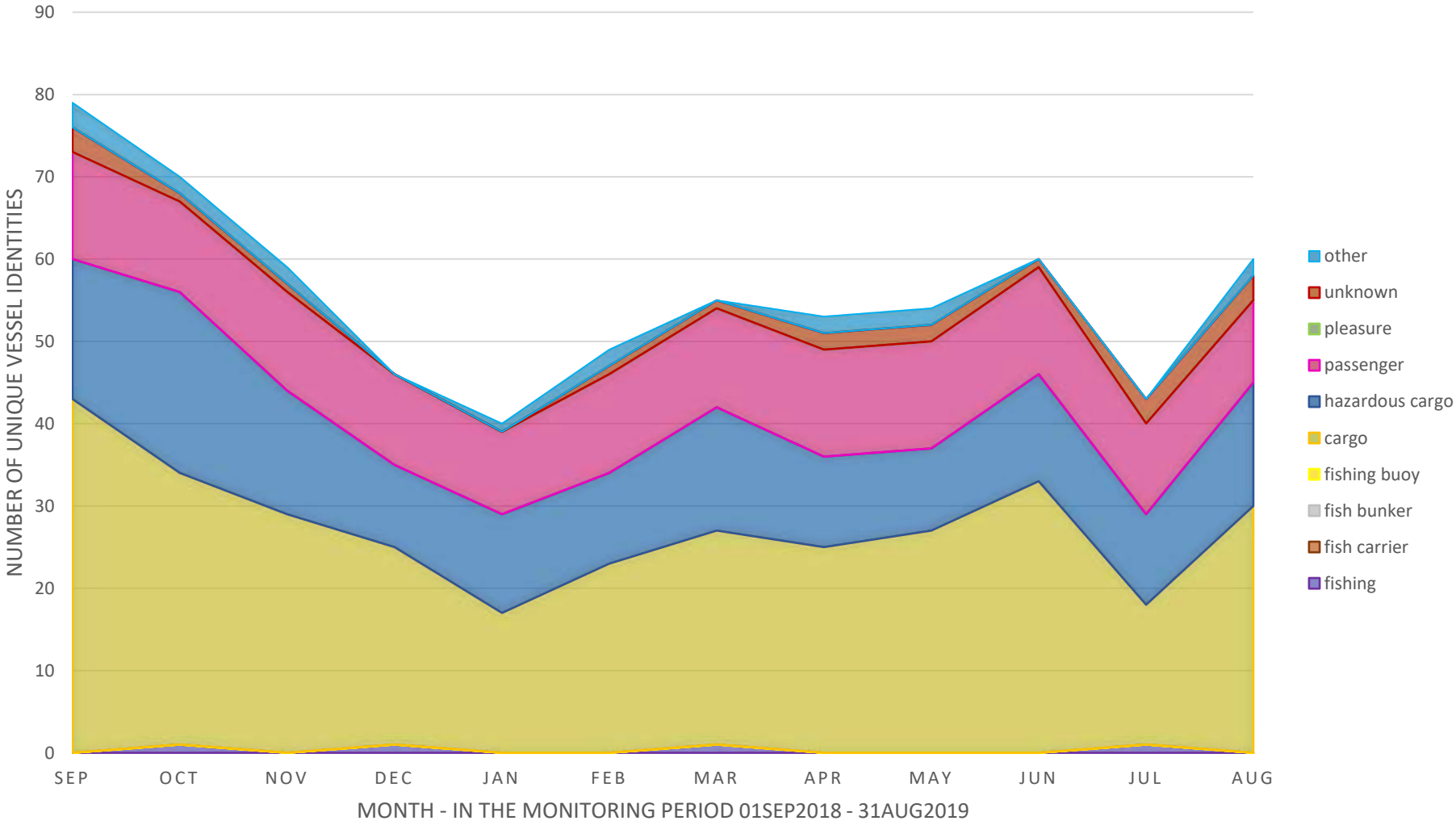


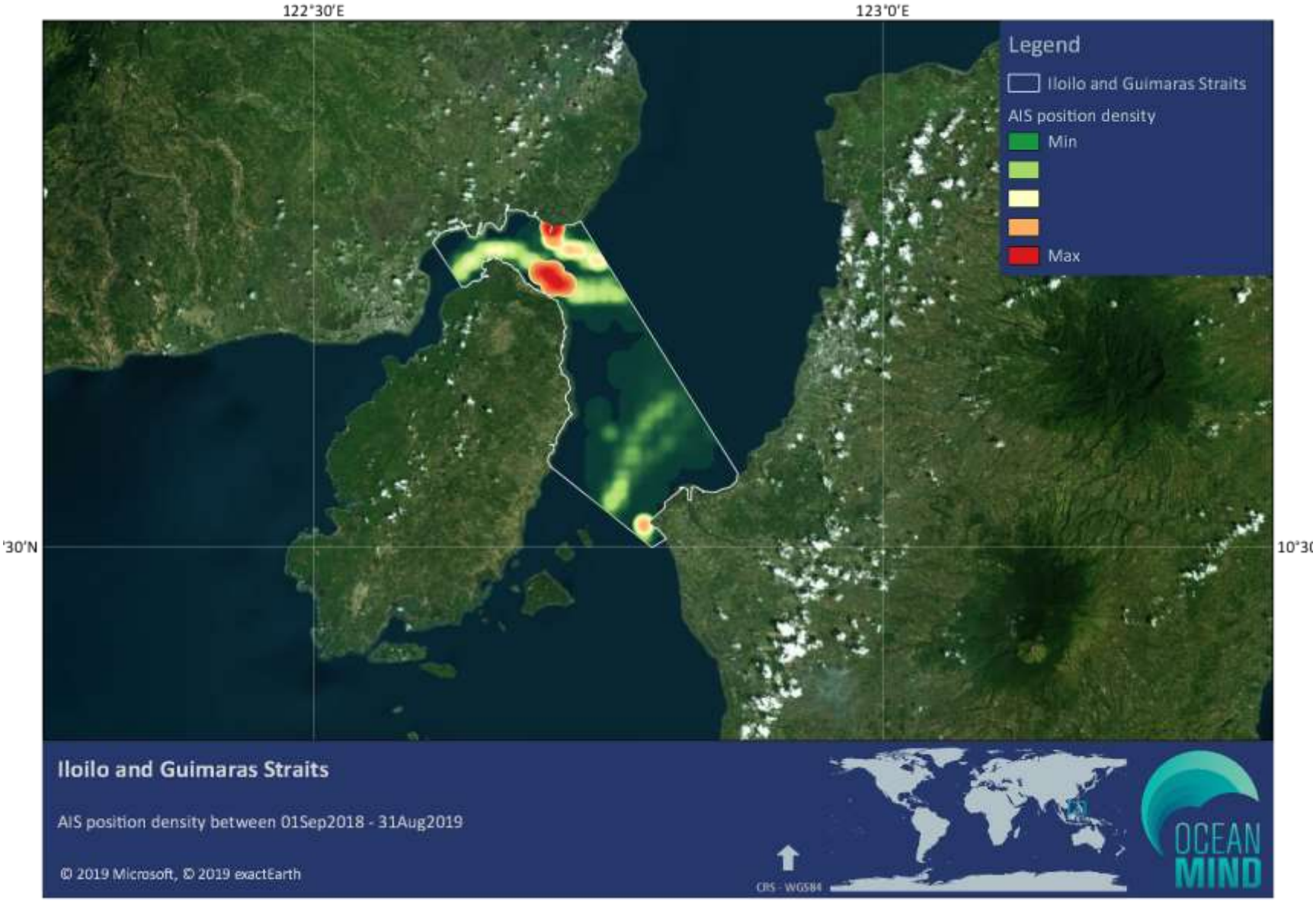


4.12 Iloilo and Guimaras Straits IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	0	1	0	0	1	0	0	0	1	0	4
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	43	33	29	24	17	23	26	25	27	33	17	30	144
Hazardous cargo	17	22	15	10	12	11	15	11	10	13	11	15	77
Passenger	13	11	12	11	10	12	12	13	13	13	11	10	17
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	3	1	1	0	0	1	1	2	2	1	3	3	8
Other	3	2	2	0	1	2	0	2	2	0	0	2	11
Total	79	70	59	46	40	49	55	53	54	60	43	60	261

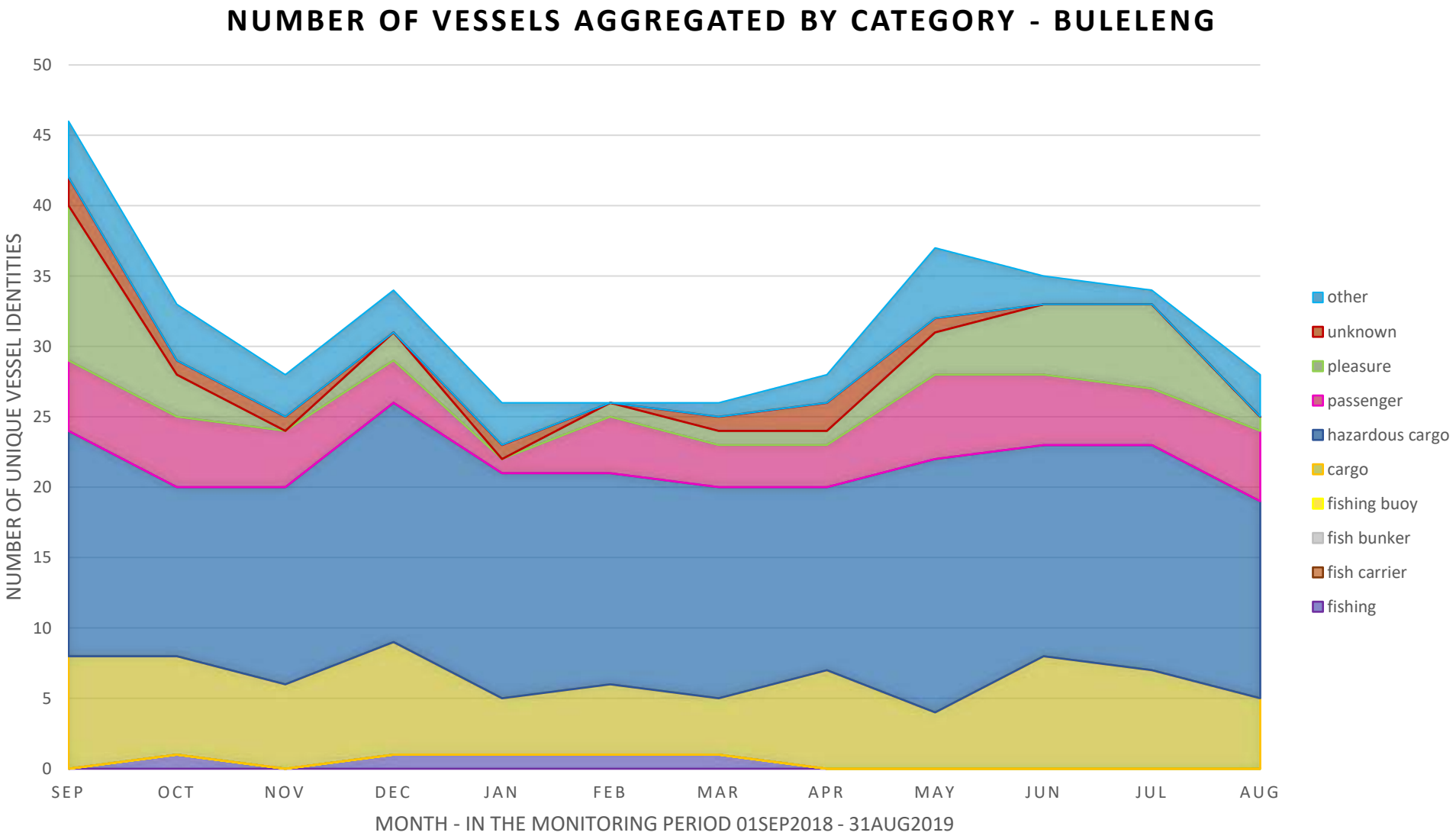
NUMBER OF VESSELS AGGREGATED BY CATEGORY - ILOILO AND GUIMARAS STRAITS

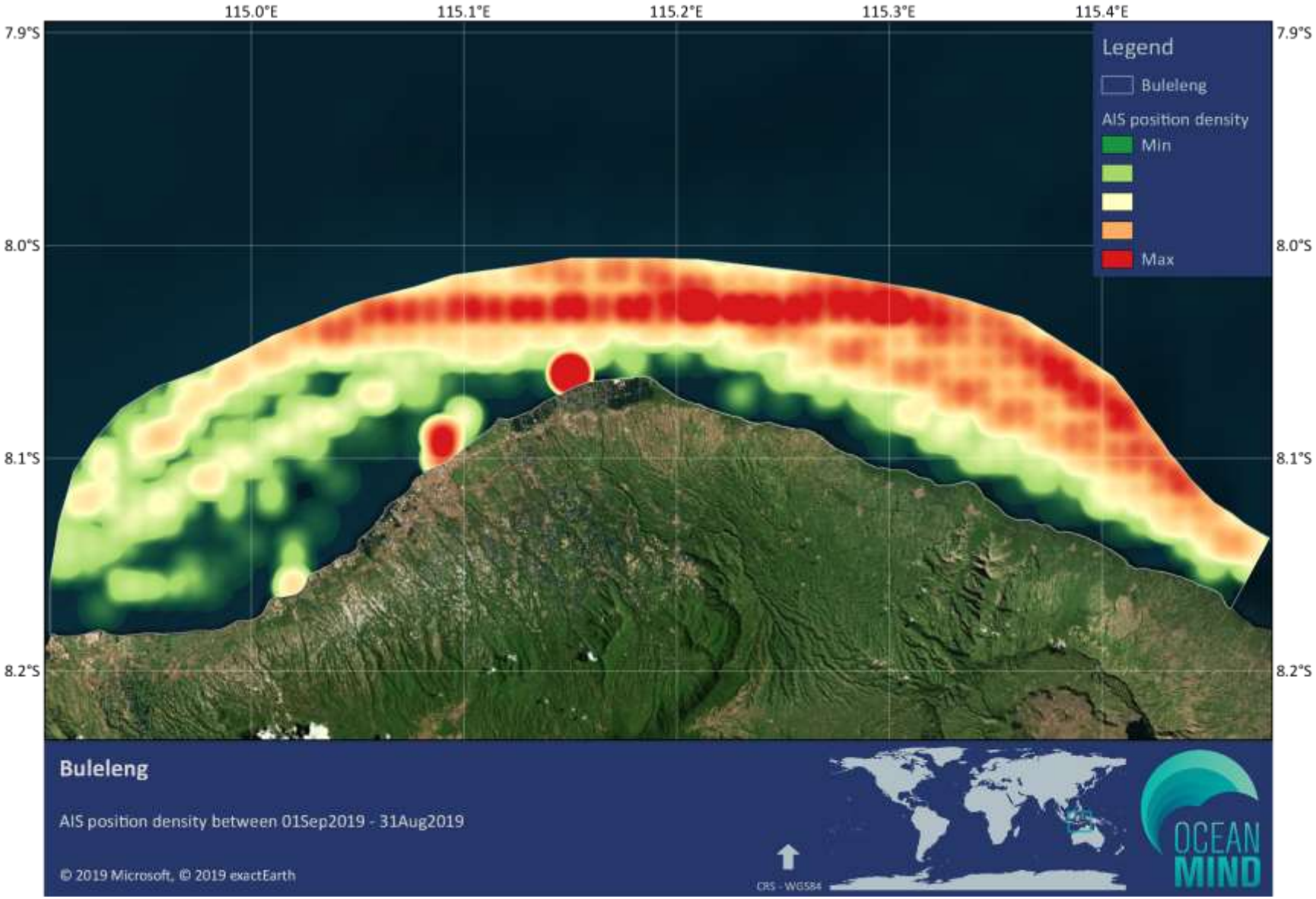




4.13 Buleleng IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	0	1	1	1	1	0	0	0	0	0	2
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	8	7	6	8	4	5	4	7	4	8	7	5	46
Hazardous cargo	16	12	14	17	16	15	15	13	18	15	16	14	64
Passenger	5	5	4	3	1	4	3	3	6	5	4	5	33
Pleasure	11	3	0	2	0	1	1	1	3	5	6	1	31
Unknown	2	1	1	0	1	0	1	2	1	0	0	0	6
Other	4	4	3	3	3	0	1	2	5	2	1	3	22
Total	46	33	28	34	26	26	26	28	37	35	34	28	204

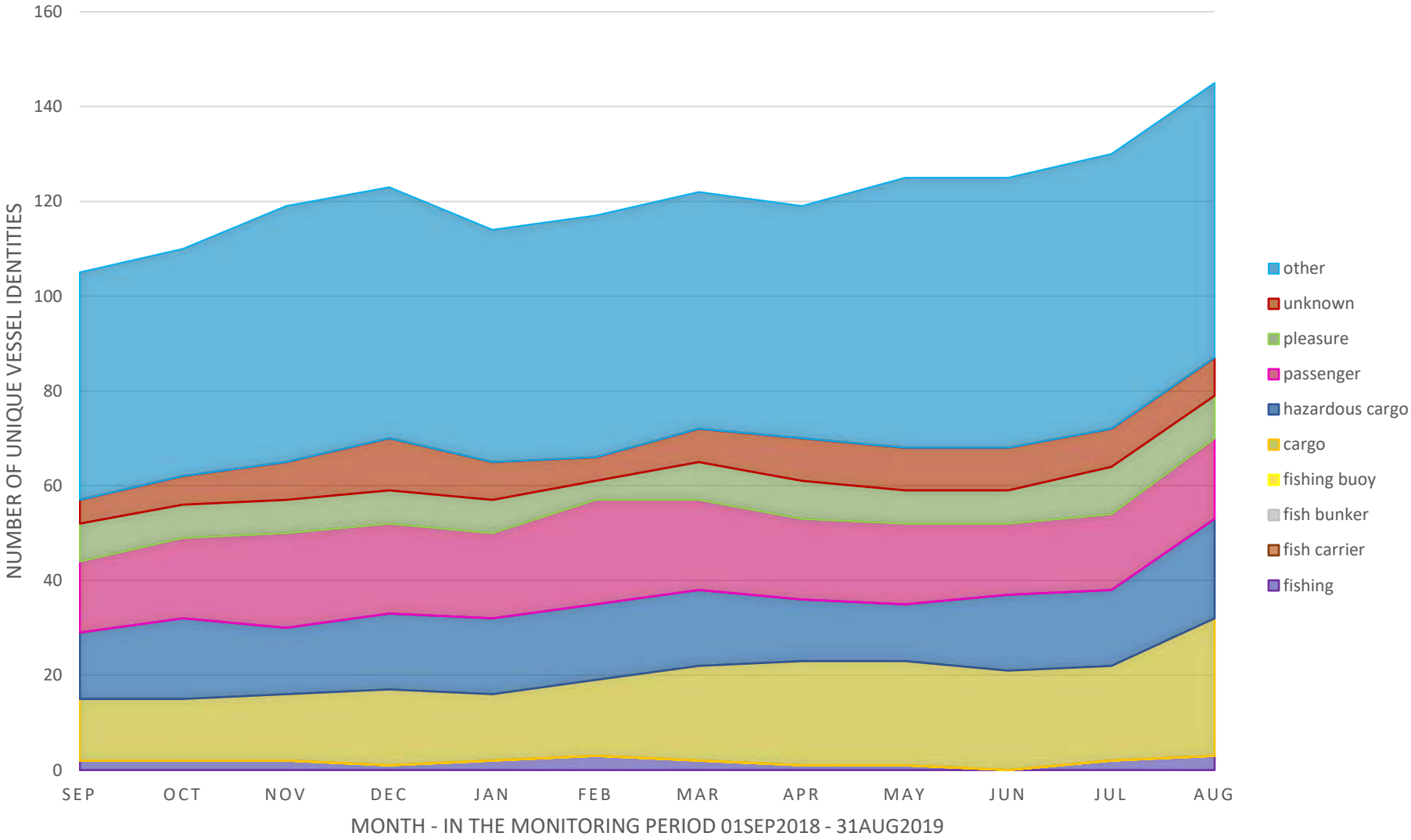


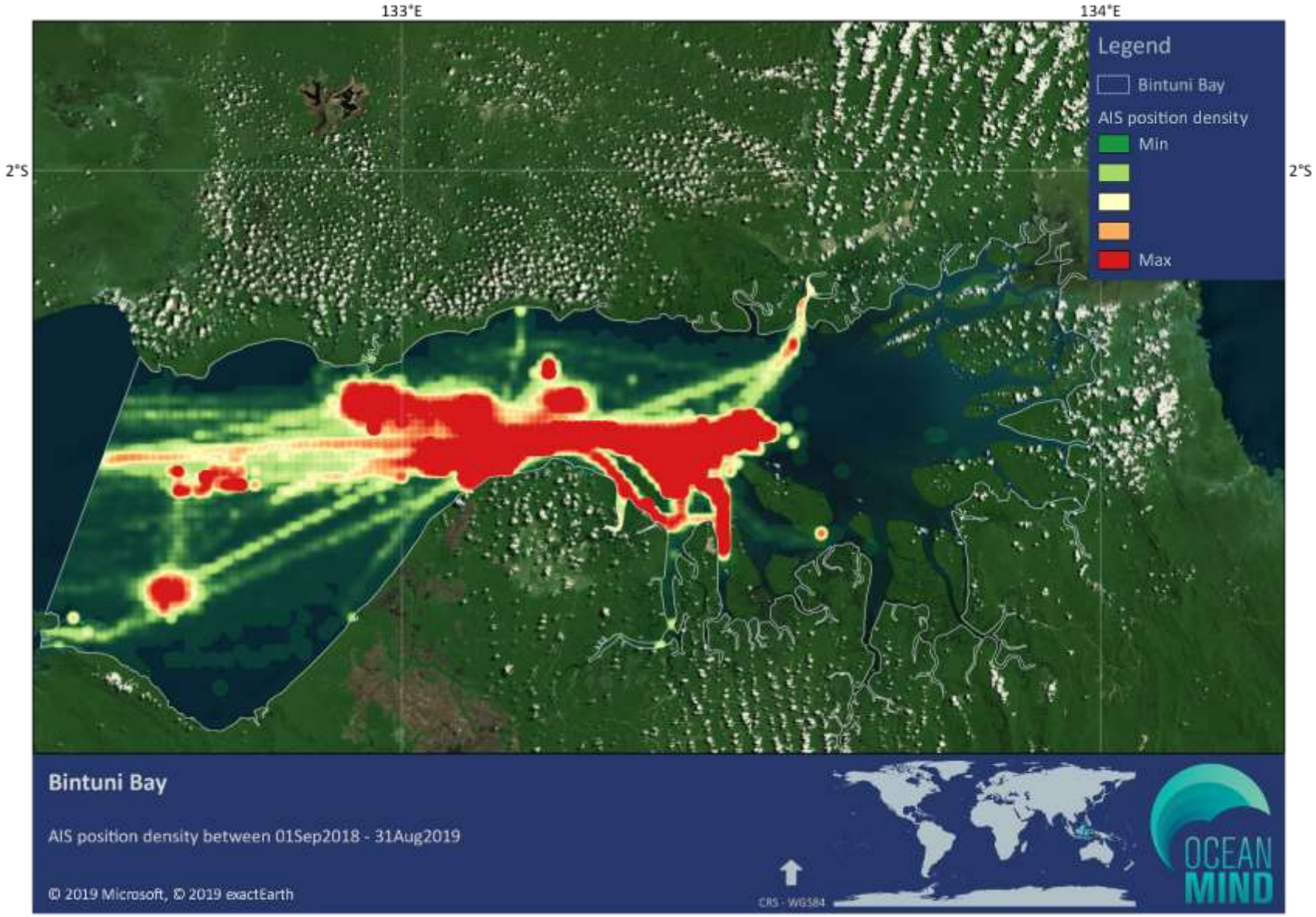


4.14 Bintuni Bay IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	2	2	2	1	2	3	2	1	1	0	2	3	5
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	13	13	14	16	14	16	20	22	22	21	20	29	54
Hazardous cargo	14	17	14	16	16	16	16	13	12	16	16	21	34
Passenger	15	17	20	19	18	22	19	17	17	15	16	17	27
Pleasure	8	7	7	7	7	4	8	8	7	7	10	9	15
Unknown	5	6	8	11	8	5	7	9	9	9	8	8	24
Other	48	48	54	53	49	51	50	49	57	57	58	58	100
Total	105	110	119	123	114	117	122	119	125	125	130	145	259

NUMBER OF VESSELS AGGREGATED BY CATEGORY - BINTUNI BAY

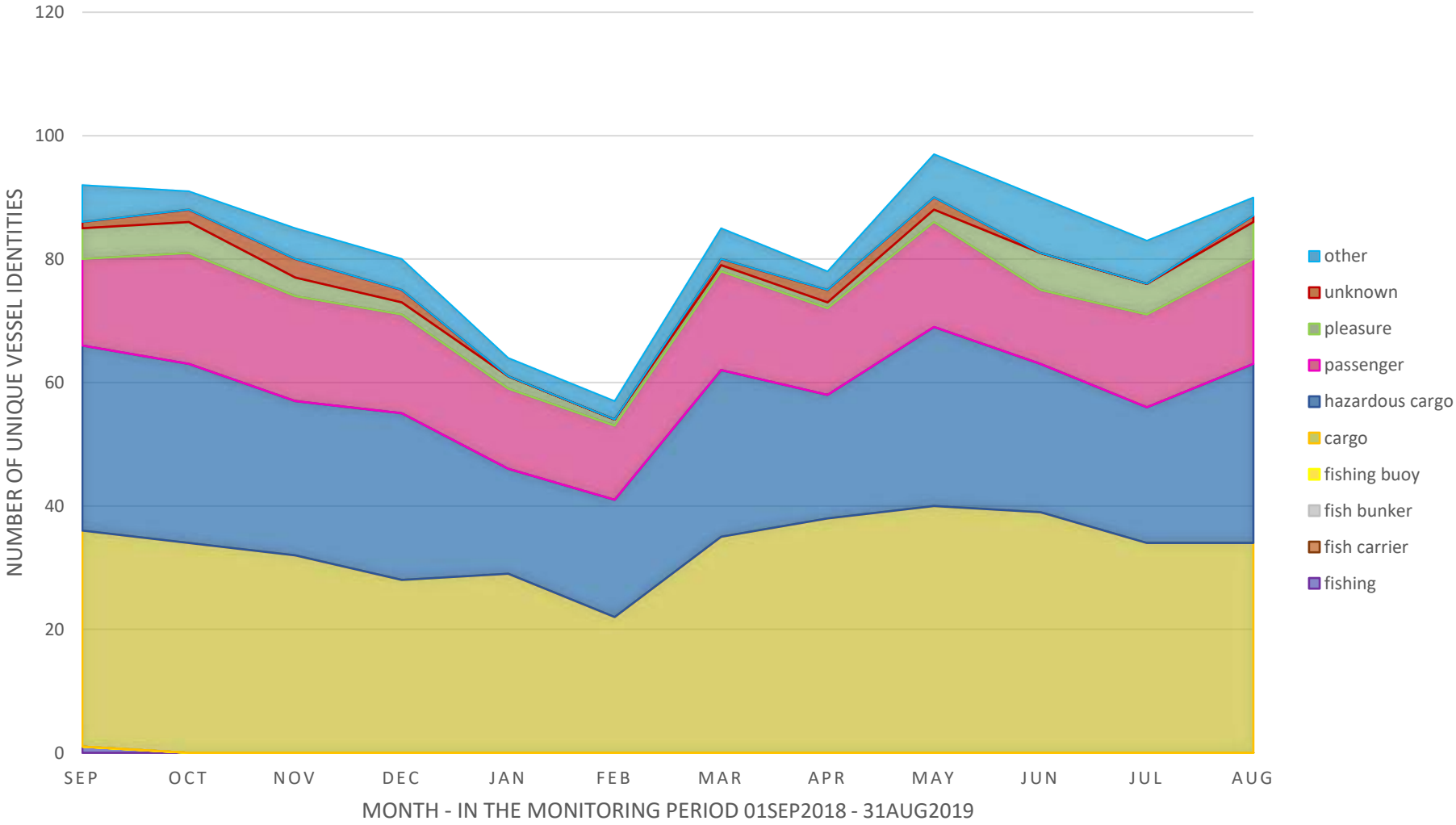


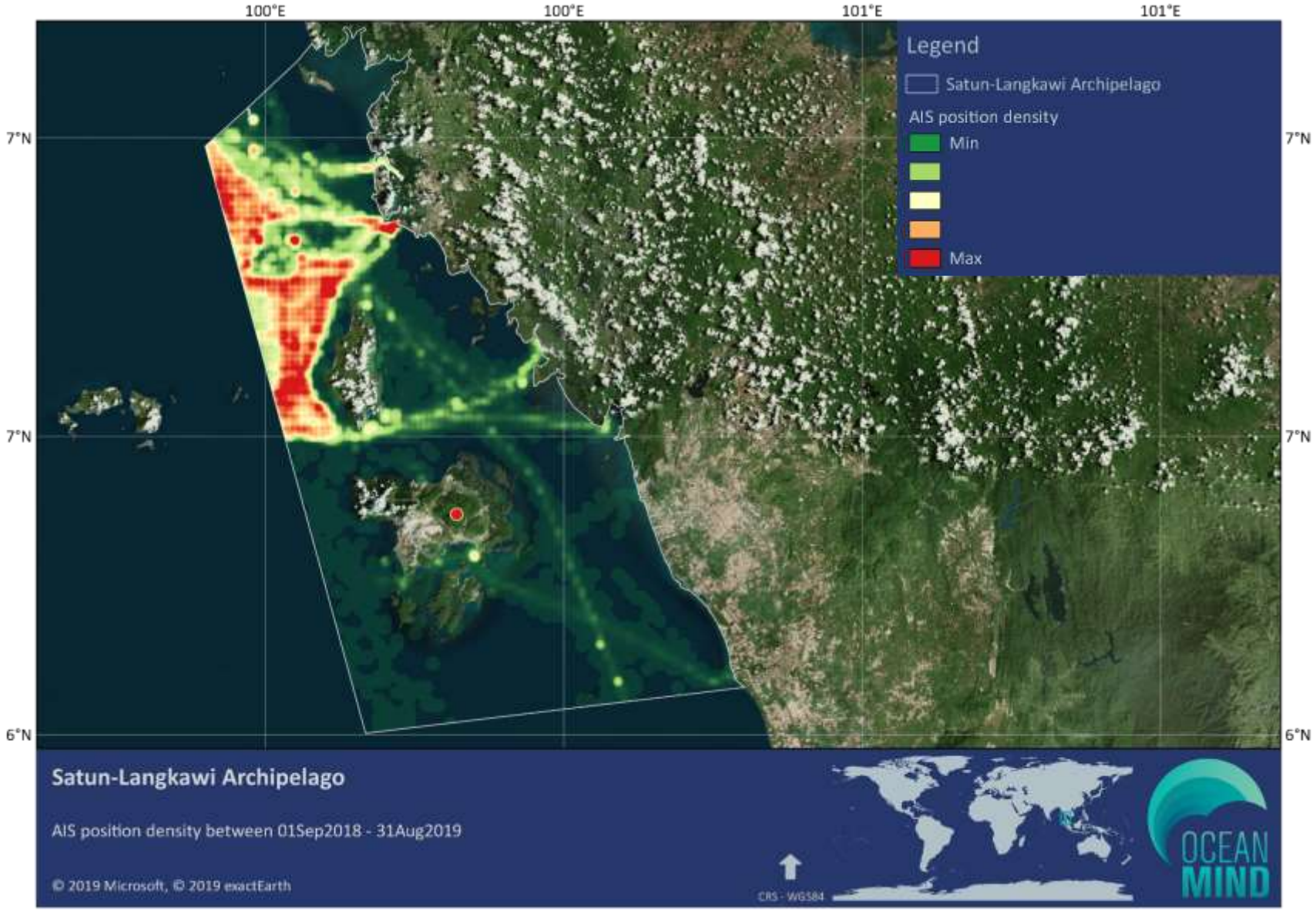


4.15 Satun-Langkawi Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	170	166	179	180	182	175	187	191	201	174	145	156	269
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	3	5	6	6	5	5	10	7	5	4	4	4	24
Hazardous cargo	1	4	4	0	2	2	5	2	1	1	1	1	19
Passenger	5	3	5	8	8	10	5	5	3	3	9	2	22
Pleasure	0	2	4	4	8	6	2	1	1	0	9	1	28
Unknown	4	4	4	6	7	8	15	9	5	4	13	6	37
Other	4	5	7	5	5	2	15	4	5	4	1	4	33
Total	187	189	209	209	217	208	239	219	221	190	182	174	432

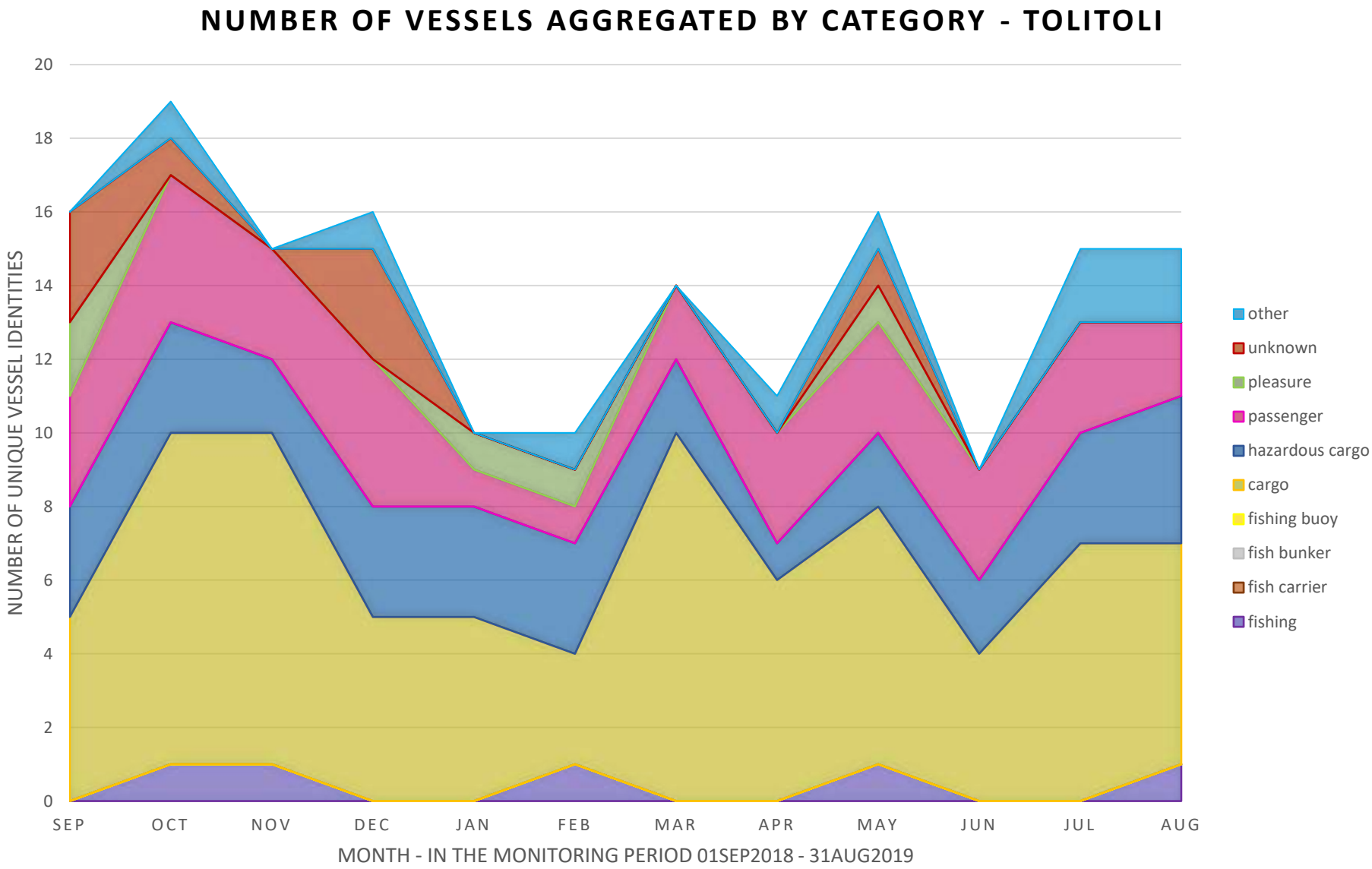
NUMBER OF VESSELS AGGREGATED BY CATEGORY - SATUN-LANGKAWI ARCHIPELAGO





4.16 Tolitoli IMMA

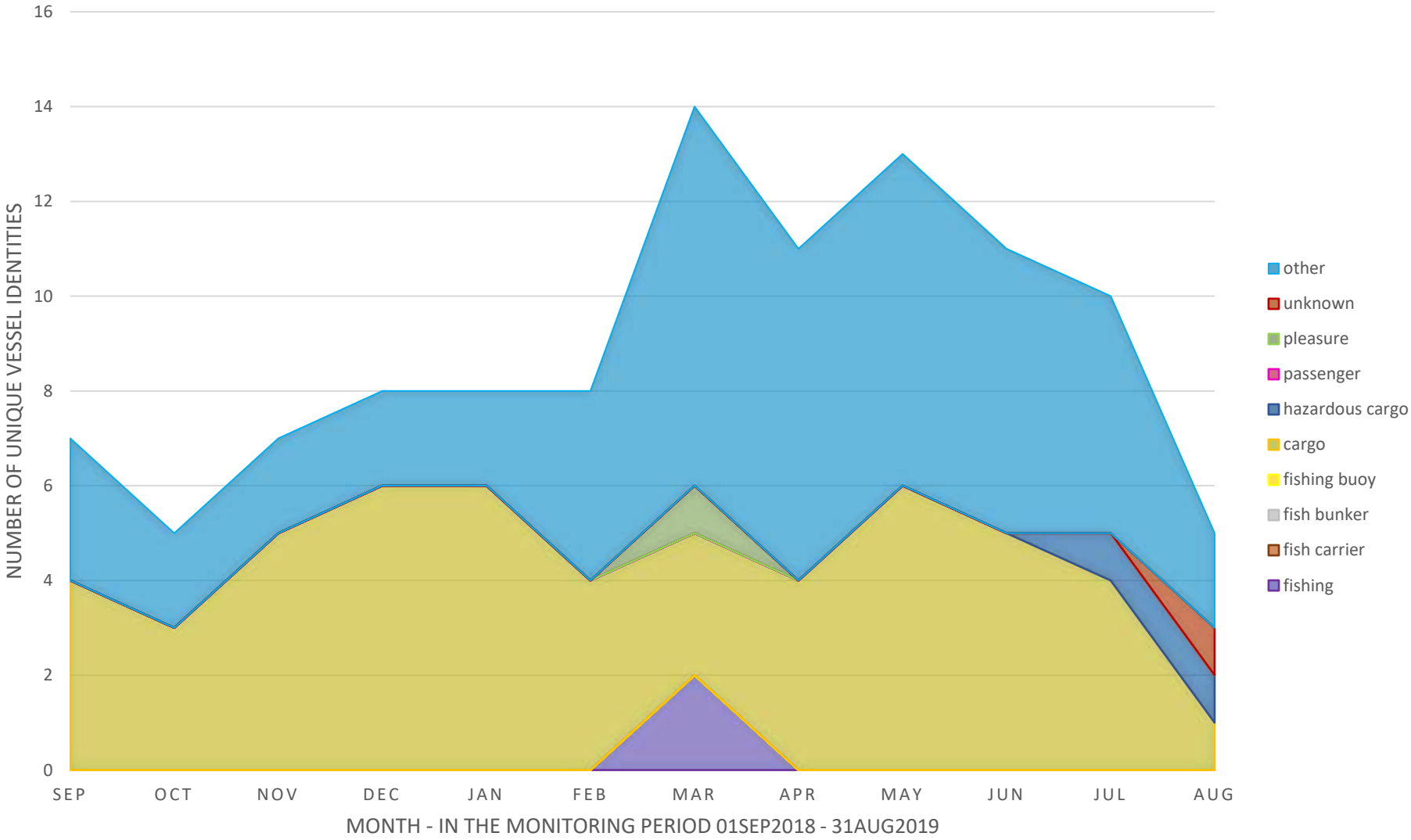
Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	1	1	0	0	1	0	0	1	0	0	1	3
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	5	9	9	5	5	3	10	6	7	4	7	6	29
Hazardous cargo	3	3	2	3	3	3	2	1	2	2	3	4	12
Passenger	3	4	3	4	1	1	2	3	3	3	3	2	6
Pleasure	2	0	0	0	1	1	0	0	1	0	0	0	3
Unknown	3	1	0	3	0	0	0	0	1	0	0	0	7
Other	0	1	0	1	0	1	0	1	1	0	2	2	8
Total	16	19	15	16	10	10	14	11	16	9	15	15	68

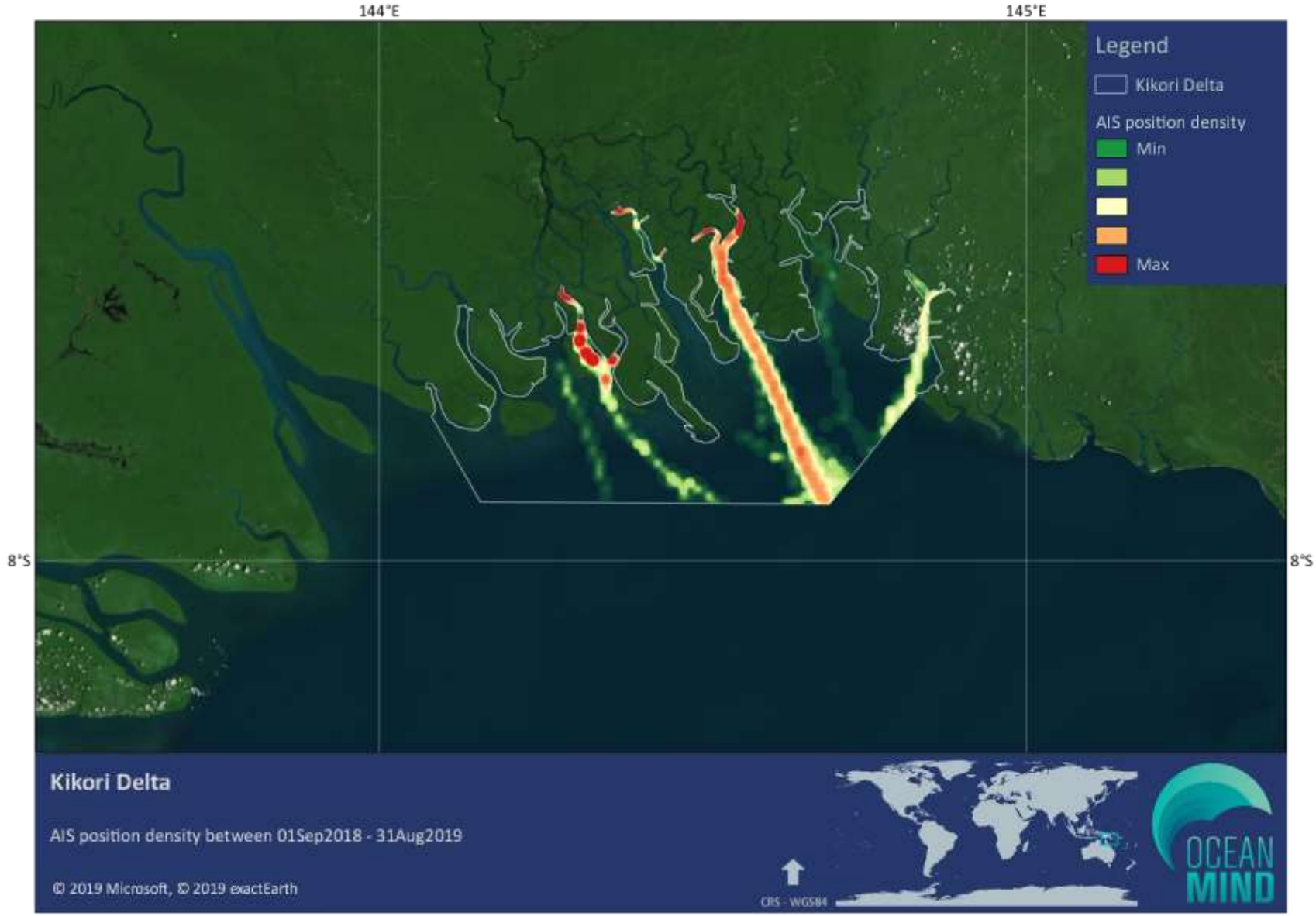


4.17 Kikori Delta IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	2	0	0	0	0	0	2
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	4	3	5	6	6	4	3	4	6	5	4	1	30
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	1	1	1
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	1	0	0	0	0	0	1
Unknown	0	0	0	0	0	0	0	0	0	0	0	1	1
Other	3	2	2	2	2	4	8	7	7	6	5	2	9
Total	7	5	7	8	8	8	14	11	13	11	10	5	44

NUMBER OF VESSELS AGGREGATED BY CATEGORY - KIKORI DELTA

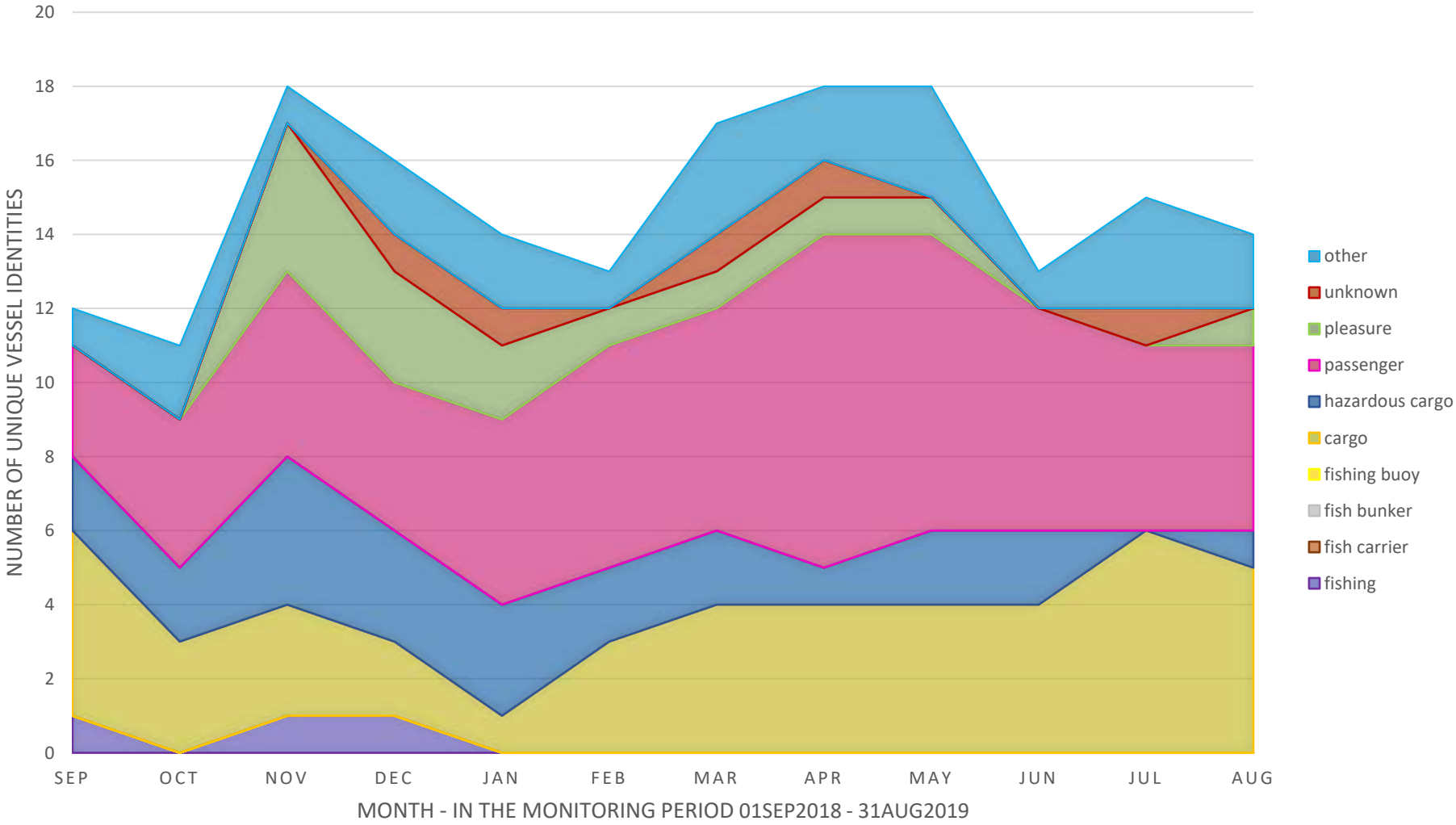


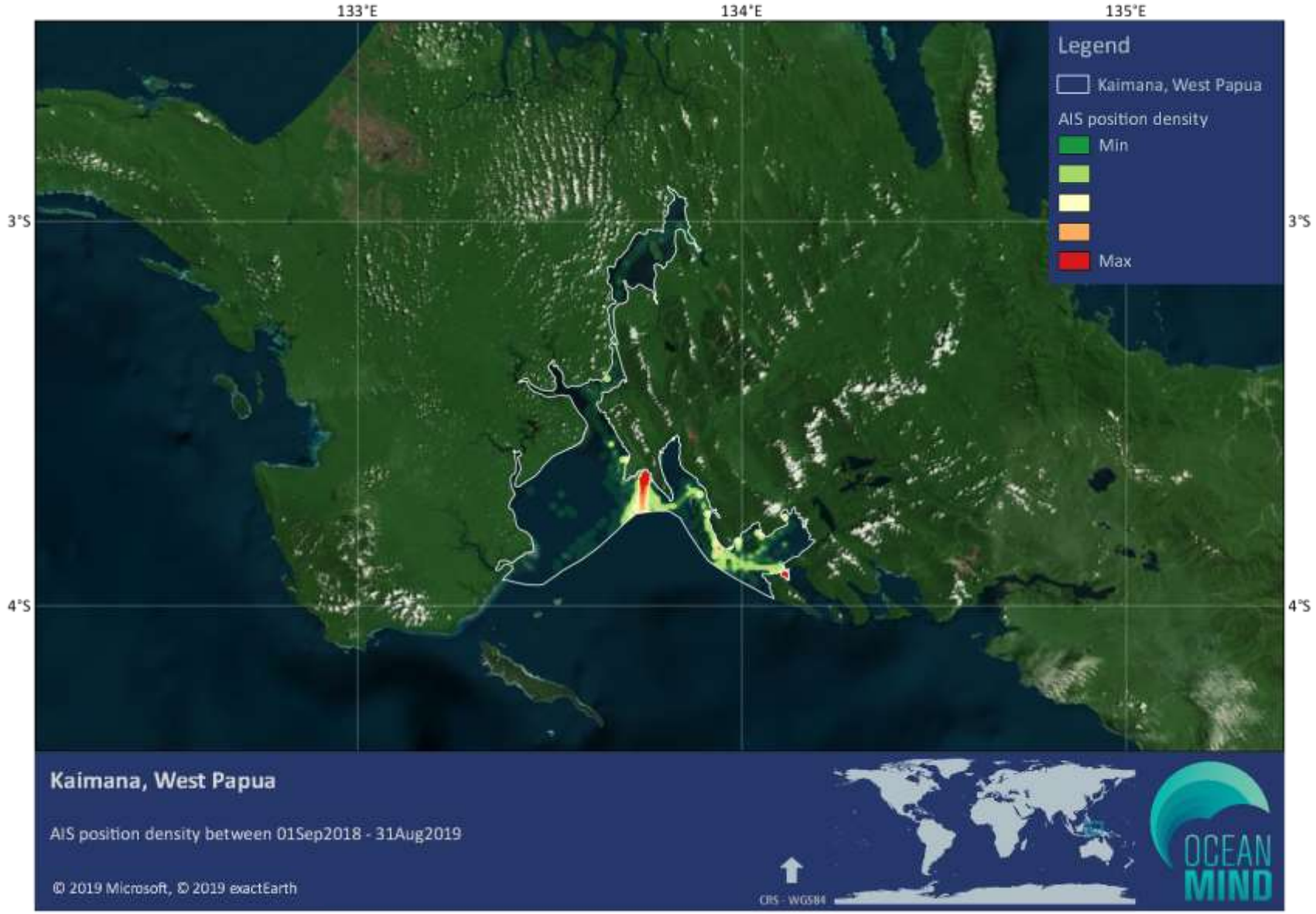


4.18 Kaimana, West Papua IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fish carrier	1	0	1	1	0	0	0	0	0	0	0	0	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous cargo	5	3	3	2	1	3	4	4	4	4	6	5	17
Passenger	2	2	4	3	3	2	2	1	2	2	0	1	12
Pleasure	3	4	5	4	5	6	6	9	8	6	5	5	20
Unknown	0	0	4	3	2	1	1	1	1	0	0	1	14
Other	0	0	0	1	1	0	1	1	0	0	1	0	2
Total	1	2	1	2	2	1	3	2	3	1	3	2	9

NUMBER OF VESSELS AGGREGATED BY CATEGORY - KAIMANA, WEST PAPUA

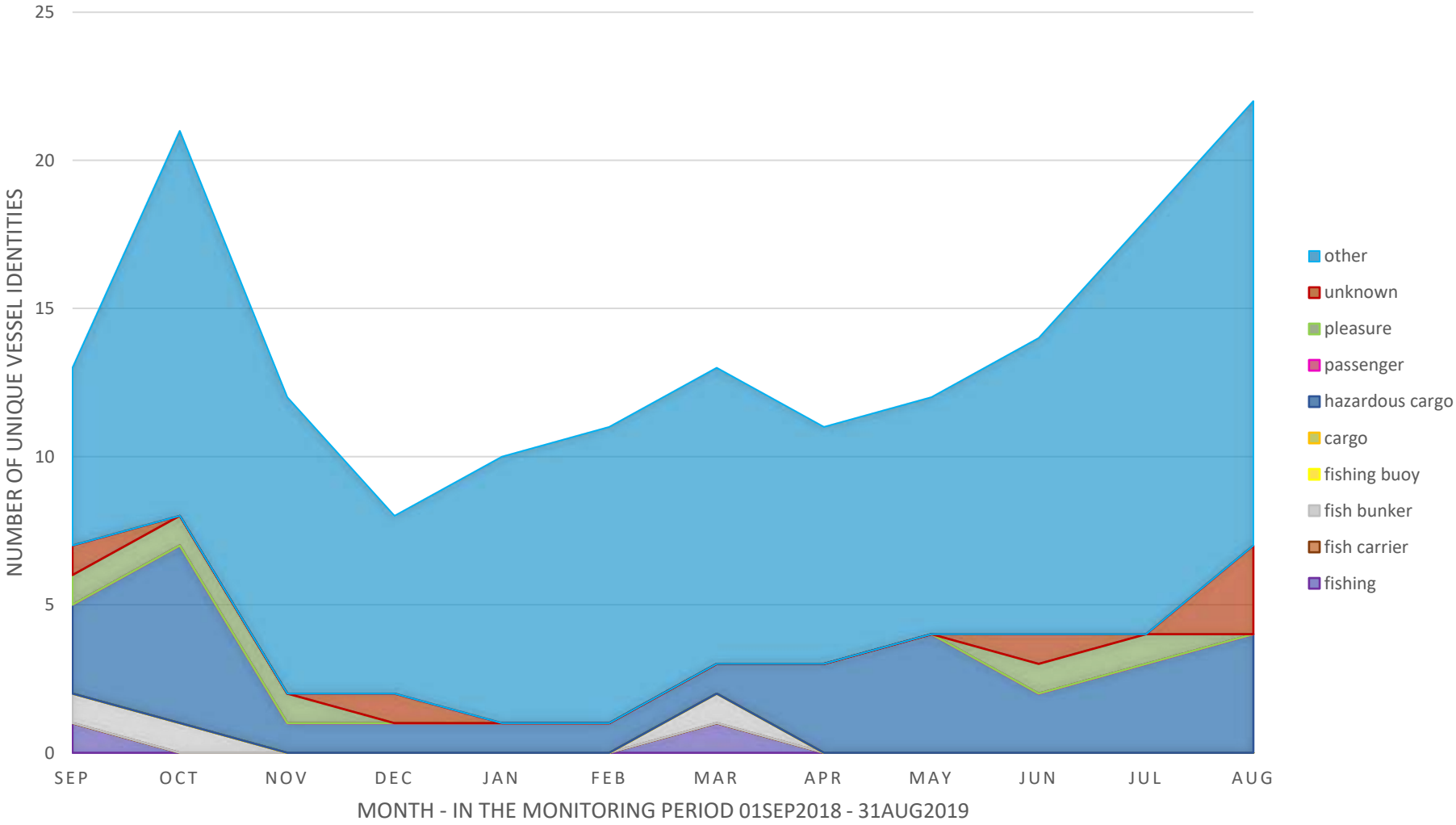


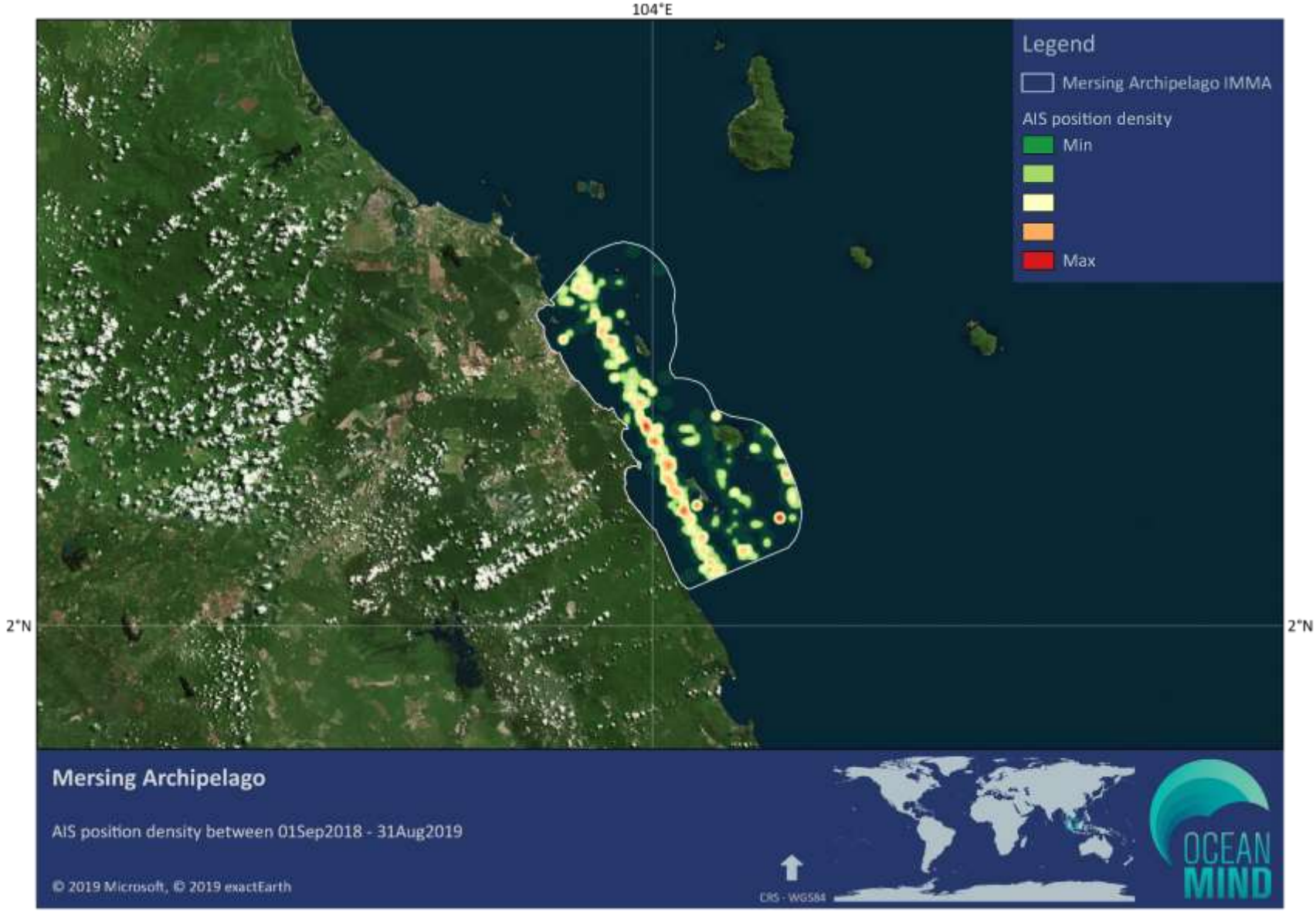


4.19 Mersing Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	0	0	0	0	0	1	0	0	0	0	0	2
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	1	1	0	0	0	0	1	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous cargo	3	6	1	1	1	1	1	3	4	2	3	4	14
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	1	1	1	0	0	0	0	0	0	1	1	0	5
Unknown	1	0	0	1	0	0	0	0	0	1	0	3	6
Other	6	13	10	6	9	10	10	8	8	10	14	15	44
Total	13	21	12	8	10	11	13	11	12	14	18	22	72

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MERSING ARCHIPELAGO

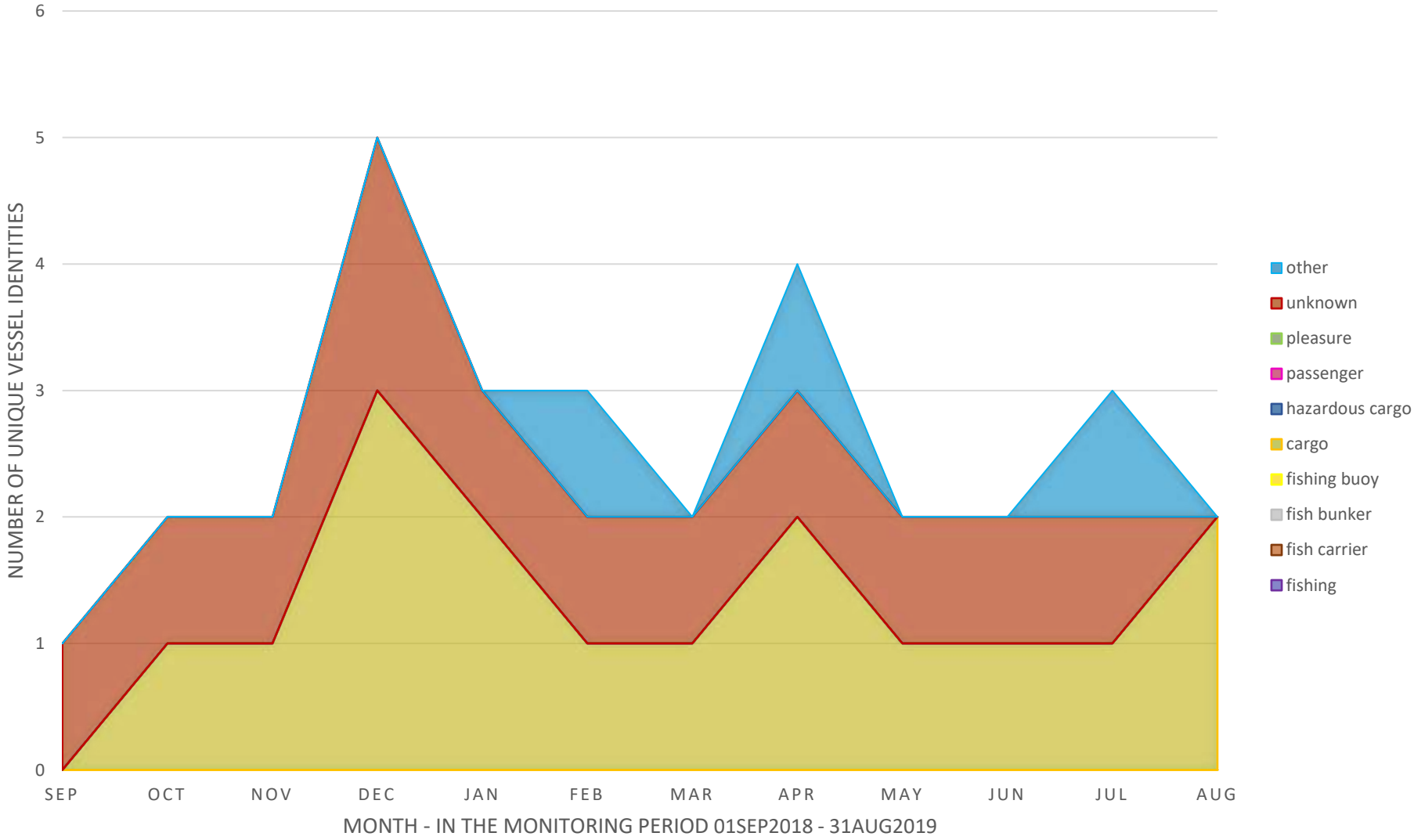




4.20 Kuching Bay IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	1	1	3	2	1	1	2	1	1	1	2	5
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	1	1	1	2	1	1	1	1	1	1	1	0	3
Other	0	0	0	0	0	1	0	1	0	0	1	0	2
Total	1	2	2	5	3	3	2	4	2	2	3	2	10

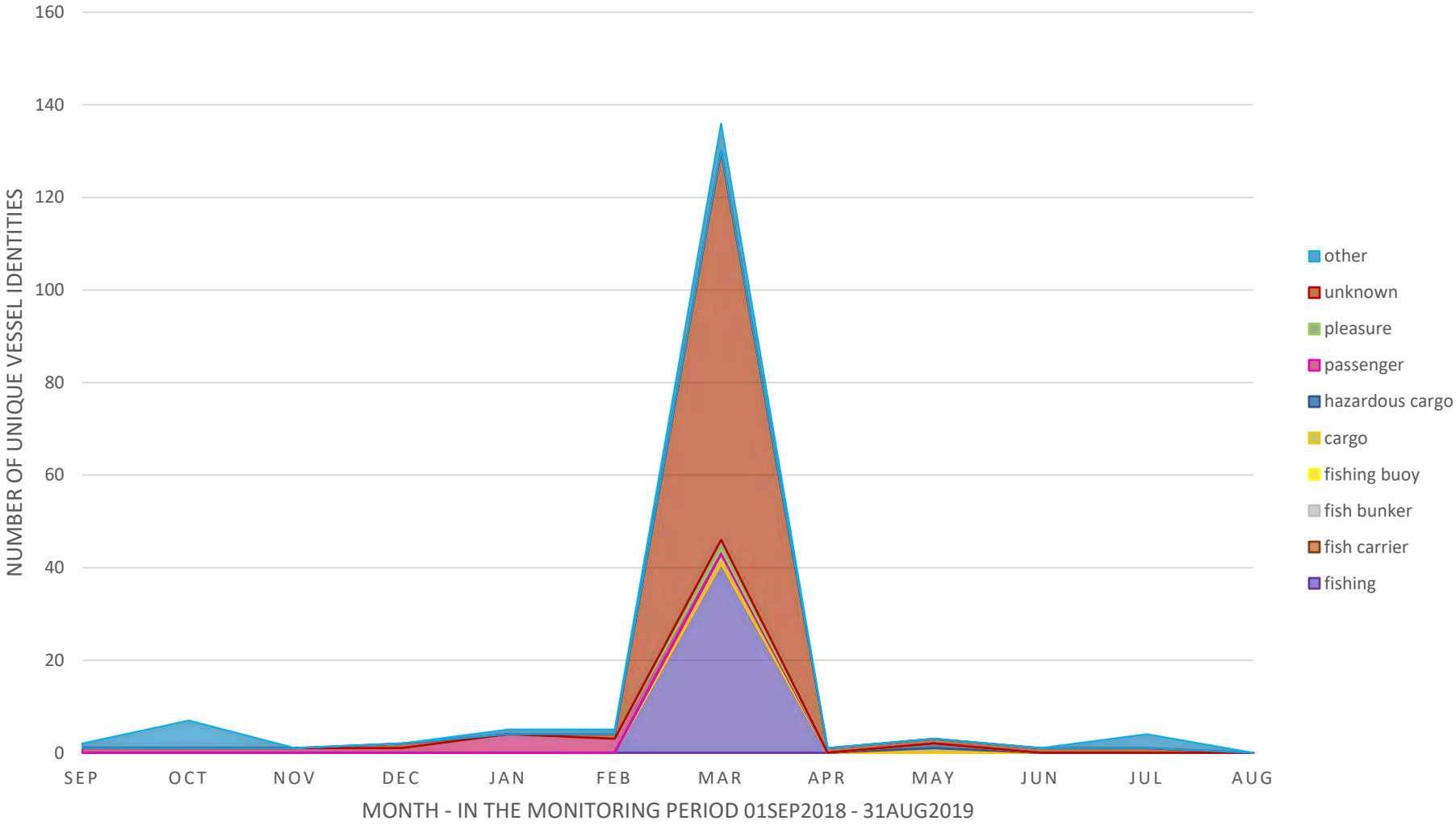
NUMBER OF VESSELS AGGREGATED BY CATEGORY - KUCHING BAY

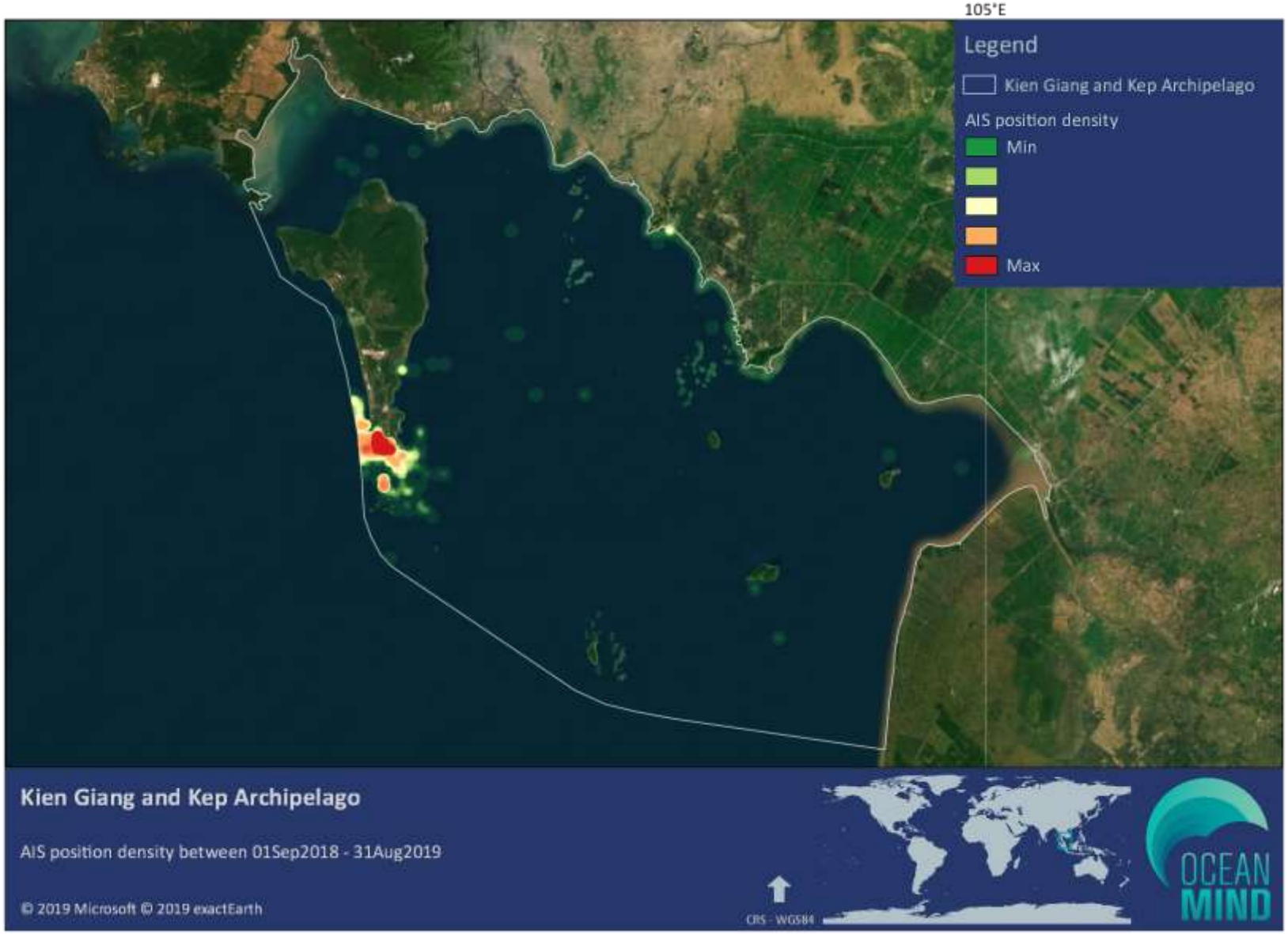


4.21 Kien Giang and Kep Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	41	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	2	0	1	0	0	0	0
Hazardous cargo	0	0	0	0	0	0	0	0	1	0	0	0	0
Passenger	1	1	1	1	4	3	1	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	2	0	0	0	0	0	0
Unknown	0	0	0	1	0	1	84	1	1	1	1	0	0
Other	1	6	0	0	1	1	6	0	0	0	3	0	0
Total	2	7	1	2	5	5	136	1	3	1	4	0	0

NUMBER OF VESSELS AGGREGATED BY CATEGORY - KIEN GIANG AND KEP ARCHIPELAGO

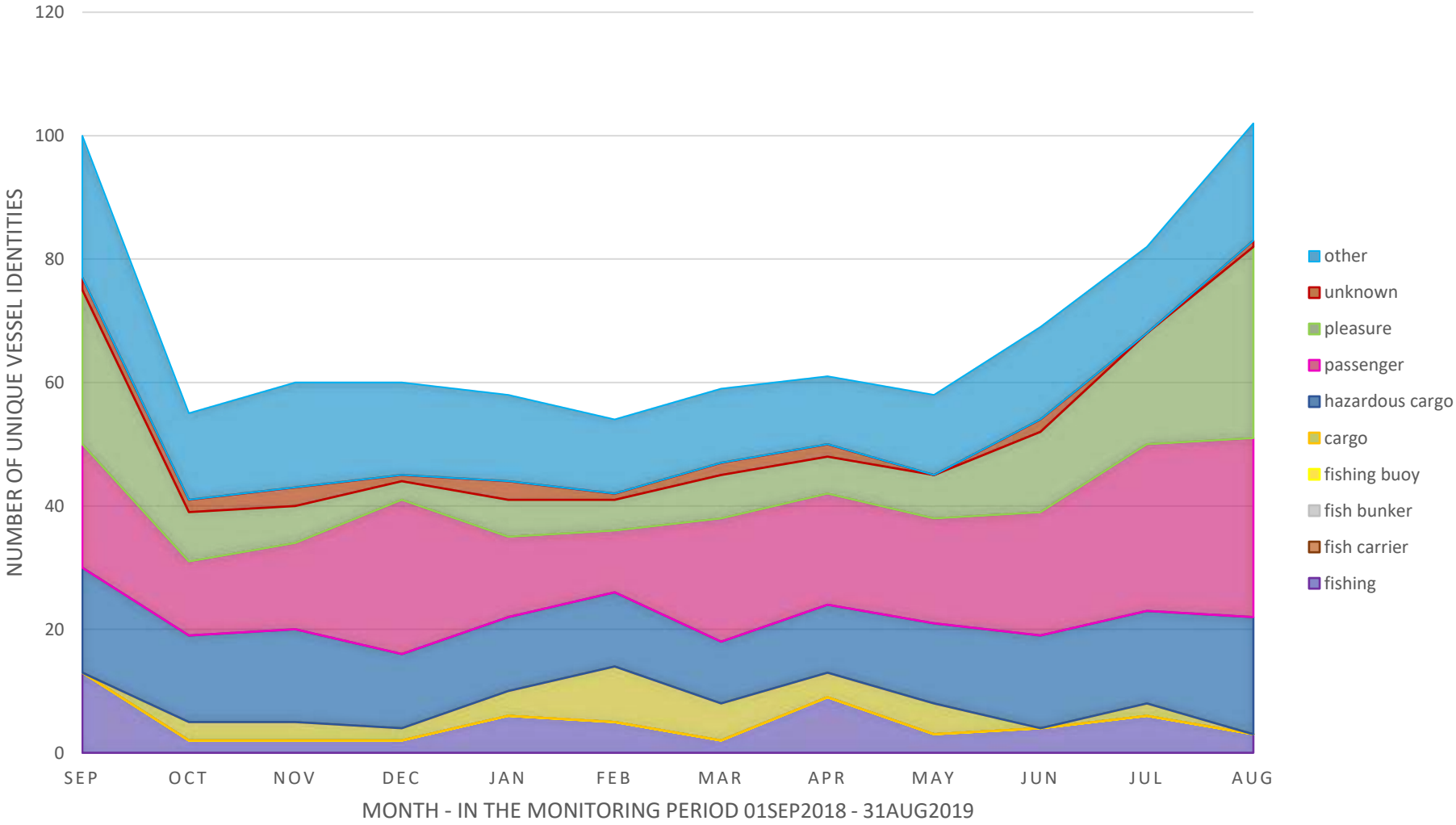




4.22 Western Lesser Sunda Islands and Sumba Coastal Area IMMA

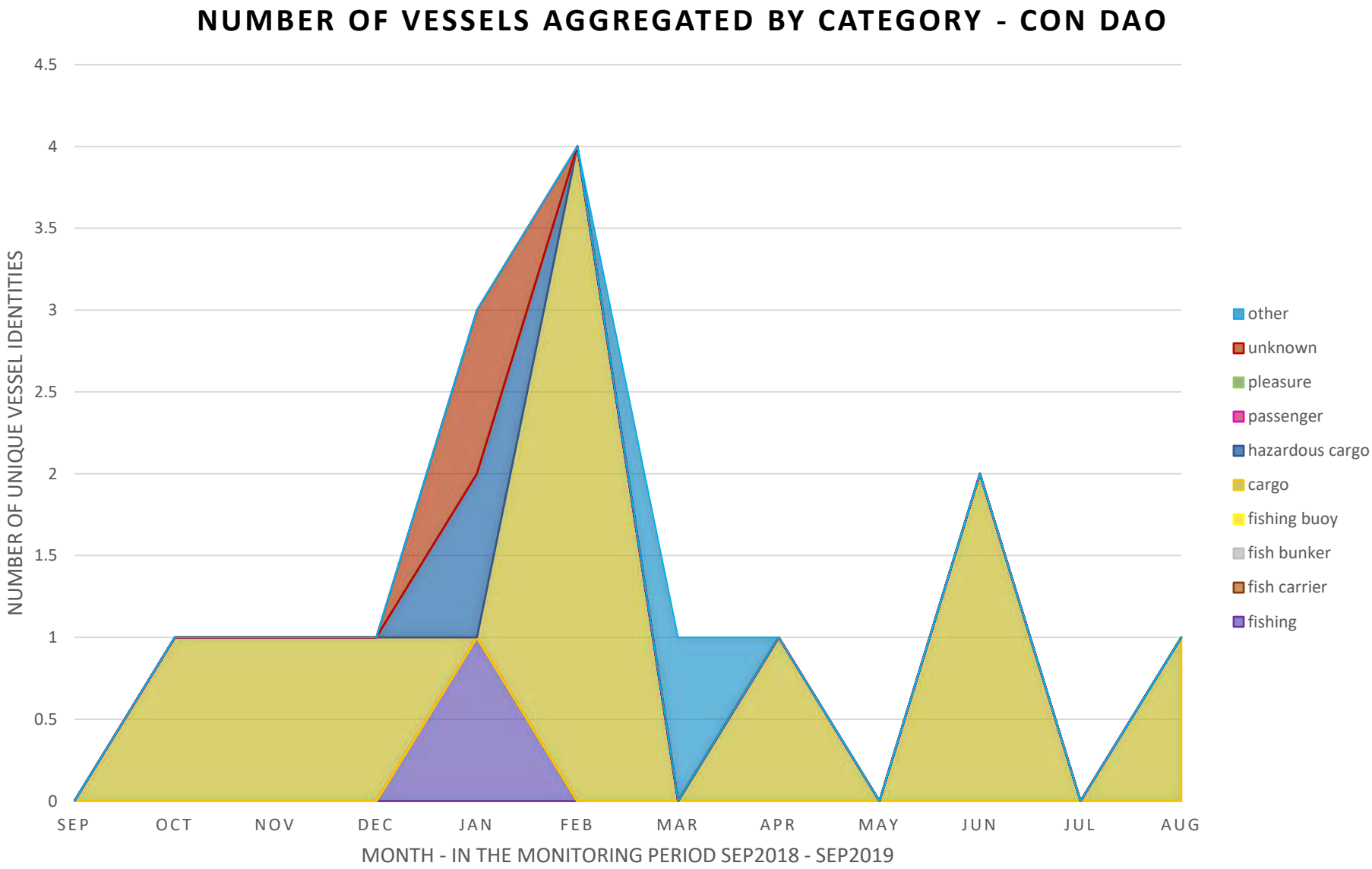
Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	13	2	2	2	6	5	2	9	3	4	6	3	25
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	3	3	2	4	9	6	4	5	0	2	0	23
Hazardous cargo	17	14	15	12	12	12	10	11	13	15	15	19	42
Passenger	20	12	14	25	13	10	20	18	17	20	27	29	73
Pleasure	25	8	6	3	6	5	7	6	7	13	18	31	79
Unknown	2	2	3	1	3	1	2	2	0	2	0	1	8
Other	23	14	17	15	14	12	12	11	13	15	14	19	56
Total	100	55	60	60	58	54	59	61	58	69	82	102	306

NUMBER OF VESSELS AGGREGATED BY CATEGORY - WESTERN LESSER SUNDA ISLANDS AND SUMBA COASTAL AREA



4.23 Con Dao IMMA

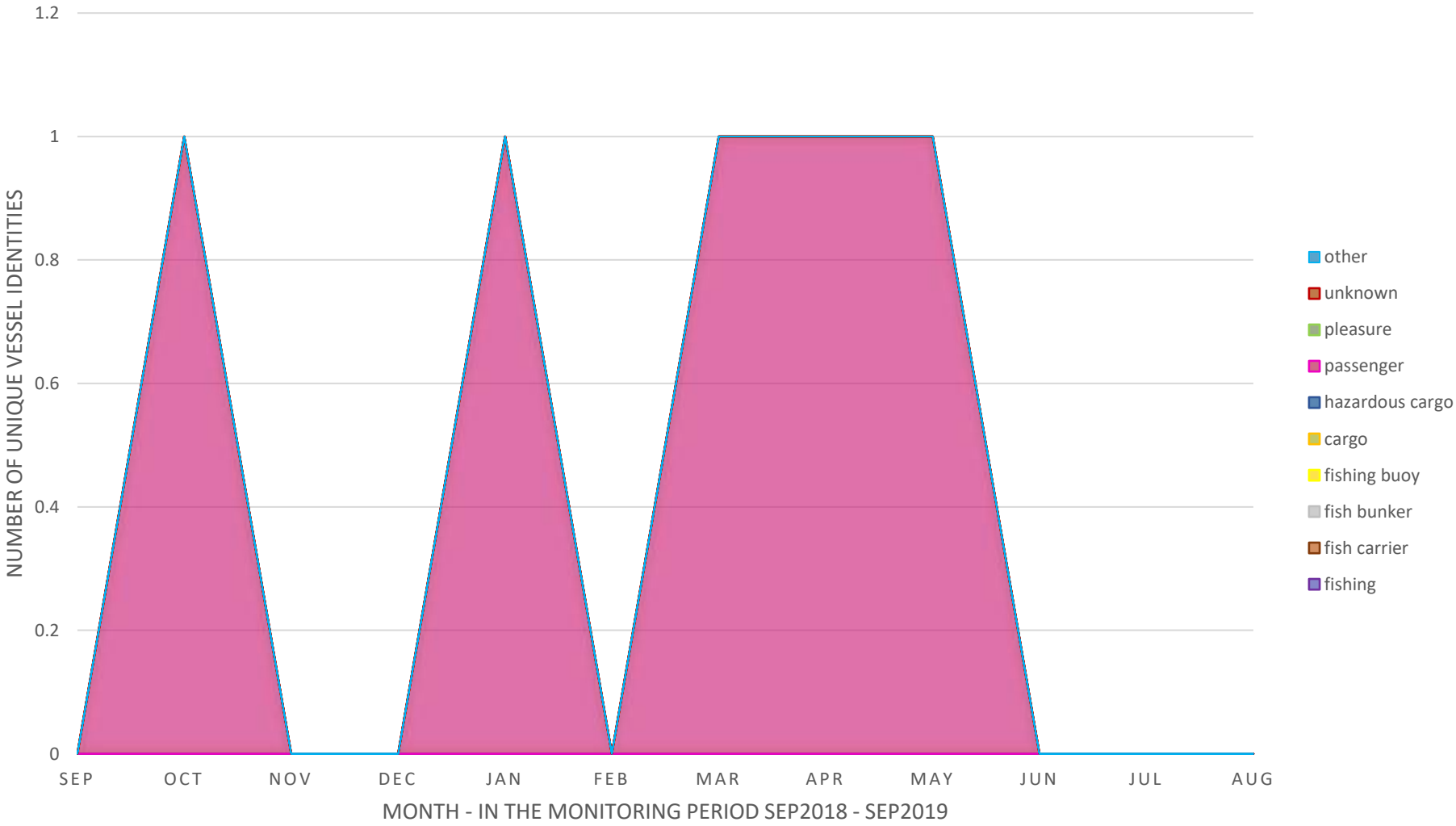
Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	1	0	0	0	0	0	0	0	1
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	1	1	1	0	4	0	1	0	2	0	1	9
Hazardous cargo	0	0	0	0	1	0	0	0	0	0	0	0	1
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	1	0	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	1	0	0	0	0	0	1
Total	0	1	1	1	3	4	1	1	0	2	0	1	13



4.24 Malampaya Sound IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger	0	1	0	0	1	0	1	1	1	0	0	0	1
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	1	0	1	1	1	0	0	0	1

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MALAMPAYA SOUND

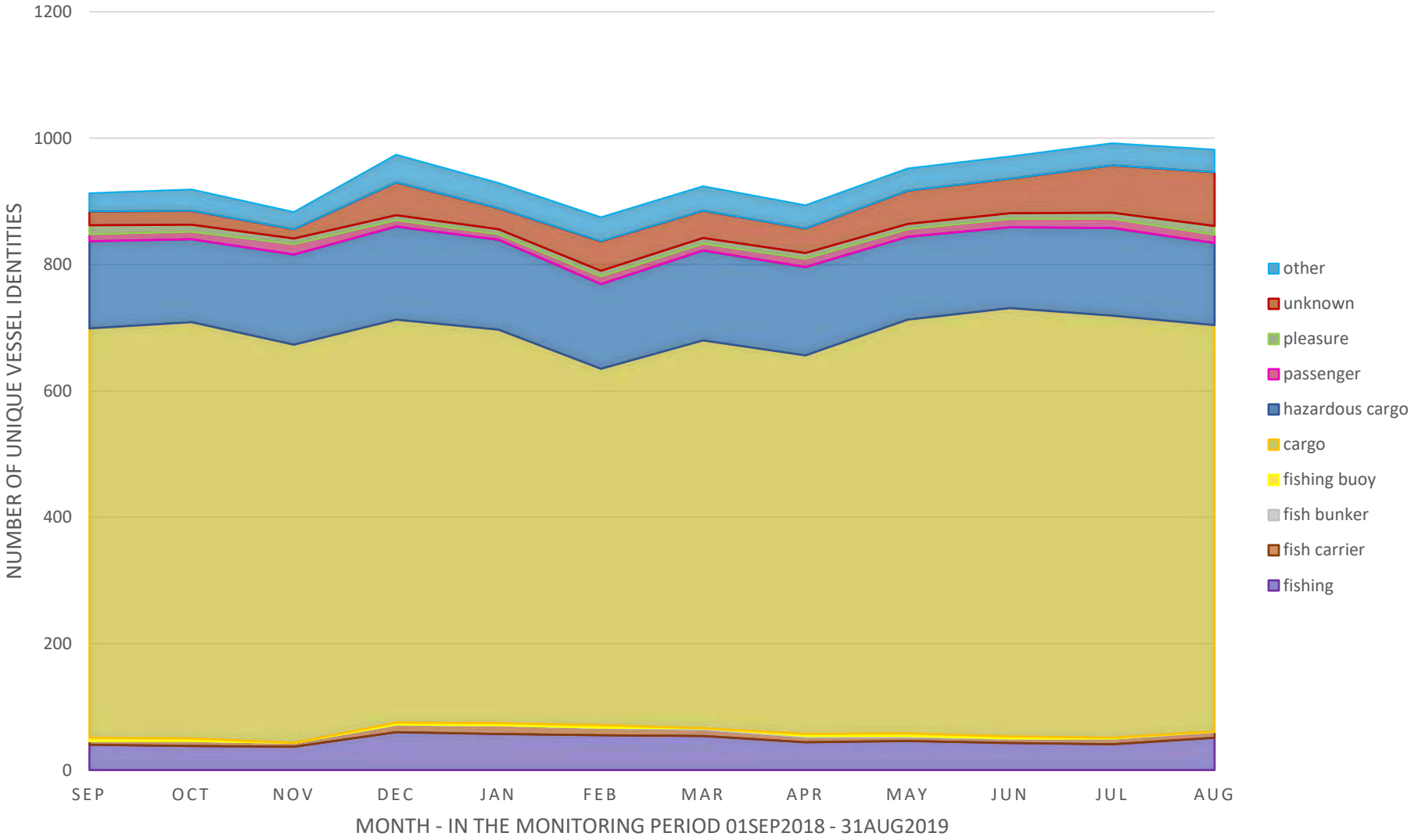


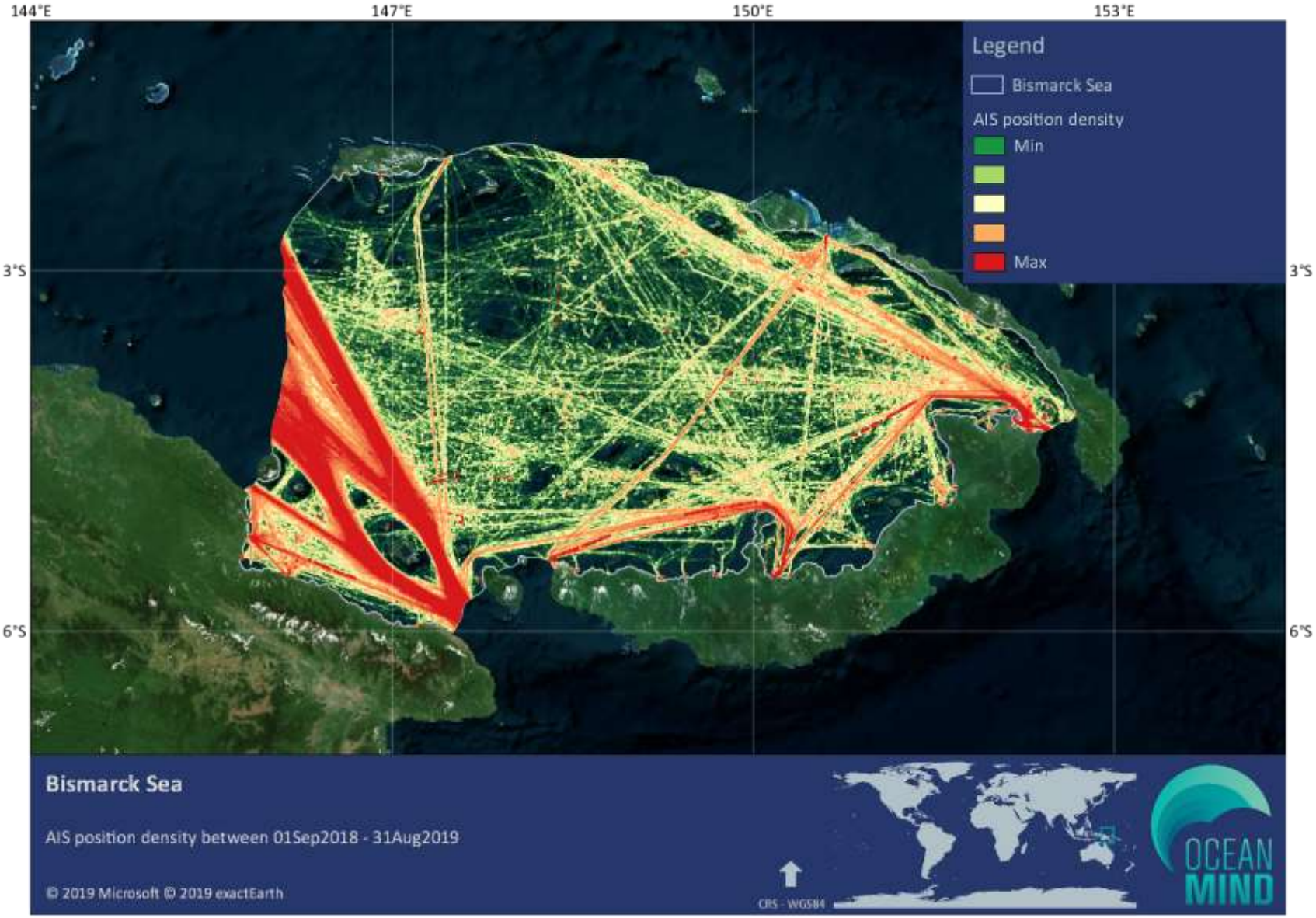
5 Pacific Islands

5.1 Bismarck Sea IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	40	38	37	60	57	55	54	44	46	43	41	51	136
Fish carrier	6	8	6	11	13	11	10	8	6	6	8	9	25
Fish bunker	0	0	0	1	1	1	2	2	2	1	1	1	5
Fishing buoy	5	4	0	3	3	4	0	3	4	3	1	0	7
Cargo	648	659	630	638	623	564	614	599	655	678	668	643	2964
Hazardous cargo	138	131	143	147	142	134	142	140	131	128	139	130	609
Passenger	11	12	16	10	9	12	11	13	12	13	14	13	46
Pleasure	14	11	9	8	8	9	9	9	8	9	10	14	70
Unknown	22	22	15	52	33	47	43	39	53	55	75	85	204
Other	29	34	27	44	40	38	39	37	35	35	35	36	133
Total	913	919	883	974	929	875	924	894	952	971	992	982	4199

NUMBER OF VESSELS AGGREGATED BY CATEGORY - BISMARCK SEA

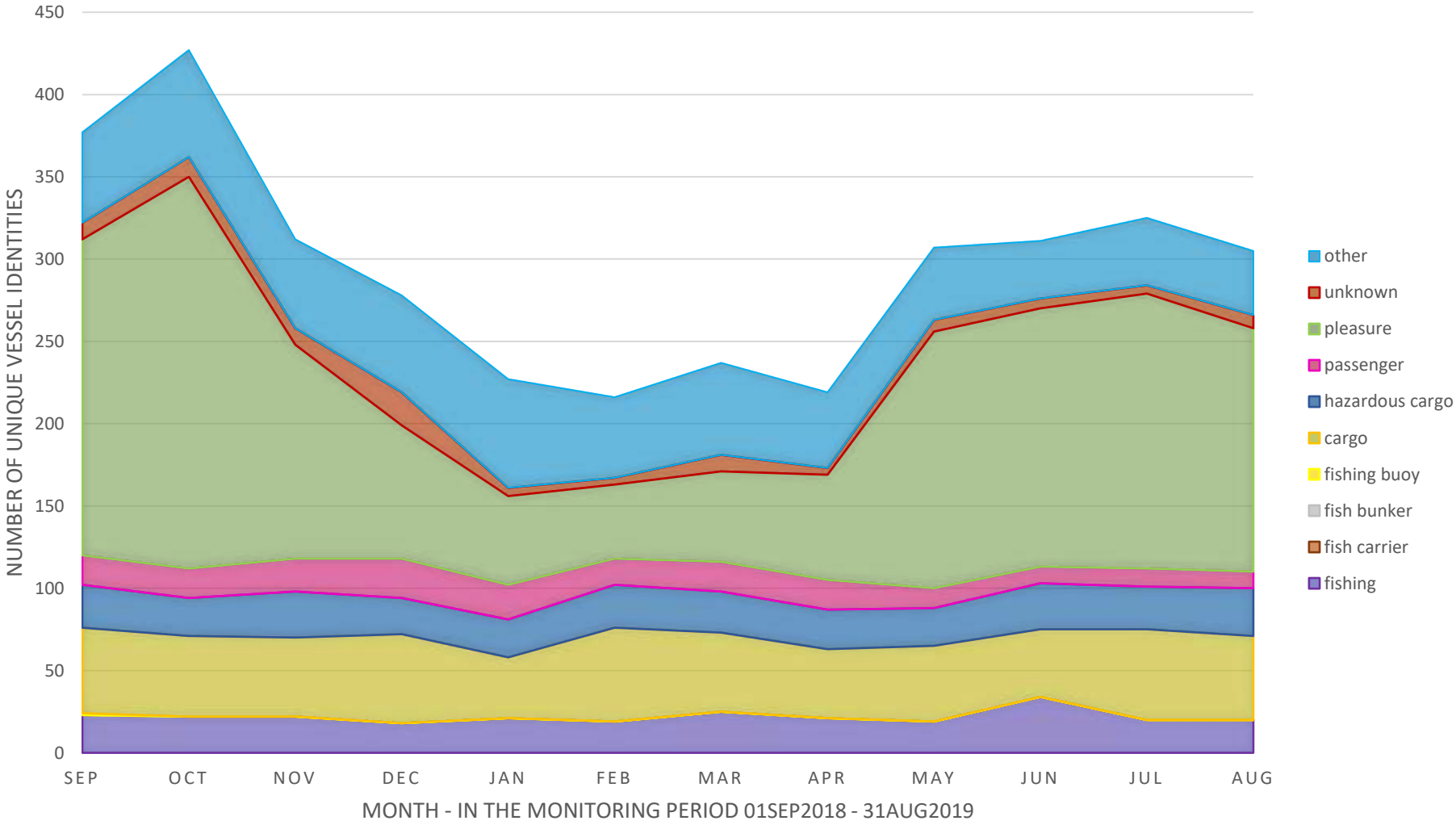




5.2 Waters of New Caledonia and Loyalty Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	23	22	22	18	21	19	25	21	19	34	20	20	54
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	1	0	0	0	0	0	0	0	0	0	0	0	1
Cargo	52	49	48	54	37	57	48	42	46	41	55	51	226
Hazardous cargo	26	23	28	22	23	26	25	24	23	28	26	29	89
Passenger	18	18	20	24	21	16	18	18	12	10	11	10	48
Pleasure	192	238	130	81	54	45	55	64	156	157	167	148	552
Unknown	10	12	10	20	5	4	10	4	7	6	5	8	48
Other	55	65	54	59	66	49	56	46	44	35	41	39	121
Total	377	427	312	278	227	216	237	219	307	311	325	305	1139

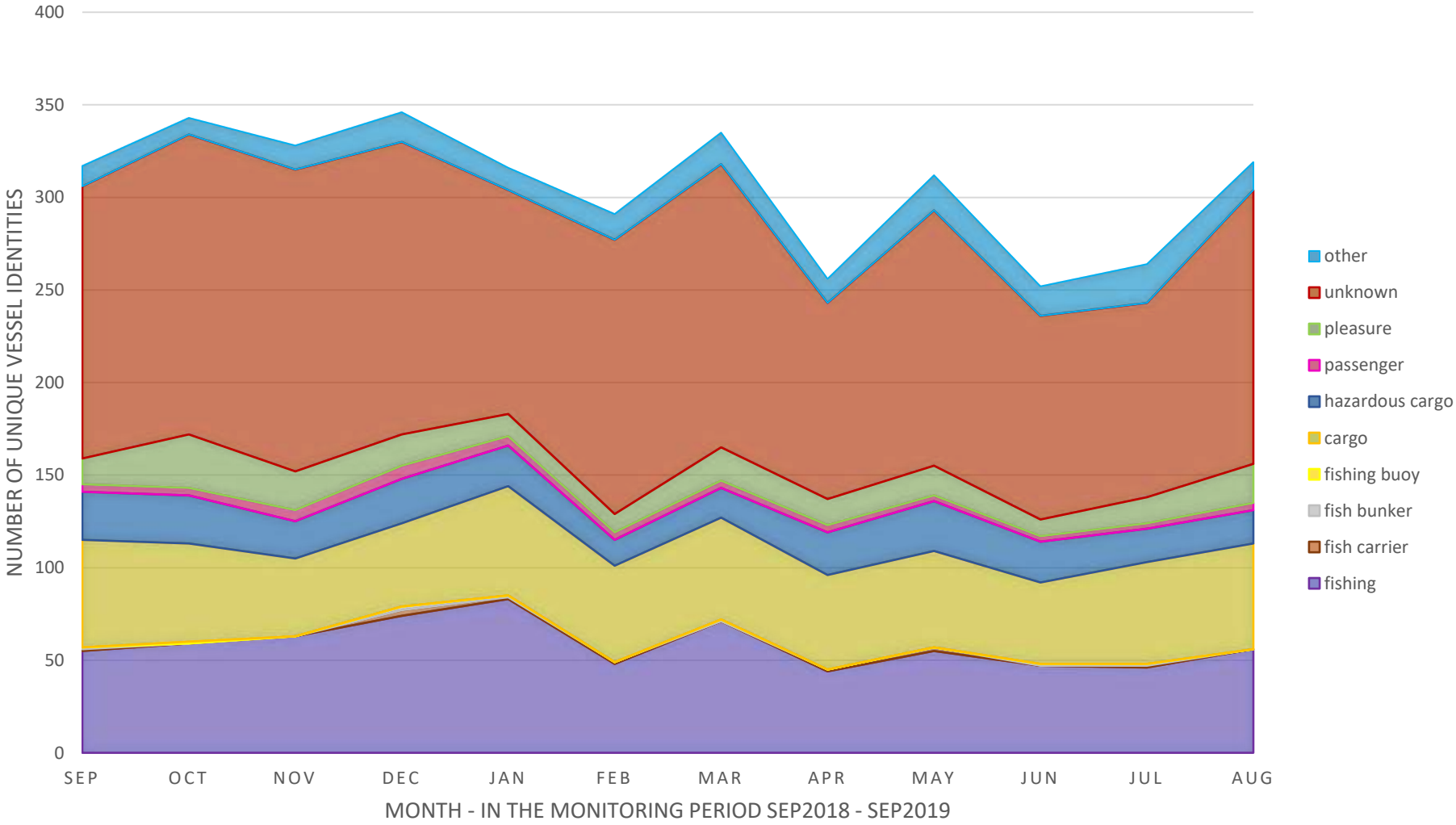
NUMBER OF VESSELS AGGREGATED BY CATEGORY - WATERS OF NEW CALEDONIA AND LOYALTY ISLANDS

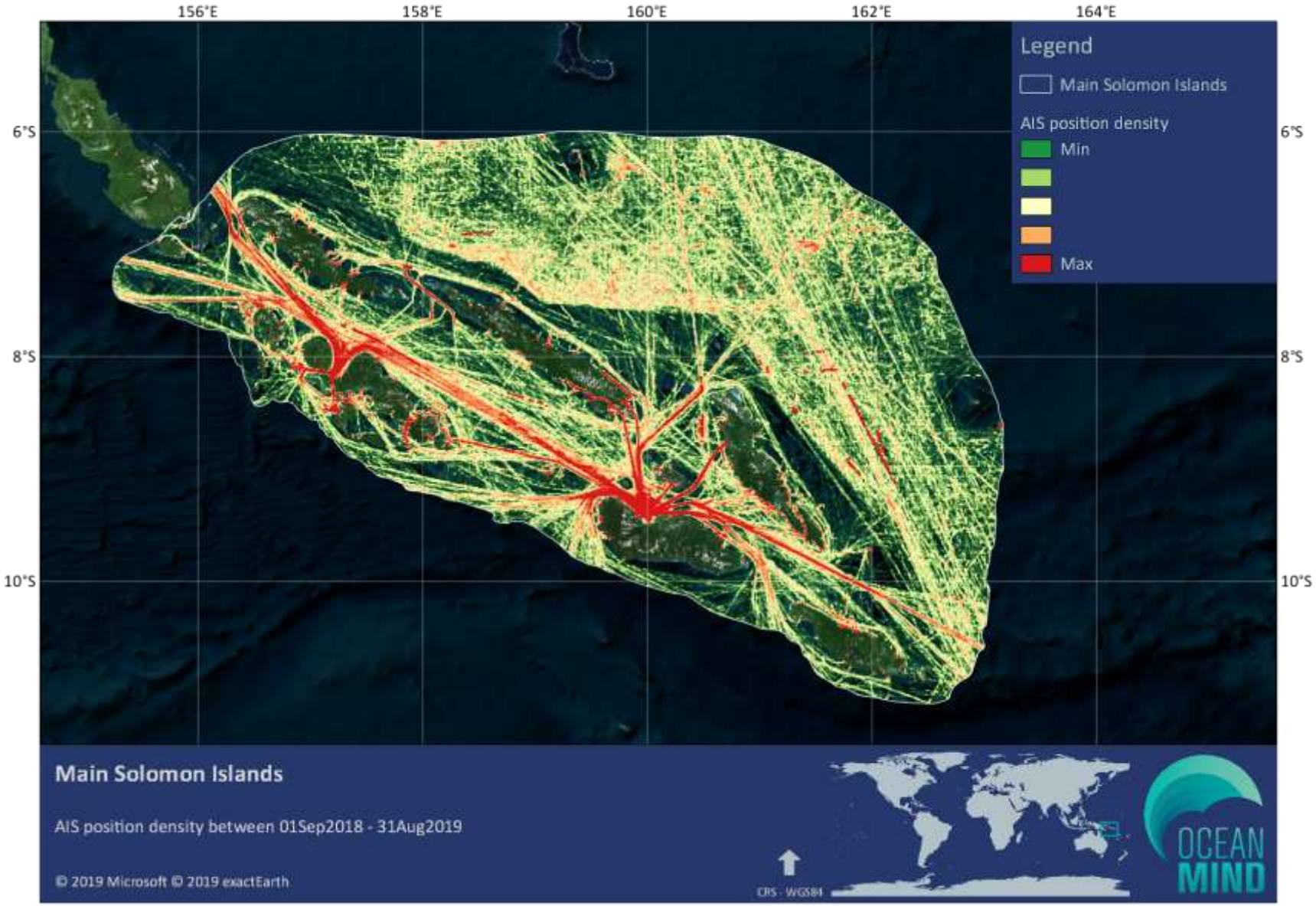


5.3 Main Solomon Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	55	59	63	74	83	48	71	44	55	47	46	56	189
Fish carrier	1	0	0	3	1	1	0	1	2	0	1	0	8
Fish bunker	1	0	0	2	1	0	1	0	0	1	1	0	5
Fishing buoy	0	1	0	0	0	0	0	0	0	0	0	0	1
Cargo	58	53	42	45	59	52	55	51	52	44	55	57	228
Hazardous cargo	26	26	20	24	22	14	16	23	27	22	18	18	77
Passenger	4	4	6	7	5	4	4	4	3	3	3	4	18
Pleasure	14	29	21	17	12	10	18	14	16	9	14	21	73
Unknown	147	162	163	158	121	148	153	106	138	110	105	148	403
Other	11	9	13	16	12	14	17	13	19	16	21	15	62
Total	317	343	328	346	316	291	335	256	312	252	264	319	1064

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MAIN SOLOMON ISLANDS SOLOMON ISLANDS

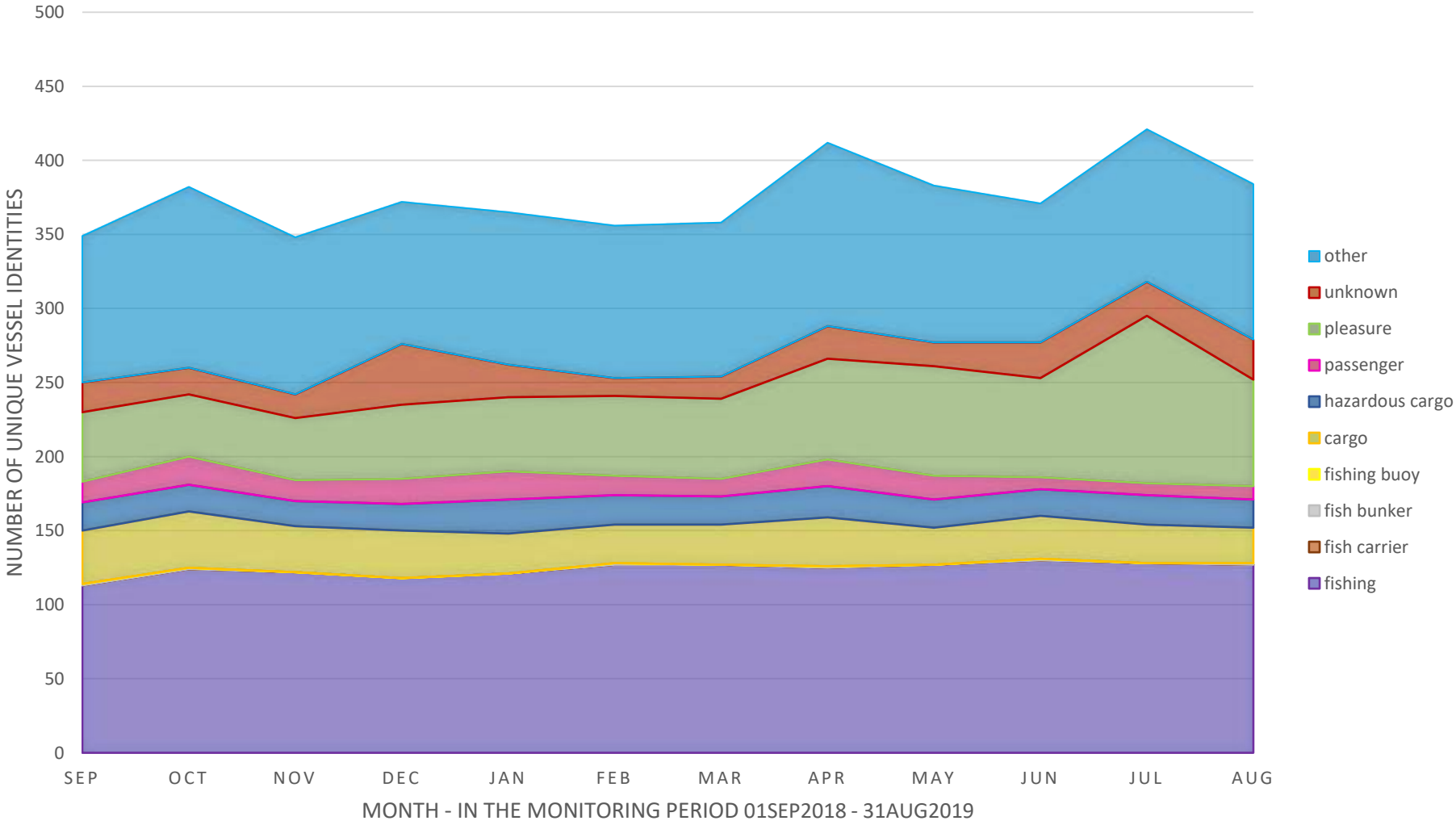


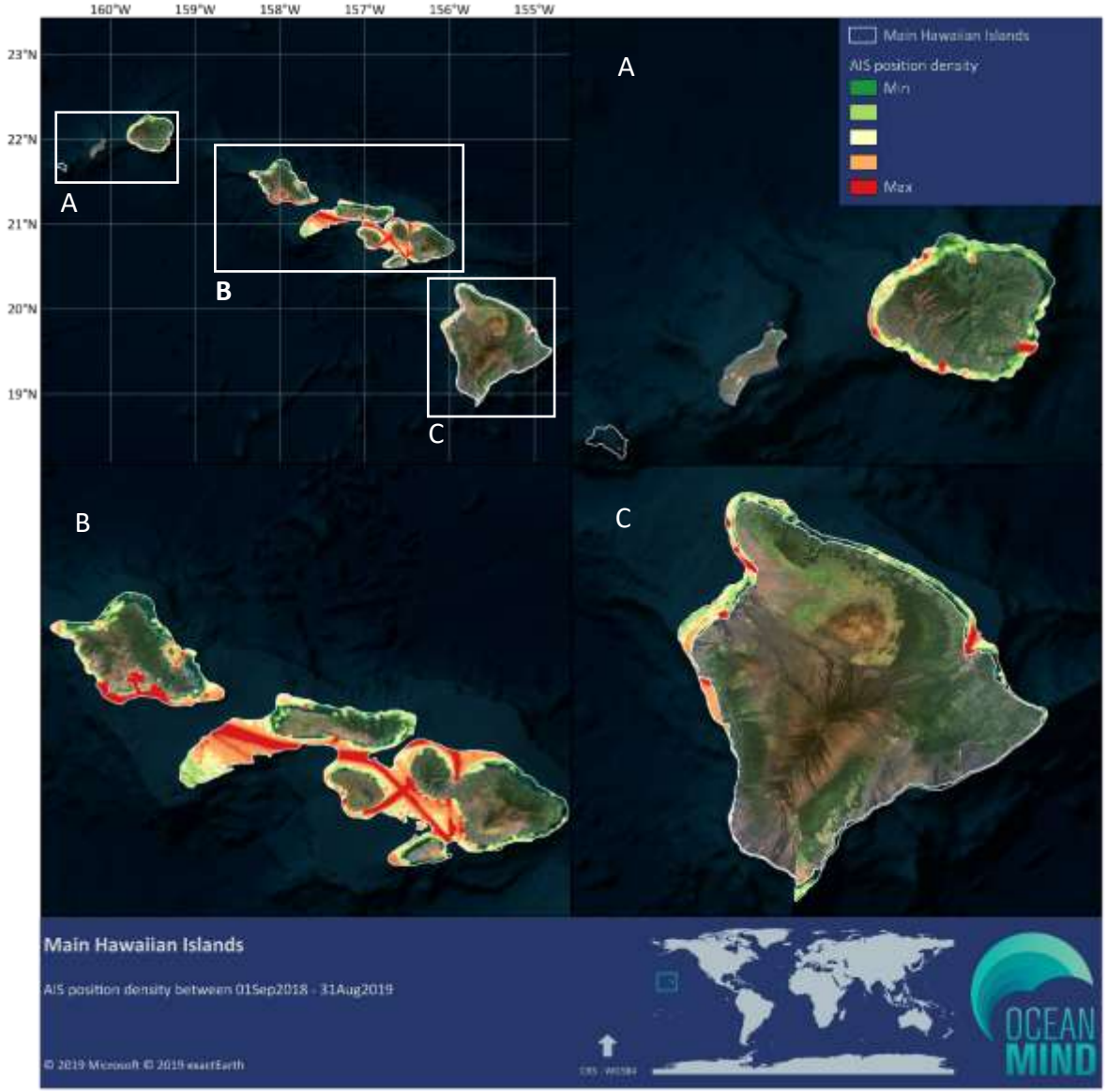


5.4 Main Hawaiian Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	113	124	122	118	121	127	127	125	127	130	128	127	170
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	1	1	0	0	0	1	0	1	0	1	0	1	1
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	36	38	31	32	27	26	27	33	25	29	26	24	119
Hazardous cargo	19	18	17	18	23	20	19	21	19	18	20	19	102
Passenger	14	19	14	17	19	13	12	18	16	8	8	9	44
Pleasure	47	42	42	50	50	54	54	68	74	67	113	72	227
Unknown	20	18	16	41	22	12	15	22	16	24	23	27	113
Other	99	122	106	96	103	103	104	124	106	94	103	105	254
Total	349	382	348	372	365	356	358	412	383	371	421	384	1030

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MAIN HAWAIIAN ISLANDS

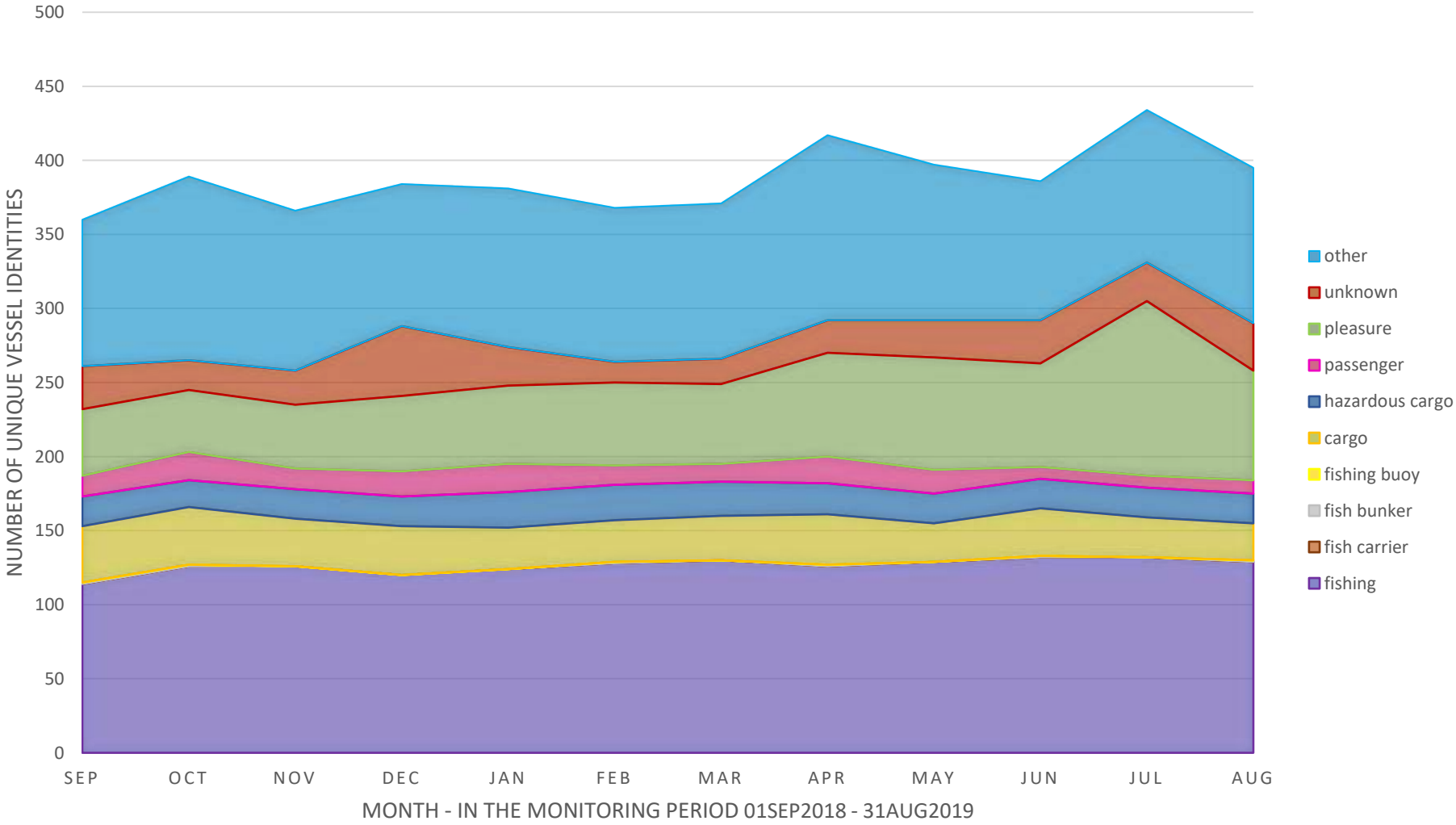


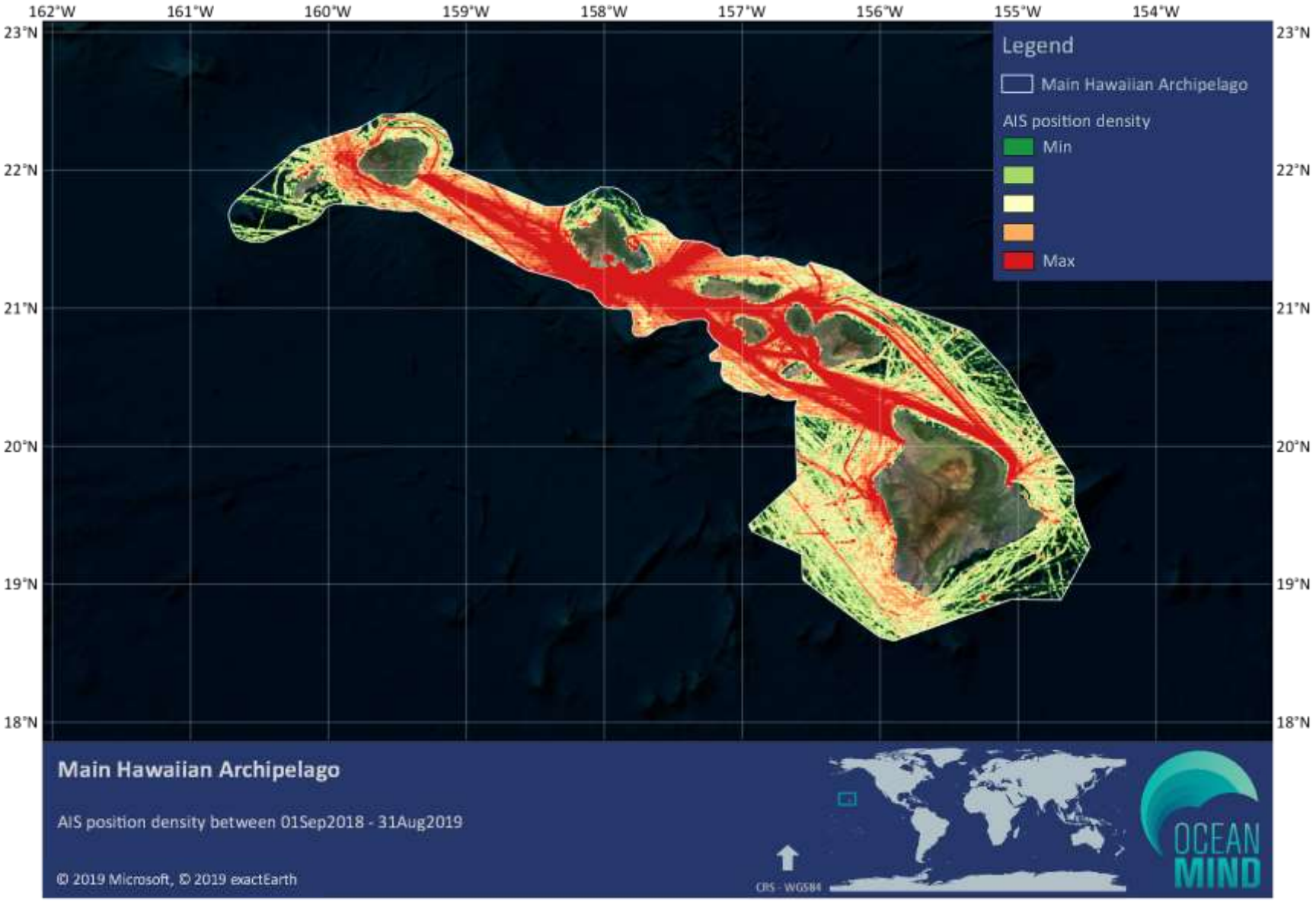


5.5 Main Hawaiian Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	114	126	126	120	124	128	130	126	129	132	132	129	185
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	1	1	0	0	0	1	0	1	0	1	0	1	1
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	38	39	32	33	28	28	30	34	26	32	27	25	126
Hazardous cargo	20	18	20	20	24	24	23	21	20	20	20	20	122
Passenger	14	19	14	17	19	13	12	18	16	8	8	9	44
Pleasure	45	42	43	51	53	56	54	70	76	70	118	74	235
Unknown	29	20	23	47	26	14	17	22	25	29	26	32	141
Other	99	124	108	96	107	104	105	125	105	94	103	105	254
Total	360	389	366	384	381	368	371	417	397	386	434	395	1108

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MAIN HAWAIIAN ARCHIPELAGO

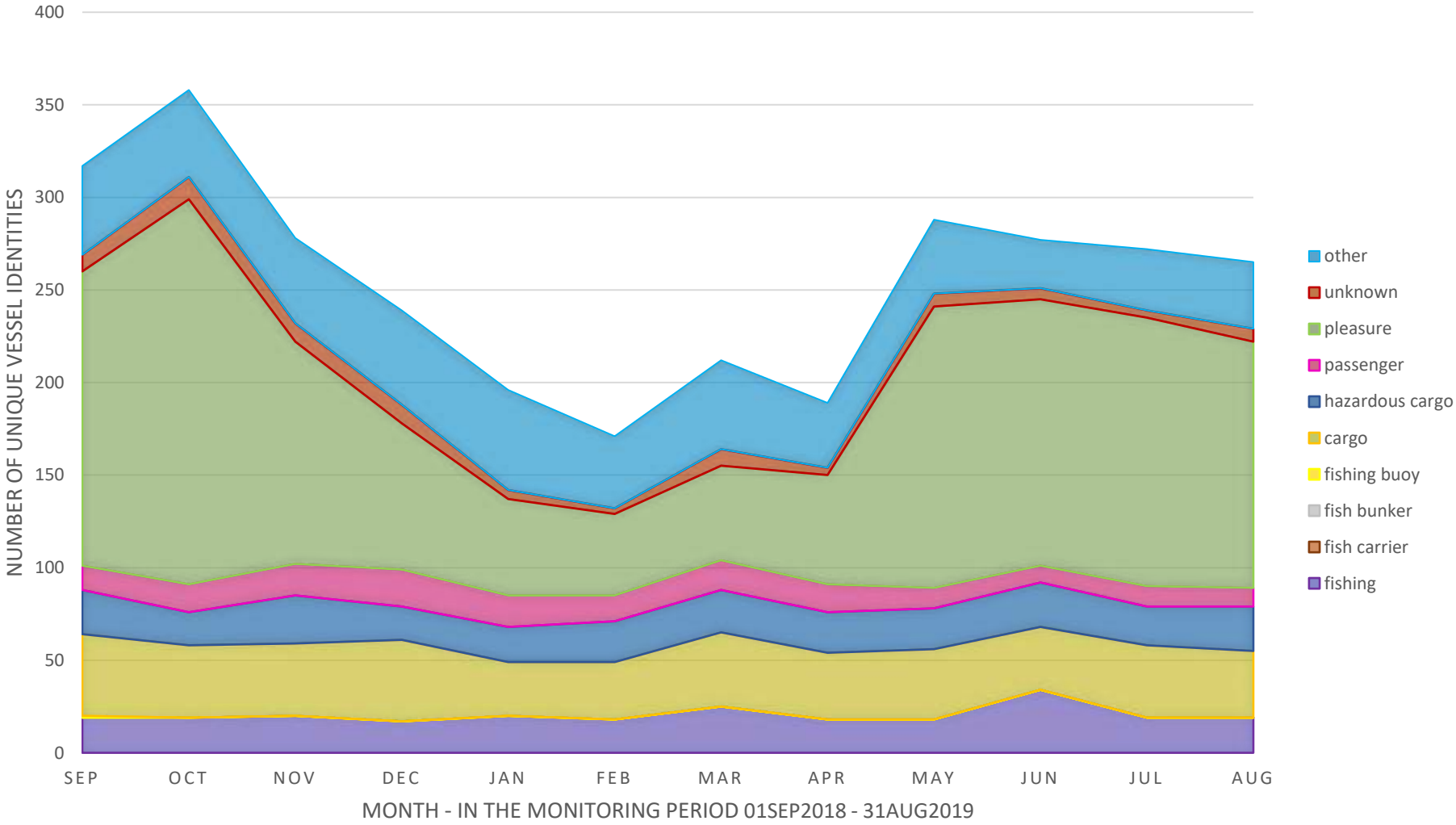




5.6 New Caledonian Lagoons and Shelf Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	19	19	20	17	20	18	25	18	18	34	19	19	45
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	1	0	0	0	0	0	0	0	0	0	0	0	1
Cargo	44	39	39	44	29	31	40	36	38	34	39	36	139
Hazardous cargo	24	18	26	18	19	22	23	22	22	24	21	24	69
Passenger	13	15	17	20	17	14	16	15	11	9	11	10	38
Pleasure	159	208	120	79	52	44	51	59	152	144	145	133	479
Unknown	9	12	10	10	5	3	9	4	7	6	4	7	33
Other	48	47	46	51	54	39	48	35	40	26	33	36	104
Total	317	358	278	239	196	171	212	189	288	277	272	265	908

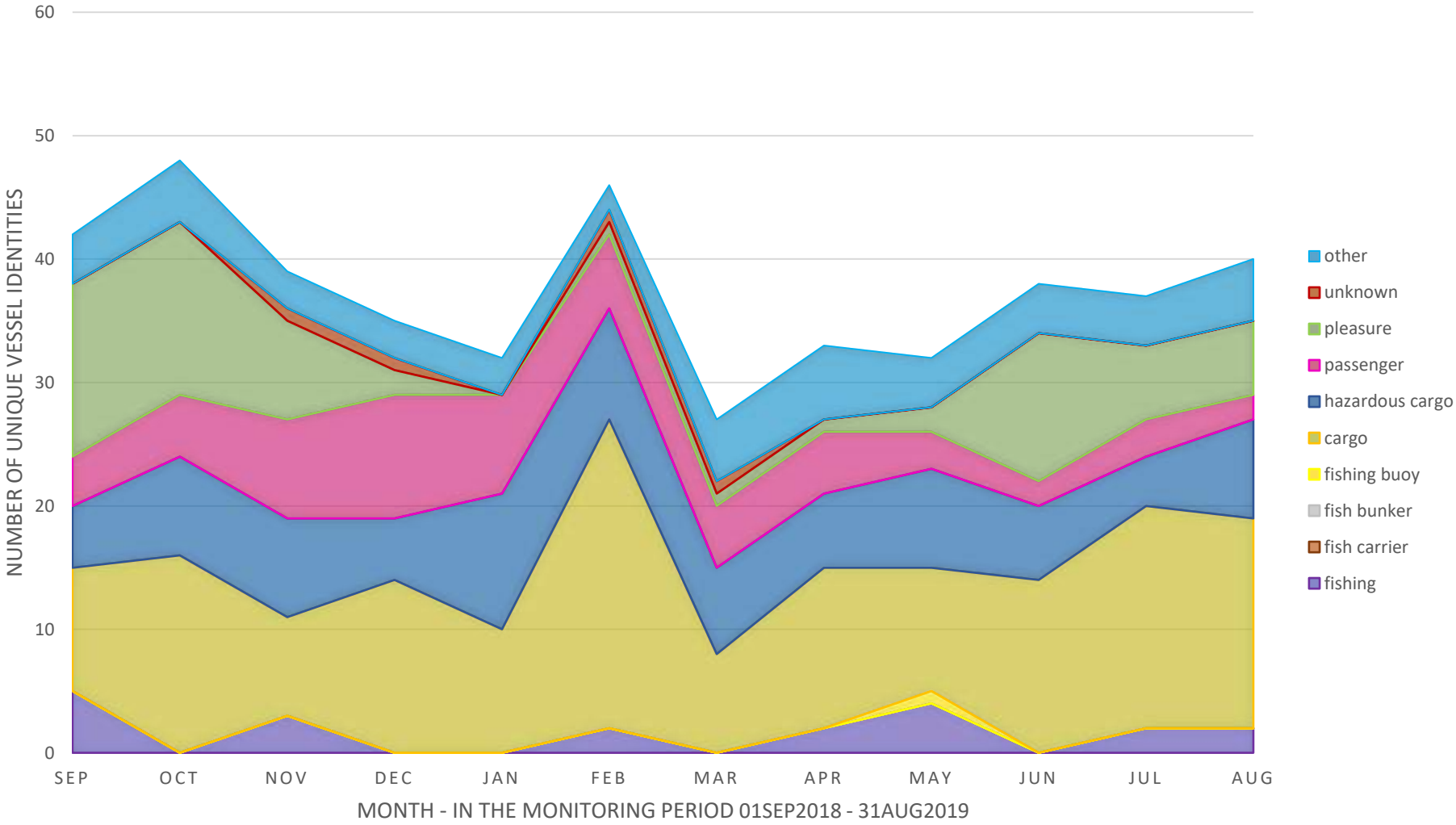
NUMBER OF VESSELS AGGREGATED BY CATEGORY - NEW CALEDONIAN LAGOONS AND SHELF WATERS

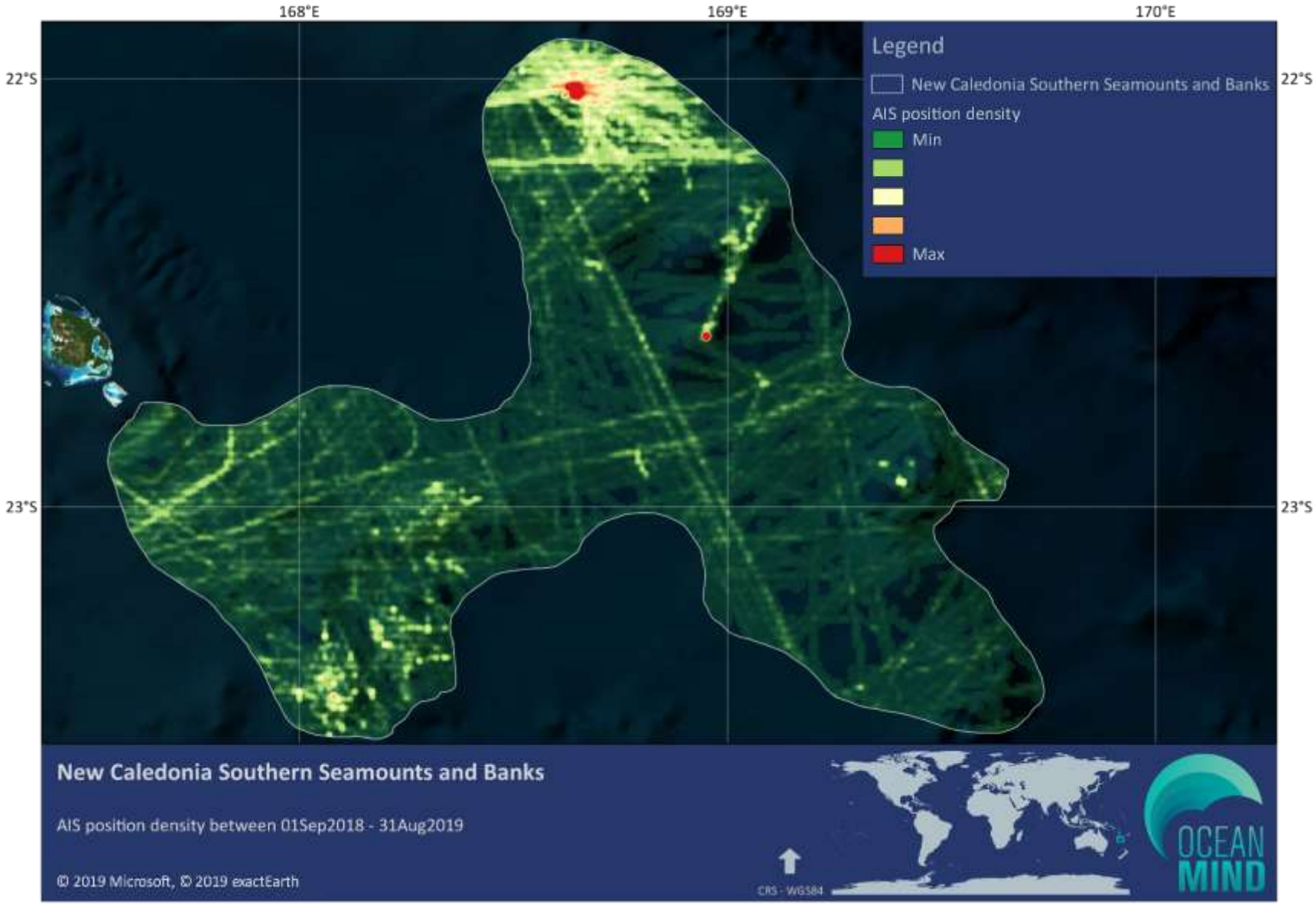


5.7 New Caledonia Southern Seamounts and Banks IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	5	0	3	0	0	2	0	2	4	0	2	2	17
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	1	0	0	0	1
Cargo	10	16	8	14	10	25	8	13	10	14	18	17	106
Hazardous cargo	5	8	8	5	11	9	7	6	8	6	4	8	48
Passenger	4	5	8	10	8	6	5	5	3	2	3	2	19
Pleasure	14	14	8	2	0	1	1	1	2	12	6	6	64
Unknown	0	0	1	1	0	1	1	0	0	0	0	0	4
Other	4	5	3	3	3	2	5	6	4	4	4	5	11
Total	42	48	39	35	32	46	27	33	32	38	37	40	270

NUMBER OF VESSELS AGGREGATED BY CATEGORY - NEW CALEDONIA SOUTHERN SEAMOUNTS AND BANKS

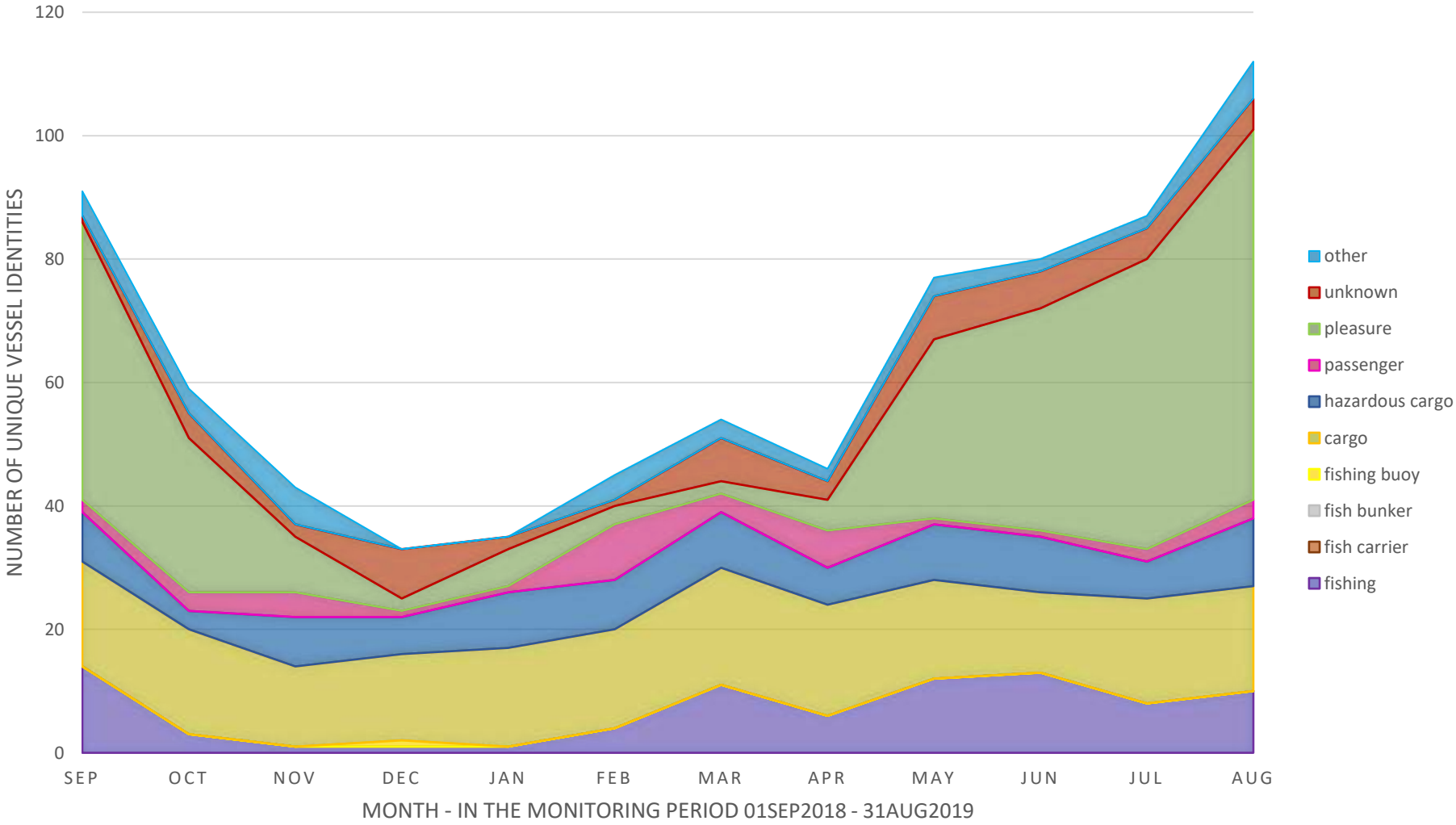




5.8 Cook Islands Southern Group IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	14	3	1	1	1	4	11	6	12	13	8	10	60
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	1	0	0	0	0	0	0	0	0	1
Cargo	17	17	13	14	16	16	19	18	16	13	17	17	100
Hazardous cargo	8	3	8	6	9	8	9	6	9	9	6	11	45
Passenger	2	3	4	1	1	9	3	6	1	1	2	3	26
Pleasure	45	25	9	2	6	3	2	5	29	36	47	60	232
Unknown	1	4	2	8	2	1	7	3	7	6	5	5	47
Other	4	4	6	0	0	4	3	2	3	2	2	6	28
Total	91	59	43	33	35	45	54	46	77	80	87	112	539

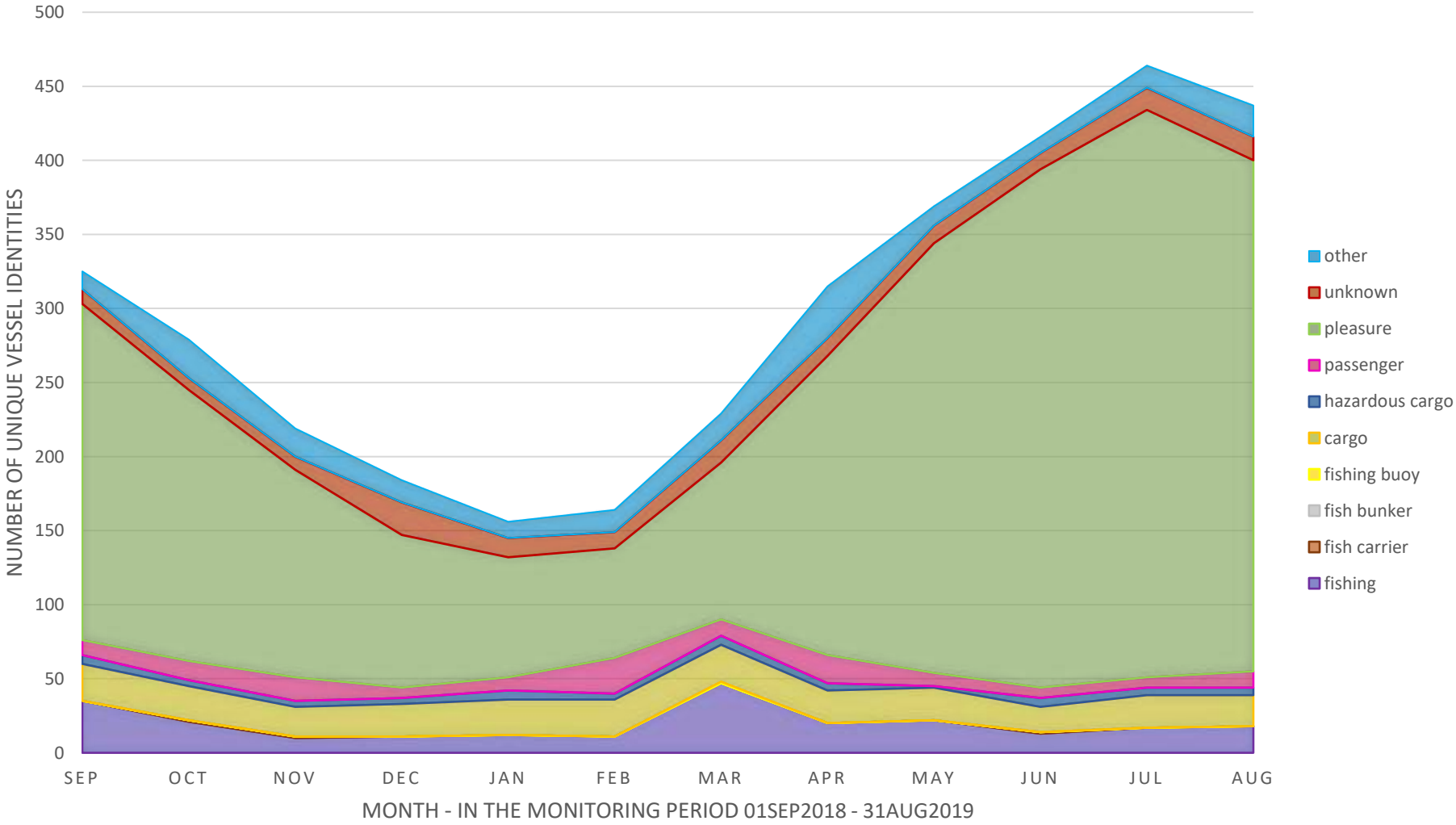
NUMBER OF VESSELS AGGREGATED BY CATEGORY - COOK ISLANDS SOUTHERN GROUP

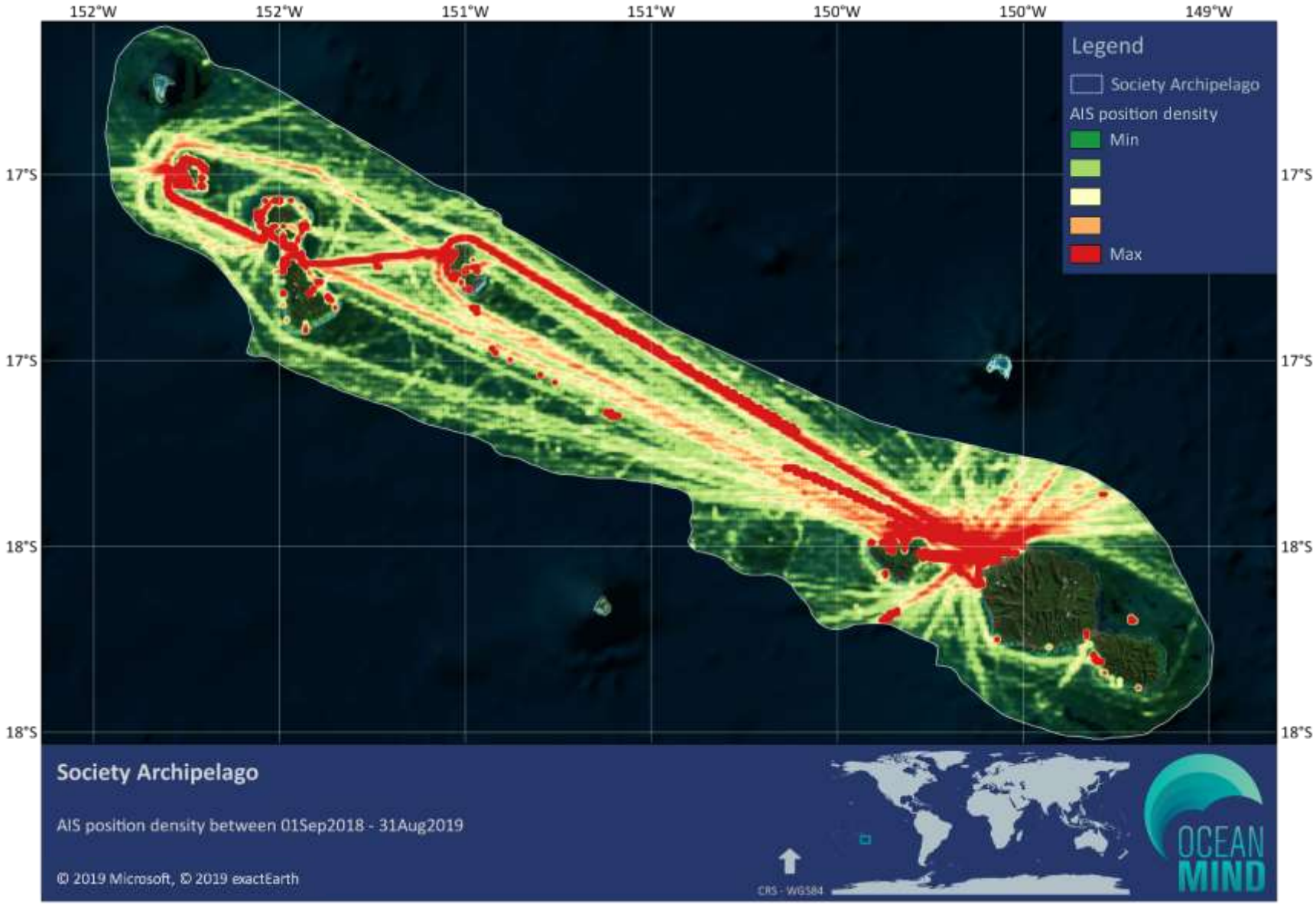


5.9 Society Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	35	21	10	11	12	11	47	20	22	13	17	18	99
Fish carrier	0	1	1	0	0	0	0	0	0	1	0	0	2
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	1	0	0	0	0	0	1
Cargo	25	23	20	22	24	25	25	22	22	17	22	21	80
Hazardous cargo	6	4	4	4	6	4	6	5	1	6	5	5	17
Passenger	10	13	16	7	9	24	11	19	9	7	7	11	60
Pleasure	227	183	140	103	81	74	106	202	290	350	383	345	782
Unknown	10	8	9	22	13	11	15	12	12	11	15	16	64
Other	12	26	19	15	11	15	18	35	13	11	15	21	83
Total	325	279	219	184	156	164	229	315	369	416	464	437	1188

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOCIETY ARCHIPELAGO

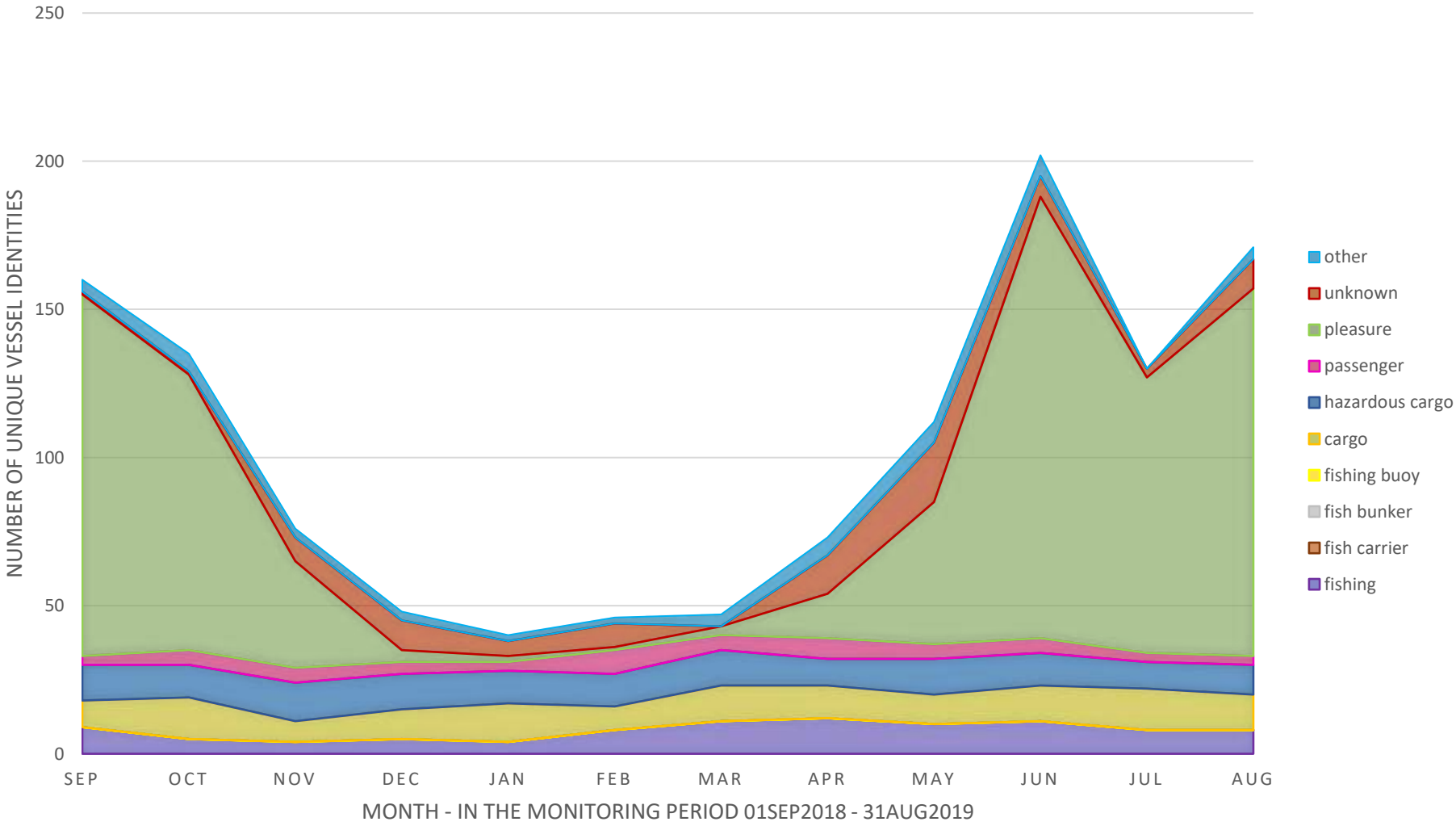


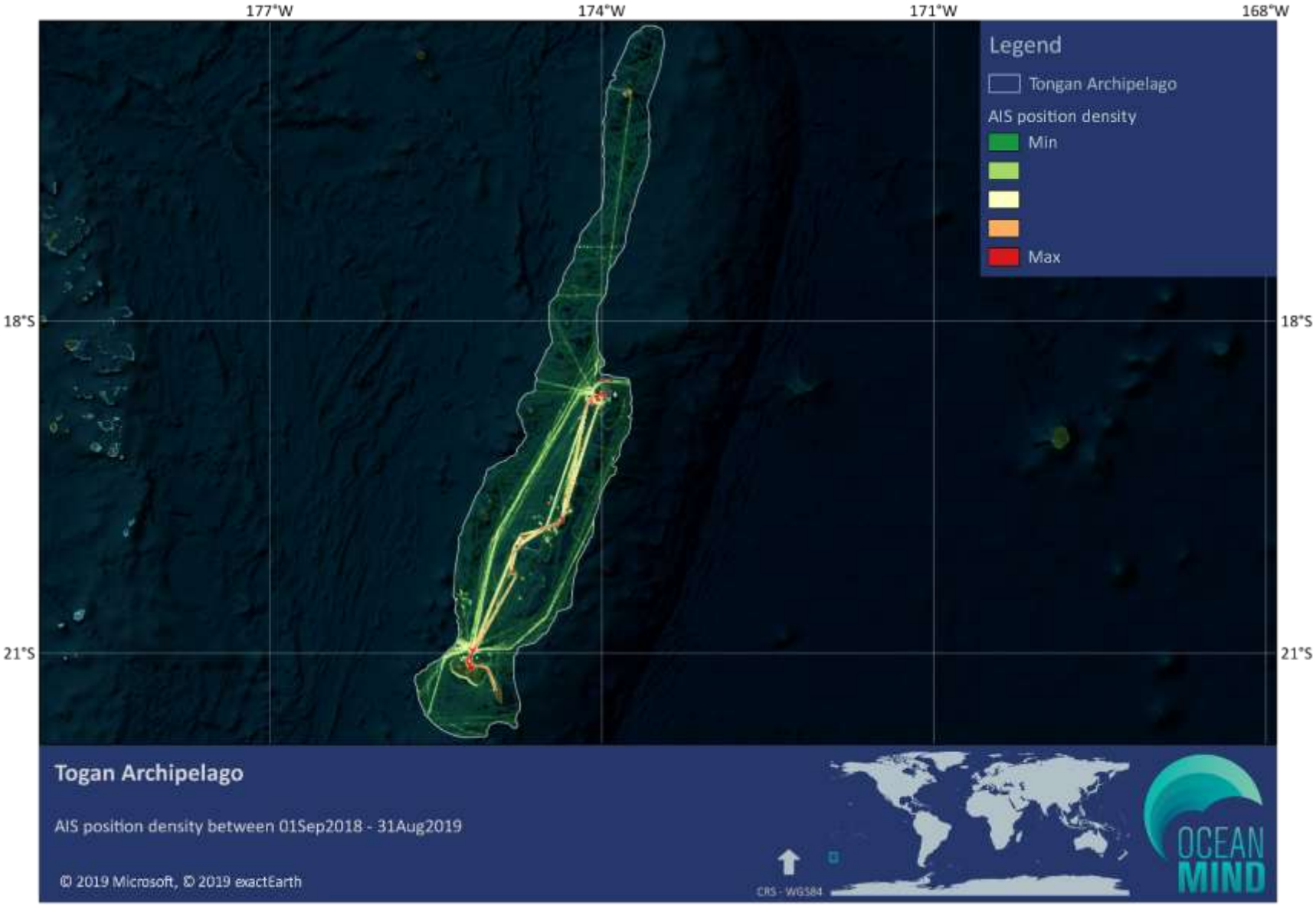


5.10 Tongan Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	9	5	4	5	4	8	11	12	10	11	8	8	39
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	9	14	7	10	13	8	12	11	10	12	14	12	57
Hazardous cargo	12	11	13	12	11	11	12	9	12	11	9	10	34
Passenger	3	5	5	4	3	8	5	7	5	5	3	3	21
Pleasure	122	93	36	4	2	1	3	15	48	149	93	124	453
Unknown	1	1	8	10	5	8	0	13	20	7	3	10	54
Other	4	6	3	3	2	2	4	6	7	7	0	4	30
Total	160	135	76	48	40	46	47	73	112	202	130	171	688

NUMBER OF VESSELS AGGREGATED BY CATEGORY - TONGAN ARCHIPELAGO

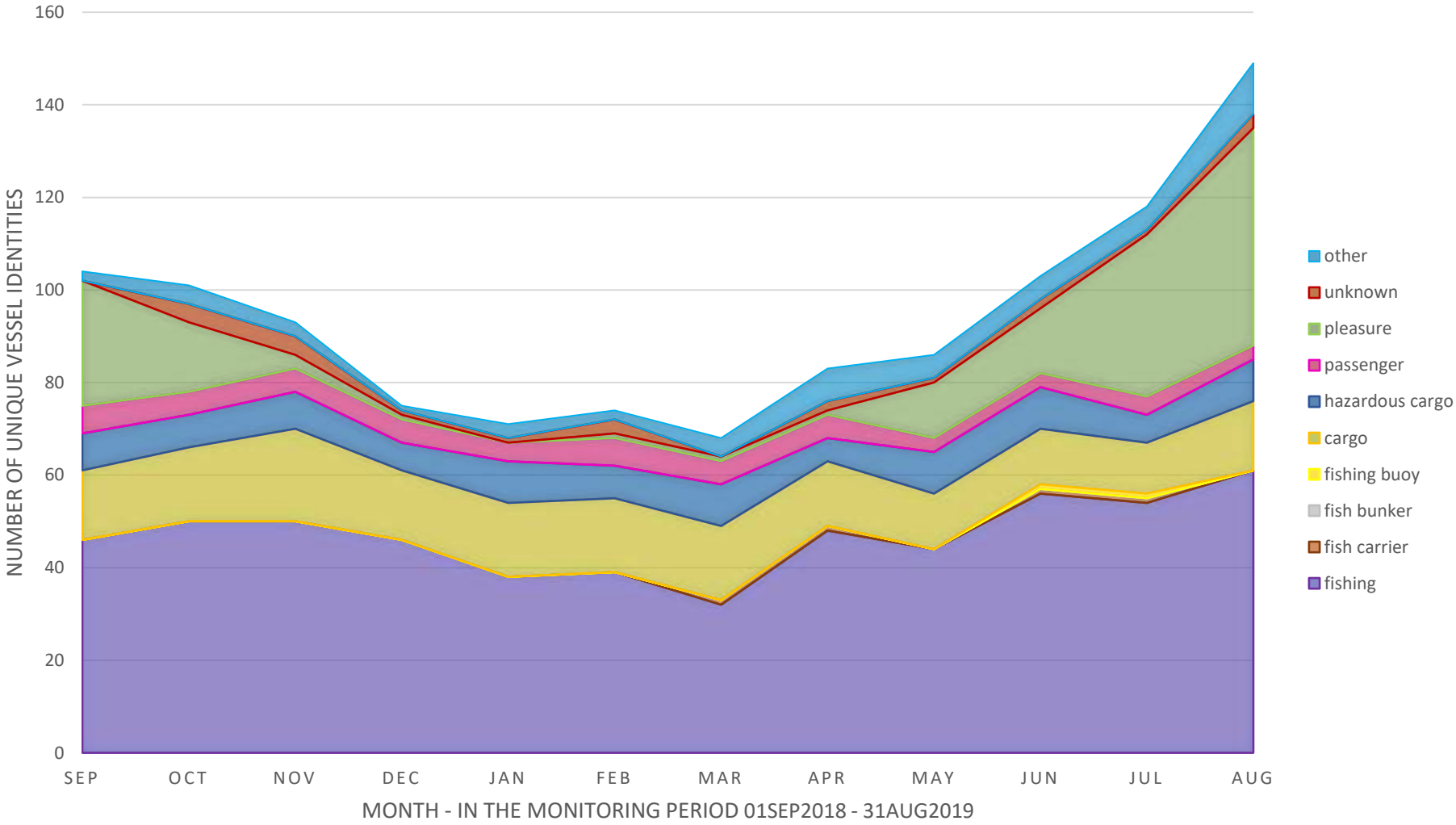


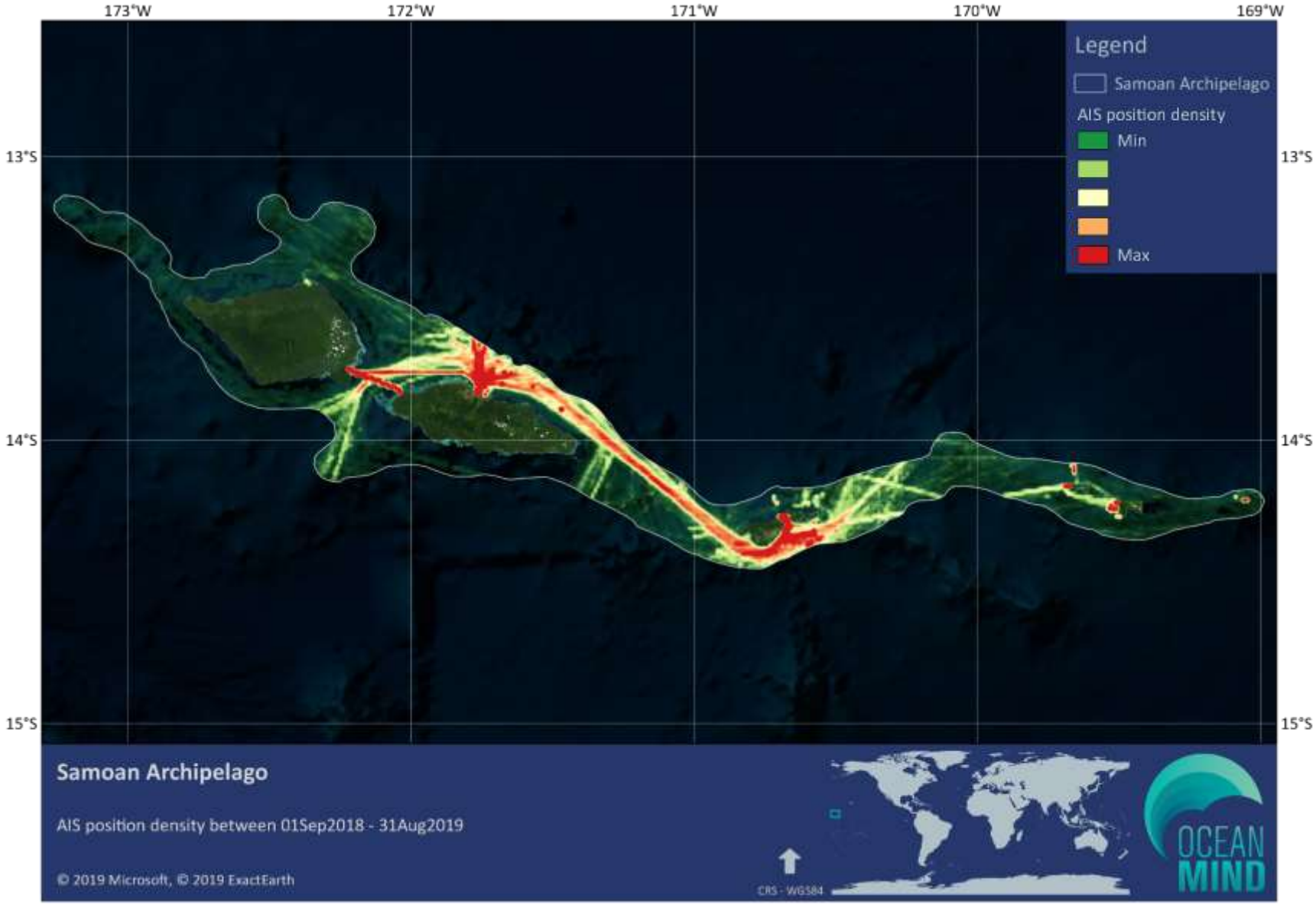


5.11 Samoan Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	46	50	50	46	38	39	32	48	44	56	54	61	164
Fish carrier	0	0	0	0	0	0	1	1	0	1	1	0	2
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	1	1	0	1
Cargo	15	16	20	15	16	16	16	14	12	12	11	15	49
Hazardous cargo	8	7	8	6	9	7	9	5	9	9	6	9	24
Passenger	6	5	5	5	4	6	5	5	3	3	4	3	20
Pleasure	27	15	3	1	0	1	1	1	12	14	35	47	113
Unknown	0	4	4	1	1	3	0	2	1	2	1	3	16
Other	2	4	3	1	3	2	4	7	5	5	5	11	26
Total	102	97	90	74	68	72	64	76	81	98	113	138	389

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SAMOAN ARCHIPELAGO

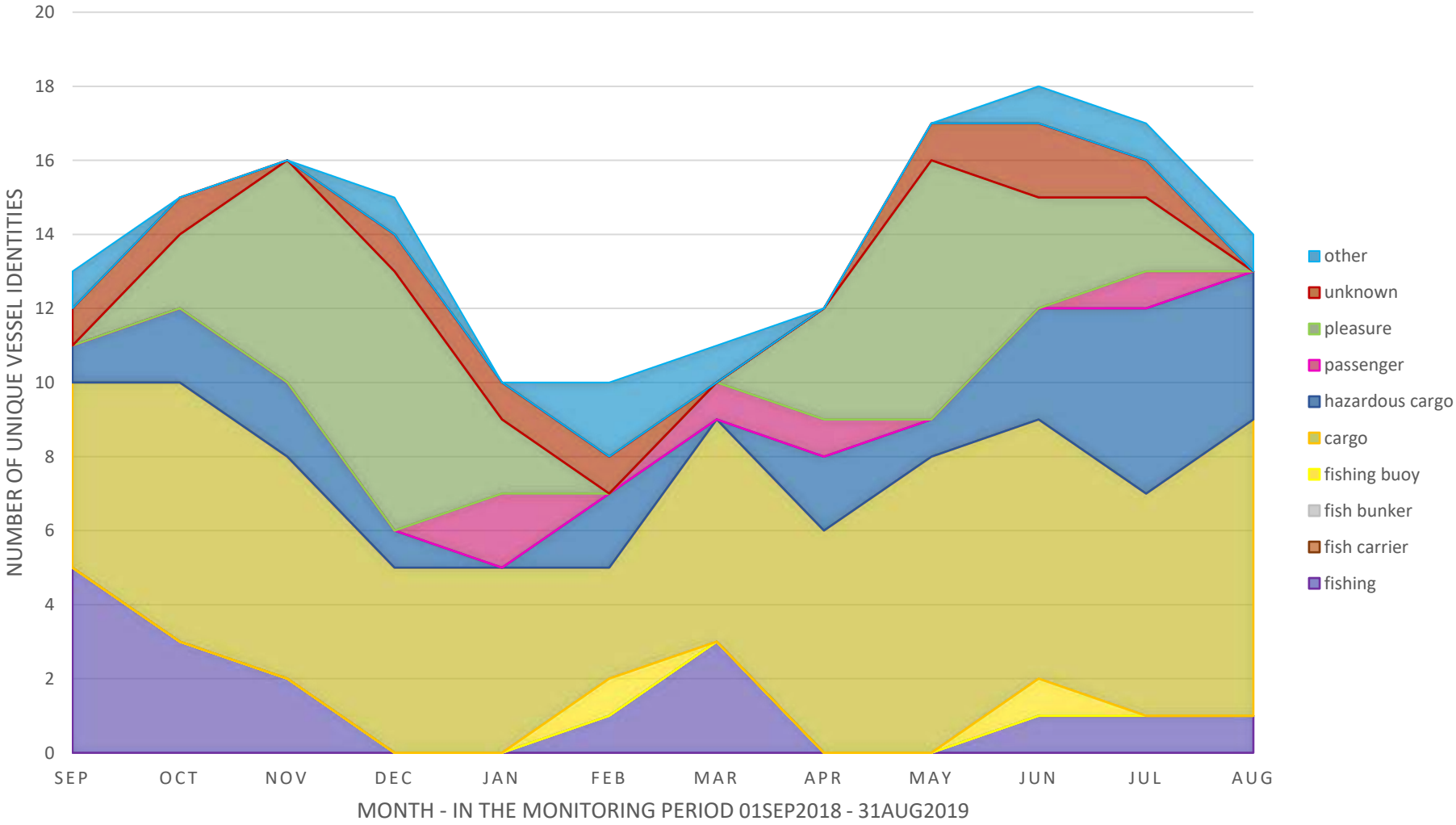


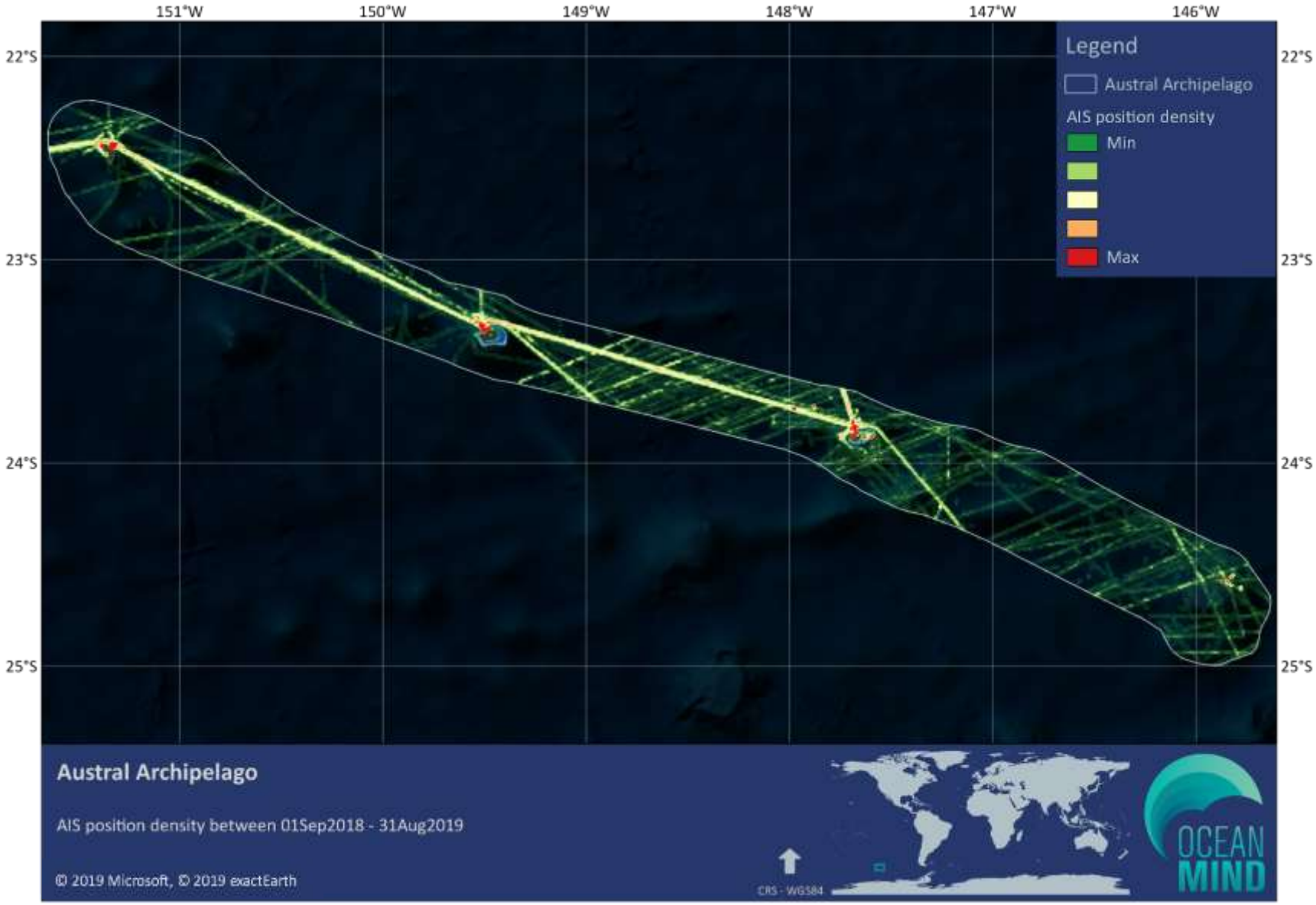


5.12 Austral Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	5	3	2	0	0	1	3	0	0	1	1	1	14
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	1	0	0	0	1	0	0	1
Cargo	5	7	6	5	5	3	6	6	8	7	6	8	50
Hazardous cargo	1	2	2	1	0	2	0	2	1	3	5	4	17
Passenger	0	0	0	0	2	0	1	1	0	0	1	0	4
Pleasure	0	2	6	7	2	0	0	3	7	3	2	0	21
Unknown	1	1	0	1	1	1	0	0	1	2	1	0	9
Other	1	0	0	1	0	2	1	0	0	1	1	1	6
Total	13	15	16	15	10	10	11	12	17	18	17	14	122

NUMBER OF VESSELS AGGREGATED BY CATEGORY - AUSTRAL ARCHIPELAGO

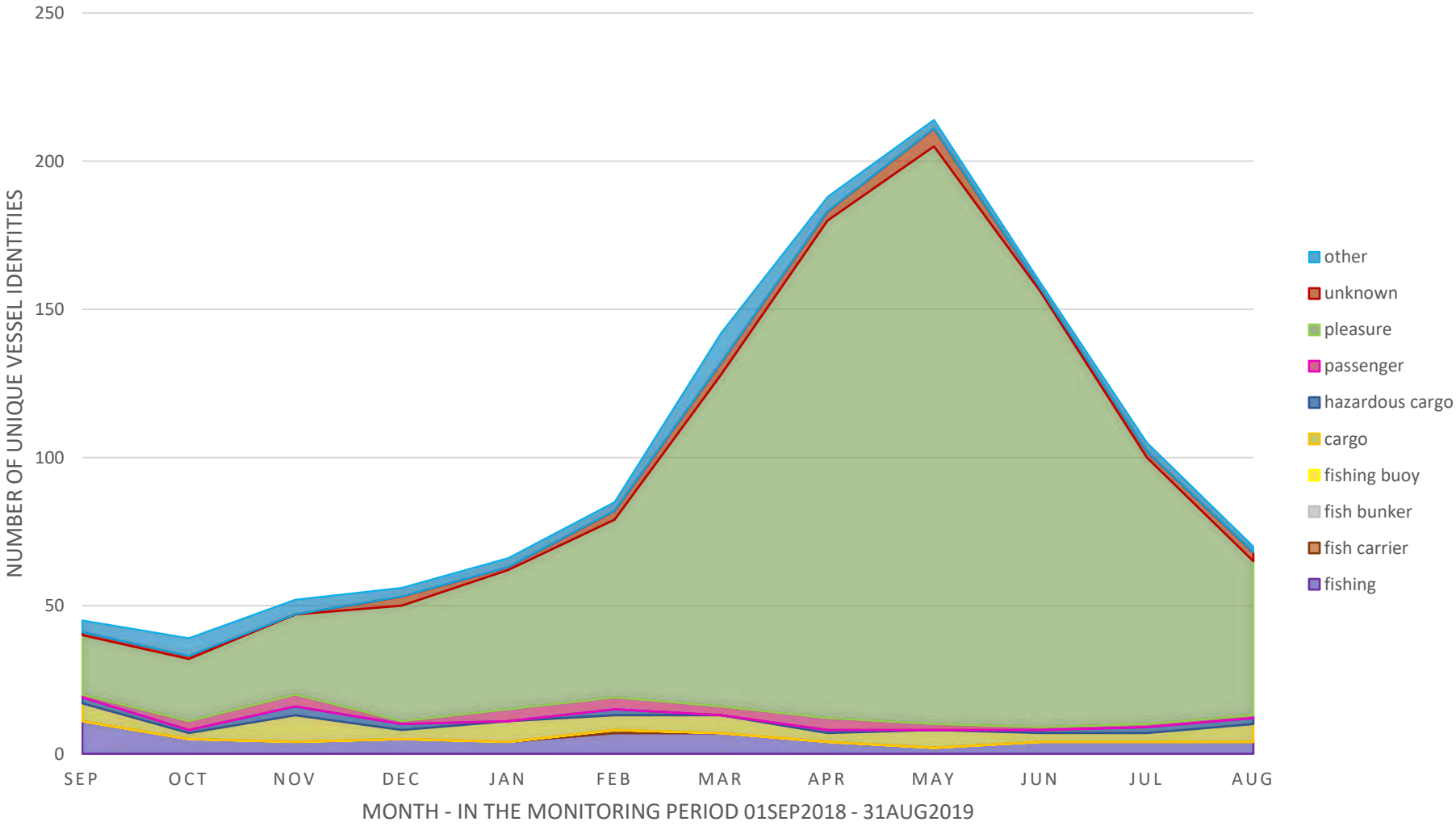


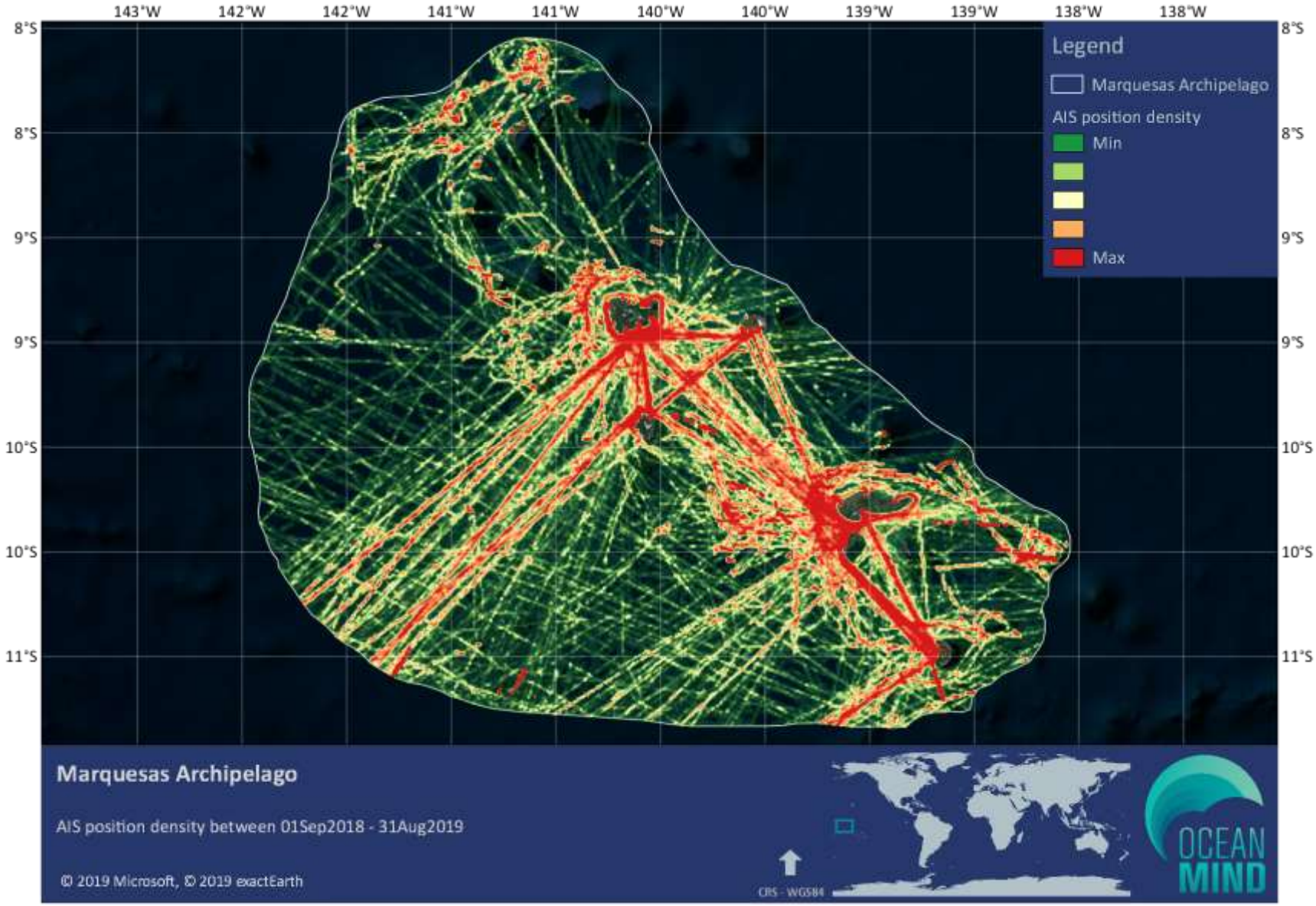


5.13 Marquesas Archipelago IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	11	5	4	5	4	7	7	4	2	4	4	4	42
Fish carrier	0	0	0	0	0	1	0	0	0	0	0	0	1
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	6	2	9	3	7	5	6	3	6	3	3	6	41
Hazardous cargo	2	1	3	2	0	2	0	1	0	1	2	2	12
Passenger	1	3	4	1	4	4	3	4	2	1	1	1	11
Pleasure	20	21	27	39	47	60	112	168	195	147	90	52	476
Unknown	1	1	0	3	1	3	4	3	6	1	2	3	21
Other	4	6	5	3	3	3	10	5	3	2	3	2	20
Total	45	39	52	56	66	85	142	188	214	159	105	70	624

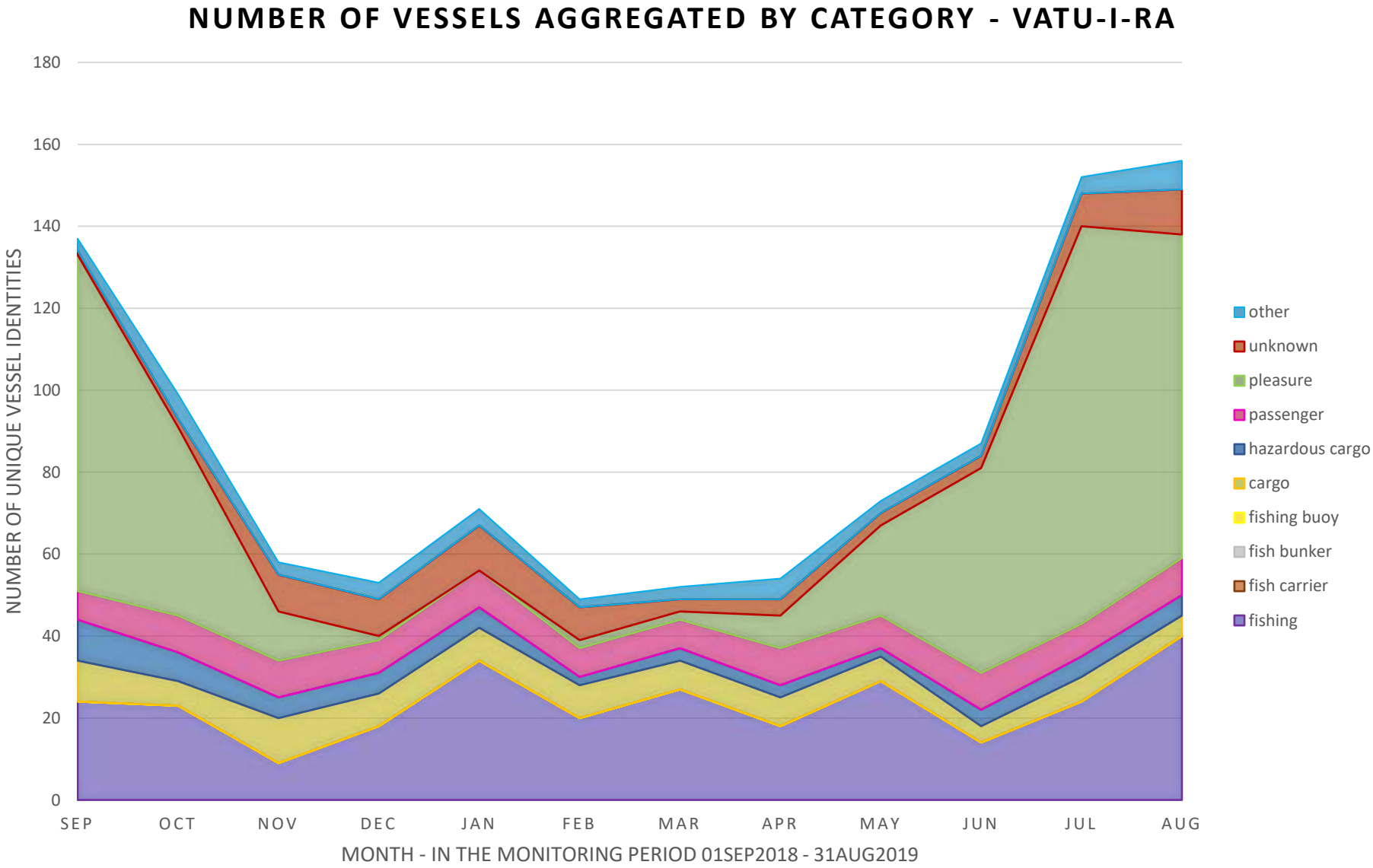
NUMBER OF VESSELS AGGREGATED BY CATEGORY - MARQUESAS ARCHIPELAGO

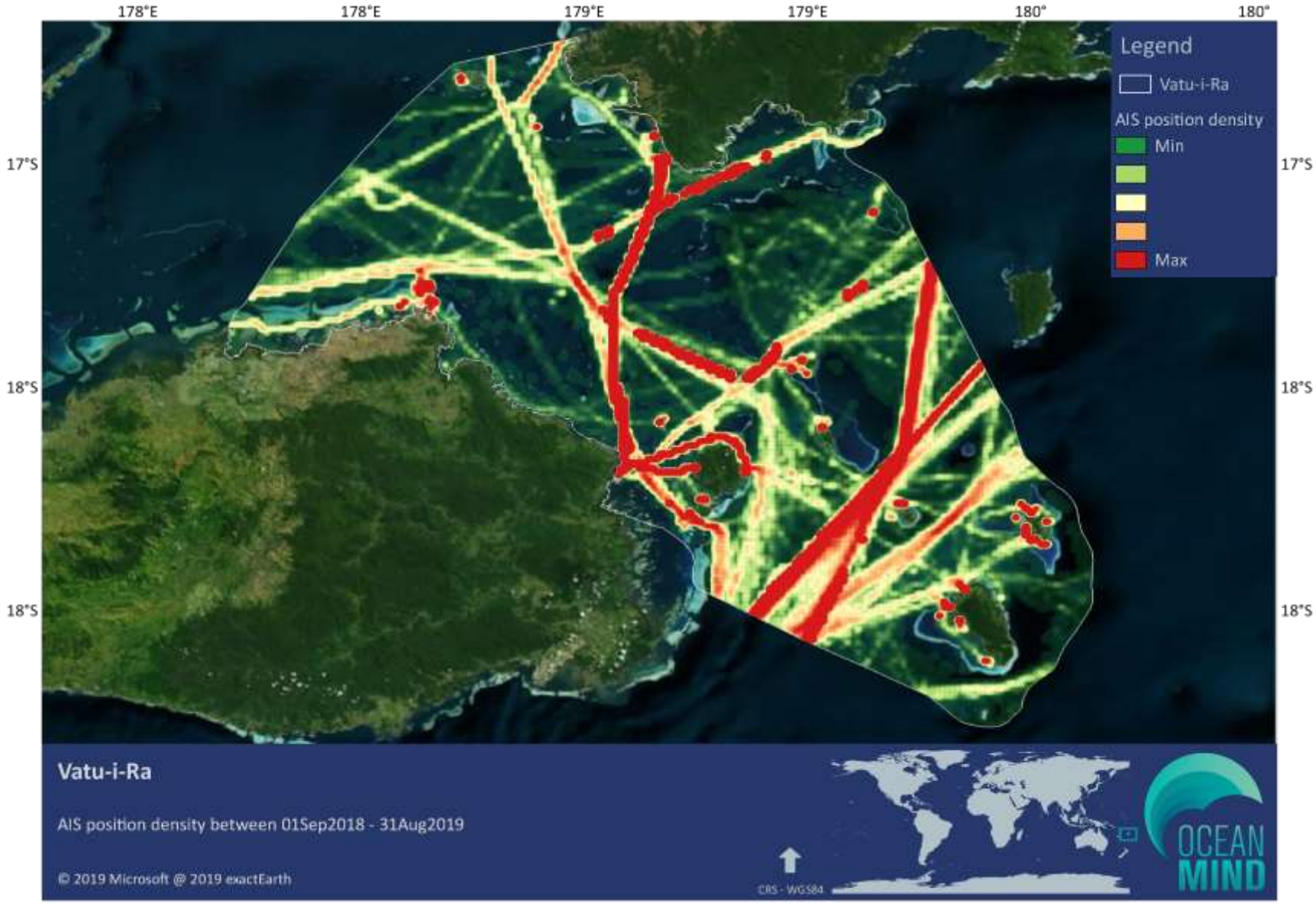




5.14 Vatu-i-Ra IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	24	23	9	18	34	20	27	18	29	14	24	40	128
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	10	6	11	8	8	8	7	7	6	4	6	5	23
Hazardous cargo	10	7	5	5	5	2	3	3	2	4	5	5	15
Passenger	7	9	9	8	9	7	7	9	8	9	8	9	25
Pleasure	82	46	12	1	0	2	2	8	22	50	97	79	305
Unknown	1	2	9	9	11	8	3	4	3	3	8	11	27
Other	3	6	3	4	4	2	3	5	3	3	4	7	20
Total	137	99	58	53	71	49	52	54	73	87	152	156	543

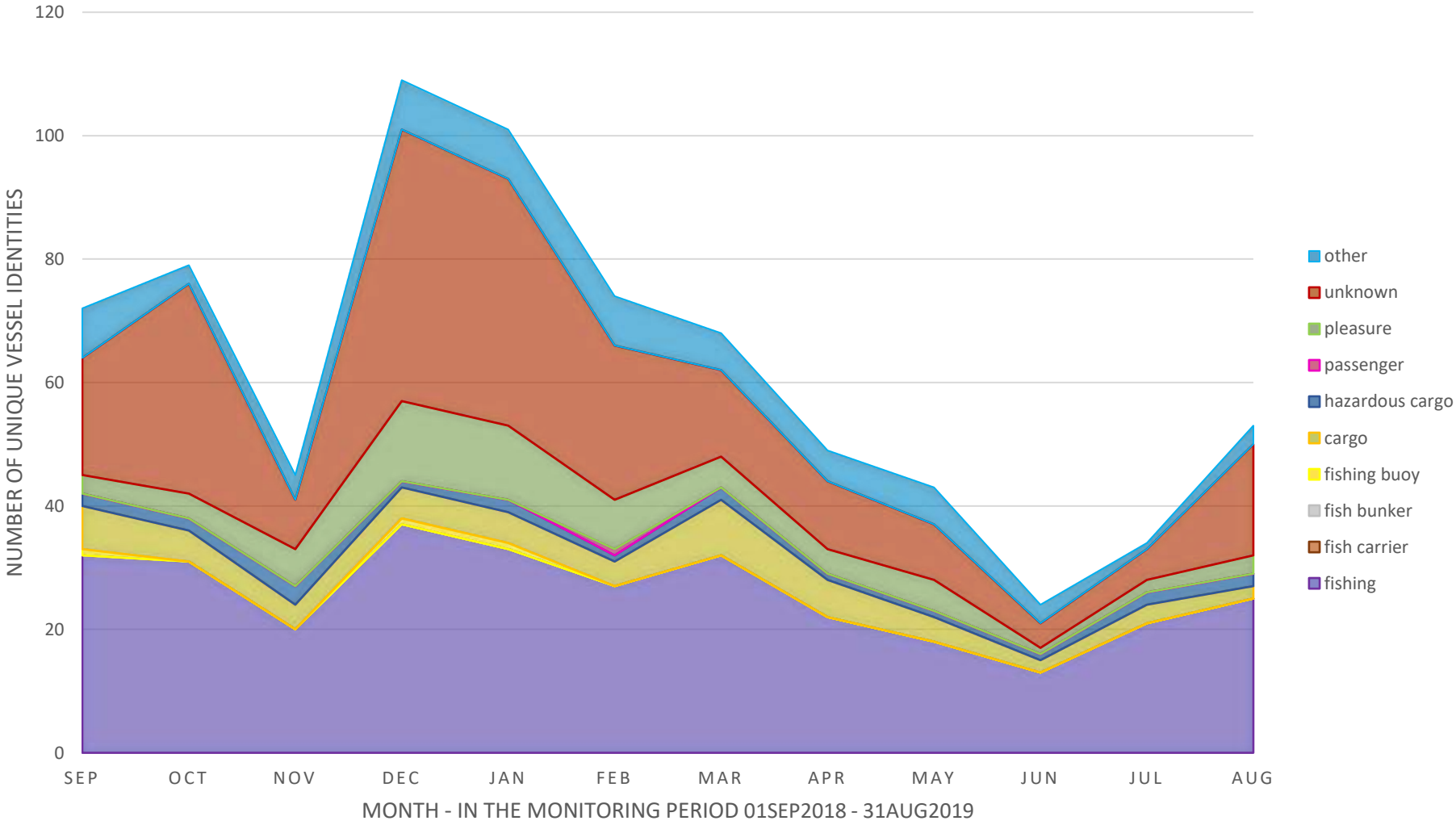


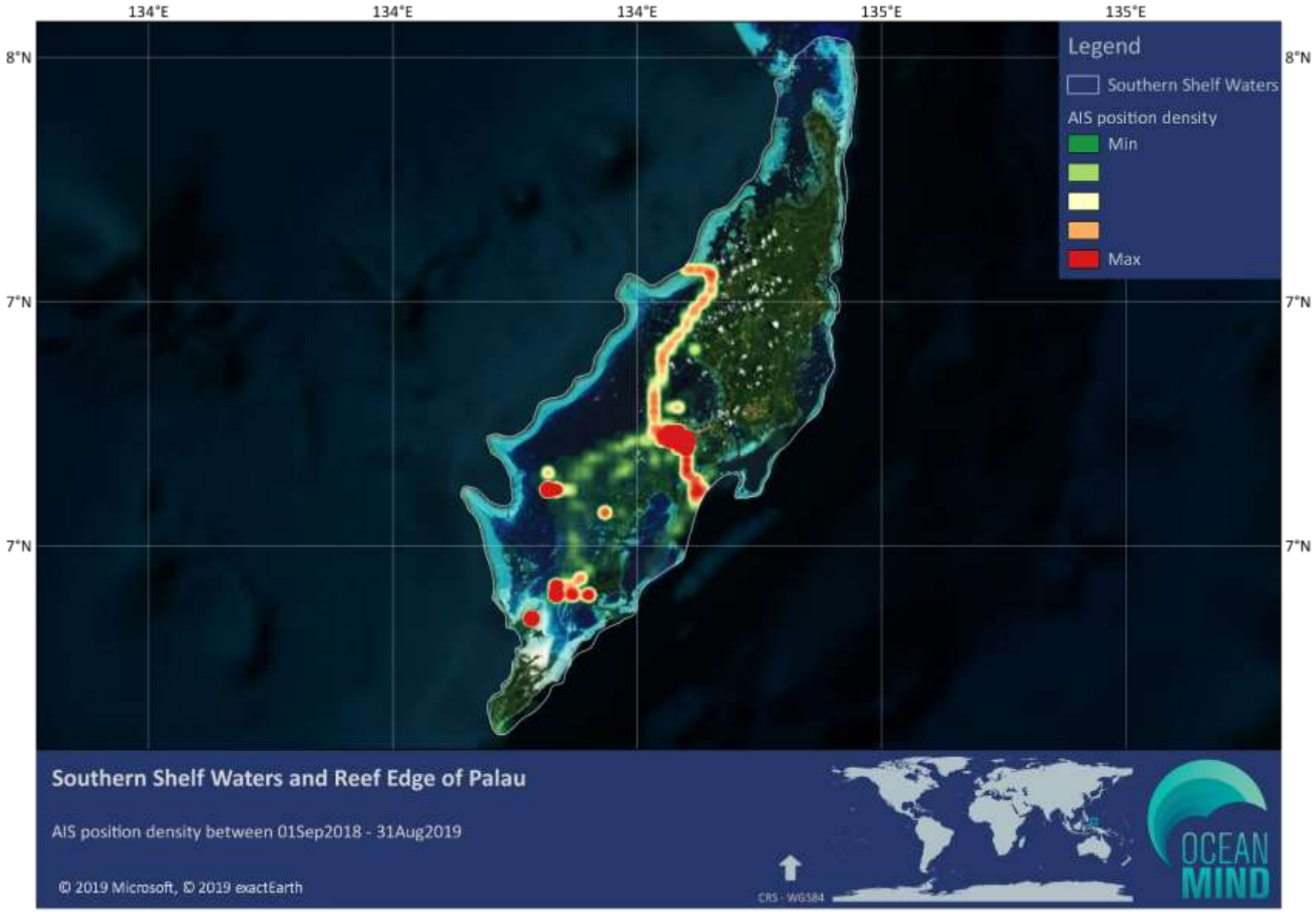


5.15 Southern Shelf Waters and Reef Edge of Palau IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	32	31	20	37	33	27	32	22	18	13	21	25	64
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	1	0	0	1	1	0	0	0	0	0	0	0	1
Cargo	7	5	4	5	5	4	9	6	4	2	3	2	14
Hazardous cargo	2	2	3	1	2	1	2	1	1	1	2	2	7
Passenger	0	0	0	0	0	1	0	0	0	0	0	0	1
Pleasure	3	4	6	13	12	8	5	4	5	1	2	3	26
Unknown	19	34	8	44	40	25	14	11	9	4	5	18	132
Other	8	3	4	8	8	8	6	5	6	3	1	3	29
Total	72	79	45	109	101	74	68	49	43	24	34	53	274

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTHERN SHELF WATERS AND REEF EDGE OF PALAU

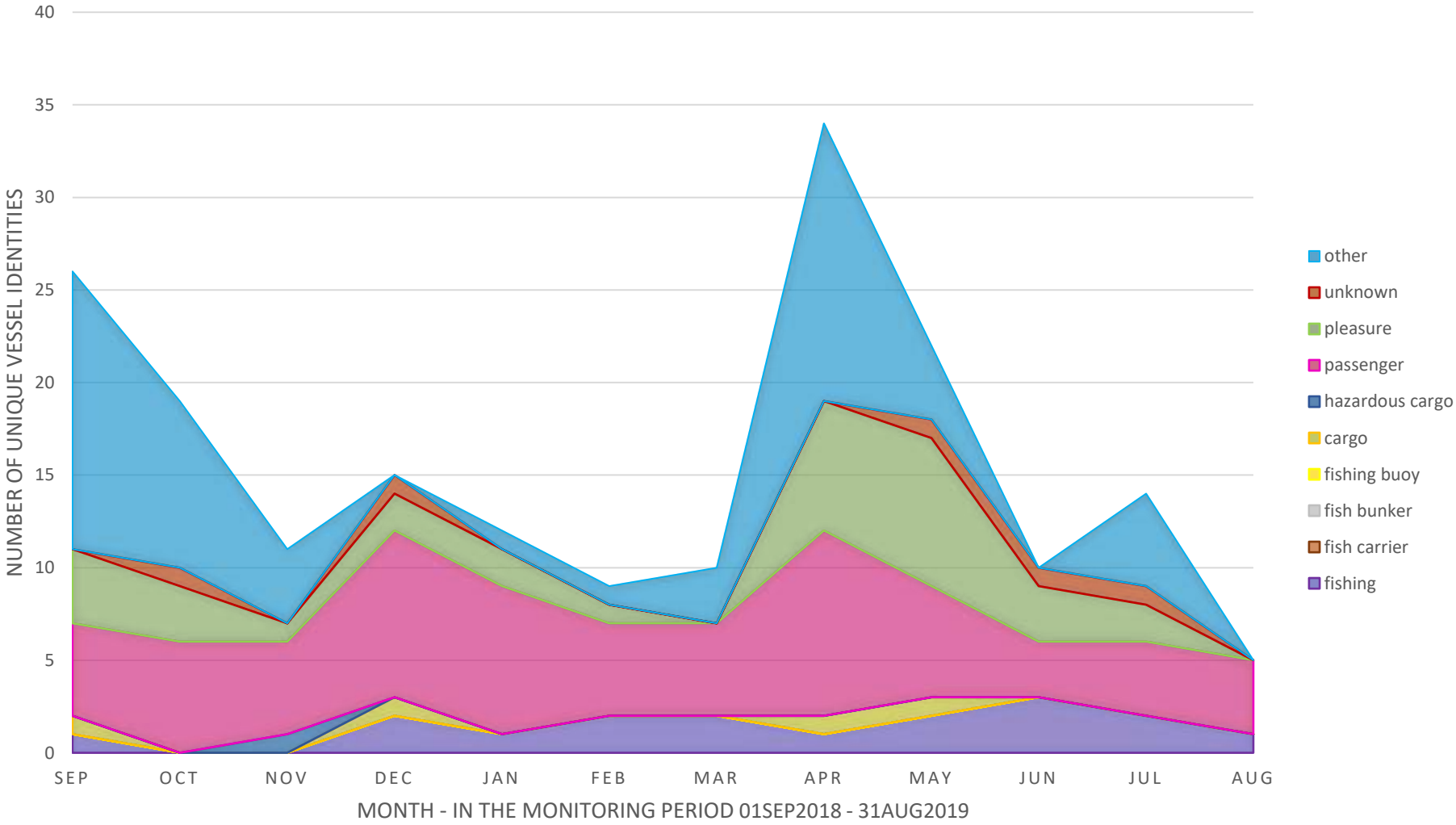


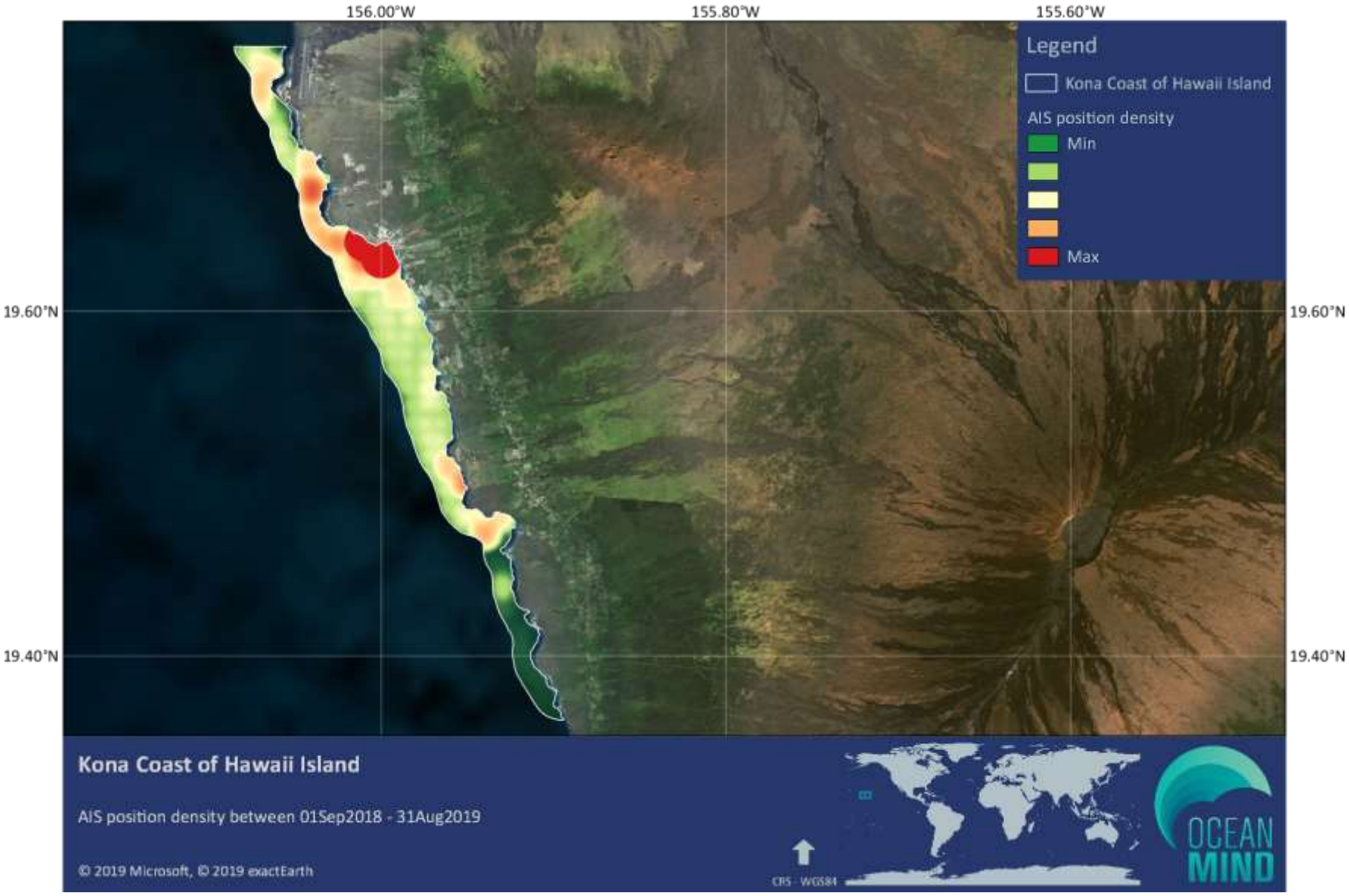


5.16 Kona Coast of Hawaii Island IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	1	0	0	2	1	2	2	1	2	3	2	1	3
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	1	0	0	1	0	0	0	1	1	0	0	0	3
Hazardous cargo	0	0	1	0	0	0	0	0	0	0	0	0	1
Passenger	5	6	5	9	8	5	5	10	6	3	4	4	18
Pleasure	4	3	1	2	2	1	0	7	8	3	2	0	21
Unknown	0	1	0	1	0	0	0	0	1	1	1	0	3
Other	15	9	4	0	1	1	3	15	4	0	5	0	38
Total	26	19	11	15	12	9	10	34	22	10	14	5	87

NUMBER OF VESSELS AGGREGATED BY CATEGORY - KONA COAST OF HAWAII ISLAND

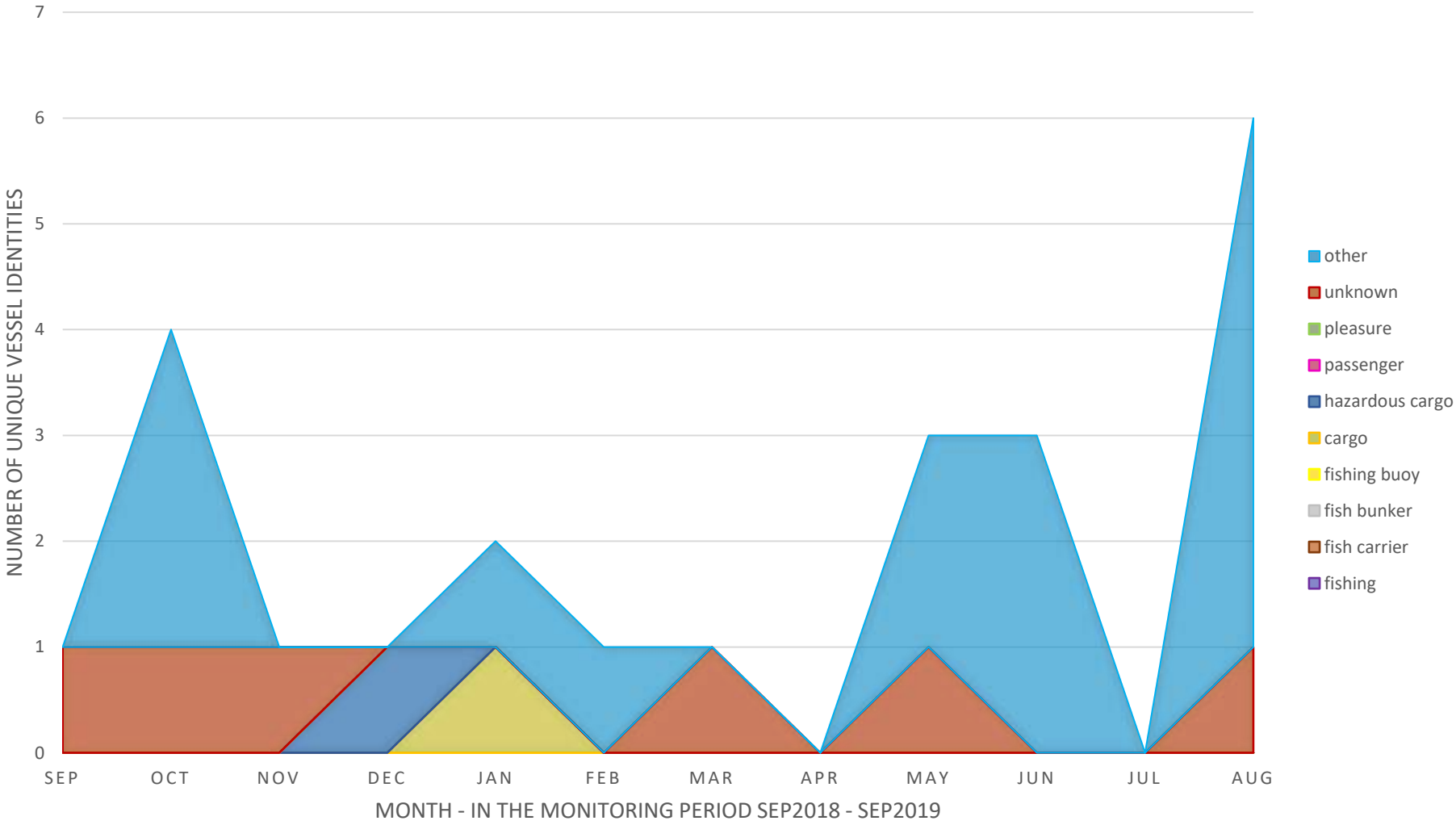




5.17 North West Hawaiian Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	1	0	0	0	0	0	0	0	1
Hazardous cargo	0	0	0	1	0	0	0	0	0	0	0	0	1
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	1	1	1	0	0	0	1	0	1	0	0	1	1
Other	0	3	0	0	1	1	0	0	2	3	0	5	9
Total	1	4	1	1	2	1	1	0	3	3	0	6	12

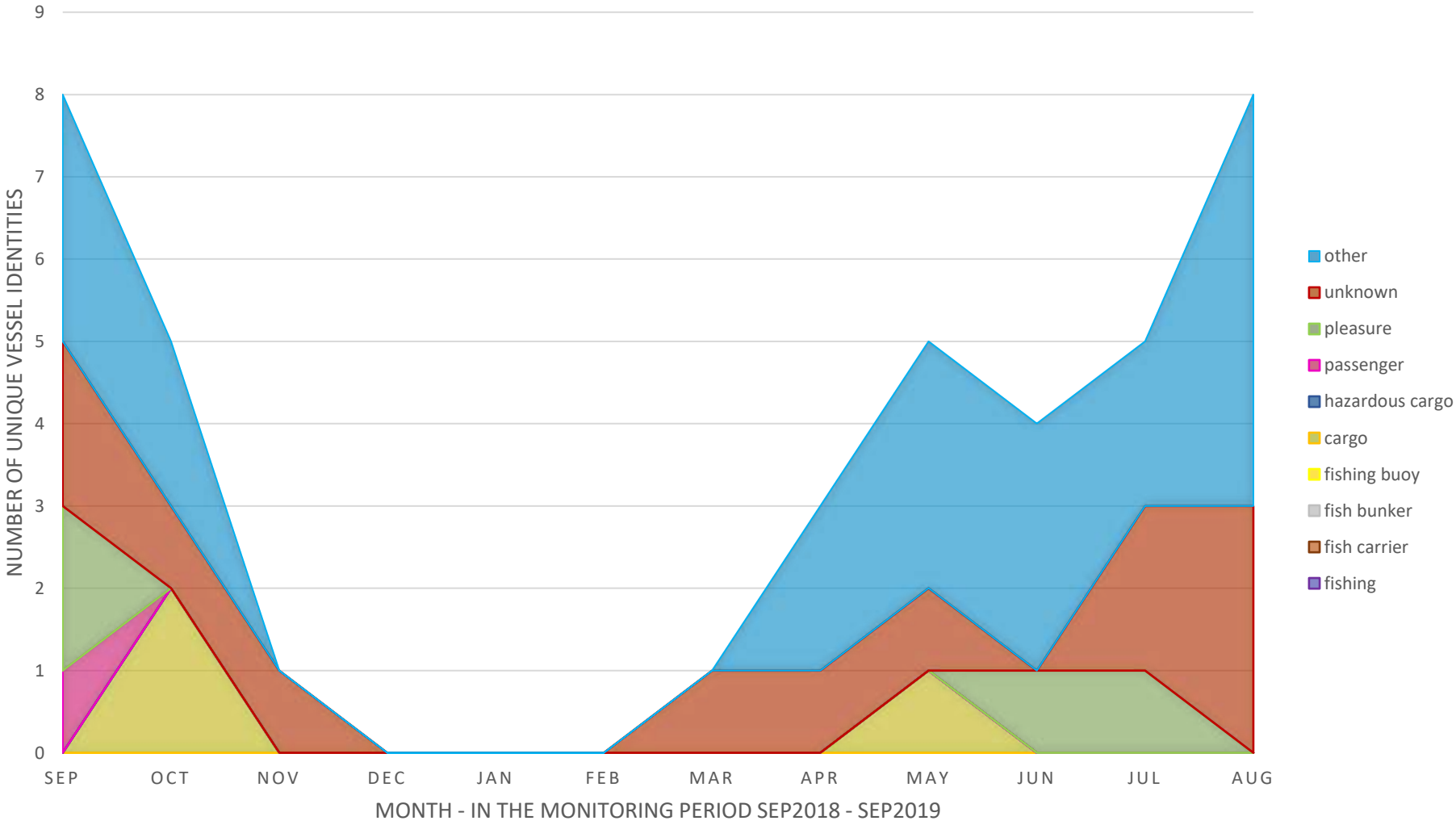
NUMBER OF VESSELS AGGREGATED BY CATEGORY - NORTH WEST HAWAIIAN ISLANDS

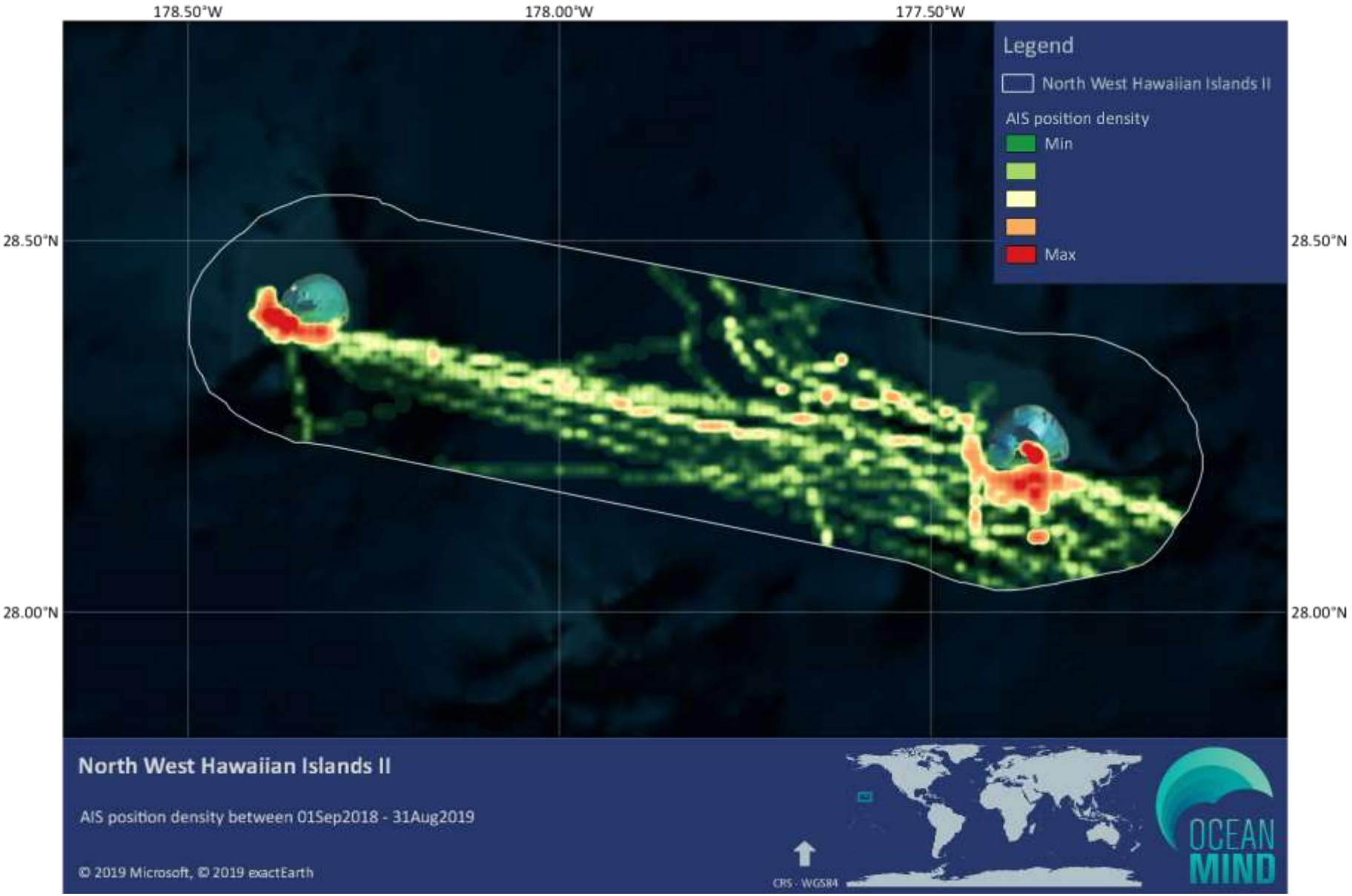


5.18 North West Hawaiian Islands IMMA II

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	2	0	0	0	0	0	0	1	0	0	0	3
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Passenger	1	0	0	0	0	0	0	0	0	0	0	0	1
Pleasure	2	0	0	0	0	0	0	0	0	1	1	0	2
Unknown	2	1	1	0	0	0	1	1	1	0	2	3	3
Other	3	2	0	0	0	0	0	2	3	3	2	5	6
Total	8	5	1	0	0	0	1	3	5	4	5	8	15

NUMBER OF VESSELS AGGREGATED BY CATEGORY -NORTH WEST HAWAIIAN ISLANDS II

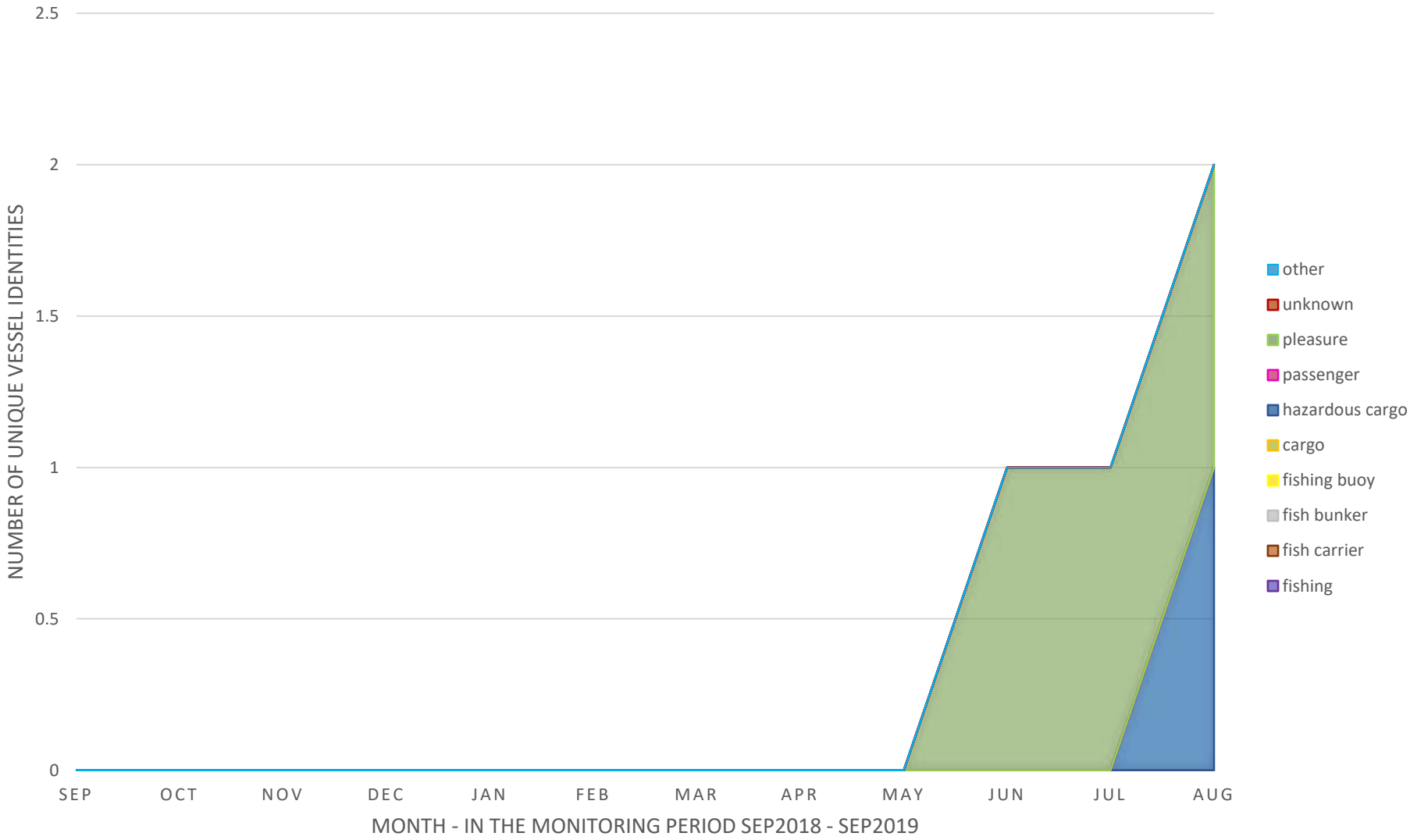


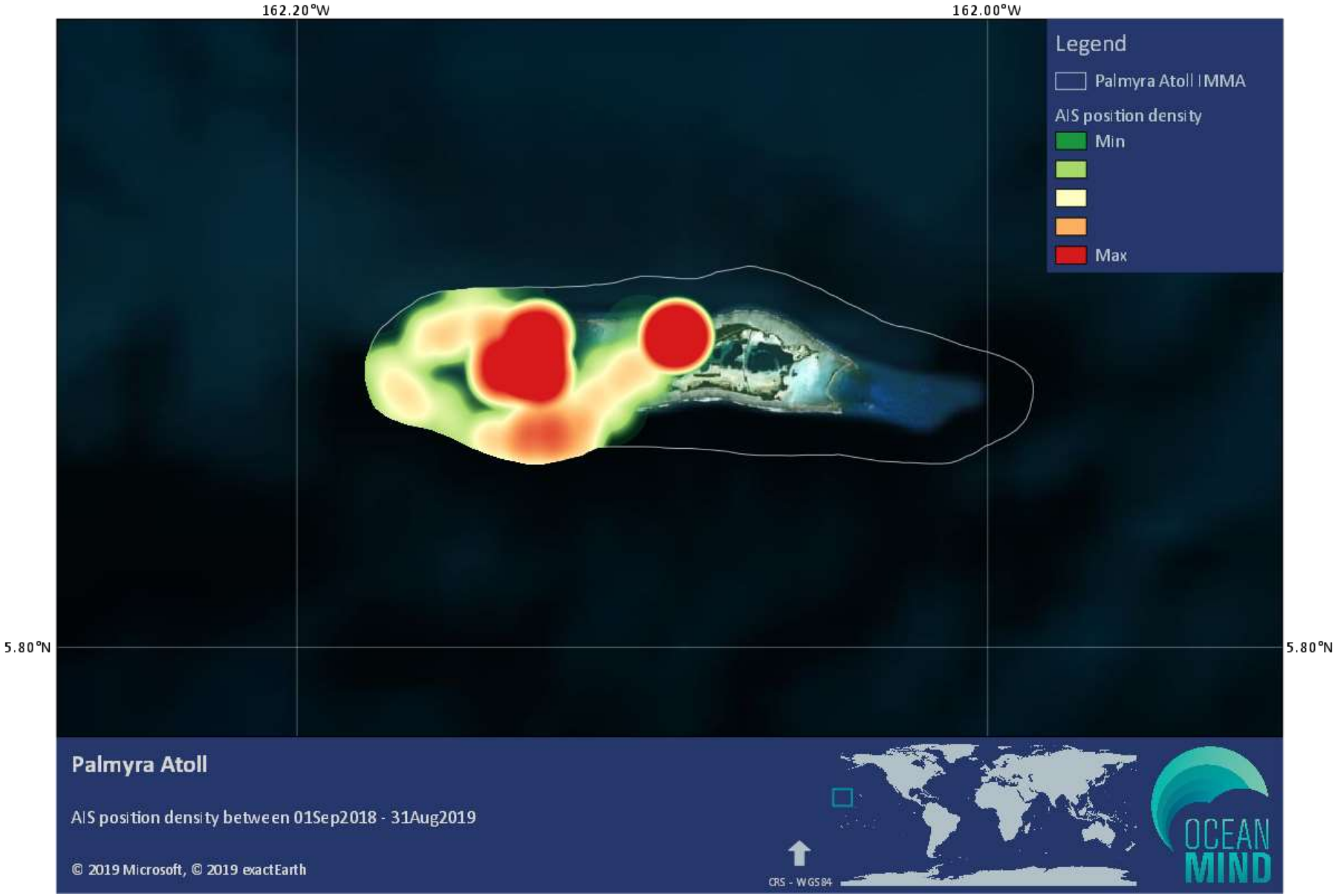


5.19 Palmyra Atoll IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous cargo	0	0	0	0	0	0	0	0	0	0	0	1	1
Passenger	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleasure	0	0	0	0	0	0	0	0	0	1	1	1	3
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	1	1	2	4

NUMBER OF VESSELS AGGREGATED BY CATEGORY - PALMYRA ATOLL



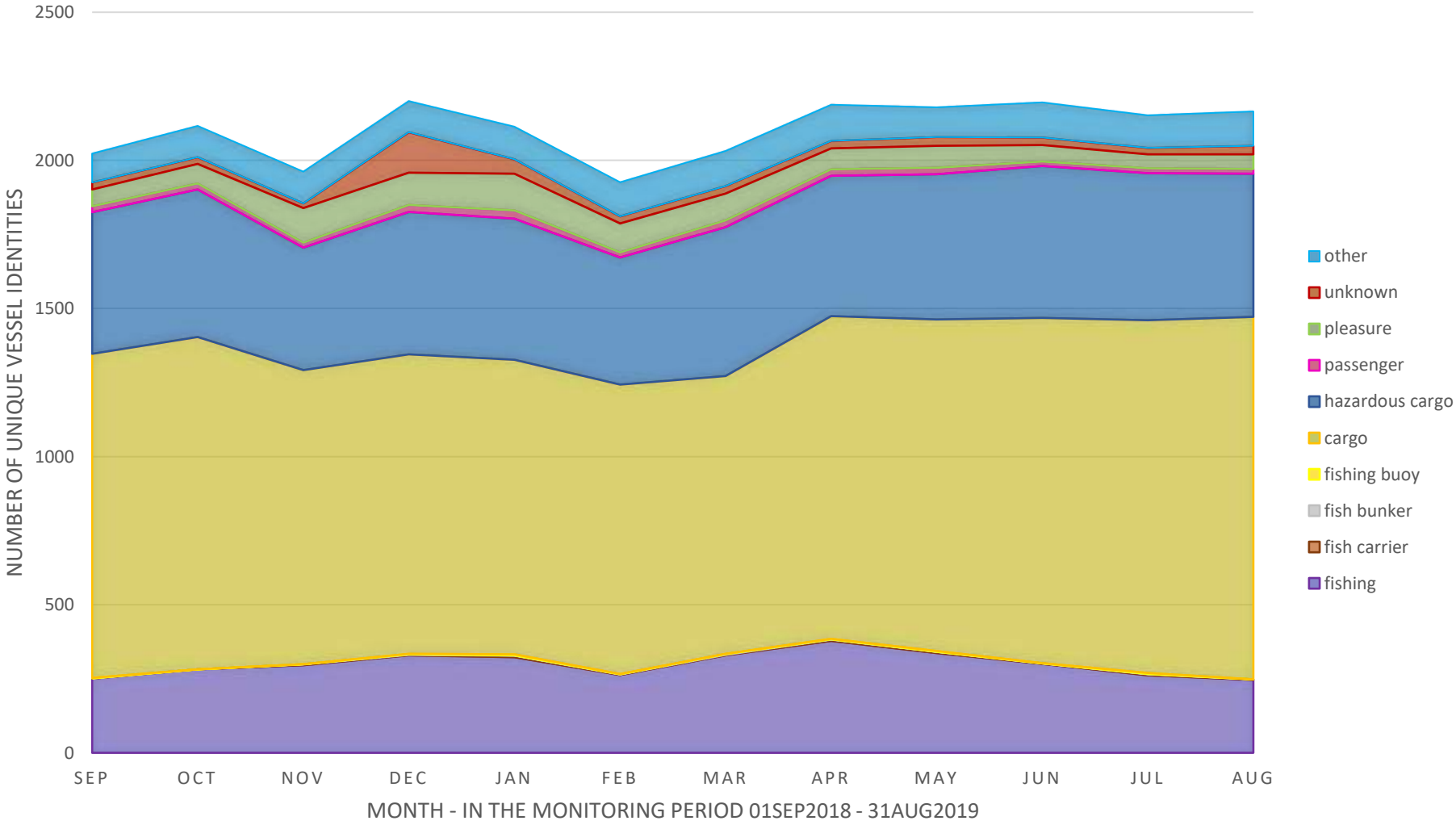


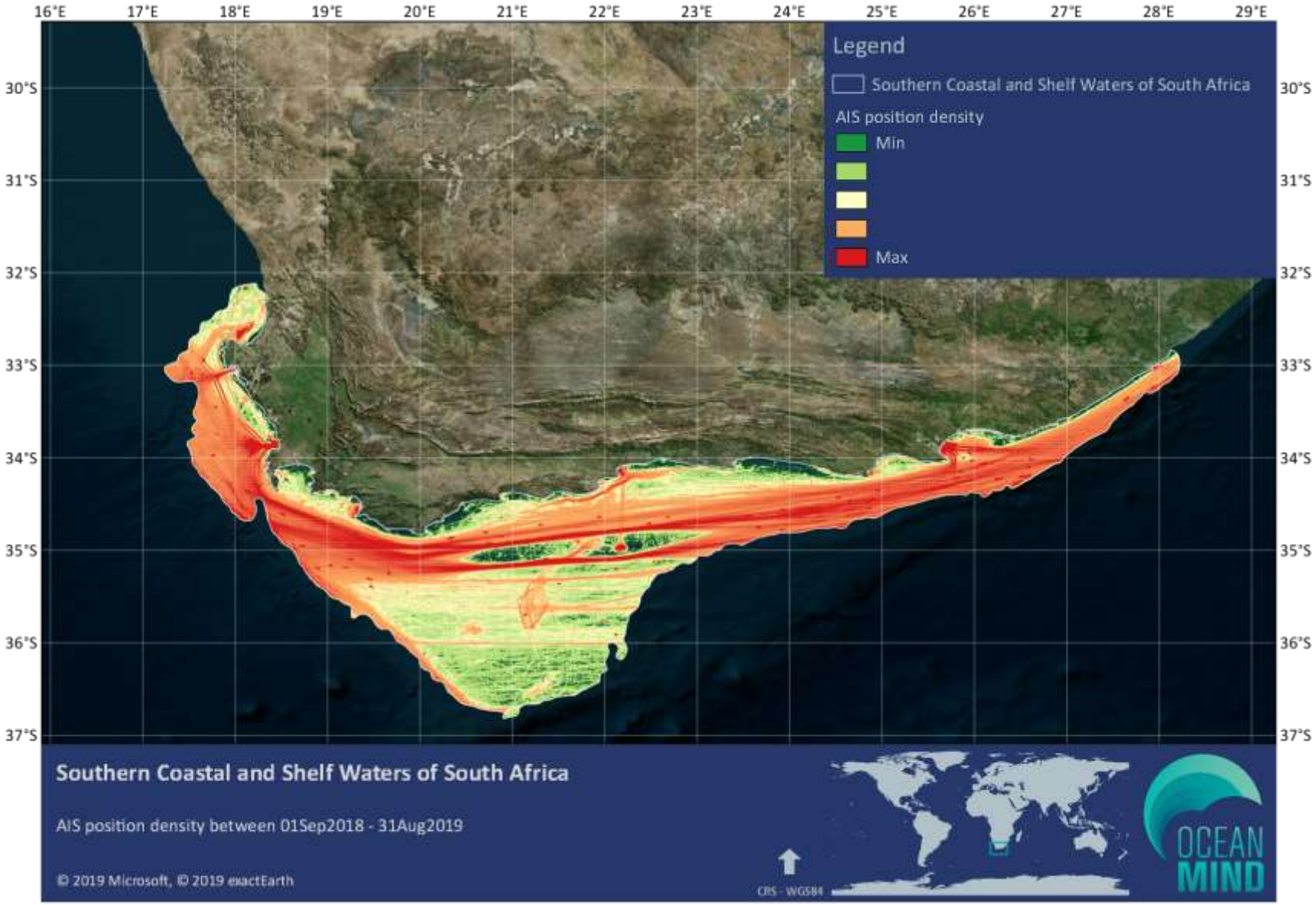
6 Atlantic

6.1 Southern Coastal and Shelf Waters of South Africa IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	250	282	296	329	323	263	329	378	337	300	262	246	839
Fish carrier	1	0	2	2	5	1	2	4	4	2	3	2	15
Fish bunker	0	0	1	1	1	1	2	1	0	0	1	0	3
Fishing buoy	2	0	0	2	3	1	1	2	3	1	4	0	13
Cargo	1094	1122	993	1011	995	977	938	1089	1119	1165	1190	1224	5353
Hazardous cargo	478	498	413	481	476	429	502	474	490	513	497	483	2257
Passenger	20	20	17	23	28	17	23	22	22	15	16	16	88
Pleasure	57	66	117	109	124	98	91	70	74	56	47	49	284
Unknown	23	23	16	137	49	24	25	26	30	25	22	29	301
Other	98	105	107	105	110	115	119	122	100	119	110	116	374
Total	2023	2116	1962	2200	2114	1926	2032	2188	2179	2196	2152	2165	9527

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTHERN COASTAL AND SHELF WATERS OF SOUTH AFRICA

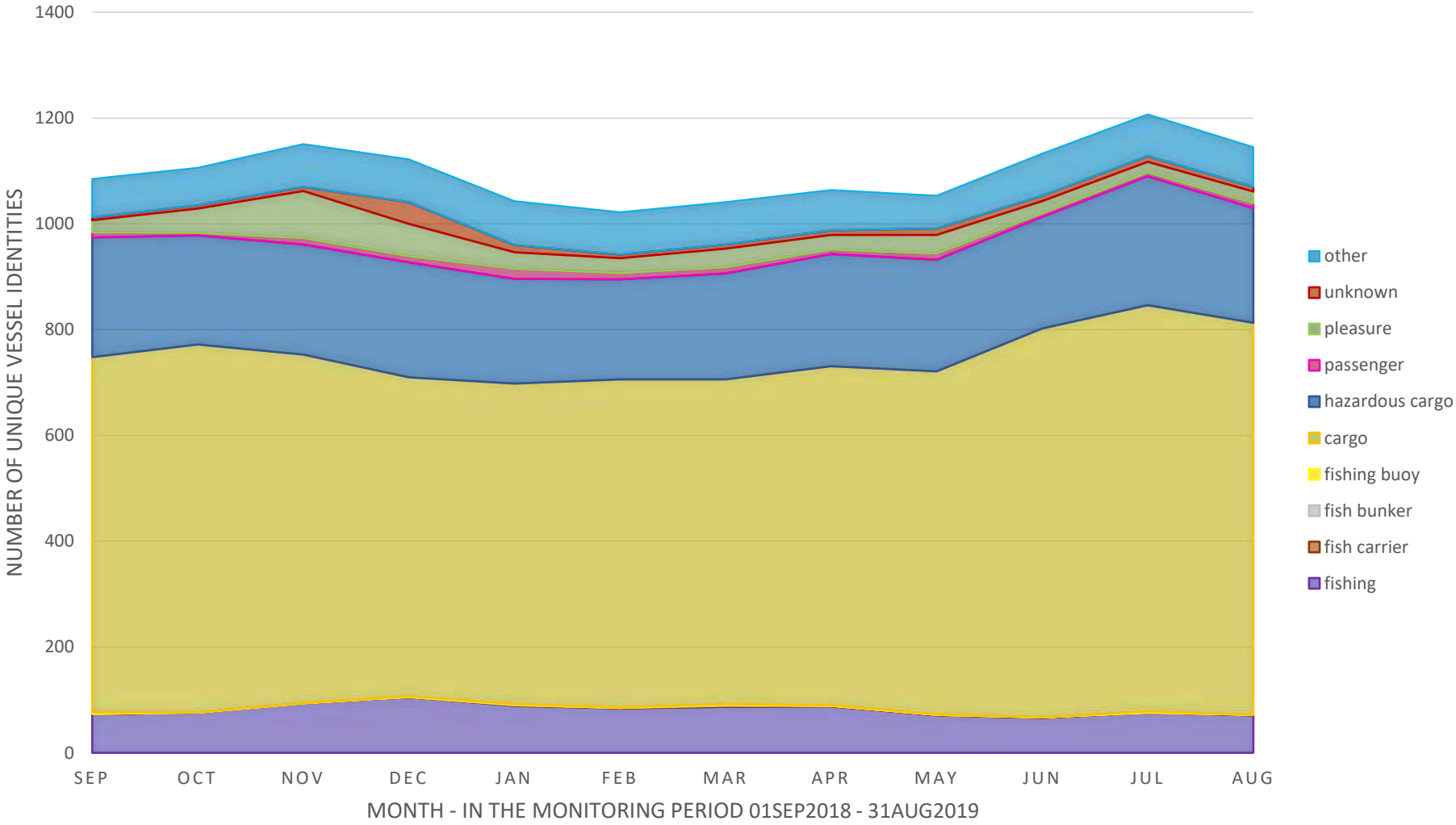


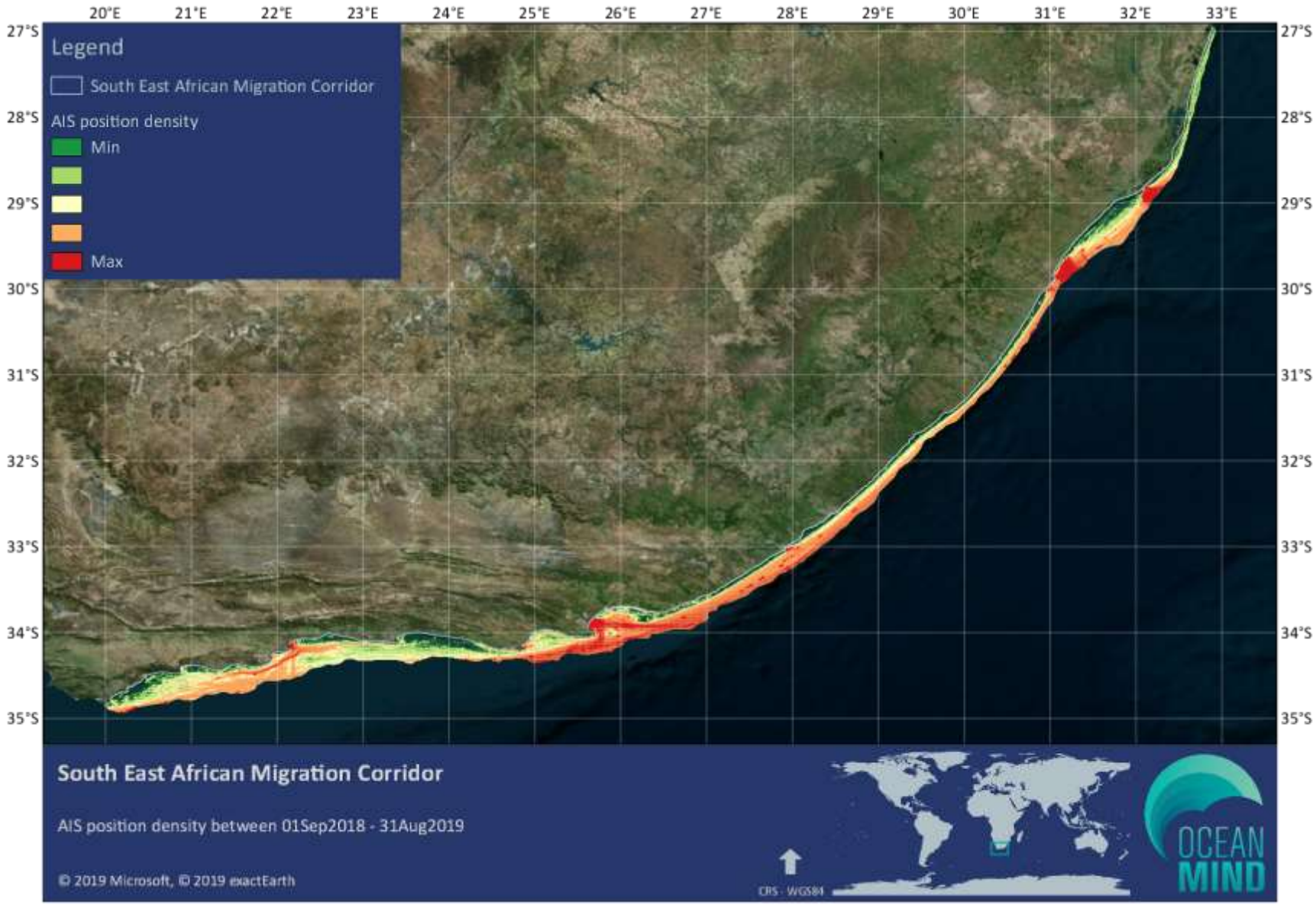


6.2 South East African Migration Corridor IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	73	76	94	105	89	84	87	88	71	66	76	71	251
Fish carrier	1	0	0	0	1	1	2	1	1	1	0	1	6
Fish bunker	0	0	0	1	1	0	2	0	0	0	0	0	2
Fishing buoy	2	0	0	1	1	1	1	1	1	0	2	0	6
Cargo	672	696	659	603	606	620	614	641	648	735	768	741	4129
Hazardous cargo	226	206	208	217	198	189	200	212	211	211	244	217	1136
Passenger	10	5	12	12	19	12	12	8	12	7	7	9	74
Pleasure	23	46	89	61	31	28	35	28	35	23	20	22	204
Unknown	5	6	8	41	14	7	8	9	12	10	11	9	90
Other	73	71	81	81	83	80	80	76	62	80	79	75	256
Total	1085	1106	1151	1122	1043	1022	1041	1064	1053	1133	1207	1145	6154

NUMBER OF VESSELS AGGREGATED BY CATEGORY - SOUTH EAST AFRICAN MIGRATION CORRIDOR

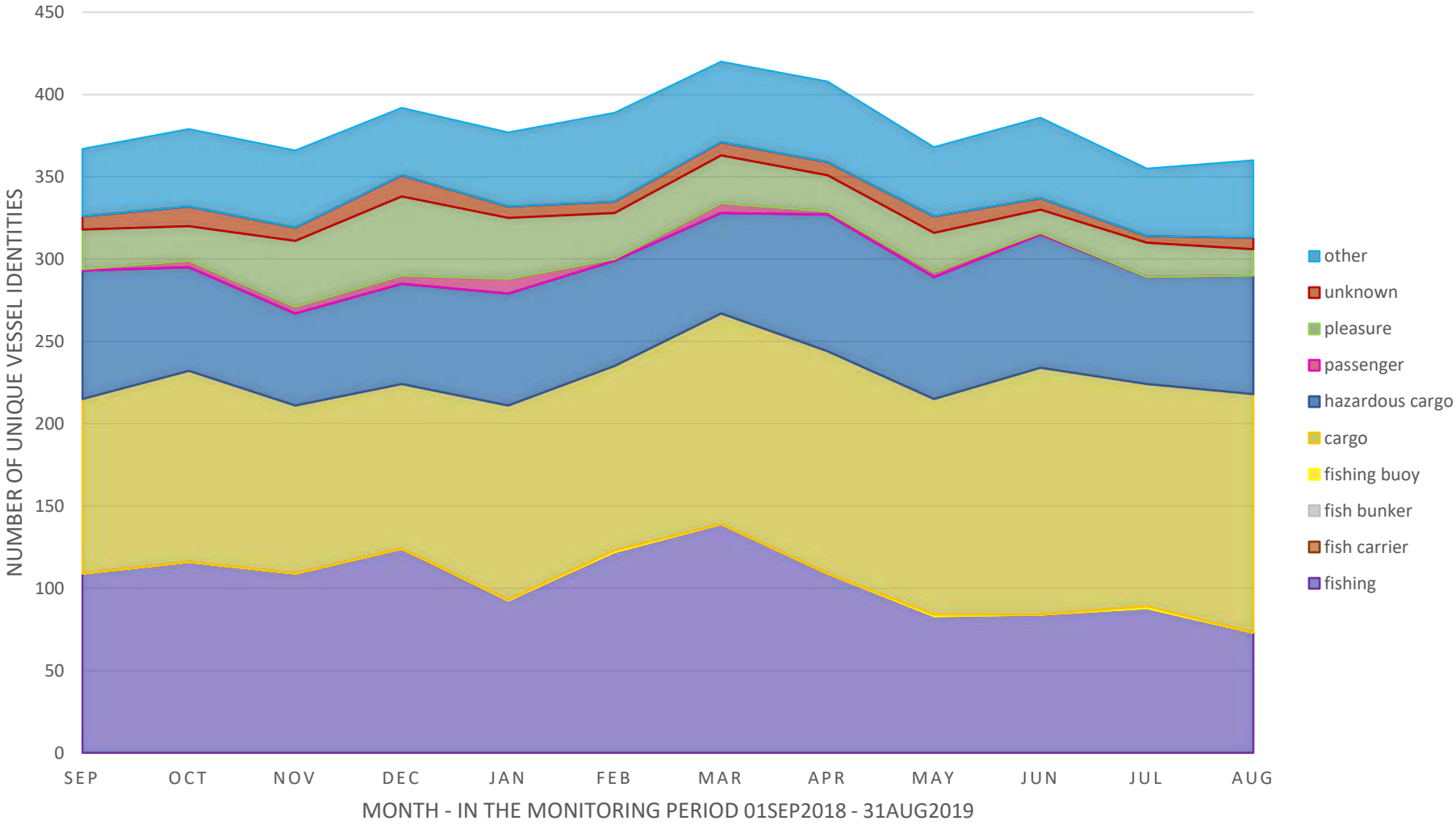


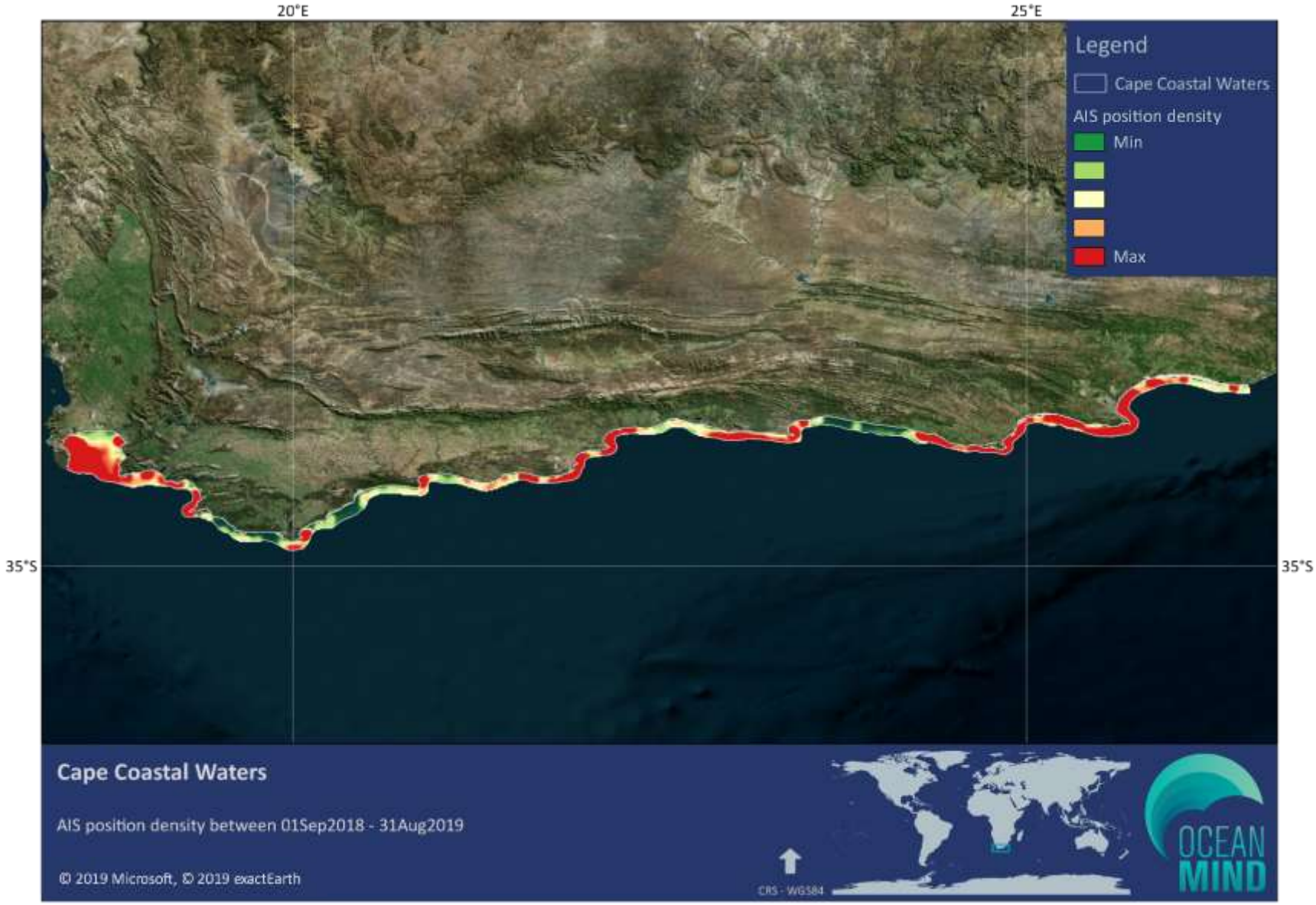


6.3 Cape Coastal Waters IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	109	116	109	124	92	122	139	109	83	84	88	73	294
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	1	0	0	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	1	0	0	1	0	1	0	2
Cargo	106	116	102	100	118	112	128	135	131	150	135	145	1093
Hazardous cargo	78	63	56	61	68	64	61	83	74	81	65	72	424
Passenger	1	4	4	5	9	1	6	2	3	1	0	0	29
Pleasure	24	21	40	48	37	28	29	22	24	14	21	16	156
Unknown	8	12	8	13	7	7	8	8	10	7	4	7	35
Other	41	47	47	41	45	54	49	49	42	49	41	47	127
Total	367	379	366	392	377	389	420	408	368	386	355	360	2161

NUMBER OF VESSELS AGGREGATED BY CATEGORY - CAPE COASTAL WATERS

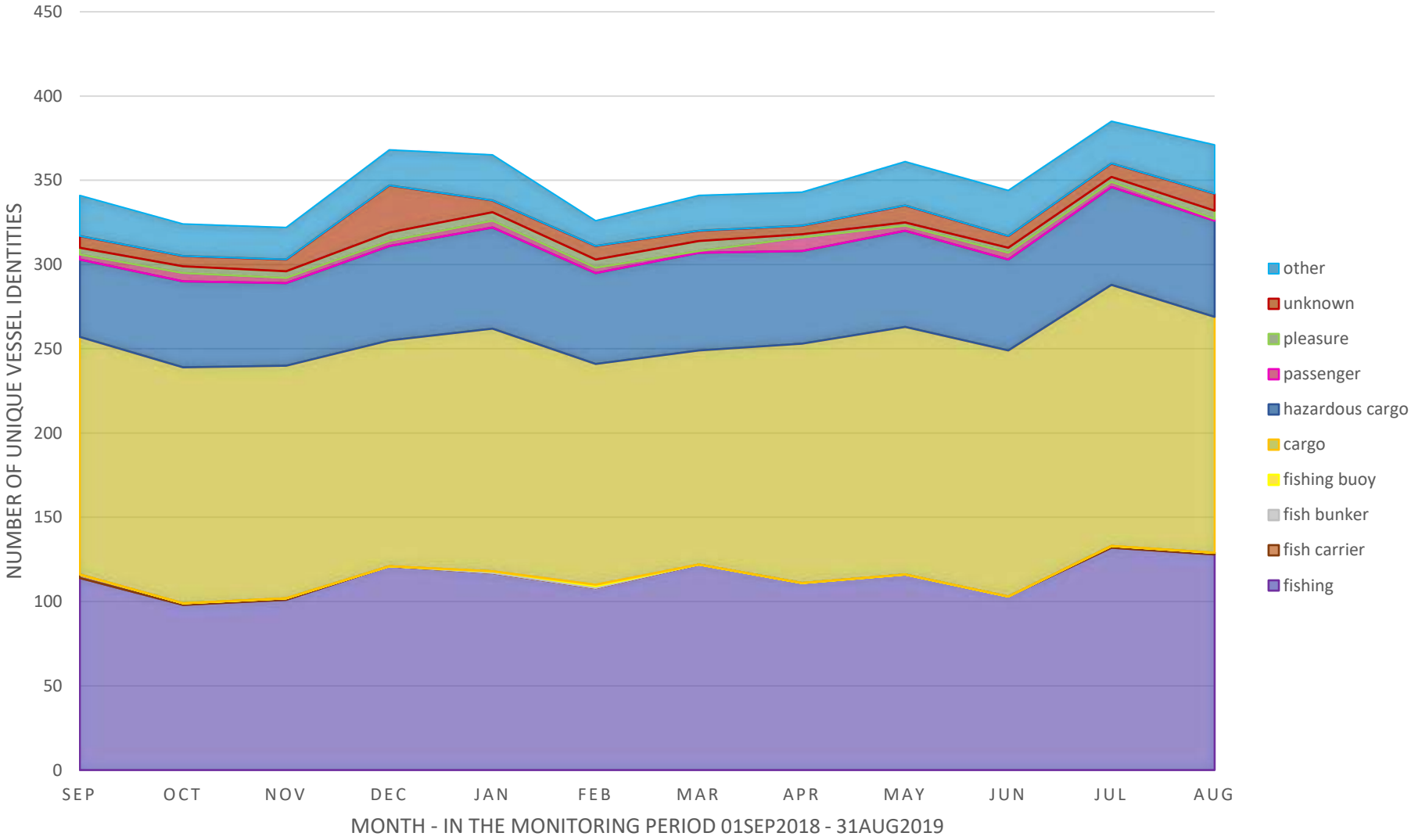


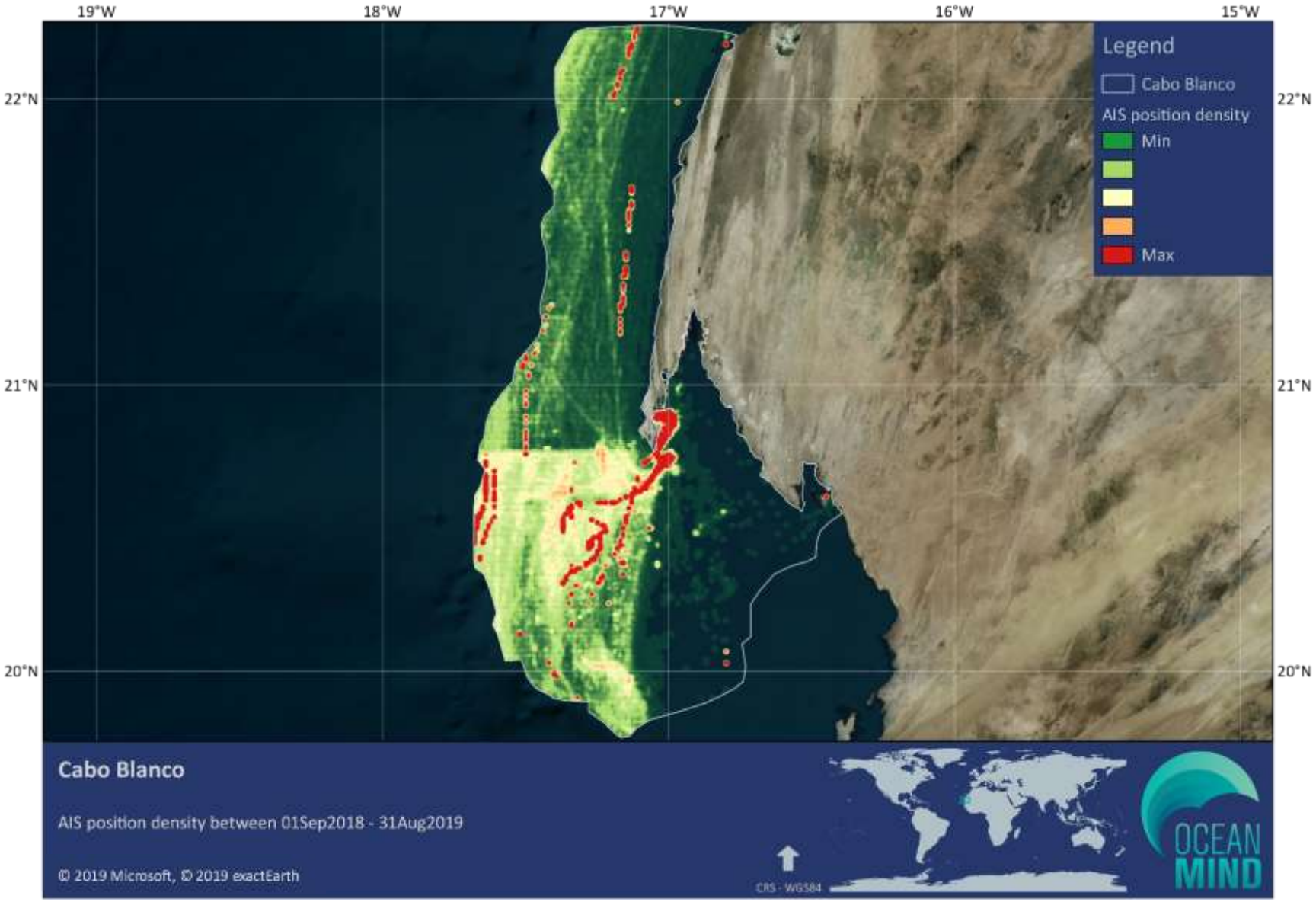


6.4 Cabo Blanco IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	114	98	101	121	117	108	122	111	116	103	132	128	298
Fish carrier	2	1	1	0	0	0	0	0	0	0	1	1	3
Fish bunker	0	0	0	0	1	1	0	0	0	0	0	0	1
Fishing buoy	0	0	0	0	0	1	0	0	0	0	0	0	1
Cargo	141	140	138	134	144	131	127	142	147	146	155	140	846
Hazardous cargo	46	51	49	56	60	54	58	55	57	54	58	57	253
Passenger	3	5	3	3	4	3	1	8	3	4	3	1	14
Pleasure	4	4	4	5	5	5	6	2	2	3	3	5	14
Unknown	7	6	7	28	7	8	6	5	10	7	8	10	43
Other	24	19	19	21	27	15	21	20	26	27	25	29	90
Total	341	324	322	368	365	326	341	343	361	344	385	371	1563

NUMBER OF VESSELS AGGREGATED BY CATEGORY - CABO BLANCO

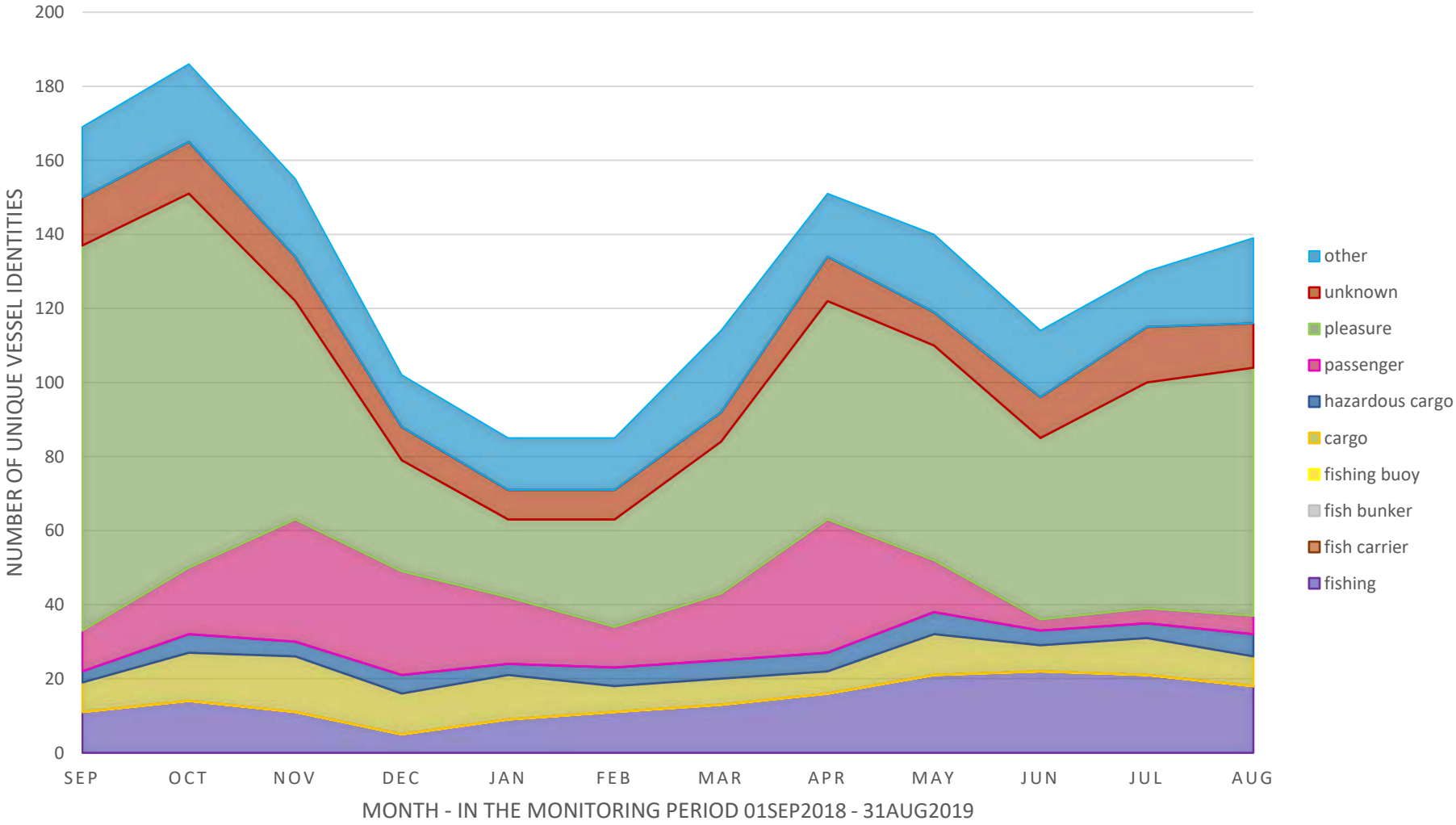




6.5 Madeira and Desertas Islands IMMA

Vessel category	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Fishing	11	14	11	5	9	11	13	16	21	22	21	18	30
Fish carrier	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish bunker	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishing buoy	0	0	0	0	0	0	0	0	0	0	0	0	0
Cargo	8	13	15	11	12	7	7	6	11	7	10	8	44
Hazardous cargo	3	5	4	5	3	5	5	5	6	4	4	6	21
Passenger	11	18	33	28	18	11	18	36	14	3	4	5	95
Pleasure	104	101	59	30	21	29	41	59	58	49	61	67	492
Unknown	13	14	12	9	8	8	8	12	9	11	15	12	36
Other	19	21	21	14	14	14	22	17	21	18	15	23	68
Total	169	186	155	102	85	85	114	151	140	114	130	139	786

NUMBER OF VESSELS AGGREGATED BY CATEGORY - MADEIRA AND DESERTAS ISLANDS



PART II: Case Studies

Introduction

Following the ranking exercise to determine the top ten IMMAs where densities of vessel traffic as indicated by AIS are likely to lead to a risk of ship strikes and/or bycatch, we applied a number of criteria select two of these IMMAs to become the focus of more in depth analysis of the vessel traffic and its potential interaction with marine mammals. The multiple criteria applied for selection of these two IMMAs can be found in Appendix I, and included factors such as the presence of species likely to be affected by ship strikes, the existence of enabling conditions to be able to act on any recommendations for conservation action. Another important factor that was considered was the ability of this exercise to highlight new areas and information that may not yet have flagged concern.

Statistics on global shipping demonstrate that that the highest proportion of seaborne cargo travels through Asia (Figure 3). However, reviews of the data available on OBIS Seamap (Kot et al., 2010) as well as global reviews of cetacean survey data, demonstrate that data is skewed toward North America and Europe, with notable gaps in the Indian Ocean and Southeast Asia (Kaschner et al., 2012). Many of the IMMAs featuring in the top 10 list for potential risk of ship strikes are already the focus of ongoing studies that recommend actions to reduce this risk. For example, studies are ongoing to highlight the risk of ship strikes to sperm whales in the Hellenic Trench (Frantzis et al., 2019), and for fin whales throughout the Mediterranean (De Stephanis and Urquiola, 2006; Panigada et al., 2006; Jacob and Ody, 2016). Studies also highlight the risks that shipping poses to blue whales in Sri Lanka (Priyadarshana et al., 2016), and research is ongoing to assess the potential impact of vessel traffic to Endangered Arabian Sea humpback whales throughout their range (Willson et al., 2016).

This project chose to focus on IMMAs in the Indian Ocean and Southeast Asian regions, where high densities of AIS transmissions indicate heavy vessel traffic but where studies focusing on the potential interaction between cetaceans and vessels had not yet been conducted. Although data on cetacean abundance and distribution is limited in these areas when compared to North America or Europe, threats are known to be present both in the form of shipping (as demonstrated by the present study) and fisheries bycatch (Perrin et al., 2005; Temple et al., 2018; Temple et al., 2019; Anderson et al., 2020). Quantifying these threats has proven extremely difficult in regions where dedicated cetacean surveys or monitoring efforts are limited (Lewison et al., 2014).

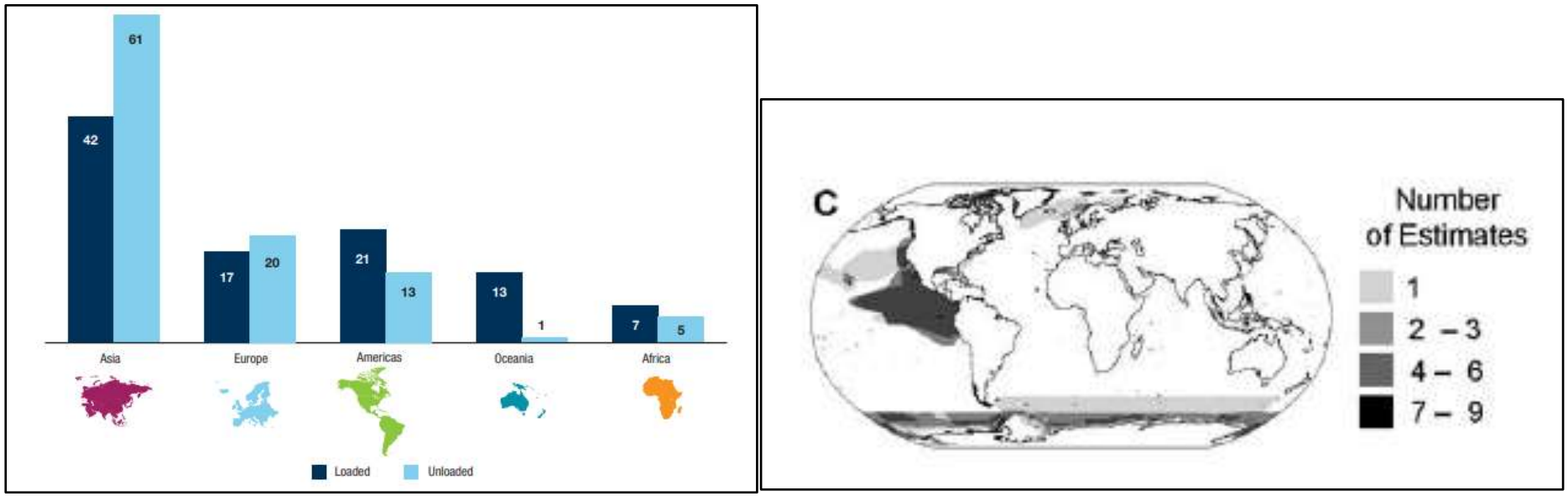


Figure 3 | A) World Seaborne trade by region, 2017 (percentage share in world tonnage). Taken from UNCTAD, 2018. Review of Maritime Transport 2018, Report by the Secretariat of the United Nations Conference on Trade and Development, United Nations, Geneva, p. 116. C) Map depicting survey coverage that would allow assessment of large scale population trends for sperm whales, as an example of the paucity of cetacean population data available from regions such as the Indian Ocean and Southeast Asia – taken from Kaschner, K., N. J. Quick, R. Jewell, R. Williams, and C. M. Harris. 2012. Global Coverage of Cetacean Line-Transect Surveys: Status Quo, Data Gaps and Future Challenges. PLoS ONE 7(9):e44075. doi: 10.1371/journal.pone.0044075

Mascarene Islands and Associated Oceanic Features IMMA - Case study

Overview

In this case study, we provide a further examination of data arising from the broadscale analysis of shipping traffic and likely fishing activity in Important Marine Mammal Areas (IMMAs), which are defined as habitats, with the potential to be delineated and managed for conservation (Notarbartolo di Sciara et al., 2016) (see https://www.marinemammalhabitat.org/immas/ for more detail). This case study aims to increase the understanding of the likelihood of spatial interactions between marine mammals and all types of vessels that could pose a potential threat to these species and their habitats. While the conclusions of this case study are limited in scope and scale, this exercise highlights the first steps in assessing the types of information needed to manage potential risks. We highlight the important role that nations with territorial waters can play for marine management, and we emphasize the need for further research and collaboration between researchers, managers and local stakeholders to develop strategies and to implement precautionary measures to mitigate potential risks.

Introduction

Initial analyses of information assessed at a global level highlighted the Mascarene Islands and Associated Oceanic Features IMMA (hereafter to be referred to as "Mascarene Islands IMMA") as one of ten IMMAs where a high density of fishing and marine transport activities pose a potential concern to the species of marine mammals for which the IMMA was identified. The Mascarene Islands IMMA is located 700 - 800 km east of Madagascar in the Indian Ocean, and includes Réunion Island, Mauritius Island and the St. Brandon shoal to the north-east of Mauritius. Réunion forms the southern tip of the Mascarene Plateau, a resource-rich undersea shelf which extends north to the Seychelles (Payet, 2005). Shipping lanes through the Mascarene Islands connect South Africa to Southeast Asian ports, creating a potential risk of 'ship-strikes' between marine mammals and vessels. The likelihood of interactions occurring increases with vessel size, speed and the size of the marine mammal species (Laist et al., 2001; Redfern et al., 2020). Fishing vessels operating in the area may also pose a further concern to marine mammals that can additionally become accidentally entangled, resulting from the deployment of differing varieties of fishing gear. This potential concern of 'bycatch' interactions is increased by the use of less selective fishing gear types (Read, 2008; Northridge et al., 2017), intensity of fishing effort and the presence of smaller marine mammal species, such as dolphins and porpoises, that are known to be susceptible to high levels of bycatch (IWC, 1994).

The cetacean species that are assessed as the most likely to be affected by ship-strikes in the Mascarene Islands include humpback whales (*Megaptera novaeangliae*) that come to the area seasonally to mate, calve, and nurse their young (Dulau-Drouot et al., 2012), as well as sperm whales (*Physeter macrocephalus*), that appear to be resident off the coast of Mauritius (Huijser et al., 2020). At least three species of dolphins are known to be resident year-round in the IMMA (Webster et al., 2014, 2015; Dulau et al., 2017a; Estrade and Dulau, In Press), while other small cetacean species are also known to be present within the IMMA at various times. Bycatch is further known to be a major cause of mortality for small cetaceans throughout the Southwest Indian Ocean (Temple et al., 2019; Anderson et al., 2020).

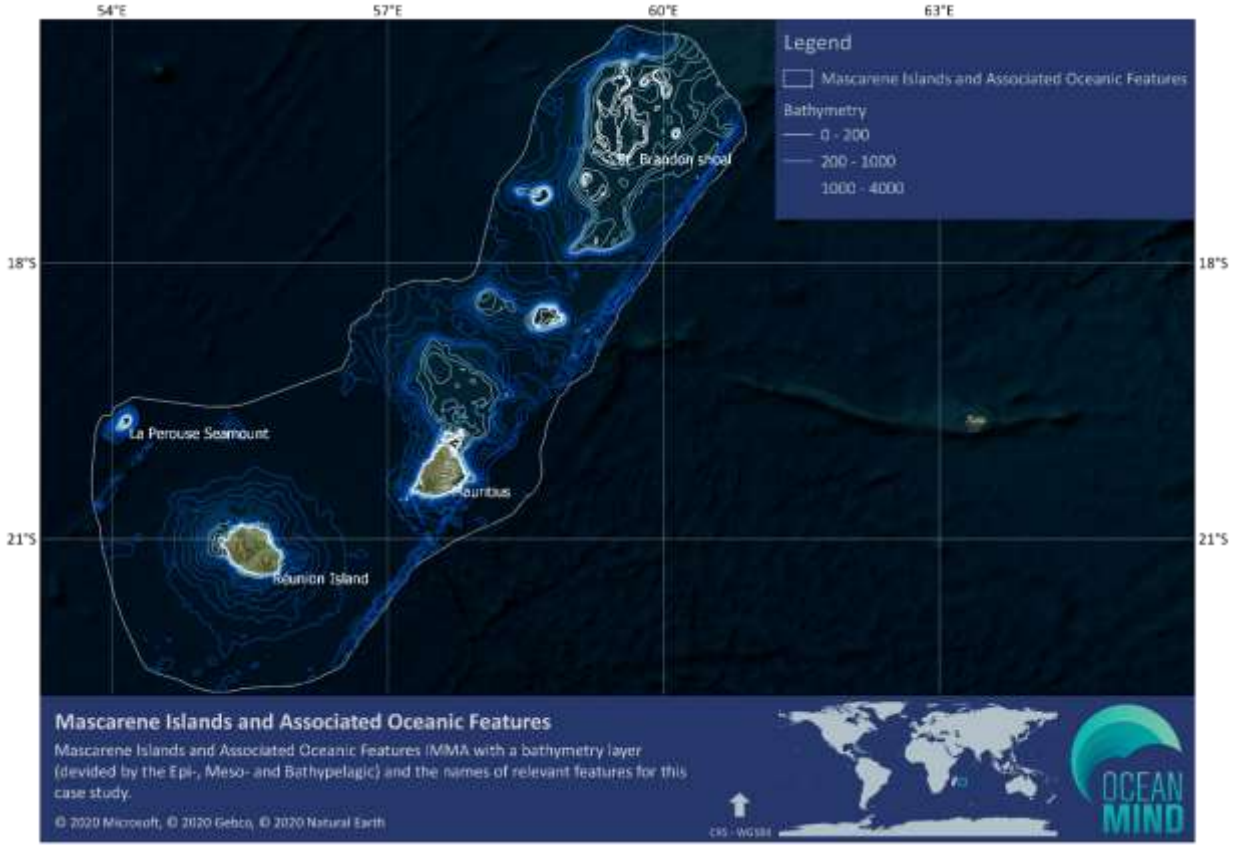


Figure 4 | The Mascarene Island and Associated Oceanic Features IMMA with a bathymetry layer highlighting important features of this case study.

Methodology

In order to conduct a finer scale analysis of the potential concerns to marine mammals posed by the co-occurrence of shipping activity and species in the Mascarene Islands IMMA, this case study examined the geospatial distribution of marine mammals sightings in relation to AIS signals transmitted over the course of one year. Marine mammal observation data from the Mascarene Islands IMMA was provided by two sources:

- REMMOA, a programme led by Observatoire Pelagis/AFB that conducted aerial surveys of the area in 2010 as part of a French territory-wide census of marine mammals and other pelagic megafauna (Laran et al., 2017); and
- GLOBICE-Reunion- whose sightings were obtained through vessel-based surveys in and around Reunion and Mauritius in 2018-19, as well as through satellite tracking of humpback whales in 2013. (Dulau et al., 2017a; Dulau et al., 2017b, and Globice unpub. Data).

OceanMind collected Automatic Identification System (AIS) data for the period 01Sep2018 through 31Aug2019 (Figure 4). AIS is a maritime collision avoidance system transmitted on marine VHF radio and provides vessels receiving it with information on position, speed, course and identity data as inputted by the transmitting vessel. While mandatory on all passenger vessels and merchant vessels over 300 gross tonnes, some flag states give their fishing vessels exemptions and so it does not provide all possible vessel information.

We overlaid the provided marine mammal observation data with available marine traffic transmissions from between 01Sep2018 – 31Aug2019, the latest available data at the commencement of the project. Vessel traffic was examined in relation to the category of vessels transmitting signals, as well as their average speed. Co-occurrence of marine mammals with all probable vessel traffic was then examined in two different ways to gain an understanding of possible concern to marine mammals with regards to ship-strike interactions: 1) Cetacean sightings data were plotted over AIS transmission data to get a visual impression of areas of co-occurrence and potential 'hot spots' for ship-strike interactions; 2) the IMMA was divided into grid cells of 0.2 x 0.2 decimal degrees, and a co-occurrence value was calculated for each cell by multiplying a marine mammal score (pod size for bycatch risk and occurrence for ship-strike risk) with vessel activity and normalizing that result. Co-occurrence of marine mammals with fishing vessels with transmission patterns likely to be indicative of active fishing was examined in the same manner in order to build further spatial understanding of the possible risks of bycatch interactions that may also occur. Vessels, classified in the AIS system as fishing vessels, were considered likely to have been actively fishing and deploying gear where transmissions showed speeds of between 0.5 and 4.5 nm per hour (Natale et al., 2015; de Souza et al., 2016; Vespe et al., 2016), which is associated with fishing activity (e.g. slow speeds while deploying or hauling differing gear types).

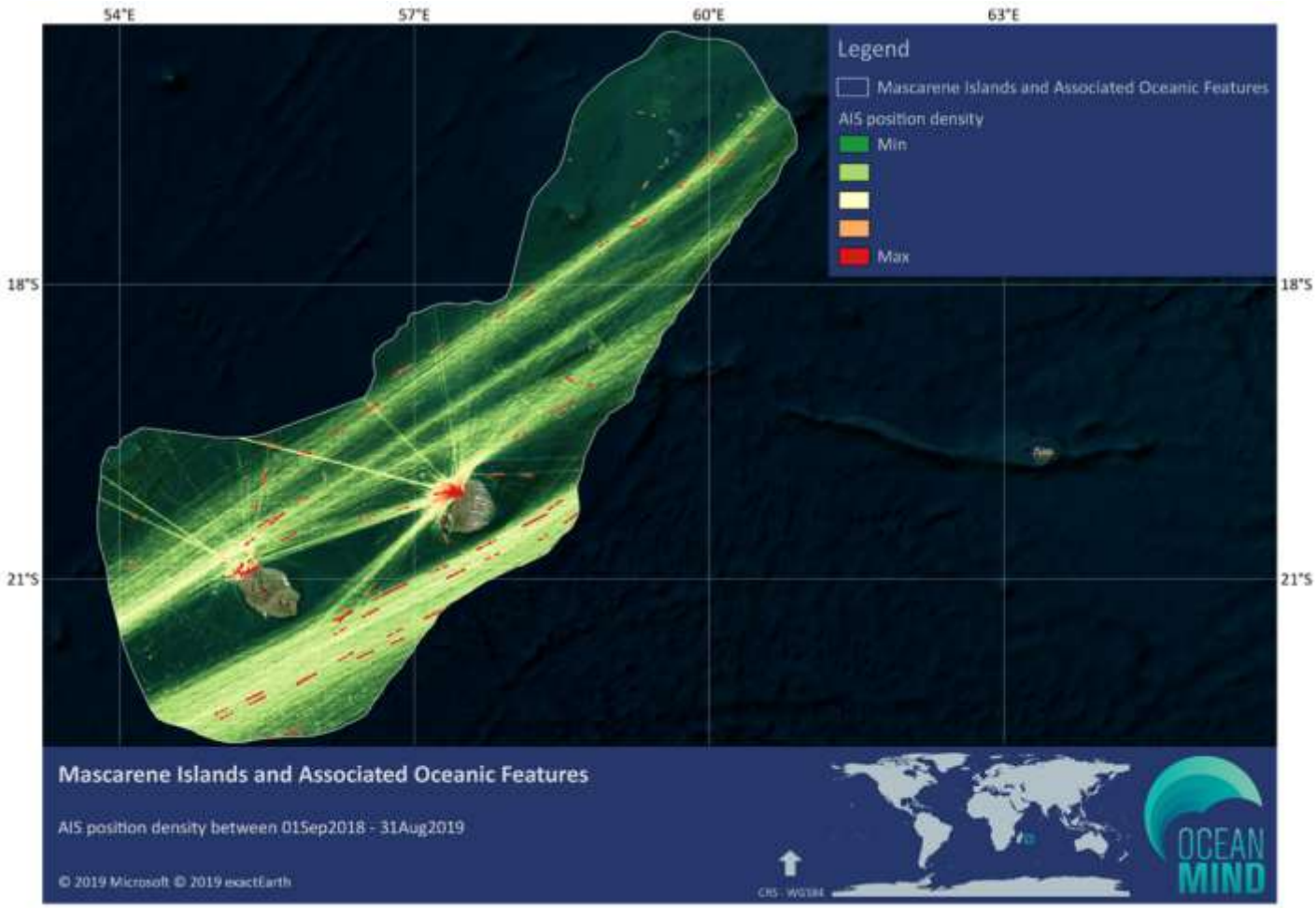


Figure 5 | Vessel traffic in the Mascarene Islands and Associated Oceanic Features IMMA

Results

The Mascarene Islands IMMA exhibits high AIS transmission density in relation to other IMMAs. Between 01Sep2018 and 31Aug2019, 7,248 vessels transmitted positions within the boundaries of the IMMA. Of these, 80% transmitted as cargo or hazardous cargo, and 8.7% transmitted with fishing-associated identities (Table 2). The activity of fishing vessels was the highest between January and February 2019 and the lowest between April and July 2019.

Table 2 | Average speeds and length by vessel categories inside the Mascarene Islands IMMA

Vessel category	No. of vessels	Proportion [%]	Average speed [kts]	Length [m]	Width [m]
Fishing	596	8.22	5.0	-	-
Fish carrier	20	0.28	8.15	113	32
Fish bunker	4	0.06	7.7	147	42
Fishing buoy	10	0.14	10.33	-	-
Cargo	4378	60.40	11.5	227	59
Hazardous cargo	1454	20.06	12.4	246	69
Passenger	79	1.09	11.6	-	-
Pleasure	152	2.10	4.8	-	-
Unknown	314	4.33	5.9	147	44
Other	241	3.33	7.7	123	65
Total	7248	100	NA	NA	NA

Data related to the fishing gear used by transmitting vessels was available for 81% of the fishing vessels transiting in the area. Figure 5 depicts the breakdown of types of gear reported. No vessels were reported to be using drift nets, which are known to be the fishing gear that causes the highest bycatch risks to marine mammals in the northern Indian Ocean and around the world (Read et al., 2006; Anderson et al., 2020). This type of fishery is banned in the EEZ of France/Reunion (>2.5km) and Mauritius. Nonetheless, other non-selective gears, such as trawls and purse seines are known to present a bycatch risk to small cetacean species (e.g. Wade, 1996; Romanov, 2002; Gerrodette and Forcada, 2005; Allen et al., 2014). Longlines present a medium to low risk of bycatch to most cetaceans although conflict with fisheries occurs when small to medium-sized cetaceans engage in depredation, i.e. stealing bait from lines (e.g. Passadore et al., 2015; Werner et al., 2015; Richard et al., 2019). Furthermore, some instances of humpback whale entanglement in longlines have been reported in Reunion (Globice, unpublished data), and they also presents a high bycatch risk for other taxa such as sea turtles and seabirds (Lewison and Crowder, 2007; Wallace et al., 2013). Handlines and pole & line fishing are thought to cause little or no risk of bycatch or depredation (e.g. Anderson, 2014) and were classified as low concern of bycatch risk, though certain pole and line fisheries may further cause concerns to marine mammals through the use of anti-predation acoustic deterrents and explosive devices (Reeves et al., 2001; Hall and Román-Verdesoto, 2013). Preliminary disaggregation of fishing vessel gear types (Figure 6) indicate that an estimated 4% of fishing gears detected in the area are likely to pose a high likelihood of bycatch interactions (Purse seine and trawl), whilst 73% were evaluated to pose a low to medium potential risk of bycatch interactions (longlines) with small cetaceans.
However, 19% of fishing vessels in the dataset did not define their gear type, thereby representing an unknown level of spatial bycatch interaction.

Bycatch Concern	Gear Type
HIGH	Trawl Purse Seine
MEDIUM - LOW	Longline
LOW	Jig Handline Pole & Line

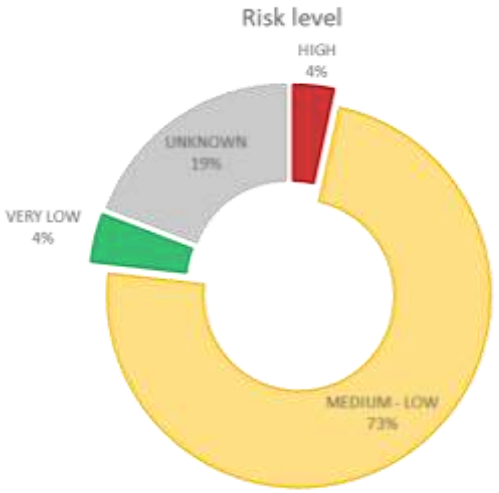


Figure 6 | Risk level by fishing vessel gear type in the Mascarene Islands IMMA

Marine mammal sightings and vessel activity occurrence

Observations of marine mammals, in the form of GPS coordinates, indicate that cetaceans are likely to be present throughout the majority of the IMMA, whilst the most densely transited shipping lanes occur to the northeast and the southwest across the IMMA (Figure 7).

Cargo vessels averaged over 220 m in length (Stand. Dev. = 58 m). They transited the Mascarene Islands IMMA at an average speed of 11 - 12 kts. However, cargo vessels can reach speeds as high as 20 – 25 kts while in transit (Lindstad et al., 2011). Studies have shown that the potential risk of lethal ship-strike interactions between marine mammals and vessels increases as a vessel transits at greater speeds (Vanderlaan and Taggart, 2007). Furthermore, the potential for ship-strike interaction also depends upon the species present, as well as their behaviour. The risk of ship strike increases with whales' body size and ability to take evasive action (McKenna et al., 2015; Redfern et al., 2020), as well as their behavior at the surface, with some whales that rest or 'log' at the surface, such as humpback whales and sperm whales, potentially being at greater risk (Herman et al., 2007; Miller et al., 2008; Van Waerebeek and Leaper, 2008; Whitehead, 2009).

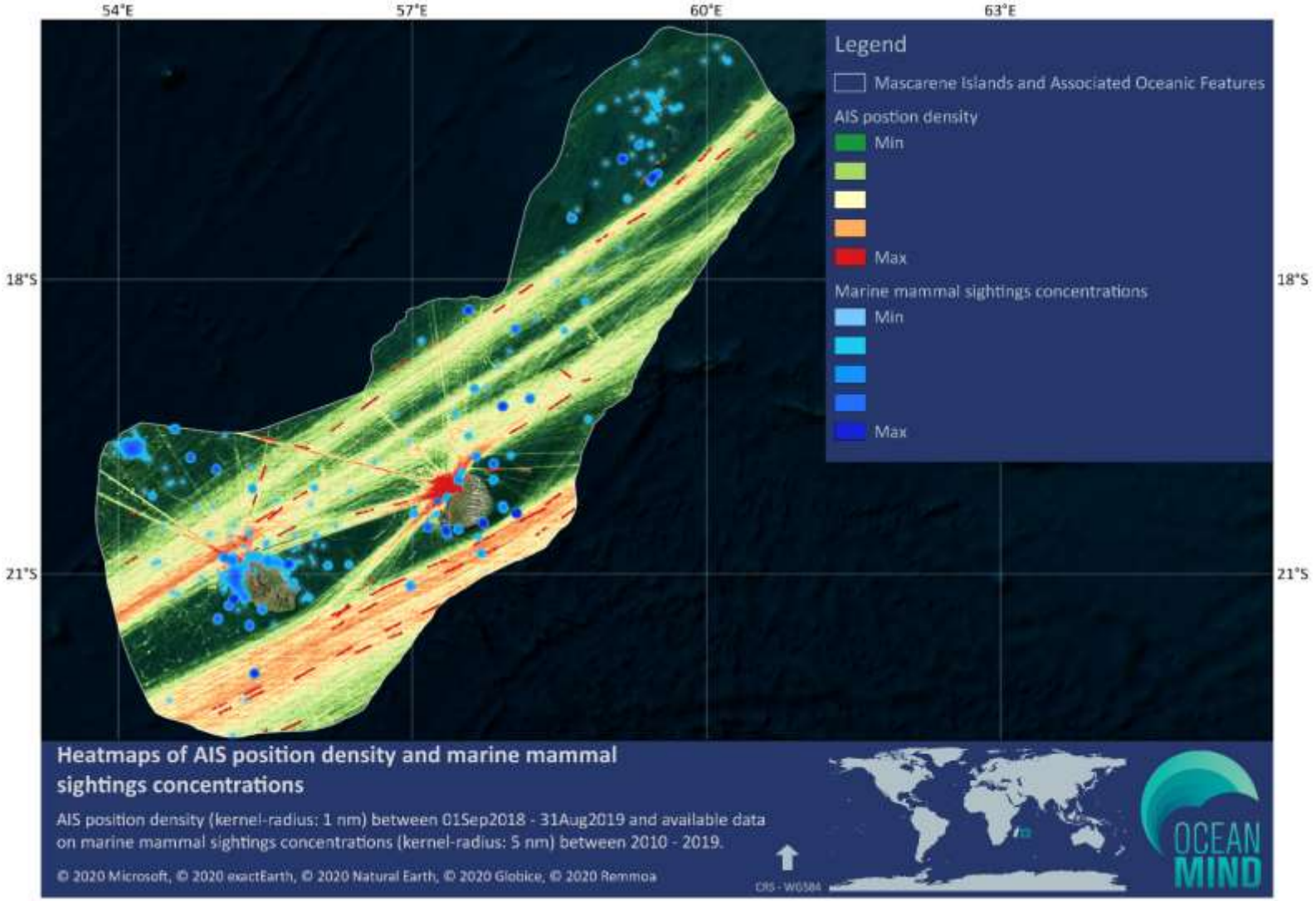


Figure 7 | Sightings of marine mammals and AIS position density data heatmaps

The co-occurrence of vessels and marine mammals, as assessed by 0.2-degree gridded cells, provides a preliminary indication of possible areas where potential ship-strike interaction could occur (Figure 8). High co-occurrence values in cells located in and around ports (Figure 9) were skewed by the higher number of transmissions from ships that were stationary or transiting at very low speeds in these areas (thus transmitting a higher number of signals within the same time frame as faster transiting vessels). . It is important to point out that this analysis therefore specifically focuses on potential ship-strike risks. The fact that vessels slow down, the high concentration of vessels converging toward ports and their associated activity in ports represent an increased risk in terms of noise pollution. However, because stationary or very slow-moving vessels pose little risk of ship strike, these transmissions were removed from the grid-cell analysis, revealing a truer, higher co-occurrence and possible risk in the shipping lanes to the NE and SW of the islands.Co-occurence is higher along the shipping lane, which is further to the north, and particularly more so in the southern portions of IMMA where apparent greater vessel speeds intersect with multiple marine mammal observations. Lower concentrations of marine mammal sightings can be observed co-occurring with transit traffic in the southern transit lane, which results in relatively lower co-occurrence values in this area, with the exception of the territorial waters of Mauritius.

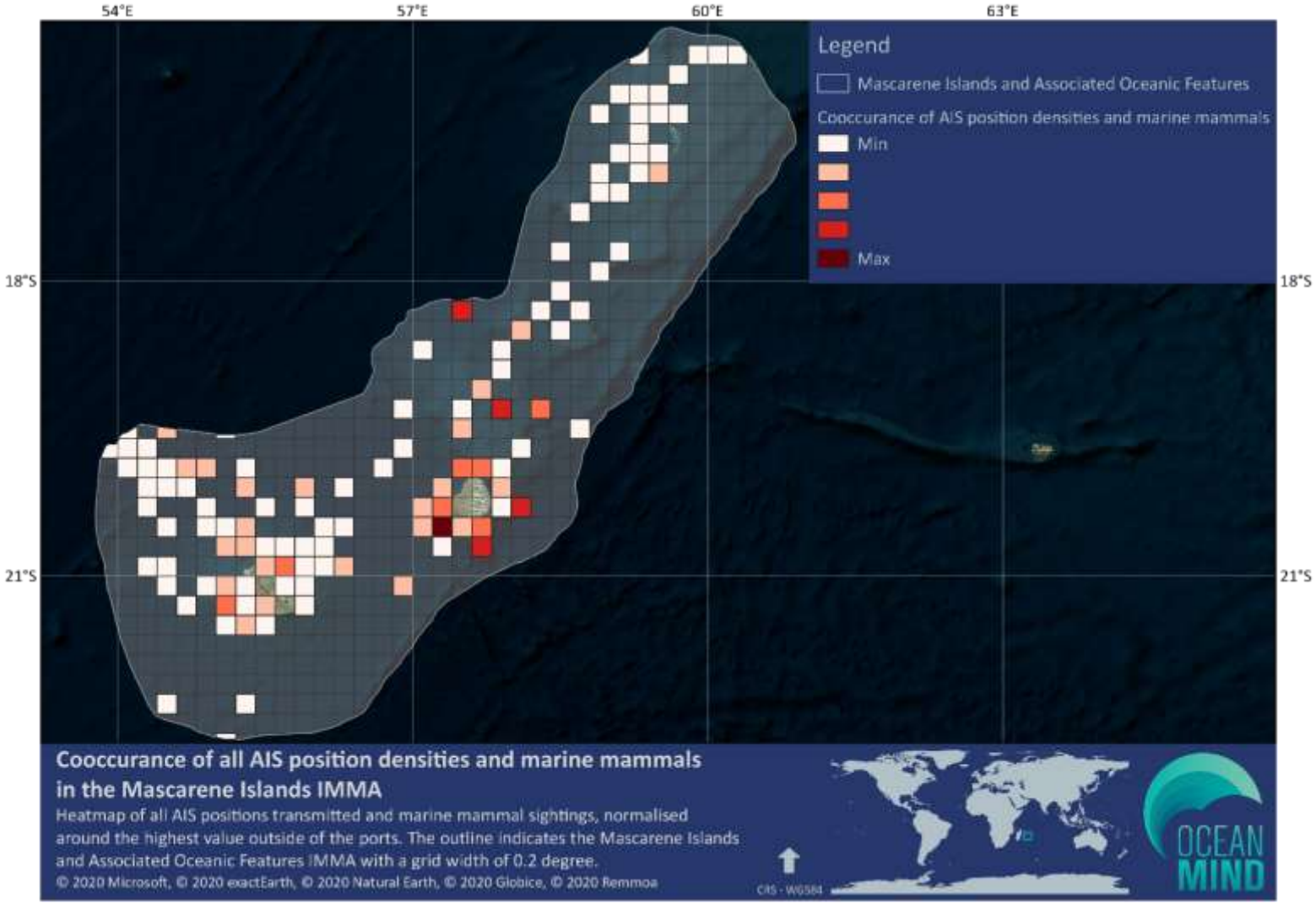


Figure 8 | Cooccurrence of marine mammals and AIS position density normalized around the highest value.

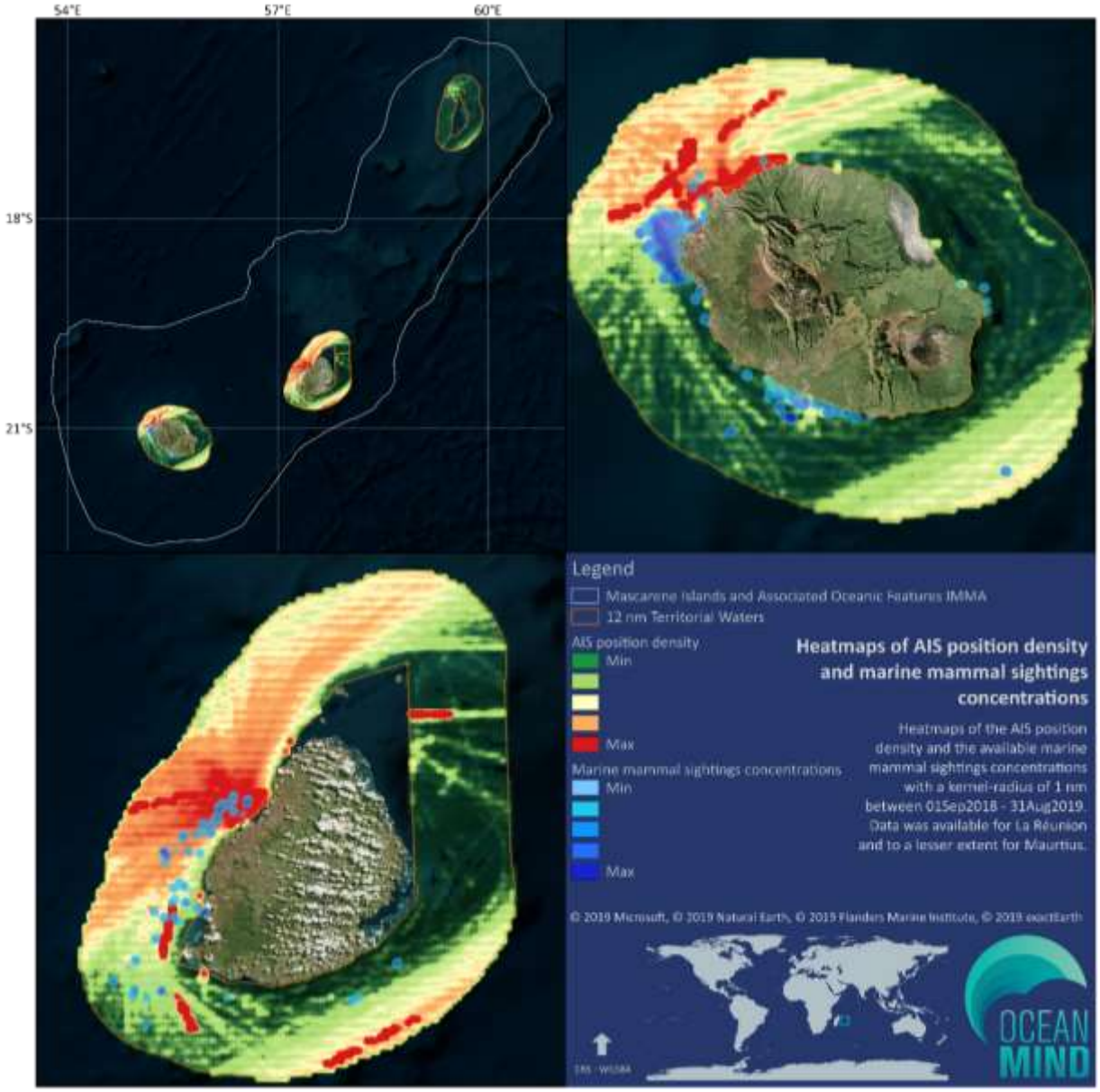


Figure 9 | Marine traffic shows particularly high density around port areas; Pointe des Galets (A), Saint-Pierre (B), and Port Louis (C). Note that this figure portrays only the cetacean sightings data that overlaps with the period during which AIS data was collected. Also note that the waters off the northwest corner of Mauritius are strewn with banks and islands and are thus considered 'inland waters' not easily navigable by large vessels. Therefore, this area is masked in this map, with no depiction of AIS transmissions, which are only provided for territorial waters.

The spatial overlap between cetacean sightings and vessel transmissions in territorial waters indicates high levels of co-occurrence to the northwest sides of both Mauritius and Reunion (Figure 9). While this could be an indication of increasing ship-strike concern, this interpretation is somewhat biased by the following factors:

- The high AIS transmission density areas (red) on the northeast sides of both islands are located around the Pointes de Galets and Saint-Pierre ports in Reunion and the Port Louis in Mauritius. Both cargo and fishing vessels approach and depart these ports at low speed, resulting in a higher density of transmission points.
- Cetacean survey effort is also focused around the nearshore areas in relative proximity to the ports, resulting in a higher relative concentration of cetacean sightings in those areas.

As such, future studies should attempt to correct for these two factors with more sophisticated and finer-scale modelling techniques that consider cetacean observations in relation to survey effort, as well as a more detailed breakdown of ship types, lengths and speeds observed in these areas of co-occurrence. Data collected during Globice marine mammal surveys in 2018-19 allowed a spatiotemporal analysis of the marine mammal sightings in relation to the AIS data from the same period (Figure 9). Marine mammal sightings in both Réunion Island and around Mauritius are concentrated in their territorial waters clustered along the coast, where the bulk of cetacean survey effort was conducted.

As noted above, slower moving vessels near the ports of both islands and in the shallows on the northwest of Reunion are likely to may be 'inflating' cooccurrence values due to a higher proportion of AIS signals per unit of time. However, the cooccurrence between cetaceans and vessels in these nearshore territorial waters, and the potential risk incurred cannot be disputed. As such, territorial waters may be highlighted for additional marine management or possible ship-strike mitigation measures. Additional research on the abundance and behavior of marine mammals is therefore required to further assess this concern.

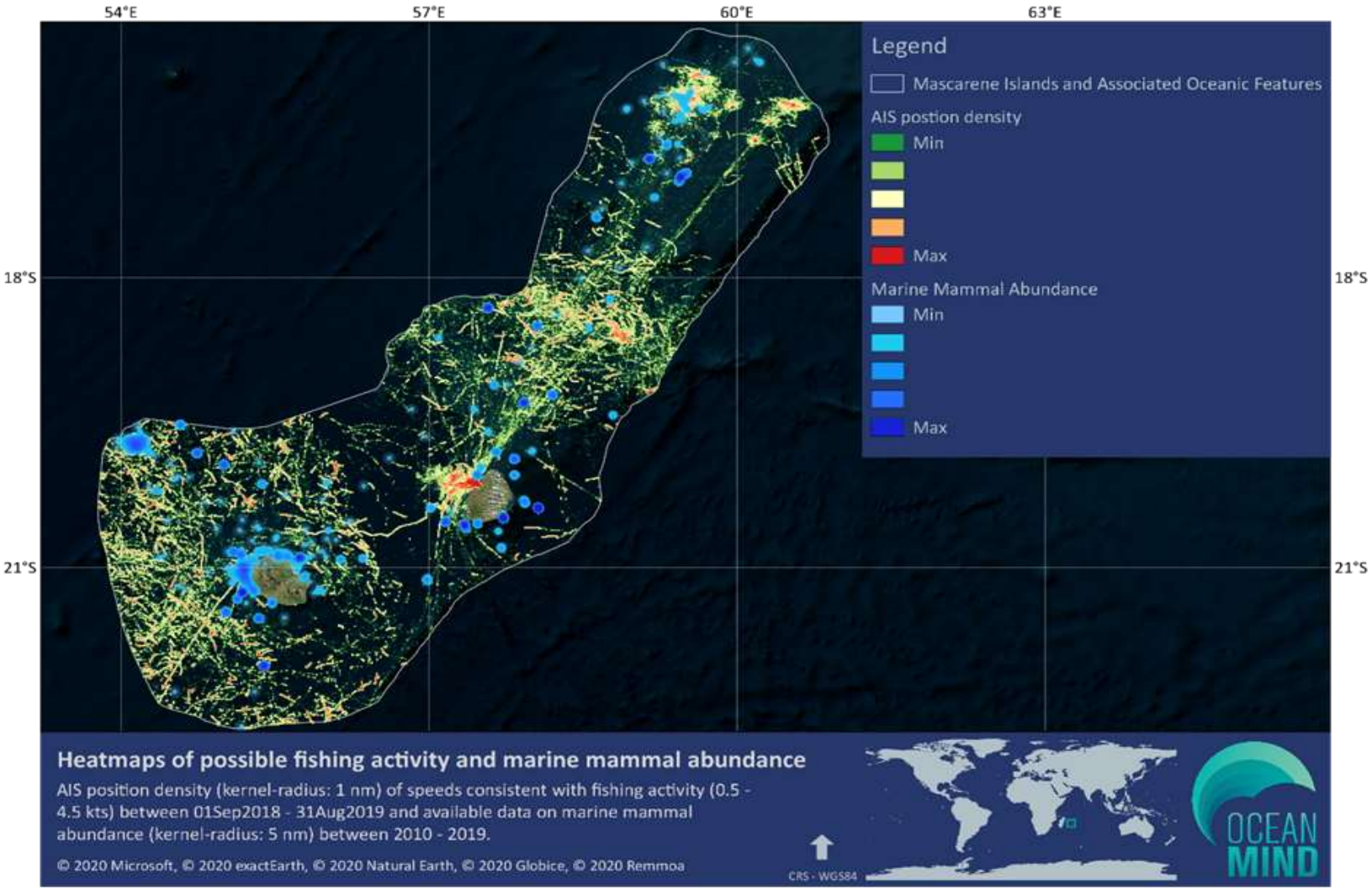


Figure 10 | Data heatmaps of marine mammals' sightings and AIS position density from fishing vessels operating on fishing associated speeds. High activity which is close to the ports is likely not related to fishing activity.

Cooccurrence of marine mammals and fishing activity

The spatial analysis of possible fishing activity shows that potential concerns related to bycatch, associated with these operations, differ from risks associated with transit activity of vessels. Higher densities of fishing vessel activity are observed to occur about 100 nm northeast of Mauritius and around St. Brandon. There is some additional vessel activity to the west of Réunion Island (Figure 10). Marine mammal observation data indicate that cetaceans can be present throughout this area and appear to co-occur with higher densities of fishing activity, occurring within the EEZ of both islands (Figure 11).

The co-occurrence of possible fishing activity and marine mammal observation points are also represented by 0.2-degree grid-cells (Figure 11). This spatial analysis provides a preliminary indication of areas of concern with a potential for marine mammal bycatch due to the co-occurrence of marine mammals and deployed fishing gear. For this graph the group sizes of dolphins were used to provide a more thorough representation of the potential risk of interactions in comparison to whale species, that are more likely to occur in smaller groups and interact with a vessel singularly, than larger pods of small cetaceans interacting with fishing gear. In addition to the territorial waters of Réunion Island and Mauritius, where more data was available, the waters around St. Brandon and around the La Perouse Seamount, off the north-west of Reunion, appear to show the highest co-occurrence of marine mammal sightings and possible activity of fishing vessels. If this preliminary interpretation of the data available is accurate, these areas may be highlighted for further investigation and possible fisheries management for the necessary mitigation of cetacean bycatch. Further research on the abundance and behavior of marine mammals is needed to validate this initial assessment.

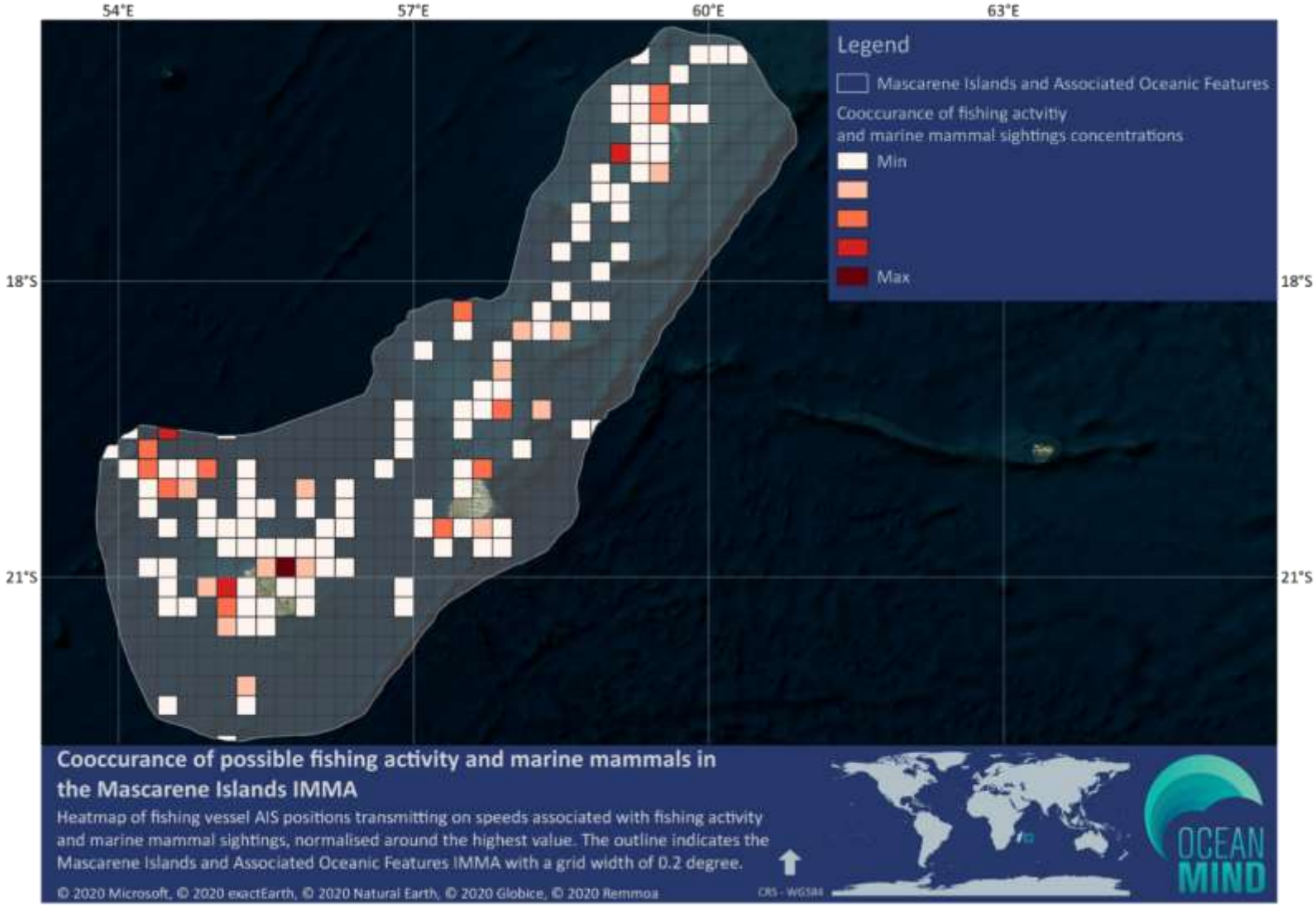


Figure 11 | Cooccurrence of marine mammals and AIS position density of fishing vessels operating between 0.5—4.5 kts (typical fishing speeds) normalized around the highest value.

Assumptions and limitations

This case study provides important initial insight into the potential conservation and management concerns posed by shipping and fishing activities to cetaceans in the Mascarene Islands IMMA, as well as highlighting gaps that require further investigation. In considering these conservation concerns and recommendations to mitigate any risk, it is important to bear in mind the following assumptions and limitations:

- Marine mammal observation data was limited in the offshore areas, where AIS data indicates the highest densities of large (AIS transmitting) vessel traffic occur. This sparse data coverage gives disproportionate weight to single sightings, and does not allow a sufficient sample size to break down and analyze co-occurrence by species. More sophisticated modelling accounting for (relative) abundance in relation to survey effort may be able to compensate for these factors but are beyond the scope of this project.

- Furthermore, aerial surveys were conducted in austral summer (Laran et al., 2017), and thus not during the presence of large migrating baleen whales. Conversely, only humpback whales were represented form tagging data (Dulau et al., 2017b). Only the Cetacean survey data from Reunion overlaps temporally with the AIS transmission data. As such, only limited conclusions can be drawn regarding the risk to different species at different times of the year, or between years, when densities of both marine mammals and shipping may differ significantly (e.g. Globice unpublished data indicates that humpback whale observations were greatly reduced in 2015-2016 and 2020 breeding season). In the absence of year-round, and multi-year marine mammal sightings data for the whole IMMA, it was necessary to assume that activity patterns of observed marine mammals in the region do not change significantly over time,

- Slow vessel speeds increase the density of AIS transmissions in a given area, therefore high densities of transmissions from vessels operating near ports or in shallow waters may ‘inflate’ the perceived potential risk of ship-strike interactions in these areas.

- AIS provides frequent transmissions but varies in its ability to transmit clear data. In areas of very high AIS transmission density, some messages may not be received. Furthermore, AIS is susceptible to tampering and relies on vessel operators to accurately input their own identity information. For the purposes of this case study, the information transmitted by vessels has been assumed to be correct. However, it would be ideal to investigate vessel identities and obtain secondary positional data for the purposes of accuracy.

Finally, it is important to bear in mind that this report only reflects the activity of vessels transmitting on AIS. This is particularly important in relation to the results related to fishing activity, as a large proportion of fishing activity, particularly in areas close to shore and overlapping with the highest observed densities of cetacean sightings, is likely to be carried out by smaller commercial or artisanal fishing vessels. These vessels may not be using any AIS transmitters. As such, the lack of fishing activity by larger AIS transmitting vessels in these nearshore areas should not be interpreted as a complete absence of bycatch risk. At the same time, however, it appears that even in nearshore areas, fishers in the waters of La Reunion are unlikely to be using high risk gears, as longlines and pole and line fishing are the most common fishing gears used in the territory's EEZ (Weiss et al., 2018).

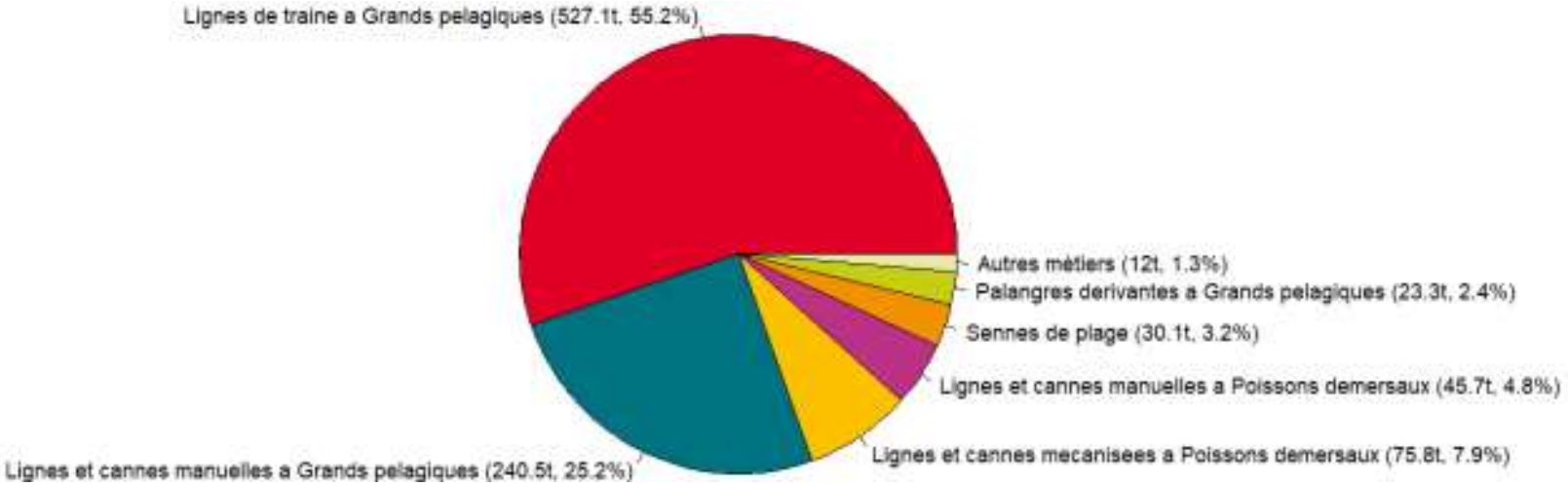


Figure 12 | Breakdown of fishing gears used in La Reunion, taken from Weiss, J., J. Duchêne, S. Le Blond, H. Evano, S. Demanèche, P. Berthou, Le Roy, and E. Leblond. 2018. Synthèse des pêcheries de Réunion, Délégation IFREMER océan Indien Station de La Réunion, La Reunion.

Conclusions and recommendations

Despite the caveats inherent to the data presented and preliminary analyses undertaken, this case study provides evidence that there are likely concerns of both ship-strike and bycatch interactions between marine mammal species and vessel activity in the Mascarene Islands IMMA. Co-occurrence of vessel traffic and cetaceans seems particularly high in the territorial waters of Reunion and Mauritius, in relation to the rest of the IMMA. This study should encourage governments and other stakeholders to engage in a process to assess what precautionary measures may be necessary to mitigate any risks.

One effective mitigation strategy involves the implementation of vessel speed restrictions in known areas of whale distribution. The slowing of vessel speeds to below 11kt can reduce mortalities from ship-strike interactions by up to 90% (Vanderlaan and Taggart, 2007; Conn and Silber, 2013), while at the same time saving fuel and reducing carbon emissions from vessels (Leaper, 2019). Vessel speed reductions, if implemented in nearshore areas close to approaches to ports, incur little extra cost to transport companies, but can be highly effective in reducing the risk of ship strikes (Leaper, 2019).

Other management tools used by the IMO and governments to reduce the risk of ship strikes is the implementation include traffic separation schemes (TSS) that channel vessel traffic through areas thought to be little-used by whales , or the designation of Particularly Sensitive Sea Areas or Areas to be Avoided by Shipping (IMO, 2009, 2016; Cates et al., 2017). This study shows that the majority of vessels operating in the IMMA are cargo vessels travelling between the northeast and southwest borders of the area in two distinct lanes. Marine mammals appear to be present across the whole IMMA, however possible higher co-occurrence between marine mammals and ship traffic were identified in the south-west. Although re-routeing measures might appear to be a means of decreasing risk for the species that were the focus of studies in La Reunion and Mauritius, such measures should not be recommended until the distribution and habitat use of all whale species using the Mascarene Islands IMMA are understood well enough to ensure that moving shipping away from one area of whale habitat would not put other species at risk either inside or outside the boundaries of the IMMA. As such, more abundant and detailed data on marine mammal distribution is urgently needed to quantify the level of co-occurrence in these shipping lanes, and to determine whether any alternative routing measures would reduce ship-strike concerns for any of the whale species involved. Further analysis should also be conducted on areas of high AIS transmission density to identify which vessels are potentially transiting at high speeds and thus posing a potentially greater risk.

The boat surveys, satellite tracking and aerial survey data provided a relatively high number of cetacean sightings data for both the territorial waters of Reunion and Mauritius and offshore waters of the IMMA when compared with some other parts of the Indian Ocean, which are presently understudied. Yet, the reliability of the analyses presented here are still constrained by a paucity of marine mammal data, especially in the offshore areas of the IMMA. A larger dataset of marine mammal observations, with greater spatial and temporal coverage within the IMMA, is needed in order to strengthen any further analysis of co-occurrence with marine traffic. It is recommended to gather observation data frequently and evenly across the whole area of assessment across all seasons, across multiple years, to account for possible seasonal and annual variation in the distribution of cetaceans and vessel traffic (Redfern et al., 2020).

Population estimates of cetacean species in the region should also be incorporated in order to strengthen understanding of abundances and to build more sophisticated risk assessments and models of the potential population-level impacts of any ship-strikes and bycatch interactions (Redfern et al., 2013; Smith et al., 2020). It would be ideal to also research shifts in marine mammal movements against climate models.

Analysis for possible marine mammal interaction with fishing activity shows possible higher co-occurrence areas in the north of the IMMA and northwest of Réunion island. However, larger disaggregated datasets are required for more detailed analysis of fishing activity by gear type and marine mammals' species. From such datasets a further comparative assessment of large to small cetaceans should help to describe potential concerns more precisely, due to the different interactions between differing species types have with varying vessels.

Nonetheless, governments can already undertake processes to consult upon and implement measures to ensure that known fishing gears of higher bycatch risk to marine wildlife, such as gillnets, are managed effectively within their territorial waters. Together with stakeholders across the public, academic, NGO and industry sectors, they should collaborate to further investigate the exact nature of the interactions that are taking place in their waters between fishing fleets and marine mammals. Such measures include the direct placement of on-board observers or mandating the use of remote electronic monitoring.

Much of the co-occurrence between fishing effort and marine mammal sightings was documented offshore, beyond territorial waters but within the Economic Zones (EEZ) of La Reunion and Maurtitius. Further assessment and management of the potential bycatch risk implied by this co-occurrence will require international collaboration between the fishing vessels' flag states, and the Indian Ocean Tuna Commission (IOTC), which is the regional fisheries management organisation (RFMO) with jurisdiction over fishing activities in the Mascarene Islands IMMA. Representative data on bycatch in the Indian Ocean are generally lacking (Lewison et al., 2014), and there is an urgent need to better understand the impact that fishing may be having on Indian Ocean cetacean populations (Temple et al., 2019; Anderson et al., 2020) as well as wider populations of marine wildlife. Once this is understood, managers can develop effective mitigation measures to reduce bycatch risks. These measures may include the creation of protected areas, seasonal time area closures, or bans on non-selective fishing gears associated with high bycatch risk.

Acknowledgement

We would like to thank Observatoire Pelagis for their data contribution, which made this case study possible.

Savu Sea Case Study

Executive summary

This case study aims to increase the understanding of the likelihood of interactions between marine mammals and vessels categorized as posing a potential threat to marine mammals in the Savu Sea and Surrounding Areas IMMA. We analyse peer reviewed literature and other sources that demonstrate the importance of the eastern and northeastern Savu Sea, particularly between Pulau Lembata, Timor and Timor-Leste, for marine mammals. We conclude that the presence of threatened cetacean species co-occurring with high densities of vessel traffic requires effective marine management of the potential risks incurred. This case study can be used to inform local stakeholders of possible areas for further investigation as well as mitigation measures that are currently available for implementation.

Introduction

Initial analysis highlighted the Savu Sea and Surrounding Areas (hereinafter to be referred to as "Savu Sea IMMA") as one of ten IMMAs with a high density of marine transport activities. The Savu Sea IMMA comprises an area of 160.513 km^2. It is located between the south-east of Indonesia and Timor-L'este. Shipping lanes through the IMMA connect Australia to Southeast Asian ports, creating a potential risk for ship-strikes with marine mammals. Ship-strike risk increases with vessel size and speed, and with marine mammal size (Redfern et al., 2020). Cetacean species that are potentially affected by these risks in the Savu Sea IMMA include blue whales (*Balaenoptera musculus*), pygmy blue whales (*Balaenoptera musculus brevicauda*), sperm whales (*Physeter macrocephalus*), Bryde's whales (*Balaenoptera brydei*), beaked whales (*Ziphiidae*), and potentially four species of dolphin. (Hoffman, 1998; Mustika, 2006; Kahn, 2007; Mustika et al., 2009; Double et al., 2014; Mujiyanto et al., 2018). Based on the limited data available, the majority of whale species are thought to use the area for migration, but there are also some residential species, including a number of small cetaceans (Mustika, 2006; Mujiyanto et al., 2018).

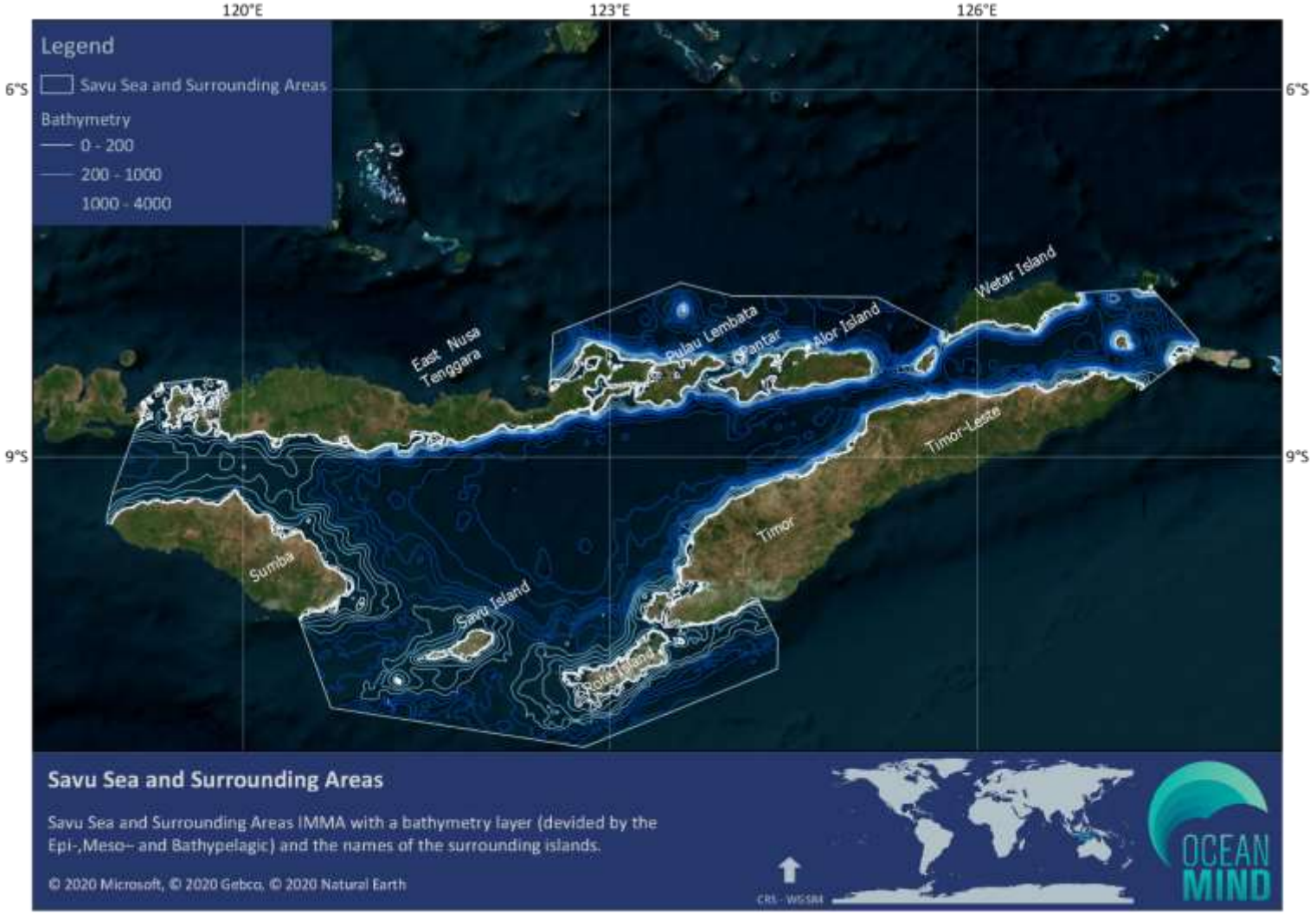


Figure 13 | Savu Sea and Surrounding Areas IMMA with a bathymetry layer (divided by the Epi-, Meso– and Bathypelagic) and the names of the surrounding islands.

Methodology

Marine mammal observation data was obtained from the Oceanographic Biodiversity Information System (OBIS) database (Halpin et al., 2006). The data comprised marine mammal sightings gathered during surveys conducted in 2010. Further areas of marine mammal occurrence were based on published studies conducted on marine mammals in the Savu Sea in 2007, 2011 and 2017, which included printed/published maps of cetacean sightings and distribution in the area but did not include raw sightings data with coordinates (Kahn, 2007; Dharmadi and Wiadnyana, 2011; Mujiyanto et al., 2018). Due to the present limitations in data availability for the IMMA, we created a 0.5-degree grid and classified the grid values by lower and higher co-occurrence described within these studies. Grid cells containing cetacean sightings data for the analysis were mainly concentrated in the east and northeastern portions of the Savu Sea IMMA, leaving the west part of the IMMA to suffer a paucity of suitable data.

OceanMind collected Automatic Identification System (AIS) data for the period 01Sep2018 through 31Aug2019 (Figure 14) the latest available data at the time of project start. AIS is a maritime collision avoidance system transmitted on marine VHF radio and provides vessels receiving it with information on position, speed, course and identity data as inputted by the transmitting vessel. While mandatory on all passenger vessels and merchant vessels over 300 gross tonnes, some flag states give their fishing vessels exemptions and so it does not provide all possible vessel information.

We overlaid the (approximate) marine mammal observation data with available marine traffic transmissions from between 01Sep2018 – 31Aug2019. The co-occurrences of marine mammals with all probable vessel traffic could potentially improve the understanding of possible risks with regards to ship-strikes and potential risk of bycatch from registered fishing vessels.

Figure 14 | Vessel traffic in the Savu Sea and Surrounding Areas IMMA

Results

Analysis of AIS transmissions shows that cargo and hazardous cargo comprise 75 % of all vessels operating within the Savu Sea IMMA. Most vessels travel within well-defined shipping lanes between the northern and southern borders and north of Timor-Leste and Alor Island (Figures 13 & 14). These shipping lanes are mainly used by cargo and hazardous cargo vessels, which transit at average speeds above 11 kts (Table 3). Marine mammals appear to be present in areas overlapping with those routes (Dharmadi and Wiadnyana, 2011; Mujiyanto et al., 2018). According to a study by Kahn (2007), this particularly applies to endangered blue whales (*Balaenoptera musculus*), and especially so for the subspecies of pygmy blue whale (*Balaenoptera m. brevicauda*) who annually migrate through the IMMA on route between their foraging and breeding areas. The likely cooccurrence of the vessels and marine mammals poses a potential threat of ship strikes to these species whilst within in these areas.

Table 3 | Average speeds and length by vessel categories inside the Mascarene Islands IMMA

Vessel category	Number of vessels	Proportion [%]	Average speed	Length [m]	Width [m]
Fishing	15	0.57	6.5	-	-
Fish carrier	0	0	-	-	-
Fish bunker	0	0	-	-	-
Fishing buoy	0	0	-	-	-
Cargo	1463	55.6	11.6	218	59
Hazardous cargo	525	19.9	12.6	203	57
Passenger	135	5.1	8.0	-	-
Pleasure	232	8.8	5.0	-	-
Unknown	96	3.6	10.1	96	54
Other	165	6.3	7.6	73	20
Total	2631	100	NA	NA	NA

The Savu Sea IMMA exhibits a high AIS transmission density in relation to other IMMAs (Table 1). Between 01Sep2018 and 31Aug2019, 2,631 vessels transmitted positions from within the IMMA. Of these, 75% transmitted cargo or hazardous cargo identities (Table 3). The activity of these categories was slightly lower between January and April but did not vary significantly throughout the year.

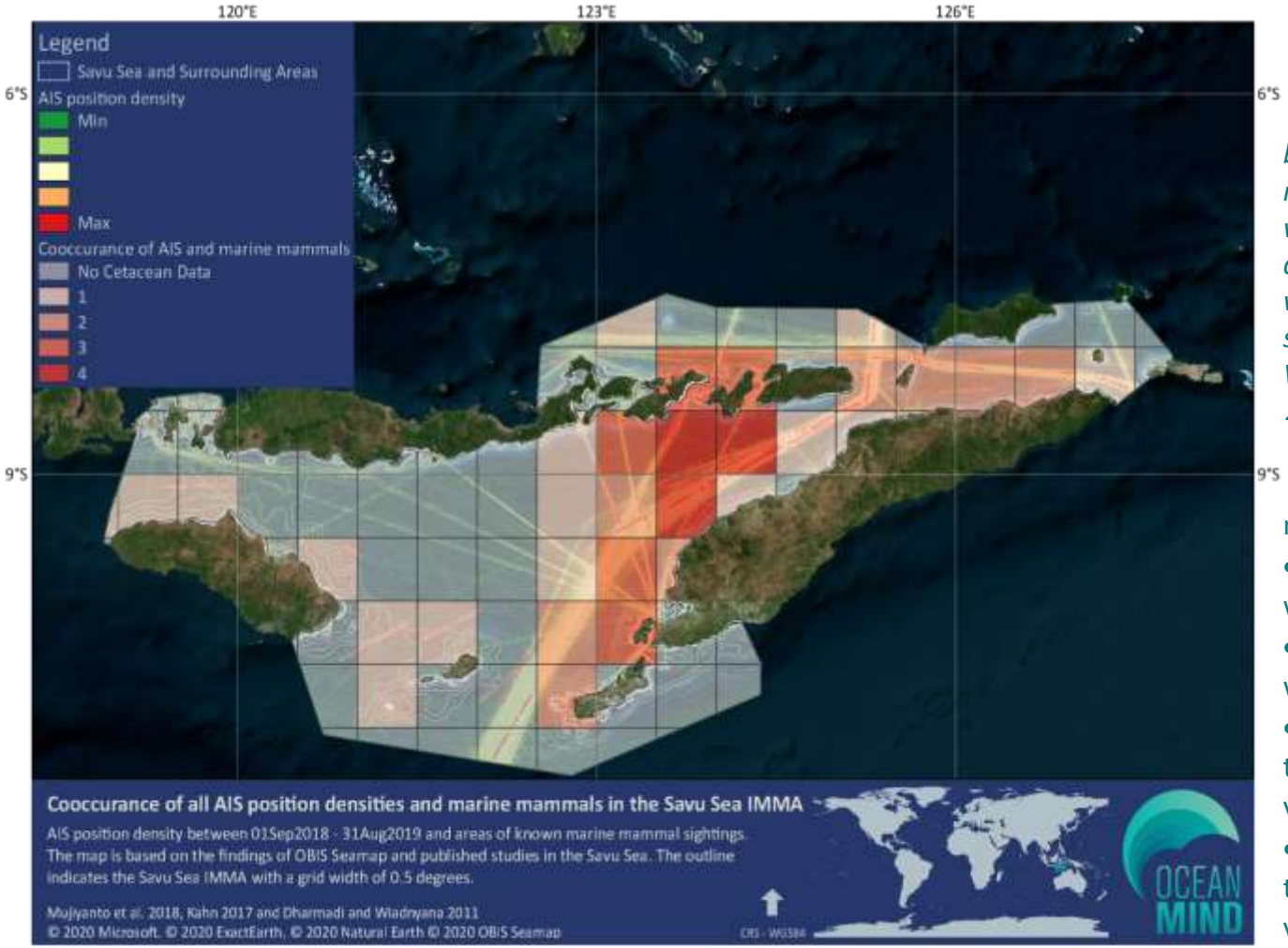


Figure 15 | Vessel traffic in the Savu Sea and Surrounding Areas IMMA with an overlay of a 0.5 decimal degree grid depicting strength of cooccurrence between the traffic and marine mammals. Cetacean distribution data was sourced from OBIS Seamap, and approximate cetacean distribution data was derived from three published studies: (Kahn, 2007; Dharmadi and Wiadnyana, 2011; Mujiyanto et al., 2018). The heatmap categories are as follows:

- No cetacean data: No data on marine mammals is available
- 1: Small Cetaceans co-occur with vessel traffic
- 2: Large Cetaceans co-occur with vessel traffic
- 3: The studies show cetaceans to occur regularly in locations with vessel traffic
- 4: The studies show cetaceans to occur regularly in locations with high vessel traffic

Marine mammal sightings and vessel activity occurrence.

Studies on marine mammal occurrence indicate that cetaceans are likely to be present across the east and northeast of the IMMA (Figure 15). High density vessel traffic appears to be passing across similar regions of the IMMA.
Cargo vessels averaged over 214 m in length (St.Dev. = 74 m) and were transiting the Savu Sea IMMA at an average speed of 11.6 - 12.6 kts. However, cargo vessel speeds can reach as high as 20 – 25 kts while in transit (Lindstad et al., 2011). Studies show that the potential risk of lethal ship-strike interactions between marine mammals and vessels increases with the vessel's speed (Vanderlaan and Taggart, 2007). Furthermore, the potential for ship-strike interaction also depends upon the species present. Large-bodied whales, like blue whales, are known to be at risk (McKenna et al., 2015; Monnahan et al., 2015; Rockwood et al., 2017; Redfern et al., 2020). Sperm whales are also present in the IMMA, and are known to be at risk of ship strike due to their 'logging' or resting behaviour at the surface of the water between deep dives (Miller et al., 2008; Whitehead, 2009).

The co-occurrence of vessels and marine mammals, as assessed by 0.5-degree gridded cells, provides a preliminary indication of possible risk areas where potential ship-strike interactions could occur (Figure 15). Higher co-occurrence and possible risk areas are located primarily in the northeast of the IMMA, where the vessel activity is higher and large marine mammals seem to occur more frequently. This is especially true for the waters between the Lembata and Wetar island, where the shipping lanes are narrower. However, it is important to consider, that the available data for this case study was limited, which applies especially to the western portion of the Savu Sea IMMA, where we classified most grid cells as data deficient.

Fishing activity might create an additional risk for cetaceans in the Savu Sea IMMA. There was a very low number of fishing vessels transmitting on AIS and their average speeds suggests that the majority was not actively fishing. However, fishing is an important livelihood in eastern Indonesia and Timor-Leste (Alonso Población, 2013; Ramenzoni, 2013), it is very likely that the activity is conducted without the use of AIS, especially for artisanal fisheries (Longépé et al., 2018).

Assumptions and limitations

This case study provides important initial insight into the potential conservation and management concerns posed by shipping activity in the Savu Sea IMMA, as well as highlighting gaps that require further investigation. In considering these conservation concerns and recommendations to mitigate any risk, it is important to bear in mind the following assumptions and limitations.

Marine mammal data was limited to the OBIS database with only a small number of data points within the Savu Sea IMMA. These were viewed in conjunction with sightings data that was reported in three available studies (Kahn, 2007; Dharmadi and Wiadnyana, 2011; Mujiyanto et al., 2018) that highlighted areas of marine mammal occurrence but did not include raw sightings data with specific coordinates. For this reason, only a broader-scale analysis of co-occurrence using a 0.5-degree grid was possible, even though the occurrence of marine mammals within an individual grid may vary significantly.

AIS provides frequent transmissions but varies in its ability to transmit clear data. In areas of very high AIS transmission density, some messages may not be received. Furthermore, AIS is susceptible to tampering and relies on vessel operators to accurately input their own identity information. For the purposes of this case study, the information transmitted by vessels has been assumed to be correct. However, it would be ideal to investigate vessel identities and obtain secondary positional data for the purposes of accuracy.

Conclusions and recommendations

Despite the caveats inherent to the data presented and preliminary analyses undertaken, this case study provides evidence that there are likely concerns of ship-strike interactions between marine mammal species and vessel activity in the Savu Sea IMMA. The exercise is an important first step in identifying areas where further study and collaboration between stakeholders is required to adequately mitigate the risk of ship strikes in areas known to be important for marine mammals.

Statistics on global shipping demonstrate that that the highest proportion of seaborne cargo travels through Asia (Figure 16). However, reviews of the data available on OBIS Seamap (Kot et al., 2010) as well as global reviews of cetacean survey data, demonstrate that data is skewed toward North America and Europe, with notable gaps the Indian Ocean and Southeast Asia (Kaschner et al., 2012). A larger dataset of marine mammal observations that covers a wider spatial and temporal distribution, is needed in order to strengthen any further analysis of co-occurrence with marine traffic.

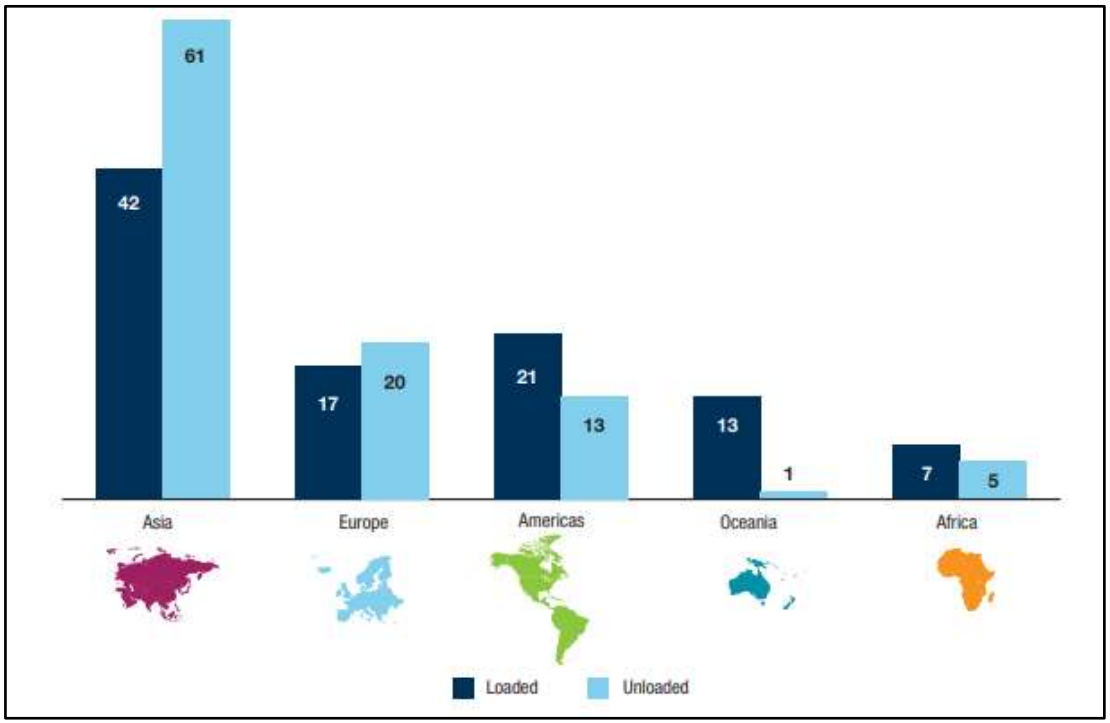


Figure 16 | World Seaborne trade by region, 2017 (percentage share in world tonnage). Taken from UNCTAD, 2018. Review of Maritime Transport 2018, Report by the Secretariat of the United Nations Conference on Trade and Development, United Nations, Geneva, p. 116.

Further research is strongly recommended to collect observation data frequently and evenly across the whole area of assessment across all seasons, across multiple years, to account for possible seasonal and annual variation in the distribution of cetaceans and vessel traffic (Redfern et al., 2020). Population estimates of cetacean species in the region should also be incorporated in order to strengthen understanding of abundances and to build more sophisticated risk assessments and models of the potential population-level impacts of any ship-strikes and bycatch interactions (Redfern et al., 2013; Smith et al., 2020). It would be ideal to also research shifts in marine mammal movements against climate models.

However, until more regular and systematic cetacean surveys can be conducted in the areas where high densities of vessel traffic are known to occur, stakeholders should be using whatever data is available to assess potential risks and develop action plans to reduce those risks. This is

especially true when endangered species or populations are known to be involved, as is the case in the Savu Sea IMMA, where studies show the regular presence of endangered blue whales and pygmy blue whales.

Co-occurrence of vessel traffic and cetaceans seems particularly high in the north and east of the IMMA, where the islands narrow down pathways for the vessel traffic. Governments and competent authorities, such as the IMO, could therefore engage in a process to assess what precautionary measures could be implemented to mitigate any risks. One mitigation measure could include implementation of vessel speed restrictions in those areas, which can reduce mortalities from ship-strike interactions by up to 90% (Vanderlaan and Taggart, 2007; Conn and Silber, 2013), while at the same time saving fuel and reducing carbon emissions from vessels (Leaper, 2019).

Another management tool used by the IMO and governments to reduce the risk of ship strikes is the implementation of traffic separation schemes (TSS) that channel vessel traffic through areas thought to be little used by whales. However, such measures could not be recommended until the distribution and habitat use of all whale species using the the Savu Sea IMMA are understood well enough to ensure that moving shipping away from one area of whale habitat would not put other species at risk either inside or outside the boundaries of the IMMA. As such, more abundant and detailed data on marine mammal distribution is urgently needed to quantify the level of co-occurrence in these shipping lanes, and to determine whether any alternative routing measures would reduce ship-strike concerns for any of the whale species involved. Enabling conditions are in place for fruitful collaborations between different categories of stakeholders, including international NGOs like WWF and The Nature Conservancy, who have both fostered research and conservation initiatives in the region (Perdanahardja and Lionata, 2017; Wijonamo et al., 2020). Further analysis should also be conducted on areas of high AIS transmission density to identify which vessels are potentially transiting at high speeds and thus posing a potentially greater risk.
With regards to fishing activities, as AIS is not widely used by fishing vessels in the Savu Sea, other tracking methods may be necessary to accurately assess fishing and bycatch risks. These include the vessel monitoring system (VMS), but also remote detection methods such as Visible Infrared Imaging Radiometer Suite (VIIRS), Synthetic-aperture radar (SAR), and electro optical methods, including unmanned aerial vehicles (UAVs).

Appendix I: Criteria used to select the two IMMAs to become the focus of more in depth analysis of the nature of vessel activity in relation to marine mammal distribution

- *At least one of the primary species for which the IMMA was identified should be one that is known to be particularly susceptible to ship strike and/or disturbance from shipping noise. This is likely to be one of the large whale species.*
- *We may also want to take into consideration the target species' conservation status (in addition to choosing an area that hosts species vulnerable to shipping impacts, it might also be valuable to choose species with a vulnerable conservation status).*
- *Enough detailed information should be available on that particular vulnerable species to allow an overlap of animal distribution data with the shipping routes, and to be able to draw meaningful inferences about the likely resulting risks.*
- *The selected IMMAs should be chosen on the basis that there is a relatively high volume of vessel traffic overlapping directly with the distribution of a vulnerable cetacean species.*
- *At least one of the two IMMAs, if not both, should be in areas where enabling conditions are in place to allow some degree of follow-up with the relevant stakeholders to implement any recommendations that arise from the in-depth analysis of the overlap between cetaceans and vessels. At the same time, we would want to take into consideration the current level of (effective) protection in the IMMA (would make more sense to focus on areas where protection is still needed, rather than an area where protection is already in place).*
- *At the same time, we should consider the feasibility of introducing management measures to mitigate the identified threats in light of multiple species and changing environmental conditions. (For example, it may not be feasible to suggest moving a shipping lane if not enough data are available on all cetacean species potentially affected by shipping, but promoting slowdowns would benefit all species both from a ship strike and a noise perspective).*
- *Ideally the two IMMAs would represent completely different geographical regions and contexts.*
- *Ideally the two IMMAs would host different focal species.*
- *Ideally the two IMMAs would host different types of vessel traffic to allow discussion of the different types of risk (e.g. container ships vs. hazardous materials or fishing-related vessels).*

- *Ideally at least IMMA included heavy amounts of fishing vessel traffic to allow an analysis of that and the additional risks posed to a wider range of cetaceans/marine mammals from the fishing activities as well as the vessel traffic.*
- *Ideally at least one of the IMMAs will be located in the territorial waters of an IWC member country.*
- *It may be interesting to choose an IMMA where we can also address the potential impacts of climate change/environmental change*
- *Species diversity (it may be valuable to focus on an area that hosts multiple species – including other taxa).*
- *WWF capacity and or involvement on the ground in that region/IMMA (it may be advantageous to choose an IMMA where WWF has capacity and/or is already active).*

Appendix II: IWC SUMMARY TABLE OF SHIP STRIKE MITIGATION MEASURES THAT HAVE BEEN IMPLEMENTED WORLDWIDE

Measure	Situation to which it might be applied	Implementation process (and observations)	Examples
Keeping vessels away from whales			
Permanent routing measures through TSS, ATBA or port approach routes	Long-term patterns of whale distribution are sufficiently predictable and well understood to enable a robust analysis of the risk reduction that might be achieved.	Implemented through IMO or national regulation if within territorial sea. Proposals should follow the IMO process including data on the problem, the risk reduction achieved and implications for shipping. (Generally well respected by industry.)	Bay of Fundy, Canada Boston, USA California, USA Panama Cabo de Gata, Spain
Seasonal routing measures	Similar requirements to permanent routing but applicable where there are strong seasonal patterns in whale distribution	As above	Roseway Basin, Canada Great South Channel, USA
Recommended (voluntary) routes	Similar requirements to permanent routing through TSS or ABTA but not mandatory	Implemented by IMO or coastal state as a non- mandatory measure	Peninsula Valdez, Argentina Hauraki Gulf, New Zealand Glacier Bay, USA Ports on US east coast
Short-term (days – weeks) and Dynamic routing measures	Implemented in response to short- term observations of whale aggregations or known high risk areas. Need almost real-time reporting systems that can identify such aggregations	Voluntary measures that need to be communicated to mariners. (Can be difficult to encourage compliance.)	DMAs off US east coast Gibraltar Strait, Spain
Slowing vessels down			
Permanent speed restriction zones	Long-term patterns of whale distribution are predictable and well understood but routing measures are not practicable.	Can be voluntary or mandatory if implemented in national waters.	East coast of USA (mandatory) Glacier Bay, USA Hauraki Gulf, New Zealand
Seasonal speed restriction zones	As above but applicable where there are strong seasonal patterns in distribution	As above	Panama California, US Peninsula Valdez, Argentina
Dynamic Management Areas for speed restrictions	Implemented in response to short- term observations of whale aggregations or known high risk areas. Need reporting systems that can identify such aggregations	Voluntary measures that need to be communicated to mariners. (Can be difficult to encourage compliance.)	US east coast
Avoidance manoeuvres			
Real-time alerting tools to warn vessels of the presence of whales or aggregations that allow vessels to alter course or slow down	A rapid reporting network of whale sightings or acoustic detections alerts all vessels transiting an area to the locations of whales so that they can alter course or slow down	Individually designed and implemented reporting systems	REPCET, ACCOBAMS, Mediterranean Sea WhaleAlert, Boston USA
Observations from the vessel that allow avoiding action to be taken	Only effective for vessels capable of rapid manoeuvres to avoid whale sightings (e.g. vessels of a few thousand GT or less)	Additional dedicated observers, education and outreach to mariners	Many initiatives

Further details of the measures given as examples can be found in SC/65b/HIM05, with a bibliography of studies relating to these examples, including evaluations of effectiveness in SC/66a/HIM04.

See https://iwc.int/ship-strikes for more details

References

Agardy, T., M. Cody, S. Hastings, E. Hoyt, A. Nelson, M. Tetley, and G. Notarbartolo di Sciara. 2019. Looking beyond the horizon: An early warning system to keep marine mammal information relevant for conservation. Aquatic Conservation: Marine and Freshwater Ecosystems 29(S2):71-83. doi: 10.1002/aqc.3072

Anderson, R. C., M. Herrera, A. D. Ilangakoon, K. Koya, M. Moazzam, P. L. Mustika, and D. N. Sutaria. 2020. Cetacean bycatch in Indian Ocean tuna gillnet fisheries. Endangered Species Research 41:39-53.

Brownell Jr, R. L., R. R. Reeves, A. J. Read, B. D. Smith, P. O. Thomas, K. Ralls, M. Amano, P. Berggren, A. M. Chit, T. Collins, R. Currey, M. L. L. Dolar, T. Genov, R. C. Hobbs, D. Kreb, H. Marsh, M. Zhigang, W. F. Perrin, S. Phay, L. Rojas-Bracho, G. E. Ryan, K. E. W. Shelden, E. Slooten, B. L. Taylor, O. Vidal, W. Ding, T. S. Whitty, and J. Y. Wang. 2019. Bycatch in gillnet fisheries threatens Critically Endangered small cetaceans and other aquatic megafauna. Endangered Species Research 40:285-296.

Cates, K., D. P. DeMaster, R. L. Brownell Jr, G. K. Silber, S. Gende, R. Leaper, F. Ritter, and S. Panigada. 2017. Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020, International Whaling Commission, Cambridge, United Kingdom.

De Stephanis, R., and E. Urquiola. 2006. Collisions between ships and cetaceans in Spain. Document presented to the Scientific Committee of the International Whaling Commission SC/58/BC5

Erbe, C., S. A. Marley, R. P. Schoeman, J. N. Smith, L. E. Trigg, and C. B. Embling. 2019. The Effects of Ship Noise on Marine Mammals—A Review. Frontiers in Marine Science 6(606)(Review) doi: 10.3389/fmars.2019.00606

Frantzis, A., R. Leaper, P. Alexiadou, A. Prospathopoulos, and D. Lekkas. 2019. Shipping routes through core habitat of endangered sperm whales along the Hellenic Trench, Greece: Can we reduce collision risks? PLOS ONE 14(2):e0212016. doi: 10.1371/journal.pone.0212016

IWC. 2019. A Joint IWC-IUCN-ACCOBAMS workshop to evaluate how the data and process used to identify Important Marine Mammal Areas (IMMAs) can assist the IWC to identify areas of high risk for ship strike, International Whaling Commission.

Jacob, T., and D. Ody. 2016. Characteristics of Maritime Traffic in the Pelagos Sanctuary and Analysis of Collision Risk with Large Cetaceans, WWF.

Kaschner, K., N. J. Quick, R. Jewell, R. Williams, and C. M. Harris. 2012. Global Coverage of Cetacean Line-Transect Surveys: Status Quo, Data Gaps and Future Challenges. PLoS ONE 7(9):e44075. doi: 10.1371/journal.pone.0044075

Kot, C. Y., E. Fujioka, L. J. Hazen, B. D. Best, A. J. Read, and P. N. Halpin. 2010. Spatio-Temporal Gap Analysis of OBIS-SEAMAP Project Data: Assessment and Way Forward. PLoS ONE 5(9):e12990. doi: 10.1371/journal.pone.0012990

Lewison, R. L., L. B. Crowder, B. P. Wallace, J. E. Moore, T. Cox, R. Zydelis, S. McDonald, A. DiMatteo, D. C. Dunn, and C. Y. Kot. 2014. Global patterns of marine mammal, seabird, and sea turtle bycatch reveal taxa-specific and cumulative megafauna hotspots. Proceedings of the National Academy of Sciences 111(14):5271-5276.

Marine Mammal Protected Areas Task Force, I. M. M. P. A. T. 2018. Guidance on the use of selection criteria for the identification of Important Marine Mammal Areas (IMMAs). Version: March 2018, Available online from https://www.marinemammalhabitat.org/download/guidance-on-the-use-of-selection-criteria-for-the-identification-of-important-marine-mammal-areas-immas/:82.

O'Connor, S., R. Campbell, H. Cortez, and T. Knowles. 2009. Whale Watching Worldwide: tourism numbers, expenditures and expanding economic benefits; a special report from the International Fund for Animal Welfare, Yarmouth MA, USA.

Panigada, S., G. Pesante, M. Zanardelli, F. Capoulade, A. Gannier, and M. T. Weinrich. 2006. Mediterranean fin whales at risk from fatal ship strikes. Marine Pollution Bulletin 52(10):1287-1298.

Perrin, W. F., R. R. Reeves, M. L. L. Dolar, T. A. Jefferson, H. Marsh, J. Y. Wang, and J. Estacion. 2005. Report of the Second Workshop on The Biology and Conservation of Small Cetaceans and Dugongs of South-East Asia. CMS Technical Series Publication No. 9, Convention on Migratory Species (CMS), Silliman University, Dumaguete City, Philippines.

Pirotta, V., A. Grech, I. D. Jonsen, W. F. Laurance, and R. G. Harcourt. 2019. Consequences of global shipping traffic for marine giants. Frontiers in Ecology and the Environment 17(1):39-47. doi: doi:10.1002/fee.1987

Priyadarshana, T., S. M. Randage, A. Alling, S. Calderan, J. Gordon, R. Leaper, and L. Porter. 2016. Distribution patterns of blue whale (*Balaenoptera musculus*) and shipping off southern Sri Lanka. Regional Studies in Marine Science 3:181-188.

Roman, J., J. A. Estes, L. Morissette, C. Smith, D. Costa, J. McCarthy, J. Nation, S. Nicol, A. Pershing, and V. Smetacek. 2014. Whales as marine ecosystem engineers. Frontiers in Ecology and the Environment 12(7):377-385.

Temple, A. J., J. J. Kiszka, S. M. Stead, N. Wambiji, A. Brito, C. N. S. Poonian, O. A. Amir, N. Jiddawi, S. T. Fennessy, S. Pérez-Jorge, and P. Berggren. 2018. Marine megafauna interactions with small-scale fisheries in the southwestern Indian Ocean: a review of status and challenges for research and management. Reviews in Fish Biology and Fisheries (journal article) doi: 10.1007/s11160-017-9494-x

Temple, A. J., N. Wambiji, C. N. S. Poonian, N. Jiddawi, S. M. Stead, J. J. Kiszka, and P. Berggren. 2019. Marine megafauna catch in southwestern Indian Ocean small-scale fisheries from landings data. Biological Conservation 230:113-121. doi: https://doi.org/10.1016/j.biocon.2018.12.024

Tulloch, V. J. D., É. E. Plagányi, C. Brown, A. J. Richardson, and R. Matear. 2019. Future recovery of baleen whales is imperiled by climate change. Global Change Biology 0(0)doi: doi:10.1111/gcb.14573

Willson, A., J. Kowalik, B. J. Godley, R. Baldwin, A. Struck, L. Struck, R. Nawaz, and M. J. Witt. 2016. Priorities for addressing whale and ship co-occurrence off the coast of Oman and the wider North Indian Ocean., IWC, Bled.

Zerbini, A. N., G. Adams, J. Best, P. J. Clapham, J. A. Jackson, and A. E. Punt. 2019. Assessing the recovery of an Antarctic predator from historical exploitation. Royal Society Open Science 6(10):190368. doi: doi:10.1098/rsos.190368

Mascarene Islands Bibliography

Allen, S. J., J. A. Tyne, H. T. Kobryn, L. Bejder, K. H. Pollock, and N. R. Loneragan. 2014. Patterns of Dolphin Bycatch in a North-Western Australian Trawl Fishery. PLoS ONE 9(4):e93178.

Anderson, R. C., M. Herrera, A. D. Ilangakoon, K. Koya, M. Moazzam, P. L. Mustika, and D. N. Sutaria. 2020. Cetacean bycatch in Indian Ocean tuna gillnet fisheries. Endangered Species Research 41:39-53.

Cates, K., D. P. DeMaster, R. L. Brownell Jr, G. K. Silber, S. Gende, R. Leaper, F. Ritter, and S. Panigada. 2017. Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020, International Whaling Commission, Cambridge, United Kingdom.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4(4):1-16. doi: 10.1890/ES13-00004.1

de Souza, E. N., K. Boerder, S. Matwin, and B. Worm. 2016. Improving Fishing Pattern Detection from Satellite AIS Using Data Mining and Machine Learning. PLOS ONE 11(7):e0158248. doi: 10.1371/journal.pone.0158248

Dulau-Drouot, V., J. Fayan, L. Mouysset, and V. Boucaud. 2012. Occurence and residency pattern of humpback whale in Reunion Island (France) during 2004–2008. J Cetacean Res Manage 12

Dulau, V., V. Estrade, and J. Fayan. 2017a. Identifying key demographic parameters of a small island–associated population of Indo-Pacific bottlenose dolphins (Reunion, Indian Ocean). PLOS ONE 12(6):e0179780. doi: 10.1371/journal.pone.0179780

Dulau, V., P. Pinet, Y. Geyer, J. Fayan, P. Mongin, G. Cottarel, A. Zerbini, and S. Cerchio. 2017b. Continuous movement behavior of humpback whales during the breeding season in the southwest Indian Ocean: on the road again! Movement Ecology 5(1):11. (journal article) doi: 10.1186/s40462-017-0101-5

Estrade, V., and V. Dulau. In Press. Abundance and site fidelity of bottlenose dolphins off a remote oceanic island (Reunion), southwest Indian Ocean. Marine Mammal Science

FAO. 2016. State of the World's Fisheries and Aquaculture 2016: Contributing to Food security and nutrition for all, Food and Agriculture Organization of the United Nations, Rome.

Gerrodette, T., and J. Forcada. 2005. Non-recovery of two spotted and spinner dolphin populations in the eastern tropical Pacific Ocean. Marine Ecology Progress Series 291:1–21.

Hall, M., and M. Román-Verdesoto. 2013. Bycatch and Non-Tuna Catch in the Tropical Tuna Purse Seine Fisheries of the World, FAO, Rome.

Herman, E. Y. K., L. M. Herman, A. A. Pack, G. Marshall, M. C. Shepard, and M. Bakhtiari. 2007. When Whales Collide: Crittercam Offers Insight into the Competitive Behavior of Humpback Whales on Their Hawaiian Wintering Grounds. Marine Technology Society Journal 41(4):35-43. doi: 10.4031/002533207787441971

Huijser, L. A. E., V. Estrade, I. Webster, L. Mouysset, A. Cadinouche, and V. Dulau-Drouot. 2020. Vocal repertoires and insights into social structure of sperm whales (*Physeter macrocephalus*) in Mauritius, southwestern Indian Ocean. Marine Mammal Science n/a(n/a)doi: 10.1111/mms.12673

IMO. 2009. Guidance Document for Minimizing the Risk of Ship Strikes with Cetaceans, International Maritime Organization, London.

IMO. 2016. Identification and protection of Special Areas and PSSAs: Information on recent outcomes regarding minimizing ship strikes to cetaceans Submitted by the International Whaling Commission.

IWC. 1994. Report of the workshop on mortality of cetaceans in passive fishing nets and traps. In: W. F. Perrin, G. P. Donovan and J. Barlow, editors, Gillnets and Cetaceans, Reports of the International Whaling Commission, Special Issue 15. International Whaling Commission, Cambridge. p. 1-72.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Laran, S., M. Authier, O. Van Canneyt, G. Dorémus, P. Watremez, and V. Ridoux. 2017. A Comprehensive Survey of Pelagic Megafauna: Their Distribution, Densities, and Taxonomic Richness in the Tropical Southwest Indian Ocean. Frontiers in Marine Science 4(139)(Original Research) doi: 10.3389/fmars.2017.00139

Leaper, R. 2019. The Role of Slower Vessel Speeds in Reducing Greenhouse Gas Emissions, Underwater Noise and Collision Risk to Whales. Frontiers in Marine Science 6(505)(Original Research) doi: 10.3389/fmars.2019.00505

Lewison, R. L., and L. B. Crowder. 2007. Putting Longline Bycatch of Sea Turtles into Perspective. Conservation Biology 21(1):79-86. doi: 10.1111/j.1523-1739.2006.00592.x

Lewison, R. L., L. B. Crowder, B. P. Wallace, J. E. Moore, T. Cox, R. Zydelis, S. McDonald, A. DiMatteo, D. C. Dunn, and C. Y. Kot. 2014. Global patterns of marine mammal, seabird, and sea turtle bycatch reveal taxa-specific and cumulative megafauna hotspots. Proceedings of the National Academy of Sciences 111(14):5271-5276.

Lindstad, H., B. E. Asbjørnslett, and A. H. Strømman. 2011. Reductions in greenhouse gas emissions and cost by shipping at lower speeds. Energy Policy 39(6):3456-3464. doi: https://doi.org/10.1016/j.enpol.2011.03.044

McKenna, M. F., J. Calambokidis, E. M. Oleson, D. W. Laist, and J. A. Goldbogen. 2015. Simultaneous tracking of blue whales and large ships demonstrates limited behavioral responses for avoiding collision. Endangered Species Research 27(3):219-232.

Miller, P. J. O., K. Aoki, L. E. Rendell, and M. Amano. 2008. Stereotypical resting behavior of the sperm whale. Current Biology 18(1):R21-R23. doi: 10.1016/j.cub.2007.11.003

Natale, F., M. Gibin, A. Alessandrini, M. Vespe, and A. Paulrud. 2015. Mapping Fishing Effort through AIS Data. PLOS ONE 10(6):e0130746. doi: 10.1371/journal.pone.0130746

Northridge, S., A. Coram, A. Kingston, and R. Crawford. 2017. Disentangling the causes of protected-species bycatch in gillnet fisheries. Conservation Biology 31:686-695. doi: doi:10.1111/cobi.12741

Notarbartolo di Sciara, G., E. Hoyt, R. Reeves, J. Ardron, H. Marsh, D. Vongraven, and B. Barr. 2016. Place-based approaches to marine mammal conservation. Aquatic Conservation: Marine and Freshwater Ecosystems 26:85-100. doi: 10.1002/aqc.2642

Passadore, C., A. Domingo, and E. R. Secchi. 2015. Depredation by killer whale (*Orcinus orca*) and false killer whale (*Pseudorca crassidens*) on the catch of the Uruguayan pelagic longline fishery in Southwestern Atlantic Ocean. ICES Journal of Marine Science 72(5):1653-1666. doi: 10.1093/icesjms/fsu251

Payet, R. 2005. Research, assessment and management on the Mascarene Plateau: a large marine ecosystem perspective. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 363(1826):295-307.

Read, A., P. Drinker, and S. P. Northridge. 2006. Bycatch of Marine Mammals in U.S. and Global Fisheries. Conservation Biology 20(1):163-169.

Read, A. J. 2008. The looming crisis: interactions between marine mammals and fisheries. Journal of Mammalogy 89(3):541-548.

Redfern, J., M. McKenna, T. Moore, J. Calambokidis, M. Deangelis, E. Becker, J. Barlow, K. Forney, P. Fiedler, and S. Chivers. 2013. Assessing the Risk of Ships Striking Large Whales in Marine Spatial Planning. Conservation Biology 27(2):292-302.

Redfern, J. V., E. A. Becker, and T. J. Moore. 2020. Effects of Variability in Ship Traffic and Whale Distributions on the Risk of Ships Striking Whales. Frontiers in Marine Science 6(793)(Original Research) doi: 10.3389/fmars.2019.00793

Reeves, R. R., A. J. Read, and G. Notarbartolo-di-Seiara. 2001. Report of the workshop on interactions between dolphins and fisheries in the Mediterranean: evaluation of mitigation alternatives ICRAM.

Richard, G., J. Bonnel, P. Tixier, J. P. Y. Arnould, A. Janc, and C. Guinet. 2019. Evidence of deep-sea interactions between toothed whales and longlines. Ambio (journal article) doi: 10.1007/s13280-019-01182-1

Romanov, E. V. 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100(1):90-105.

Smith, J. N., N. Kelly, S. Childerhouse, J. V. Redfern, T. J. Moore, and D. Peel. 2020. Quantifying Ship Strike Risk to Breeding Whales in a Multiple-Use Marine Park: The Great Barrier Reef. Frontiers in Marine Science 7(67)(Original Research) doi: 10.3389/fmars.2020.00067

Temple, A. J., N. Wambiji, C. N. S. Poonian, N. Jiddawi, S. M. Stead, J. J. Kiszka, and P. Berggren. 2019. Marine megafauna catch in southwestern Indian Ocean small-scale fisheries from landings data. Biological Conservation 230:113-121. doi: https://doi.org/10.1016/j.biocon.2018.12.024

Thomas, P. O., R. R. Reeves, and R. L. Brownell. 2015. Status of the world's baleen whales. Marine Mammal Science doi: 10.1111/mms.12281

UNCTAD. 2018. Review of Maritime Transport 2018, United Nations, Geneva.

Van Waerebeek, K., and R. Leaper. 2008. Second Report of the IWC Vessel Strike Data Standardisation Working Group, International Whaling Commission, Santiago, Chile.

Vanderlaan, A. S. M., and C. T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23(1):144-156. doi: 10.1111/j.1748-7692.2006.00098.x

Vespe, M., M. Gibin, A. Alessandrini, F. Natale, F. Mazzarella, and G. C. Osio. 2016. Mapping EU fishing activities using ship tracking data. Journal of Maps 12(sup1):520-525. doi: 10.1080/17445647.2016.1195299

Wade, P. 1996. Revised estimates of incidental kill of dolphins (Delphinidae) by the purse-seine tuna fishery in the eastern tropical Pacific, 1959-1972. Oceanographic Literature Review 1(43):69.

Wallace, B. P., C. Y. Kot, A. D. DiMatteo, T. Lee, L. B. Crowder, and R. L. Lewison. 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. Ecosphere 4(3):1-49. doi: 10.1890/ES12-00388.1

Webster, I., V. G. Cockcroft, and A. Cadinouche. 2014. Abundance of the Indo-Pacific bottlenose dolphin *Tursiops aduncus* off south-west Mauritius. African Journal of Marine Science 36(3):293-301. doi: 10.2989/1814232X.2014.946448

Webster, I., V. G. Cockcroft, and A. Cadinouche. 2015. Spinner dolphins Stenella longirostris off south-west Mauritius: abundance and residency. African Journal of Marine Science 37(1):115-124. doi: 10.2989/1814232X.2015.1017004

Weiss, J., J. Duchêne, S. Le Blond, H. Evano, S. Demanèche, P. Berthou, Le Roy, and E. Leblond. 2018. Synthèse des pêcheries de Réunion, Délégation IFREMER océan Indien Station de La Réunion, La Reunion.

Werner, T. B., S. Northridge, K. M. Press, and N. Young. 2015. Mitigating bycatch and depredation of marine mammals in longline fisheries. ICES Journal of Marine Science 72(5):1576-1586. doi: 10.1093/icesjms/fsv092

Whitehead, H. 2009. Sperm Whale, *Physeter macrocephalus*. In: W. Perrin, B. Wursig and J. G. M. Thewissen, editors, Encyclopedia of Marine Mammals. Elsevier, San Francisco. p. 1091-1097.

Savu Sea Bibliography

Alonso Población, E. 2013. Fisheries and food security in Timor-Leste: the effects of ritual meat exchanges and market chains on fishing. Food Security 5(6):807-816. doi: 10.1007/s12571-013-0308-2

Dharmadi, D., and N. N. Wiadnyana. 2011. Status and research activities on marine mammals in Indonesia Proceedings of the 6th International Symposium on SEASTAR2000 and Asian Bio-logging Science ((The 10th SEASTAR2000 workshop). p 69-74. Kuoto University, Phuket, Thailand.

Double, M. C., V. Andrews-Goff, K. C. S. Jenner, M.-N. Jenner, S. M. Laverick, T. A. Branch, and N. J. Gales. 2014. Migratory Movements of Pygmy Blue Whales (<italic>Balaenoptera musculus brevicauda</italic>) between Australia and Indonesia as Revealed by Satellite Telemetry. PLoS ONE 9(4):e93578. doi: 10.1371/journal.pone.0093578

Halpin, P. N., A. J. Read, B. D. Best, K. D. Hyrenbach, E. Fujioka, M. S. Coyne, L. B. Crowder, S. A. Freeman, and C. Spoerri. 2006. OBIS-SEAMAP: developing a biogeographic research data commons for the ecological studies of marine mammals, seabirds, and sea turtles. Marine Ecology Progress Series 316:230-246.

Hoffman, C. C. 1998. First account of Bryde's whales *Balaenoptera edeni* (Anderson, 1878), and of Spinner dolphins *Stenella longirostris* (Gray, 1828), from Komodo Island, Indonesia. The Raffles Bulletin of Zoology 46(2):324.

Kahn, B. 2007. Blue whales of the Savu Sea, Indonesia Paper presented at the 17th Biennial Marine Mammal Conference - Blue Whale Workshop, Cape Town, South Africa.

Kaschner, K., N. J. Quick, R. Jewell, R. Williams, and C. M. Harris. 2012. Global Coverage of Cetacean Line-Transect Surveys: Status Quo, Data Gaps and Future Challenges. PLoS ONE 7(9):e44075. doi: 10.1371/journal.pone.0044075

Kot, C. Y., E. Fujioka, L. J. Hazen, B. D. Best, A. J. Read, and P. N. Halpin. 2010. Spatio-Temporal Gap Analysis of OBIS-SEAMAP Project Data: Assessment and Way Forward. PLoS ONE 5(9):e12990. doi: 10.1371/journal.pone.0012990

Lindstad, H., B. E. Asbjørnslett, and A. H. Strømman. 2011. Reductions in greenhouse gas emissions and cost by shipping at lower speeds. Energy Policy 39(6):3456-3464. doi: https://doi.org/10.1016/j.enpol.2011.03.044

Longépé, N., G. Hajduch, R. Ardianto, R. d. Joux, B. Nhunfat, M. I. Marzuki, R. Fablet, I. Hermawan, O. Germain, B. A. Subki, R. Farhan, A. D. Muttaqin, and P. Gaspar. 2018. Completing fishing monitoring with spaceborne Vessel Detection System (VDS) and Automatic Identification System (AIS) to assess illegal fishing in Indonesia. Marine Pollution Bulletin 131:33-39. doi: https://doi.org/10.1016/j.marpolbul.2017.10.016

McKenna, M. F., J. Calambokidis, E. M. Oleson, D. W. Laist, and J. A. Goldbogen. 2015. Simultaneous tracking of blue whales and large ships demonstrates limited behavioral responses for avoiding collision. Endangered Species Research 27(3):219-232.

Miller, P. J. O., K. Aoki, L. E. Rendell, and M. Amano. 2008. Stereotypical resting behavior of the sperm whale. Current Biology 18(1):R21-R23. doi: 10.1016/j.cub.2007.11.003

Monnahan, C. C., T. A. Branch, and A. E. Punt. 2015. Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales? Marine Mammal Science 31(1):279-297. doi: 10.1111/mms.12157

Mujiyanto, M., R. Riswanto, D. Dharmadi, and W. Ghiffary. 2018. Composition and Distribution of Dolphin in Savu Sea National Marine Park, East Nusa Tenggara. Indonesian Fisheries Research Journal 23:55. doi: 10.15578/ifrj.23.2.2017.55-67

Mustika, P. L. K. 2006. Marine Mammals in the Savu Sea (Indonesia); indigenous knowledge, threat analysis and management options, James Cook University, Australia.

Mustika, P. L. K., P. Hutasoit, C. C. Madusari, F. S. Purnomo, A. Setiawan, K. Tjandra, and W. E. Prabowo. 2009. Whale strandings in Indonesia, including the first record of a humpback whale (*Megaptera novaeangliae*) in the Archipelago. The Raffles Bulletin of Zoology 57(1):199-206.

Perdanahardja, G., and H. Lionata. 2017. Nine Years in Lesser Sunda:, The Nature Conservancy.

Ramenzoni, V. C. 2013. Endenese Fisheries: Exploratory Findings on Environmental Perceptions, Fish Effort, and Overfishing in Eastern Indonesia. Ethnobiology Letters 4(0)doi: 10.14237/ebl.4.2013.8

Redfern, J. V., E. A. Becker, and T. J. Moore. 2020. Effects of Variability in Ship Traffic and Whale Distributions on the Risk of Ships Striking Whales. Frontiers in Marine Science 6(793)(Original Research) doi: 10.3389/fmars.2019.00793

Rockwood, R. C., J. Calambokidis, and J. Jahncke. 2017. High mortality of blue, humpback and fin whales from modeling of vessel collisions on the U.S. West Coast suggests population impacts and insufficient protection. PLOS ONE 12(8):e0183052. doi: 10.1371/journal.pone.0183052

Vanderlaan, A. S. M., and C. T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23(1):144-156. doi: 10.1111/j.1748-7692.2006.00098.x

Whitehead, H. 2009. Sperm Whale, *Physeter macrocephalus*. In: W. Perrin, B. Wursig and J. G. M. Thewissen, editors, Encyclopedia of Marine Mammals. Elsevier, San Francisco. p. 1091-1097.

Wijonamo, A., A. H. Ardisastra, C. Yusuf, C. Desyana, I. Aminuddin, J. T. Wibowo, M. E. Lazuardi, M. R. Hakim, N. EWisesa, and V. Adriano. 2020. WWF Indonesia Conservation Highlight: Marine and Fisheries: July-December 2019, WWF Indonesia.