Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

IOTC-2023-CoC20-06 [E]

REPORT ON FISHING CAPACITY

Prepared by IOTC Secretariat, 4 April 2023

The Compliance Committee at its 19th Session, noting the value of past reports[1] on fishing capacity produced under Resolution 15/11 *On the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*, and its earlier versions, requested the IOTC Secretariat to report on effective fishing capacity of the vessels on the IOTC Record of Authorised Vessels (RAV) for consideration by the future Compliance Committee meetings.

1. BACKGROUND

Fishing overcapacity is a major threat to fisheries sustainability and a key factor contributing to the decline of tuna fisheries. Effective fishing capacity management is essential to prevent or eliminate over-fishing and excess capacity and to ensure that levels of fishing effort do not exceed those commensurate with sustainable use of fishery resources[2]. Within the context of the IOTC, over the past decade over-fishing has impacted main stocks of tuna and billfishes species, drawing some to the overfished status. The estimation and regulation of fishing capacity levels becomes of paramount importance, although not without difficulties. Tuna fisheries in the IOTC area is characterized by fleets with a large range of vessel sizes and gear types. As result, relevant data on certain fleet segments (artisanal vessels), vessel characteristics (engine power) or vessel operations (number of days fishing and catch) is scarce, not available or when available, very aggregated, as required by the Commission. To aggravate this, vessel fishing capacity is not constant and varies over time due to, inter alia, technological innovation and changes in fishing operations.

Notwithstanding the difficulties outlined above, the IOTC has over the years implemented measures to limit fishing capacity. At first, Resolution 03/01 *On the limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*, prohibited CPCs, whose number of vessels in the RAV exceeded 50 units, to increase their numbers beyond the ones reported in 2003. Subsequently, a series of Resolutions superseded by Resolution 15/11 *On the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*, further limited the fishing capacity of fleets actively targeting tropical tuna and albacore plus swordfish, to the capacity measured in gross tonnage of active vessels in 2006 and 2007, respectively. Further to the above, a Working Party on Fishing Capacity, later incorporated into the Working Party on Tropical Tunas was constituted, and two relevant studies were presented to the Commission[3] (IOTC-2010-S14-04) on 2010, and the IOTC Scientific Committee[4] (IOTC-2013-SC16-INF04) on 2013.

2. DEFINITION OF FISHING CAPACITY

Fishing capacity has been used and defined differently in a variety of contexts. To shed light on it, the Food and Agriculture Organisation of the United Nations (FAO) through a Technical Consultation on the Measurement of Fishing

[1] Pursuant to Resolution 15/11, and its earlier versions, the IOTC Secretariat produced from 2011 to 2015, reports on fishing capacity and fleet development plans. Last report is available here.
[2] As per article 5(h) of the United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (available here)
[3] IOTC. Estimating the Fishing Capacity of the Tuna Fleets in the Indian Ocean. R. Gillett & M. Herrera.
[4] G. Moreno & Herrera, M. (IOTC Secretariat), 2013. Estimation of fishing capacity by tuna fishing fleets in the Indian Ocean.

Capacity held in Mexico, in 1999, agreed on a definition of fishing capacity that is both input (e.g. effort, boat numbers, etc.) and output (catch) based:

"Fishing capacity is the maximum amount of fish over a period of time (year, season) that can be produced by a fishing fleet if fully utilized, given the biomass and age structure of the fish stock and the present state of the technology."

Fishing effort in turn, is generally defined as the time spent searching for fish and/or the amount of fishing gear of a specific type used on a particular fishery over a given unit of time. Fishing capacity results from multiplying this time by a measure of fishing capacity (e.g. engine power or tonnage)

3. SCOPE

The RAV constitutes an essential tool for fisheries management in the IOTC area that contributes to the assessment of existing fishing capacity by gathering input data on the number and tonnage of vessels by fleet, vessel type, fishing gear and more recently, the total volume of fish holds. The RAV, compiles information on fishing vessels that are 24 meters in length overall (LOA) or above, and vessels below 24 meters that are authorised to operate in waters outside the Economic Exclusive Zone (EEZ) of the flag State. Fishing vessels in the RAV also include auxiliary, supply and support vessels, however, its vessel coverage calls for caution, due to a number of reasons:

- The exclusion of fishing vessels below 24 m LOA operating exclusively within their national EEZ. This fleet segment is the largest in number[5] of units and comprises a wide array of vessels with vastly different characteristics and fishing power. They range from pirogues to "semi-industrial" 15-24 m LOA vessels capable of targeting tuna offshore. Consequently, the RAV leaves out a great portion of fishing capacity pertaining to coastal States.
- The exclusion of transport vessels participating in transhipment operations. Transhipment operations at sea, contribute largely to increased fishing capacity of large-scale longliners through enhanced fishing effort (number of days fishing) and consequently catch and profitability.
- The presence in the RAV does not imply a vessel has been active in the IOTC area of competence during its period of authorisation.

The accurate estimate of fishing capacity is complex and requires not only access to data but also the in-depth analysis of fleets' characteristics with a view to identify representative fleet segments in consideration of the existing differences between them. Such a detailed study is beyond the scope of this paper that intends to give a simplified overview, based on input data available in the RAV from 2015 to 2022. For the purposes of the study, the fleet segments proposed are based on length categories (>24 m, < 24 m) and gear types. The input data used as simple indicators of fishing capacity are the number of vessels, LOA and tonnage. Given that the provision of vessel data on fishing gears and period of authorisations only became mandatory from November 2014, the year 2015 was established as baseline. Authorisation periods were used to estimate the number of vessels per year.

4. RESULTS

4.1. Total number of vessels by gear type, vessel length category and year

The measure of effort depends on the fishery and gear type used. Gear information with other fishing capacity indicators (e.g., engine power, vessel numbers, length or tonnage), provides a better understanding of fishing capacity across vessel classes and fleet segments.

The total number of vessels is presented summarized by gear group, length category and year in Table 1 (Annex I contains details by gear type). In the context of the IOTC, the largest portion of vessels are below 24 meters LOA (61%)

[5] G. Moreno & Herrera, M. (IOTC Secretariat), 2013. Estimation of fishing capacity by tuna fishing fleets in the Indian Ocean. Report presented at the 16th Session of the Scientific Committee of the Indian Ocean Tuna Commission. Busan, Republic of Korea, 2–6 December 2013. IOTC–2013–SC16–INF04.

and use drifting longlines and gillnets as main gear types. Based on the length category figures for 2022, major gear types for vessels over 24 meters LOA use drifting gillnets, longlines and a combination of hand line and pole and line. Vessels below 24 meters LOA, primarily use gillnets, longlines and a combination of multiple gears. Vessels below 24 meters LOA, although can target certain species of tuna offshore, due to their limited autonomy, stay to a large degree opportunistic. As such, depending on the season or availability of species, they can rapidly change gears and target species. Fishing capacity would be, therefore, dependant on the number of days fished with each gear type during the course of the year.

Table 1: number of vessels by gear type, length category and year

Gear Group	Total number of vessels								By length (2022)	
	2015	2016	2017	2018	2019	2020	2021	2022	<24	24+
Gillnet	1,390	1,370	1,388	1,357	1,390	1,358	1,499	1,670	1,190	480
Line	1,100	885	853	1,397	1,354	816	802	743	372	371
Longline	2,294	1,888	1,674	1,694	1,683	1,550	1,644	1,901	1,105	783
Multipurpose	2,374	942	862	833	1,286	415	442	405	403	2
Purse Seine	243	224	227	320	294	274	249	293	0	293
Supply	25	15	12	23	18	13	15	14	0	14
Trawl	10	10	6	5	5	5	2	2	0	2
Unknown	3	4								
Total	**7,439**	**5,282**	**4,967**	**5,963**	**6,661**	**4,389**	**4,612**	**4,986**	**3,044**	**1,941**

4.2. Total number of vessels by fleet, vessel length category and year

The grouping of vessels by length category and fleet points out which fleets account for larger numbers of vessels above or below 24 meters LOA, giving a rough image of their level of industrialization. Notwithstanding the foregoing, the existing large operational differences and fishing power within each length category and across fleets remains unknown. Although this grouping does not help to further reduce the variability within each fleet segment, depicts the evolution on vessel numbers by fleet throughout the years.

The number of vessels by fleet and year presented in Table 2, reflects an overall reduction on fleet numbers from 2015 to 2022. The sharp drop on vessel numbers observed for 2020 and 2021, might correspond to special circumstances and restrictions imposed during Covid19. Main fleets responsible of this overall downward trend are the European Union, Maldives and Indonesia.

Table 2: number of vessels by CPC and year

CPCs	Total number of vessels								By length (2022)	
	2015	2016	2017	2018	2019	2020	2021	2022	<24	24+
Australia	90	84	85	141	83	64	59	62	48	14
China	125	119	109	147	162	118	113	110		110
European Union	592	378	272	287	216	118	101	108	21	87
India	56	56	25	8	8	4	4	4		4
Indonesia	617	347	343	548	480	419	456	514	116	397
Iran, Islamic Republic of	1,353	1,353	1,353	1,353	1,310	1,310	1,310	1,310	815	495
Japan	270	246	226	239	239	204	193	191		191
Kenya		1	1	4	3	9	12	7		7
Korea, Republic of	186	113	101	114	115	85	61	70		70
Madagascar	7	5	5	5	5			5	5	
Malaysia	10	15	19	25	37	19	20	20		20
Maldives	1,070	866	857	1,407	1,352	786	771	725	356	369
Mauritius	7	12	8	31	27	4	4	18		18
Mozambique	12	12	12	12	12	24	24	12	12	
Oman	32	29	2	2	2	1	4	7	2	5
Philippines	63	55	55	55	55	55	55	55		55
Seychelles	73	83	80	119	143	103	96	90	26	64
South Africa	23	29	29	50	37	35	35	10	6	4
Sri Lanka	2,808	1,469	1,380	1,411	2,371	1,027	1,289	1,659	1,637	22
Tanzania	4	3	1		1	1	1	5		5
Thailand	9	4	4	5	3	3	3	3		3
United Kingdom*							1	1		1
Vanuatu**	31	1								
Liberia***	1	1								
Senegal****		1								
Total	**7,439**	**5,282**	**4,967**	**5,963**	**6,661**	**4,389**	**4,612**	**4,986**	**3,044**	**1,941**

*Membership in respect of only its Territory in the Indian Ocean from February 1995. Membership in respect of the United Kingdom of Great Britain and Northern Ireland since December 2020.
**Vanuatu was an IOTC Member until 31 December 2015.
***Liberia is an CNCP since 2015. Liberia stated that will not engage in any harvesting activities in the IOTC area of competence.
****Senegal was granted status as CNCP between 26 May 2006 to 20 May 2022.

4.3. Average vessel size (expressed on average GT or LOA) by year

Unlike tonnage, engine power or vessel numbers, average vessel size although not usually consider a common indicator of fishing capacity, is an important parameter when assessing fishing power. Larger vessels generally have a larger fishing power than smaller vessels and can travel further. Besides, average size figures allow for a relative comparison between fleets or vessel types, providing a more accurate measure of fleet industrialization.

Within the context of the IOTC, Table 3 presents the average tonnage (GT) by CPC and year. In contrast to vessel numbers, vessel size shows a marginal increase from 2015 until 2022. In individual terms, Table 3 portrays the fleets of the European Union, Tanzania and Thailand in the RAV as the ones with larger vessels. Conversely, Madagascar, Maldives and Sri Lanka are the fleets with lowest vessel size in the RAV.

Table 3: average tonnage (GT) by CPC and year

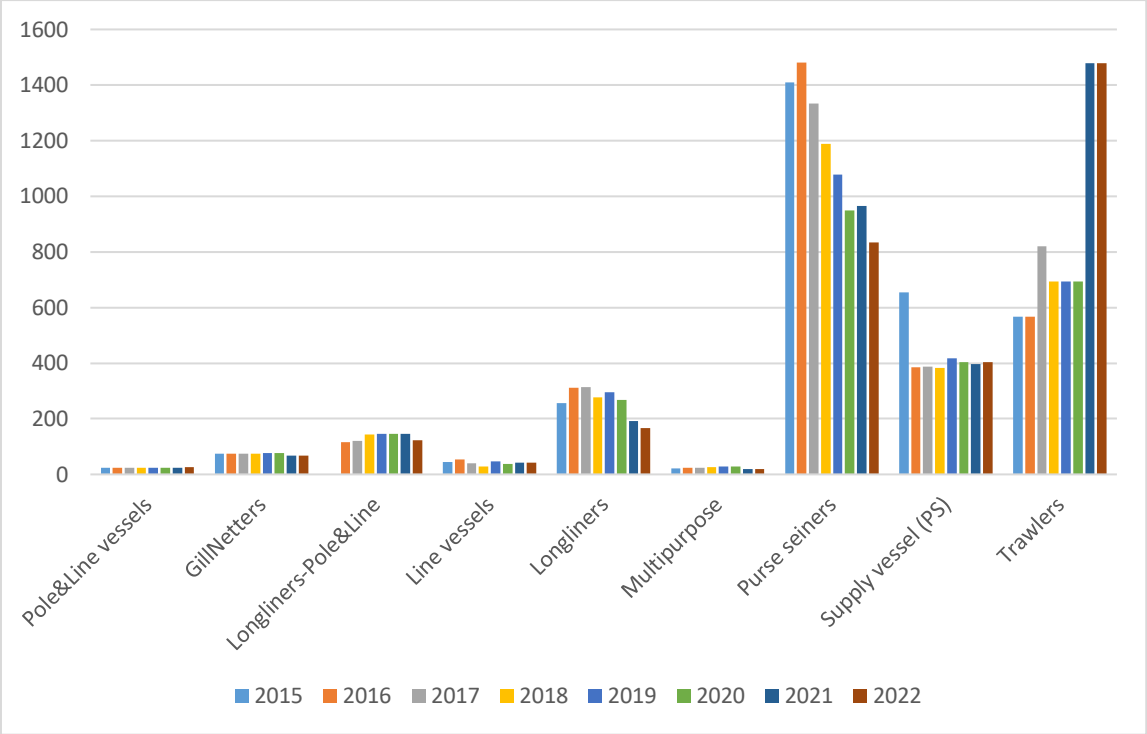
CPCs	Total number of vessels								By length (2022)	
	2015	2016	2017	2018	2019	2020	2021	2022	<24	24+
Australia	91	106	102	114	147	122	125	128	79	292
China	451	464	469	456	446	465	472	472		472
EU	339	531	659	687	695	954	983	924	61	1,132
India	109	109	100							
Indonesia	84	84	92	94	98	106	105	112	43	131
Iran, Islamic Republic of	86	86	86	86	87	87	87	87	59	134
Japan	654	651	648	669	694	671	672	661		661
Kenya		193	193	474	439	484	473	477		477
Korea, Republic of	623	740	757	744	713	747	777	759		759
Madagascar	25	27	27	27	27			30	30	
Malaysia	406	309	120	120	120	119	119	119		119
Maldives	25	26	24	25	25	23	24	25	14	36
Mauritius	1,227	746	755	591	348	2,072	2,072	791		791
Mozambique	201	201	201	201	201	125	125	36	36	
Oman	128	99	243	554	665	665	344	706	87	954
Philippines	568	427	427	427	427	427	427	427		427
Seychelles	900	805	835	961	807	676	713	694	25	966
South Africa	165	169	158	156	147	148	150	145	121	180
Sri Lanka	25	25	25	28	28	31	22	21	20	92
Tanzania	444	512	497		69	69	69	975		975
Thailand	584	1,018	1,018	854	1,291	1,291	1,293	1,293		1,293
United Kingdom*							516	516		516
Vanuatu**	505	499								
Liberia***	7,687									

* Membership in respect of only its Territory in the Indian Ocean from February 1995. Membership in respect of the United Kingdom of Great Britain and Northern Ireland since December 2020..

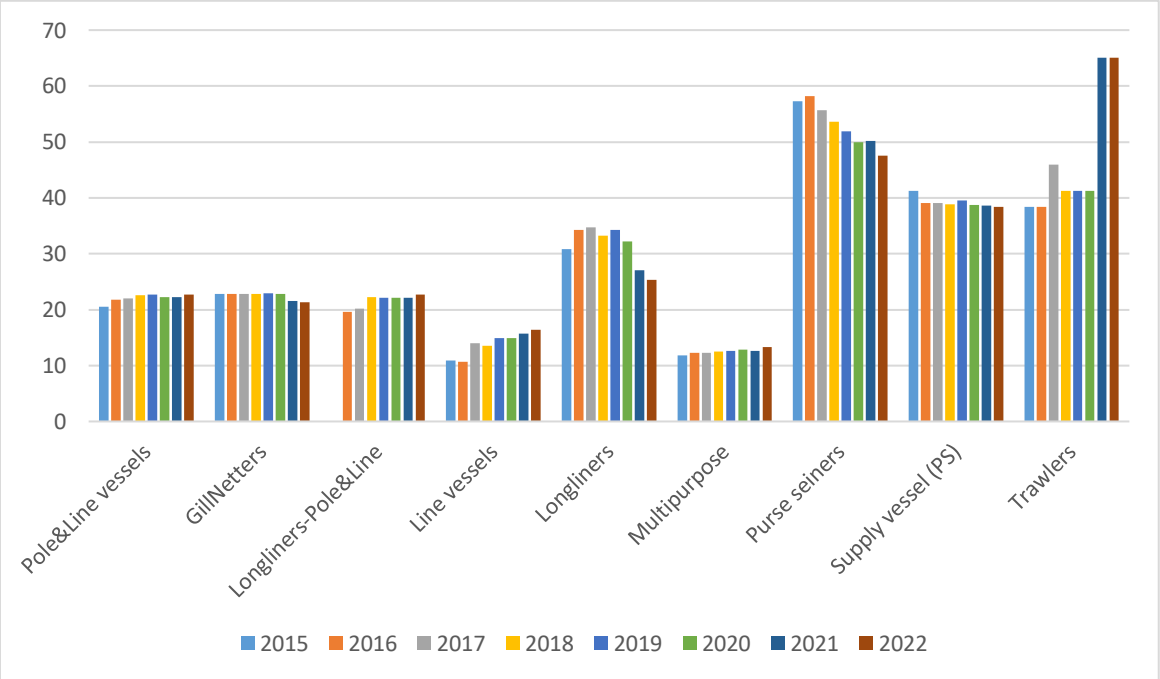
**Vanuatu was an IOTC Member until 31 December 2015.

***Liberia is a CNCP since 2015. Liberia stated that it will not engage in any harvesting activities in the IOTC area of competence.

As per Graph 1 and Graph 2, highest average vessel size values correspond to purse seiners and trawlers followed by supply vessels. Trawlers are present in small numbers, which have decreased over time down to two single large units from the Islamic Republic of Iran. Purse seiners and longliners, despite the general increase of average size by fleet, shows a declining trend in both graphs. This could respond to: the inclusion as longliners of a large number of small vessels from Sri Lanka, previously recorded as multipurpose vessels; the submission of a hundred of small vessels from Indonesia as purse seiners, and; the deregistration of large vessels from the RAV.



Graph 1: average GT by vessel type and year



Graph 2: Average LOA by vessel type and year

Purse seiners and longliners above 24 meters LOA are fleet segments that present a significant vessel variability. Large purse seiners equipped with latest technological advances such as sonars, bird radars, echo sounders, FADs and supply vessels far outweigh the fishing capacity of smaller purse seiners over 24 meters LOA. Supply vessels although do not carry fishing gears on-board, and are dedicated to deploying and maintaining FADs, do also report aggregation of tuna found under the FADs or in free-schools to purse seiners, thus increasing their fishing efficiency. As a result of the above, further characterisation of the purse seiner and longline fleets above 24 meters LOA would be necessary. Fishing capacity as occurs with vessel tonnage (GT) is not linearly proportional to LOA and, therefore, more realistically represented by the tonnage (GT), in Graph 1.

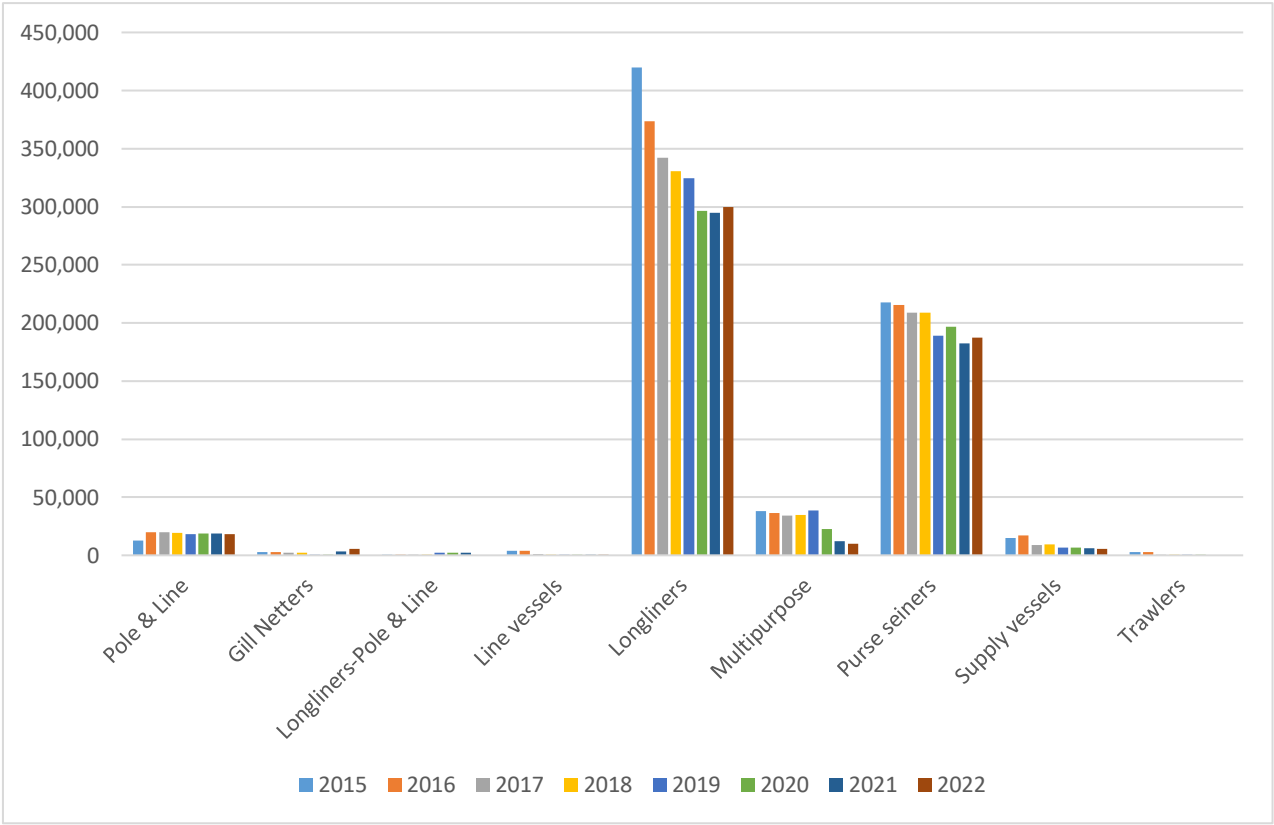
4.4. Total tonnage (GT) by year

Tonnage and engine power have been commonly used as simple measure of fishing capacity. Total tonnage (GT) by CPC and by year is presented in Table 5. In parallel to vessel numbers, fishing capacity by year expressed in total tonnage (GT) shows a declining trend through time, with a reduction close to 30% that may be reaching a plateau in 2022. Biggest contributors of this reduction are the European Union, Japan and the Republic of Korea.

Table 5: total GT by CPC and by year

CPCs	Total Tonnage (GT)								Total
	2015	2016	2017	2018	2019	2020	2021	2022	
Australia	1,891	1,760	1,766	3,013	1,961	1,410	1,314	1,393	14,508
China	5,347	5,140	4,768	6,416	6,930	5,202	5,005	4,871	43,679
European Union	14,694	13,050	10,962	11,796	8,899	5,486	4,688	4,856	74,431
India	1,673	1,673	874	293	293	147	147	147	5,246
Indonesia	14,624	8,528	8,902	14,637	13,177	11,826	12,849	14,774	99,317
Iran, Islamic Republic of	31,310	31,310	31,310	31,310	30,518	30,518	30,518	30,518	247,313
Japan	13,202	12,065	11,101	11,867	11,951	10,135	9,683	9,408	89,413
Kenya		31	31	153	111	396	530	287	1,539
Korea, Republic of	9,290	5,743	5,142	5,791	5,839	4,385	3,170	3,616	42,976
Madagascar	100	74	74	74	74			74	469
Malaysia	384	536	533	701	1,032	532	562	562	4,842
Maldives	22,100	18,762	18,609	31,494	30,569	17,458	17,152	16,450	172,594
Mauritius	407	526	328	1,091	740	298	298	866	4,554
Mozambique	290	290	290	290	290	516	516	225	2,708
Oman	802	675	70	99	99	49	142	330	2,266
Philippines	2,952	2,598	2,598	2,598	2,598	2,598	2,598	2,598	21,142
Seychelles	3,826	4,059	4,032	5,944	6,515	4,587	4,429	3,888	37,281
South Africa	576	720	694	1,214	893	833	839	249	6,018
Sri Lanka	33,589	17,984	16,986	18,134	30,723	13,838	17,614	22,888	171,756
Tanzania	187	143	49		27	27	27	215	675
Thailand	438	221	221	248	193	193	193	193	1,899
United Kingdom							45	45	90
Vanuatu	1,471	47							1,518
Liberia	117	117							233
Senegal		48							48
Total	**159,273**	**126,097**	**119,341**	**147,163**	**153,434**	**110,437**	**112,318**	**118,454**	**1,046,516**

As per Graph 3, the vessel types that suffered the biggest reductions in tonnage (GT) over time are particularly the longliners, followed by purse seiners and multipurpose vessels. Based on their large numbers and average size, longliners still concentrate the biggest amount of tonnage in the IOTC area of competence, followed by purse seiners, which although increased their numbers, reduced their average size.



Graph 3: total tonnage (GT) by vessel type and year

5. CONCLUSIONS

From 2015 to 2022, the data in the RAV shows that the IOTC area of competence has observed a general decrease on fishing capacity expressed by means of vessel numbers and tonnage (GT). The toll on tonnage reduction has primarily fallen on two types of vessels: longliners, whose numbers and average size have diminished, and; purse seiners, which although have increased on number of units, are smaller on average. Despite the above, vessel size in general remains virtually constant.

Despite that the smaller the vessel size, the more difficult to get and the less accurate the data would be, the large growing numbers and relative fishing power of vessels not included in the RAV, should not be neglected. With a view to getting a reliable estimate of fishing capacity in the IOTC area, consideration should be given to extending the RAV or Active Vessel List coverage beyond its current scope bearing in mind developing coastal States capabilities. A more comprehensive understanding on the total number of vessels fishing for IOTC species and their characteristics would contribute to a better grouping and provide a more reliable estimate of fishing capacity. A good characterization of the fleet is essential to comprehend the contribution of each fleet segment to fishing capacity.

The RAV, with its latest incorporated data reporting requirements, compiles information on vessel numbers and characteristics, which are of great value for estimating fishing capacity but not free of important limitations. Vessels in the RAV, could be fishing in other ocean areas, out of commission or targeting other species, therefore, the confirmation on whether the vessel has been active or not in the IOTC area, becomes essential. As result, the record of active vessels fishing for tunas and swordfish, complemented by information from the RAV would provide a better estimate of fishing capacity. Further to the above, the RAV alone does not include information on the number of days fishing and/or searching for IOTC species, crucial for estimating fishing effort and eventually fishing capacity. The use of data on fishing effort currently provided by the fleets, although aggregated by gears, would be of great benefit. It is worthy to note that the implementation of a regional Vessel Monitoring System (VMS) with ample coverage of vessels

currently not required to be in the RAV could provide an ideal solution to determine which vessels were active and how many days they have spent fishing.

The present study, following the request of the Compliance Committee, has used information from the RAV, namely number of vessels and tonnage, as simple measures of fishing capacity. Nonetheless, estimation of effective fishing capacity could be notably improved by progressing from input to output-based measure of fishing capacity. Despite the complexity of compiling good, disaggregated catch and fishing effort data, output-based methods would permit a more in-depth analysis of fishing capacity.

6. RECOMMENDATIONS

That the CoC20:

- **NOTE** paper IOTC-2023-CoC20-06, which provides a simplified estimate of fishing capacity in the IOTC area of competence based on the information in the RAV.
- **NOTE** previous work carried out by the IOTC Secretariat on fishing capacity, with particular regards to the studies on *Estimating the fishing capacity of the tuna fleets in the Indian Ocean* (IOTC-2010-S14-04) and *Estimation of fishing capacity by tuna fishing fleets in the Indian Ocean* (IOTC-2013-SC16-INF04).
- **NOTE** that effective fishing capacity management is essential to prevent or eliminate over-fishing.
- **NOTE** existing limitations on data sets hampering the provision of a reliable estimate on fishing capacity.
- **RECOMMEND** to explore (in collaboration with national institutions) new approaches to improve and further expand the coverage and accuracy of fishing capacity estimations within the IOTC.