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A SNAPSHOT OF THE LARGE-SCALE TROPICAL TUNA PURSE SEINE FISHING FLEETS as of June 2019

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Abstract

Purse seine vessels account for about 65% of the world's tuna catch. However, the number of purse seiners operating in the various oceans is not available from a single source. In this paper we estimate the number and fishing capacity of tuna purse seiners based primarily on information available from the five tuna Regional Fishery Management Organizations (RFMOs). After accounting for possible duplicate entries, we calculate that as of June 2019 there are at least 1,843 purse seiners fishing for tunas worldwide. This is surely an underestimate because many small-scale purse seiners or purse seiners operating in only one EEZ do not have to be listed on RFMO records of authorized fishing vessels. Focusing on large-scale purse seiners (defined here as having 335 m^3 fish hold volume or greater) that target tropical tunas (skipjack, yellowfin and bigeye), we calculate there are 686 such vessels with a combined fishing capacity of over 869,000 m^3. The number of these vessels increased by about 2% during the past year. Of those 686 large scale purse seine vessels fishing for tropical tunas, 515 are registered on the ISSF Pro Active Vessel Register (PVR), which represent 75% in number and 83% in fish hold volume (FHV). About 18% of these 686 large-scale vessels are authorized to fish in more than one RFMO, which should be taken into account in any efforts to manage fishing capacity at a regional level.

July 2019

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Research Questions

This study aimed at responding the following questions:

- What is the **current number and capacity of purse seine vessels targeting tuna worldwide**?
- What proportion of that capacity is represented by those **large-scale purse seiners that target exclusively tropical tuna**?
- How has the estimated global capacity **changed since last year**?
- Where are large-scale purse seine vessels targeting tropical tuna **authorized to fish**?
- What is the **trend in flagging changes** between developed-country economies and developing ones?
- How many large-scale purse seine vessels targeting tropical tuna have been **built in the last few years**?

1. Introduction

Purse seine fishing vessels catch about 65% of the 4.9 million tonnes of tunas taken annually worldwide (ISSF, 2019). Of the tropical tunas, purse seiners generally target skipjack and yellowfin, though they also catch bigeye tuna associated primarily with floating objects.

In recent years, several authors have estimated the number of vessels and fishing capacity of tropical tuna purse seine fleets either regionally (e.g., Gillett and Lewis, 2003) or globally (Joseph, 2003; Reid et al., 2005; Restrepo and Forrestal, 2012; Justel-Rubio and Restrepo, 2014, 2015, and 2016; Justel-Rubio *et al.*, 2017 and 2018). The aim of this paper is to provide an updated "snapshot" of the purse seine fleet as of June 2019 based primarily on the records of authorized vessels established by the five tuna RFMOs, as in Restrepo and Forrestal (2012) and all subsequent versions of this study. Some of the key factors taken into consideration in this series of studies are new vessels that are launched and improvements to the data contained in the RFMO records.

2. Methods

The Glossary (Appendix 1) defines acronyms used in this document.

We generally used the same sources of information and methodology as in the 2018 snapshot (Justel-Rubio *et al.*, 2018). Vessel registers from all tuna RFMOs were consulted, as well as the International Handling Services (IHS) Sea-Web database (IMO number database) and the TURBOBAT, a database maintained by the IRD (Institut de Recherche pour le Développement), the IEO (Spanish Institute of Oceanography) and SFA (Seychelles Fishing Authority) that focuses primarily on European and European owned vessels fishing for tropical tunas in the Atlantic and Indian Oceans. For this update, we also consulted the five tuna RFMO Consolidated List of Authorized Vessels (CLAV).

The following steps were taken to compile the list of vessels:

1. Retrieve the CCSBT, FFA, IATTC, ICCAT, IOTC and WCPFC lists and select purse seine vessels only.
2. Identify duplicates. This involved sorting by IMO, or by Flag and then by name, and manually identifying vessels of the same name or similar name (e.g., "No. 8 XXX" and "XXX No. 8") and the same characteristics such as size or radio call sign. The CLAV was consulted as needed.
3. Fill in missing fields (hold volume, fish carrying capacity, LOA) when data were available from the TURBOBAT file or IHS Sea-Web database.
4. Set LOA: If several vessel size measurements were available, LOA was set to the largest value. This is because usually either LOA or LBP, or both, are reported in the RFMO lists and LOA>LBP.
5. Set GRT: If several vessel tonnage values were available, GRT was set to the smallest value. This is because usually GRT and GT are recorded in the lists and GRT<GT.
6. Use relationships between different vessel attributes to calculate FHV for all vessels without that information (see Sections 3.1 and 3.2).
7. Determine large-scale purse seine vessels and quantify them by Flag, including FHV estimates.
8. Identify a subset of those large-scale vessels that likely target tropical tunas and quantify them.

All records from the previous version of the database were verified with updated versions of the tRFMO databases and missing values completed with the supporting databases available (IHS Sea-Web database and up-to-date TURBOBAT file). Strict quality control measures were applied to identify possible duplicate records. Length measures were again divided in LOA, LBP and RGL; and Gross Tonnage data grouped in GRT and GT.

For steps 6 and 7 we used the relationships between vessel attributes calculated using a likelihood-based approach that we used in the 2016 snapshot (Justel-Rubio and Restrepo, 2016) (described in Appendix 2). These relationships are used to categorize Large-Scale purse seine vessels following the ISSF definition, that is, purse seine vessels with ≥ 335 m^3 of capacity (fish hold volume, FHV). Taking into consideration the goodness of fit (the measure of how well the response variable is explained by the model) of the various relationships, LOA and FHV missing values were filled in this order:

1. Fill in LOA:
   If GT is available, then use the **GT-LOA** relationship.
   If GT is not available but GRT is, then use the **GRT-LOA** relationship.
2. Fill in FHV:
   If FCC is available, use the **FHV-FCC** relationship.
   Otherwise, use the **FHV-LOA** relationship.

Note that, with the aim of improving the reliability of FHV estimates, the relationships between FHV and other variables (FHV-FCC, FHV-LOA) are those calculated by Restrepo and Justel-Rubio (2016), which were based only in a subset of vessels listed at the Inter-American Tropical Tuna Commission (IATTC) Record as of April 2016. The reason to do so is that the IATTC has been the only tRFMO to verify vessels' reported FHV values up to January 2017. A more detailed explanation on the calculation of FHV for tuna purse seine vessels following a maximum likelihood approach can be found in ISSF Technical Report 2016-10 (Restrepo and Justel-Rubio, 2016).

In doing the analyses, we realised that some vessels are now flagged to countries that did not appear in the last snapshot (Justel-Rubio *et al.*, 2018), and some vessel flags are no longer represented in the list of currently active vessels. We therefore updated the list of countries according to the International Monetary Fund's (IMF) April 2019 World Economic Outlook[1], in two broad IMF groupings: "Advanced Economies" (Developed) and "Emerging and Developing Economies" (Other). **Table 1** summarizes the flag codes and development status of the flag states used in this paper.

***Table 1**. Flag codes used in this paper. The column Economy indicates whether a given flag was treated as a developed economy in this study.*

FLAG	NAME	ECONOMY	FLAG	NAME	ECONOMY	FLAG	NAME	ECONOMY
DZA	Algeria	Other	GTM	Guatemala	Other	PAN	Panama	Other
AUS	Australia	Developed	HND	Honduras	Other	PNG	Papua New	Other
BLZ	Belize	Other	IDN	Indonesia	Other	PER	Peru	Other
CPV	Cape Verde	Other	IRN	Iran	Other	PHL	Philippines	Other
CHN	China, P.R.	Other	ITA	Italy	Developed	SEN	Senegal	Other
TWN	Chinese	Developed	JPN	Japan	Developed	SYC	Seychelles	Other
COL	Colombia	Other	KIR	Kiribati	Other	SLB	Solomon	Other
HRV	Croatia	Other	KOR	Korea, Rep.	Developed	ESP	Spain	Developed
CUR	Curaçao	Other	LBY	Libya	Other	SYR	Syria	Other
CYP	Cyprus	Developed	MLT	Malta	Developed	TUN	Tunisia	Other
ECU	Ecuador	Other	MHL	Marshall	Other	TUR	Turkey	Other
SLV	El Salvador	Other	MAU	Mauritius	Other	TUV	Tuvalu	Other
FSM	Fed. States	Other	MEX	Mexico	Other	USA	USA	Developed
FRA	France	Developed	MAR	Morocco	Other	VUT	Vanuatu	Other
GEO	Georgia	Other	NAU	Nauru	Other	VEN	Venezuela	Other
GHA	Ghana	Other	NZL	New Zealand	Developed			
GRC	Greece	Developed	NIC	Nicaragua	Other			

[1] https://www.imf.org/~/media/Files/Publications/WEO/2019/April/English/tableB.ashx?la=en

3. Results and Discussion

3.1. Global list of purse seine vessels

Merging the RFMO lists, selecting purse seine vessels only and identifying likely duplicates, resulted in a total of 1,843 vessels. This is 1% less than the 1,871 purse seiners in Justel-Rubio *et al*. (2018) and is mainly due to the removal of vessels under 24 m from the WCPFC and ICCAT authorized vessel records. The large majority of vessels delisted from the WCPFC Record of Fishing Vessels were small- or very small-scale vessels flagged to Chinese Taipei. In the case of ICCAT, many mostly medium-sized (15-25 m LOA) vessels targeting eastern Atlantic and Mediterranean bluefin tuna were delisted from ICCAT's vessel record, or are now listed as inactive or inoperative. There may be other causes for changes in the number of purse seine vessels, such as changes in vessel type as reported to the RFMOs (for example, fish carriers and support vessels are sometimes listed as purse seiners and vice versa).

After following steps 3-5 outlined above in Section 2, and updating the vessels' information with the most recent tRFMO vessel records and supporting databases, the resulting database contained information as follows (the percentage of vessels with completed information is shown):

Data field	Restrepo and Forrestal (2012)	Justel-Rubio and Restrepo (2014)	Justel-Rubio and Restrepo (2015)	Justel-Rubio and Restrepo (2016)	Justel-Rubio et al. (2017)	Justel-Rubio et al. (2018)	Justel-Rubio et al. (2019)
LOA	83%	82%	85%	84%	94%	94%	95%
GRT	76%	57%	47%	43%	52%	52%	49%
GT	N/A	48%	57%	61%	56%	61%	61%
FHV	33%	47%	30%	36%	35%	35%	35%
FCC	19%	33%	23%	29%	28%	28%	28%

In terms of vessel sizes, the available data showed a bi-modal distribution (**Figure 1**), with a high peak at around 22.5 meters and a second, much less pronounced mode, at around 72.5 meters (LOA). Vessel sizes ranged from 7.1 to 116 meters LOA. There is a large drop in the frequency of registered vessels below 20 m because most RFMOs generally do not require registration below this size.

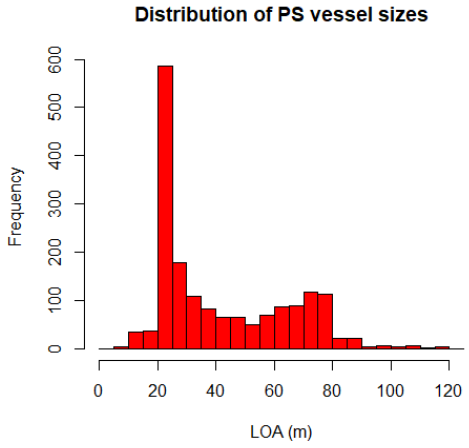

***Figure 1**. Distribution of purse seine vessel sizes (LOA in m) in the RFMO vessel records.*

3.2. Filling in missing values

The following missing values were filled using the relationships as described in Section 2. For full details of the relationships used, see Appendix 2.

1. Fill in LOA
   Using the **GT-LOA** relationship: done for 49 vessels.
   Using the **GRT-LOA** relationship: done for 38 vessels.
2. Fill in FHV
   Using the **FHV-FCC** relationship: done for 130 vessels.
   Using the **FHV-LOA** relationship: done for 1060 vessels.

3.3. The global tuna purse seine fleet

We found that 1,843 purse seine vessels were authorized by the tRFMOs to fish for tunas in June 2019. We estimate that these 1,843 vessels have a combined FHV of over 1,100,000 m^3. The distribution by Flag is given in **Table 2**. The ratio of vessels flagged to developing versus developed countries is 2.2:1.0 in number of vessels but about 1.9:1.0 in capacity. Both ratios are similar although slightly higher than those calculated in Justel-Rubio and *et al*. (2018).

***Table 2**. Distribution of tuna purse seiners (all sizes) by flag as of June 2019. The entries represent the number of vessels and their estimated combined FHV.*

FLAG	VESSELS	FHV(m^3)	FLAG	VESSELS	FHV(m^3)	FLAG	VESSELS	FHV(m^3)
DZA	2	576	GTM	2	3702	PAN	23	31791
AUS	8	1576	HDN	2	3019	PNG	28	34415
BLZ	7	7700	IDN	86	23364	PER	16	7749
CPV	1	2200	IRN	8	11296	PHL	107	64064
CHN	79	37010	ITA	114	22584	SEN	7	10436
TWN	32	56171	JPN	70	54282	SYC	13	26277
COL	14	14860	KIR	11	15448	SLB	10	7173
HRV	24	5972	KOR	51	67654	ESP	154	74700
CUR	5	9666	LBY	16	4041	SYR	2	235
CYP	1	201	MLT	1	208	TUN	3	805
ECU	115	92557	MHL	11	17418	TUR	88	29214
SLV	7	13371	MAU	3	4730	TUV	2	4057
FSM	23	30132	MEX	54	63198	USA	49	56955
FRA	51	40713	MAR	445	73489	VUT	4	7713
GEO	2	1038	NAU	2	3228	VEN	23	30067
GHA	17	24355	NZL	1	118			
GRC	45	7225	NIC	4	5829			

Total	1,843	1,104,581
Developed	577	382,388
Other	1266	722,194
Oth:Dev	2.19	1.89

3.4. The large-scale purse seine tuna fleet

There are many ways to approach the definition or categorization of large-scale fishing vessels. In various ISSF Conservation Measures, large-scale purse seiners are considered those with FHV of 335 m^3 or greater, which is the definition we used. Limiting the list to large-scale vessels excluded 1,049 vessels, resulting in a total of 794 large-scale purse seiners with an overall estimated FHV of ~927,000 m^3 (**Table 3**). Limiting the list to large scale vessels removed about 57% of the vessels in numbers — but only removed 16% of the combined hold volume. The Developing: Developed ratio of capacity slightly decreased both in terms of FHV and in number of vessels.

***Table 3**. Distribution of large-scale tuna purse seiners (≥ 335 m^3 FHV) by flag as of June 2019. The entries represent the number of vessels and their estimated combined FHV.*

FLAG	VESSELS	FHV(m^3)	FLAG	VESSELS	FHV(m^3)	FLAG	VESSELS	FHV(m^3)
AUS	3	495	HDN	2	3019	PNG	28	34415
BLZ	7	7700	IDN	19	7122	PER	14	7149
CPV	1	2200	IRN	8	11296	PHL	65	56761
CHN	24	28292	ITA	16	8661	SEN	7	10436
TWN	32	56171	JPN	50	50125	SYC	13	26277
COL	13	14590	KIR	11	15448	SLB	10	7173
HRV	5	2204	KOR	51	67654	ESP	32	55877
CUR	5	9666	LBY	3	1237	TUN	1	388
ECU	88	85691	MHL	11	17418	TUR	44	24574
SLV	7	13371	MAU	3	4730	TUV	2	4057
FSM	23	30132	MEX	49	61989	USA	34	55381
FRA	34	36382	MAR	2	1121	VUT	4	7713
GEO	2	1038	NAU	2	3228	VEN	23	30067
GHA	17	24355	NIC	4	5829			
GTM	2	3702	PAN	23	31791			
						Total	794	926,923
						Developed	252	330,745
						Other	542	596,178
						Oth:Dev	2.15	1.80

3.5. The large-scale tropical tuna purse seine tuna fleet

The tRFMO lists include purse seine vessels that fish for bluefin tuna either permanently or sporadically. In addition, the WCPFC record includes purse seiners which operate north of 20°N and do not target tropical tunas year-round.

In consultation with members from the industry and several agencies, the following vessels were excluded:

- Vessels flagged to Mediterranean countries (other than Spain and France);
- Vessels flagged to Spain and France that are only authorized on the ICCAT record and are not on the TURBOBAT database;
- Vessels flagged to Japan that are on the WCPFC record but not the FFA record.

Removing these resulted in an estimated 686 large-scale, tropical tuna purse seine vessels with a combined hold volume of 869,640 m^3 (**Table 4**). Compared to the list of all large-scale tuna purse seiners above, these correspond to 14% and 6% reductions in number of vessels and aggregate FHV, respectively. The Developing: Developed country ratio of capacity was around 2.4:1.0 in vessel numbers and 1.9:1.0 in FHV.

Table 4*. Distribution of large-scale tropical tuna purse seiners (mostly targeting tropical tunas) by flag at the end of June 2019. The entries represent the number of vessels and their estimated combined FHV.*

FLAG	VESSELS	FHV(m^3)	FLAG	VESSELS	FHV(m^3)	FLAG	VESSELS	FHV(m^3)
AUS	3	495	HDN	2	3019	PNG	28	34415
BLZ	7	7700	IDN	19	7122	PER	14	7149
CPV	1	2200	IRN	8	11296	PHL	65	56761
CHN	24	28292	ITA	1	1790	SEN	7	10436
TWN	32	56171	JPN	28	36419	SYC	13	26277
COL	13	14590	KIR	11	15448	SLB	10	7173
CUR	5	9666	KOR	51	67654	ESP	26	53317
ECU	88	85691	MHL	11	17418	TUV	2	4057
SLV	7	13371	MAU	3	4730	USA	34	55381
FSM	23	30132	MEX	49	61989	VUT	4	7713
FRA	26	32795	NAU	2	3228	VEN	23	30067
GHA	17	24355	NIC	4	5829			
GTM	2	3702	PAN	23	31791			
						Total	686	869,640
						Developed	201	304,023
						Other	485	565,616
						Oth:Dev	2.41	1.86

It is important to note where these 686 vessels are authorized to fish. **Table 5** shows the current number of authorized vessels by RFMO (the diagonal shows the number of authorizations in each RFMO). Eighteen percent of these vessels were registered in more than one tRFMO in June 2019. The largest number of authorizations – 347 – was in the WCPFC. However, several sources suggest that the number of active large-scale tropical tuna vessels in that region is about 250 (e.g., Williams *et al.* 2017). Thus, about 100 vessels despite being authorized to fish in the WCPFC area are either not fishing there or are not required to be listed on the record (note that, in the WCPFC, vessels that fish solely in their own EEZ do not need to be on the WCPFC Record). Most tRFMOs maintain lists of vessels authorized to operate in the Convention Areas, but do not maintain lists of vessels that are actively fishing in the Convention Areas, so it is difficult to estimate active capacity by region at any given time.

Table 5. *Distribution of large-scale tropical tuna purse seiners (≥ 335 m^3 FHV) registered in tRFMOs.*

	CCSBT	IATTC	ICCAT	IOTC	WCPFC
CCSBT	**2**			2	2
IATTC		**235**	21	5	31
ICCAT			**105**	37	33
IOTC				**155**	61
WCPFC					**347**

It is also useful to examine flagging changes between developed-country economies ("Developed") and emerging and developing ones ("Other"). The available data does not always indicate the year of flag change and, therefore, these results reflect changes that took place over several decades. **Table 6** summarizes the available information on these vessels' previous flags: 132 flag changes (42%) were from developed to developing economies, and 157 (50%) were between developing economies. Relatively fewer flag changes (9%) were to developed countries.

Table 6. *Summary of current and previous flags for large-scale tropical tuna purse seiners (≥ 335 m^3 FHV).*

		Current Flag	
		Developed	**Other**
Previous Flag	**Developed**	10	132
	Other	17	157

A considerable number of the large-scale tropical tuna purse seiners discussed in this section are registered in ISSF's Proactive Vessel Register (PVR). ISSF created the PVR to give vessel owners an opportunity to identify themselves as active participants in meaningful tuna sustainability efforts. At the same time, the PVR provides validated information to tuna purchasers and interested stakeholders that reflects the positive steps each vessel is taking in implementing a series of commitments designed to improve tuna fishing practices (more info is at http://iss-foundation.org/knowledge-tools/databases/proactive-vessel-register/). The number of large-scale PS vessels targeting tropical tuna that have registered in the PVR keeps increasing. Specifically, 515 large scale purse seine vessels, with a combined FHV of 721,739 m^3 are now registered in the PVR; which represents 75% of the global fleet in number and an 83% in FHV of the total of 686 large scale purse seine vessels fishing for tropical tunas.

3.5.1. CHANGES SINCE 2018

Justel-Rubio *et al.* (2018) estimated that there were 673 large-scale vessels fishing for tropical tunas in June 2018. The estimate of 686 in June 2019 represents a 2% increase. However, this increase is not all due to new constructions. **Table 7** summarizes all changes that took place since 2014.

Nine recently constructed (between 2012 and 2019) large-scale vessels have been added to the tropical tuna authorized purse seine lists since 2018 (**Table 7**). There are also 9 large-scale purse seiners that were constructed prior to 2012 which were not listed in the RFMO Records in June 2018 as they may have been inactive for some time or participating in a different fishery. There are 14 additional vessels that are now authorized by one of the tRFMOs but whose year of construction is unknown from public records. Using the available data, it is not possible to determine the fisheries in which those vessels not registered in RFMO Records in 2018 participated before, if any.

As shown in Section 3.2, there is considerable variability in the relationships between different vessel dimensions to estimate FHV and, hence, to determine whether a vessel is large-scale or not in terms of FHV. The tRFMO records are updated regularly, and reported dimensions can change, or missing dimensions can start being reported when they were not. Because of these newly reported data, a number of vessels were re-classified (**Table 7**), for example two vessels that were estimated to be large-scale in Justel-Rubio *et al*. (2018) were no longer so in this study.

Several other factors explain the differences between the estimates in the previous snapshot (Justel-Rubio *et al.*, 2018) and this study. Eighteen vessels either sank or somehow are no longer in the authorized vessels records of the RFMO (most of them were previously registered to the WCPFC). Twenty-nine vessels changed name and/or flag (**Table 7**).

Without Unique Vessel Identifiers (UVIs), it is difficult to track vessel flag/name changes. Fortunately, the situation is improving since organizations like ISSF have been advocating for the use of UVIs such as the IMO number. The number of large-scale tropical tuna purse seiners with publicly known IMO numbers increased from 12% in 2011 to 99% in 2018. The percentage as of June 2019 is 97%, but it may be higher, as it is unclear at the moment of writing this report whether some vessels newly registered at IOTC have IMO numbers or not. The four tropical tuna RFMOs (IATTC, ICCAT, IOTC and WCPFC) now require mandatory use of UVIs, such as IMO numbers.

Table 7. *Changes between large-scale tropical tuna vessels estimated in* consecutive *versions of the snapshot.*

	2014	2015	2016	2017	2018	2019
Vessels deleted						
Sank or no longer found in tRFMO records	39	23	40	72	19	18
No longer classified as Large	12	16	7	7	1	2
No longer classified as targeting trop. tuna	13	1	5	-	-	-
Duplicate records	3	-	-	-	-	-
Different vessel type	-	1	13	-	2	-
Total	**67**	**41**	**65**	**79**	**22**	**20**
Vessels added						
New in the RFMO records and built before 2012	24	46	2	15	7	9
New in the RFMO records and built in 2012 or after	24	33	30	12	1	9
New in the RFMO records (year unknown)	12	12	1	-	-	14
Now classified as Large	22	2	1	8	2	-
Now classified as targeting trop. tuna	-	14	-	-	-	1
Different vessel type	-	-	-	1	-	-
Total	**82**	**107**	**34**	**36**	**10**	**33**
Vessels changed						
Changed flag	49	24	19	13	8	16
(Of which changed flag and name)	(30)	(12)	(11)	(6)	(2)	(10)
Changed name only	11	10	6	10	4	13
Total	**60**	**34**	**25**	**23**	**12**	**29**
IMO#						
Percentage of vessels with IMO# in 2011					12%	
Percentage of vessels with IMO# in 2014					88%	
Percentage of vessels with IMO# in 2015					87%	
Percentage of vessels with IMO# in 2016					91%	
Percentage of vessels with IMO# in 2017					95%	
Percentage of vessels with IMO# in 2018					99%	
Percentage of vessels with IMO# in 2019						97%

3.5.2. VESSELS CONSTRUCTED IN RECENT YEARS

The number of large-scale tropical tuna purse seine vessels constructed during the 2013-2019 period according to tRFMO records is summarized in **Table 8**. It is worth noting that the total number of new vessels by year have significantly decreased since 2016.

Table 8. *Large-scale tropical tuna purse seine vessels built in recent years grouped by flag and development status of the flag states.*

		2013	2014	2015	2016	2017	2018	2019	
Developed	Chinese Taipei	4	3[2]	4			2		13
	France				2				2
	Japan	2	2						4
	Korea, Rep.	2	5[3]	2		1			10
	Spain	1	2						3
Other	Cape Verde		1						1
	China, P.R.		3	4	1				8
	Curaçao			1					1
	Ecuador		1						1
	El Salvador			1[4]					1
	Fed. States Micronesia	1[5]	2[6]		3				6
	Indonesia			1					1
	Kiribati		1						1
	Marshall Islands						3		3
	Mexico	2	3	2		1			8
	Panama		2			1		1	4
	Papua New Guinea	2	6				1		9
	Philippines	1	1	2	3				7
	Seychelles		4	3					7
	Solomon Islands		1	2					3
	Venezuela		1						1
	Grand Total	**15**	**38**	**22**	**9**	**3**	**6**	**1**	**94**

[2] One of these vessels was initially flagged to Papua New Guinea

[3] Two of these vessels were initially flagged to Papua New Guinea

[4] This vessel was initially flagged to USA

[5] This vessel was initially flagged to Papua New Guinea.

[6] These two vessels were initially flagged to Papua New Guinea

4. Conclusions

Using updated information available from both the tRFMOs and the supporting databases, we estimate that —in June 2019 — there were 1,843 purse seine vessels authorized to fish for tunas worldwide, with a combined FHV of over 1,100,000 cubic meters. This represents a 1% decrease in the number of vessels since the previous snapshot report by Justel-Rubio *et al*. (2018), due mainly to the removal of several vessels from the tRFMO authorized vessels lists, predominantly those of medium-small size and/or targeting bluefin tuna. Restricting the list to large-scale vessels, defined here as ≥335 m^3 FHV, reduces the number of purse seiners to 794, with a combined FHV of almost 927,000 m^3.

Focusing on large-scale purse seine vessels that target tropical tunas brings the number down to 686 vessels with about 870,000 m^3 of combined FHV. Over twice as many of these vessels are flagged to developing countries than are flagged to developed countries. A large proportion of these vessels (75% in number, 83% in FHV) are registered in ISSF's Proactive Vessel Register. About 18% of these vessels are authorized to fish in two or more RFMOs, indicating a large potential mobility of these fleets at a global level. We recommend that RFMOs consider extending their authorized vessel records to include information about the RFMO area in which each individual vessel is active each year. This will facilitate the monitoring of active fishing capacity by region.

A comparison with the estimates obtained one year ago (Justel-Rubio *et al*., 2018), using updated data, shows that, once more, there were numerous changes in the tRFMO authorized vessel records (**Table 7**). Several vessels that appeared on the records in 2018 can no longer be found. Other (older) vessels that were not on the records are now listed, and some vessels changed in reported dimensions. The quality of the data in tRFMO records has been undoubtedly improving in recent years, but there are still substantial gaps and opportunities for improvement. We recommend that tRFMO members exercise greater quality control of the data they submit to the tRFMOs for the vessel records and that tRFMOs adopt vessel registry requirements that include quality control mechanisms.

Since Justel-Rubio *et al*. (2018), 9 recently constructed (between 2012 and June 2019), large-scale purse seine vessels have been added to the tRFMO records.

Recommendations

This study resulted in three recommendations:

Recommendation 1:

- Owners of vessels of other eligible types and sizes (other than large-scale purse seine vessels) also apply for IMO numbers, given the utility of using IMO numbers as Unique Vessel Identifiers as a powerful tool to combat Illegal unreported and unregulated (IUU) fishing.

Recommendation 2:

- Tuna RFMO members exercise greater quality control of the data they submit to the tRFMOs for the vessel records and tRFMOs adopt vessel registry requirements that include quality control mechanisms.

Recommendation 3:

- tRFMOs maintain not only lists of vessels authorized to operate in the Convention Areas, but also maintain lists of vessels that are actively fishing in the Convention Areas, to make it possible to estimate active capacity by region in any given year.

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Appendix 1. Glossary

FCC. Fish Carrying Capacity. The amount of fish, in tonnes, that a vessel can carry. This is related to the size of the fish wells. However, the actual tonnage carried may vary depending on the size of the fish and how they are stored. FCC is often measured as the maximum landings observed for a given vessel.

FHV. Fish Hold Volume: The total measured cubic content of the fish wells, in cubic meters.

GRT. Gross Register Tonnage: The total measured cubic content of the permanently-enclosed spaces of a vessel, with some allowances or deductions for exempt spaces such as living quarters (1 gross register ton = 100 ft3 = 2.83 m3).

GT. Gross Tonnage: The volume of all ship's enclosed spaces (from keel to funnel) measured to the outside of the hull framing.

LBP. Length between perpendiculars: The length of a vessel (loaded) along the waterline from the forward surface of the stem, or main bow perpendicular member, to the after surface of the sternpost, or main stern perpendicular member.

LOA. Length overall: The maximum length of a vessel from the two points on the hull measured perpendicular to the waterline.

RGL. Registered length: The length of the vessel as registered with the national authorities. Different countries have different requirements, so RGL could be LOA, LBP, or other measurements.

Appendix 2. Relationships between vessel attributes

1. GROSS TONNAGE VS LOA

a) GRT vs LOA

The relationship between GRT (tonnes) and LOA (m) estimated using a MLE approach followed a function of the form (**Figure 1a**):

$GRT = 0.0497*LOA^{2.3382}$ $\hat{\sigma}_*^2 = 1045.15$ $\varphi = -3466.65$ $(n=510, R^2=0.80)$

There is considerable variability in the relationship, especially for the larger vessels.

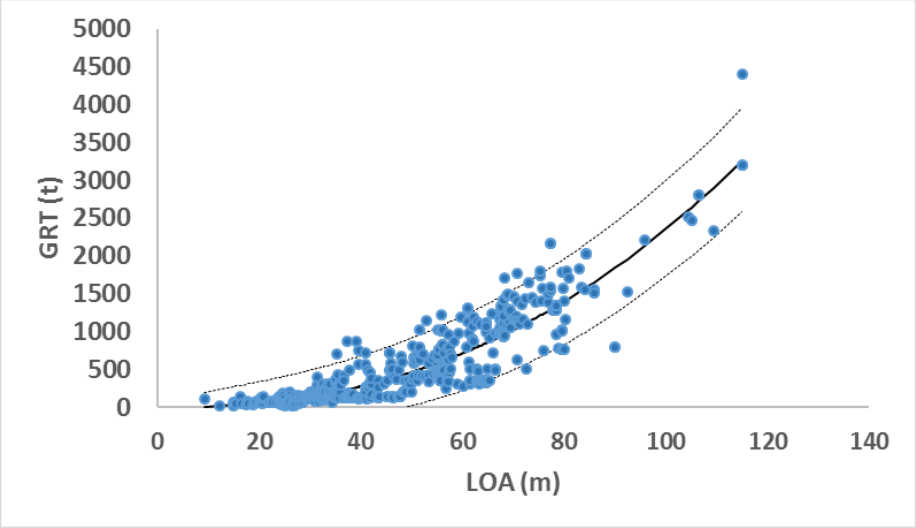

***Figure 1a**. Relationship between GRT (tonnes) and LOA (m) and 95% confidence intervals.*

b) GT vs LOA

The relationship between GT (tonnes) and LOA (m) estimated using a MLE approach followed a function of the form (**Figure 1b**):

$GT = 0.0380*LOA^{2.4789}$ $\hat{\sigma}_*^2 = 624.26$ $\varphi = -6125.12$ $(n=942, R^2=0.97)$

LOA is more strongly correlated to GT than it is to GRT.

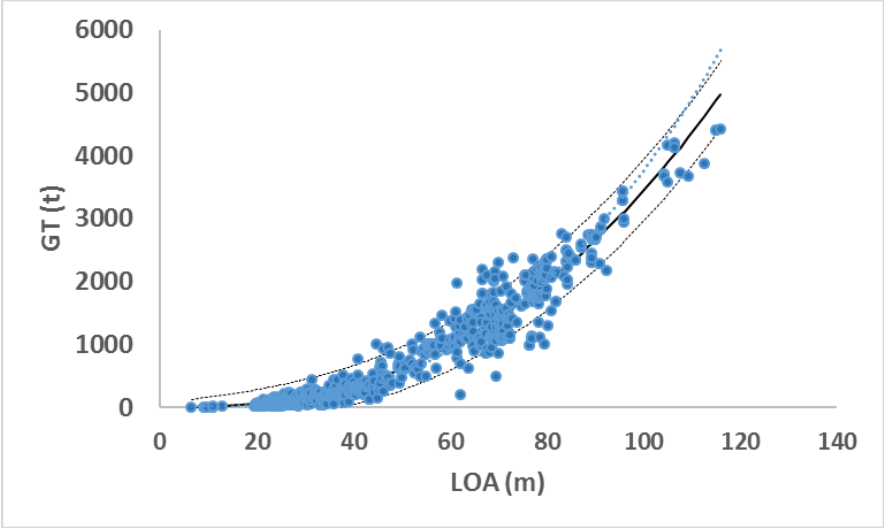

***Figure 1b**. Relationship between GT (tonnes) and LOA (m) and 95% confidence intervals.*

2. FHV VS FCC

The relationship between FHV (m^3) and FCC (tonnes) estimated using a MLE approach on the subset of IATTC vessels for which FHV values were verified was linear (**Figure 2**):

FHV=1.2839*FCC $\hat{\sigma}_*^2$ = 19.83 φ = -1679.53 (n=277, R^2=0.95)

Fish Carrying Capacity and Fish Hold Volume are highly correlated.

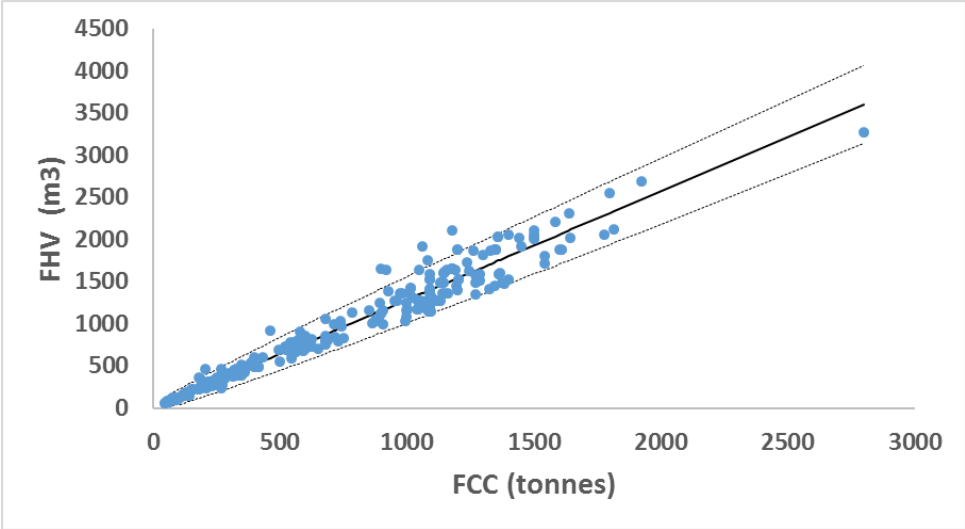

***Figure 2**. Relationship between FHV (m^3) and FCC (tonnes) and 95% confidence intervals.*

3. FHV VS LOA

The relationship between FHV (m^3) and LOA (m) estimated using a MLE approach on the subset of IATTC vessels for which FHV values were verified followed a power function of the form (**Figure 3**):

$FHV = 0.3043*LOA^{1.9806}$ $\hat{\sigma}_*^2 = 688.13$ $\varphi = -1727.30$ ($n=259$, $R^2=0.89$)

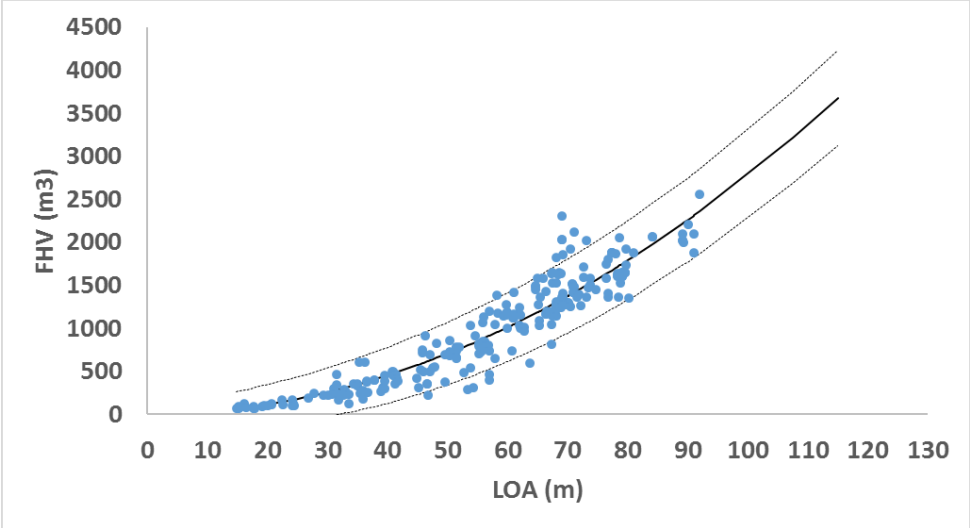

Figure 3. Relationship between FHV (m^3) and LOA (m) and 95% confidence intervals.

Appendix 3. Version log

VERSION	DATE	TECHNICAL[7] REPORT	AUTHORS
1.0	01/2012	2012-01	Víctor Restrepo and Francesca Forrestal
2.0	04/2014	2014-07	Ana Justel-Rubio and Víctor Restrepo
3.0	05/2014	2015-05	Ana Justel-Rubio and Víctor Restrepo
4.0	07/2016	2016-12	Ana Justel-Rubio and Víctor Restrepo
5.0	08/2017	2017-05	Ana Justel-Rubio, Lorena Recio and Víctor Restrepo
6.0	06/2018	2018-17	Ana Justel-Rubio, Lorena Recio and Víctor Restrepo
7.0	07/2019	2019-09	Ana Justel-Rubio and Lorena Recio

[7] Earlier versions of the report can be requested by e-mail (info@iss-foundation.org)

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