A Snapshot of the Large-Scale Tropical Tuna Purse Seine Fishing Fleets as of May 2016

Ana Justel-Rubio* and Victor R. Restrepo*

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*International Seafood Sustainability Foundation

SUMMARY

Purse seine vessels account for over 60% of the world's tuna catch. However, the numbers 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 the end of April 2016 there are at least 1,644 purse seiners fishing for tunas worldwide. This is likely an underestimate because many small-scale purse seiners or some of those operating in only one EEZ do not have to be listed in the RFMOs. 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 728 such vessels with a combined fishing capacity of over 880,000 m^3. The number of these vessels decreased by about 4% during the past year. About 17% of these 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.

1. Introduction

Purse seine fishing vessels catch about 64% of the 4.6 million tonnes of tunas taken annually worldwide (ISSF, 2016). 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 and 2015). The aim of this paper is to provide an updated "snapshot" of the purse seine fleet as of the end of April 2016 based primarily on the records of authorized vessels established by the five tuna RFMOs, as in Restrepo and Forrestal (2012) and Justel-Rubio and Restrepo (2014 and 2015). 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.

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2. Methods

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

We generally used the same sources of information and methodology as those used in the 2015 snapshot (Justel-Rubio and Restrepo, 2015). Vessel registers from all tuna RFMOs were consulted, as well as the IHS Sea-Web database (IMO number database) and the TURBOBAT, a database maintained by the IRD (Institut de Recherche pour le Developpement), the IEO (Spanish Institute of Oceanography) and SFA (Seychelles Fishing Authority) that focuses primarily on European and associated flag vessels fishing for tropical tunas in the Indian Ocean. For this update, we also consulted the recently revised version of the Consolidated List of Authorized Vessels (CLAV).

The following steps were taken to compile the former 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. Estimate relationships between different vessel attributes in order to calculate FHV for all vessels (see Sections 3.1 and 3.2) that are missing that information.
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 tRFMOs 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 in order to identify possible duplicate records. Length measures were again divided in LOA, LBP and RGL; and Gross Tonnage data grouped in GRT and GT.

In previous snapshots (Restrepo and Forrestal, 2012; Justel-Rubio and Restrepo, 2014 and 2015), the relationship between various types of vessel dimensions were calculated with all data available in order 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). Then, 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.

In this study, we followed the same procedure to fill in missing LOA and FHV values and again calculated the relationships between vessel dimensions using a likelihood-based approach. Furthermore, with the aim of improving the reliability of FHV estimates, the relationships between FHV and other variables (FHV-FCC, FHV-LOA) were based only in a subset of vessels which were listed at the Inter-American Tropical Tuna Commission (IATTC) Record as of April 2016. The reason to do so is that the IATTC is the only tRFMO that verifies vessels' reported FHV values. 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 (ISSF 2016b).

Using a maximum-likelihood approach, the relationships fitted include a function that describes how the variability in the response variable changes with increasing values of the explanatory dimension. In all cases, it was assumed that the Variance of the response variable (σ_*^2) is proportional to the value of the explanatory variable. Also, a Normal distribution was assumed in the fits (no other possibilities were investigated, but a normality assumption seems reasonable upon visual examination). The predicted values of GRT (G_i), GT (T_i) or FHV (h_i) for each vessel were obtained by either linear (with intercept = 0) or power relationships with the explanatory variable:

GRT (G, in tonnes) as a function of LOA (L, in meters):

$$\hat{G}_i = \hat{a}L_i^{\hat{b}} \qquad \text{with} \qquad \sigma_i^2 = \hat{\sigma}_*^2 L_i$$

A total of n=510 observations were available.

GT (T, in tonnes) as a function of LOA (L, in meters):

$$\hat{T}_i = \hat{a}L_i \qquad \text{with} \qquad \sigma_i^2 = \hat{\sigma}_*^2 L_i$$

A total of n=942 observations were available.

FHV (h, in m³) as a function of FCC (C, in tonnes):

$$\hat{h}_i = \hat{a}C_i \qquad \text{with} \qquad \sigma_i^2 = \hat{\sigma}_*^2 C_i$$

A total of n=277 observations were available.

FHV (h, in m³) as a function of LOA (L, in meters):

$$\hat{h}_i = \hat{a}L_i^{\hat{b}} \qquad \text{with} \qquad \sigma_i^2 = \hat{\sigma}_*^2 L_i$$

A total of n=259 observations were available.

The fits were obtained by maximizing the value of the log-likelihood:

$$\varphi = \sum_i [-log(\sqrt{2\pi}) - log(\sigma_i) - \frac{1}{2\sigma_i^2}(h_i - \hat{h}_i)]$$

given the parameters for the selected relationship ($\hat{a}, \hat{b}, \hat{\sigma}_*^2$).

In doing the analyses, it became evident that some vessels are now flagged to countries that did not appear in Justel-Rubio and Restrepo (2015) 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 April 2016 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 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
ALB	Albania	Other	GHA	Ghana	Other	NIC	Nicaragua	Other
DZA	Algeria	Other	GRC	Greece	Developed	PAN	Panama	Other
AUS	Australia	Developed	GTM	Guatemala	Other	PNG	Papua New Guinea	Other
BLZ	Belize	Other	IDN	Indonesia	Other	PER	Peru	Other
BRA	Brazil	Other	IRN	Iran	Other	PHL	Philippines	Other
CPV	Cape Verde	Other	ITA	Italy	Developed	SEN	Senegal	Other
CHN	China, P.R.	Other	JPN	Japan	Developed	SYC	Seychelles	Other
TWN	Chinese Taipei	Developed	KIR	Kiribati	Other	SLB	Solomon Islands	Other
COL	Colombia	Other	KOR	Korea, Rep.	Developed	ESP	Spain	Developed
HRV	Croatia	Other	LBY	Libya	Other	SYR	Syria	Other
CUR	Curaçao	Other	MLT	Malta	Developed	TUR	Turkey	Other
ECU	Ecuador	Other	MHL	Marshall Islands	Other	TUV	Tuvalu	Other
EGY	Egypt	Other	MAU	Mauritius	Other	GBR	United Kingdom	Developed
SLV	El Salvador	Other	MEX	Mexico	Other	USA	USA	Developed
FSM	Fed. States Micronesia	Other	MAR	Morocco	Other	VUT	Vanuatu	Other
FRA	France	Developed	NZL	New Zealand	Developed	VEN	Venezuela	Other

[1] http://www.imf.org/external/pubs/ft/weo/2016/01/weodata/groups.htm

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 1,644 vessels. This is 16% less than the 1,955 purse seiners in Justel-Rubio and Restrepo (2015) and is mainly due to removals from the authorized RFMO vessel records, probably as a result of the CLAV maintenance process. In particular, a large number of mostly medium-sized vessels are no longer listed in ICCAT's vessel record as purse seiners. 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 2.2, and updating the vessels' information with the most recent tRFMO vessel records and supporting databases, this list contained information as follows:

Data Field	Restrepo and Forrestal (2012)	Justel-Rubio and Restrepo (2014)	Justel-Rubio and Restrepo (2015)	This study
LOA	83%	82%	85%	84%
GRT	76%	57%	47%	43%
GT	N/A	48%	57%	61%
FHV	33%	47%	30%	36%
FCC	19%	33%	23%	29%

In terms of sizes, the vessels with available data showed a bi-modal distribution (**Figure 1**), with a clearly defined mode around 22.5 meters and a second one around 67.5 meters (LOA). Vessel sizes ranged from 6.5 to 116 meters. 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.

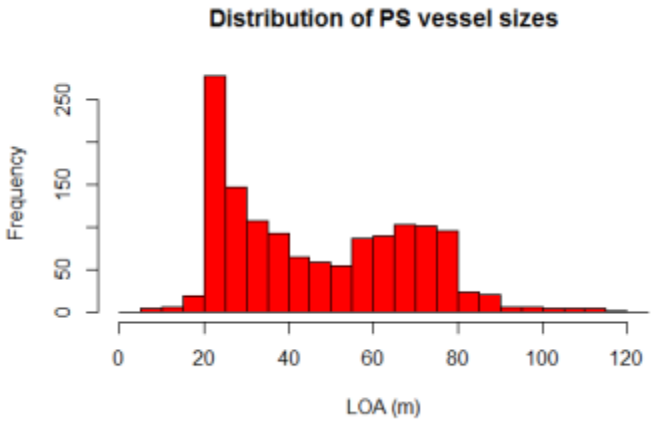

Figure 1. Distribution of purse seine vessel sizes (LOA in m) in the RFMO vessel records.

3.2 Relationships between different vessel attributes

3.2.1 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 2a**):

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

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

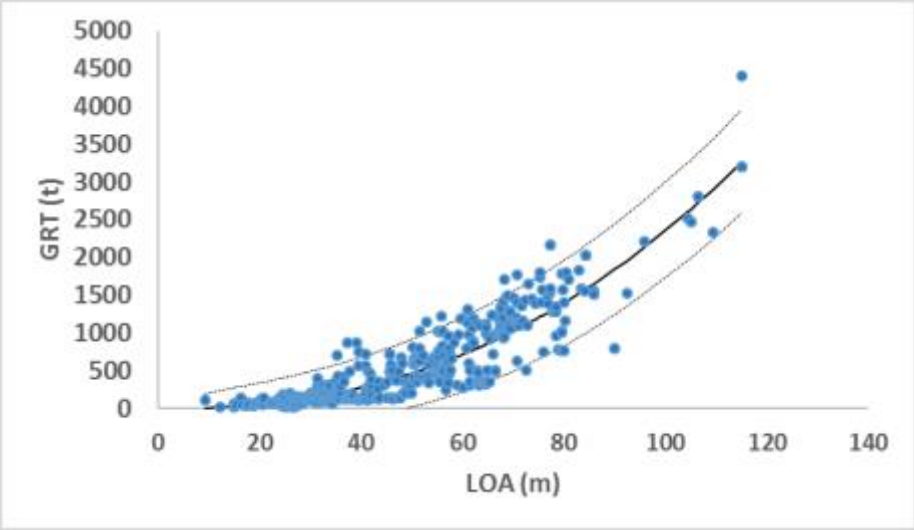

Figure 2a. Relationship between GRT (tonnes) and LOA (m) and 95% confidence intervals.

b) GT vs LOA

The relationship between GT (tonnes) and LOA (m) estimated using a MLE approach followed a function of the form (**Figure 2b**):

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

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

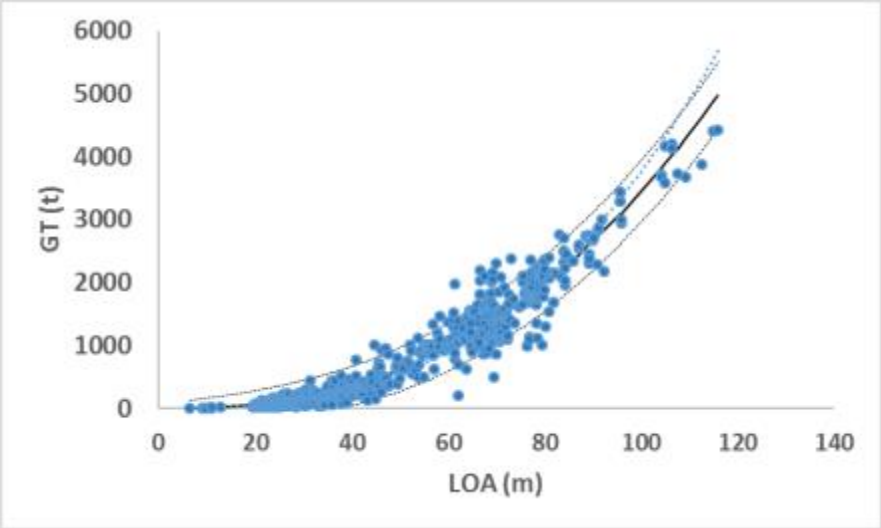

Figure 2b. Relationship between GT (tonnes) and LOA (m) and 95% confidence intervals.

3.2.2 FHV vs FCC

The relationship between FHV (m^3) and FCC (tonnes) estimated using a MLE approach on the IATTC vessels subset was linear (**Figure 3**):

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

Fish Carrying Capacity and Fish Hold Volume are highly correlated.

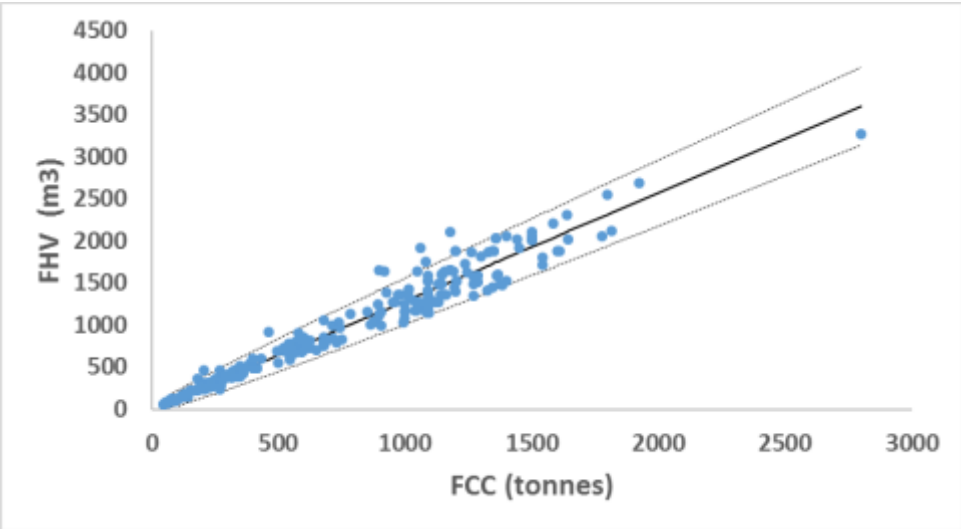

Figure 3. Relationship between FHV (m^3) and FCC (tonnes) and 95% confidence intervals.

3.2.3 FHV vs LOA

The relationship between FHV (m^3) and LOA (m) estimated using a MLE approach on the IATTC vessels subset followed a power function of the form (**Figure 4**):

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

Using only those vessels for which FHV values are verified reduced substantially the variability in this relationship.

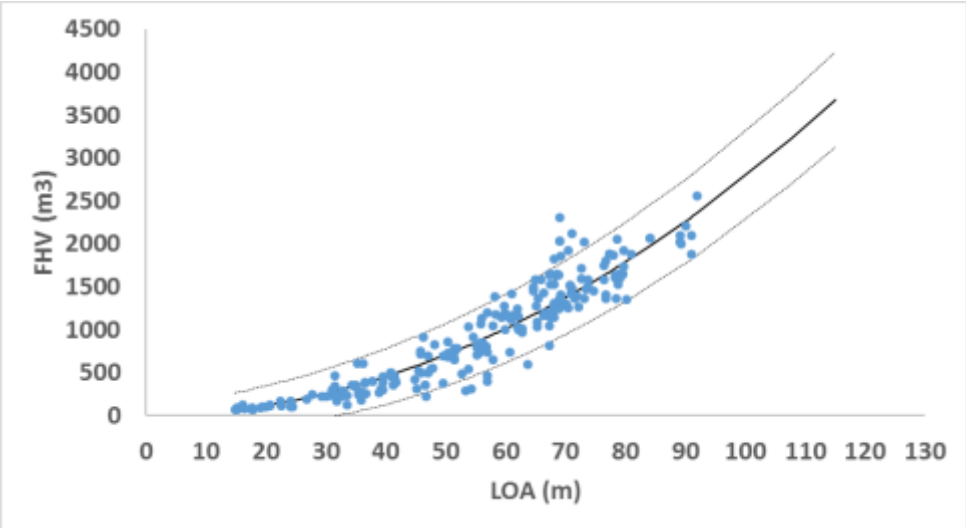

Figure 4. Relationship between FHV (m^3) and LOA (m) and 95% confidence intervals.

3.3 Filling in missing values

The following missing values were filled using the relationships described in the previous section:

1. Fill in LOA
   Using the **GT-LOA** relationship in Section 3.2.1b: done for 69 vessels.
   Using the **GRT-LOA** relationship in Section 3.2.1a: done for 196 vessels.
2. Fill in FHV
   Using the **FHV-FCC** relationship from Section 3.2.2: done for 183 vessels.
   Using the **FHV-LOA** relationship from Section 3.2.3: done for 869 vessels.

3.4 The global tuna purse seine fleet

We found that 1,644 purse seine vessels were authorized by the RFMOs to fish for tunas at the end of April 2016. We estimate, following the methodology mentioned above, that these 1,644 vessels have a combined fish hold volume of almost 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 about 1.4:1.0.

Table 2. Distribution of tuna purse seiners (all sizes) by flag at the end of April 2016. 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)
ALB	2	549	GHA	17	17144	NIC	6	8478
DZA	7	1698	GRC	15	2888	PAN	18	25358
AUS	11	3399	GTM	3	5177	PNG	36	39831
BLZ	6	6075	IDN	160	41703	PER	8	3618
BRA	3	515	IRN	8	11296	PHL	170	83929
CPV	2	3900	ITA	100	20562	SEN	4	4891
CHN	84	43343	JPN	79	59013	SYC	13	25205
TWN	99	75432	KIR	12	14960	SLB	8	4743
COL	14	14860	KOR	61	72332	ESP	159	78649
HRV	11	3283	LBY	28	7961	SYR	1	121
CUR	5	9758	MLT	2	392	TUR	99	35791
ECU	117	93391	MHL	8	9501	TUV	1	1937
EGY	1	172	MAU	2	3260	GBR	14	7307
SLV	6	11440	MEX	48	59150	USA	71	70075
FSM	15	17622	MAR	14	3090	VUT	3	6597
FRA	67	46068	NZL	4	7405	VEN	22	28594
						Total	1,644	1,092,462
						Developed	682	443,522
						Other	962	648,940
						Oth:Dev	1.41	1.46

3.5 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 Resolutions, large-scale purse seiners are those with FHV of 335 m^3 or greater, which is the definition we used. Limiting the list to large-scale vessels excluded 795 vessels, resulting in a total of 849 large-scale purse seiners with an overall estimated FHV of 946,892 m^3 (**Table 3**). Limiting the list to large scale vessels removed about 48% of the vessels in numbers, but only removed 13% of the combined hold volume. The Developing: Developed ratio of capacity increased to 1.8:1.0 in terms of numbers of vessels.

Table 3. Distribution of large scale tuna purse seiners (≥ 335 m^3 FHV) by flag at the end of April 2016. The entries represent the number of vessels and their estimated combined FHV.

Flag	Vessels	FHV(m3)	Flag	Vessels	FHV(m3)	Flag	Vessels	FHV(m3)
ALB	1	344	GTM	3	5177	PNG	32	39474
DZA	1	453	IDN	22	15242	PER	6	3019
AUS	4	1886	IRN	8	11296	PHL	91	68012
BLZ	6	6075	ITA	15	7324	SEN	4	4891
CPV	2	3900	JPN	56	54195	SYC	13	25205
CHN	29	34253	KIR	12	14960	SLB	8	4743
TWN	48	66427	KOR	57	71448	ESP	34	59476
COL	13	14590	LBY	6	2405	TUR	44	23448
HRV	4	1760	MHL	8	9501	TUV	1	1937
CUR	5	9758	MAU	2	3260	GBR	6	5797
ECU	88	86399	MEX	46	58640	USA	42	66578
SLV	6	11440	MAR	2	1206	VUT	3	6597
FSM	15	17622	NZL	4	7405	VEN	22	28594
FRA	39	41176	NIC	6	8478			
GHA	17	17144	PAN	18	25358			
						Total	849	946892
						Developed	305	381712
						Other	544	565180
						Oth:Dev	1.78	1.48

3.6 The large-scale tropical tuna purse seine tuna fleet

The RFMO 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) and Great Britain;
- 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 728 large-scale, tropical tuna purse seine vessels with a combined hold volume of 881,651 m^3 (**Table 4**). Compared to the list in the previous section (all large-scale tuna purse seiners), these are reductions of 14% and 7% in number of vessels and aggregate FHV, respectively. The Developing: Developed country ratio of capacity was 2.0:1.0 in vessel numbers and 1.6:1.0 in FHV.

Table 4. Distribution of large-scale tropical tuna purse seiners (mostly targeting tropical tunas) by flag at the end of April 2016. The entries represent the number of vessels and their estimated combined FHV.

Flag	Vessels	FHV(m3)	Flag	Vessels	FHV(m3)	Flag	Vessels	FHV(m3)
AUS	4	1886	GTM	3	5177	PNG	32	39474
BLZ	6	6075	IDN	22	15242	PER	6	3019
CPV	2	3900	IRN	8	11296	PHL	91	68012
CHN	29	34253	JPN	30	38945	SEN	4	4891
TWN	48	66427	KIR	12	14960	SYC	13	25205
COL	13	14590	KOR	57	71448	SLB	8	4743
CUR	5	9758	MHL	8	9501	ESP	28	56925
ECU	88	86399	MAU	2	3260	TUV	1	1937
SLV	6	11440	MEX	46	58640	USA	42	66578
FSM	15	17622	NZL	4	7405	VUT	3	6597
FRA	29	36474	NIC	6	8478	VEN	22	28594
GHA	17	17144	PAN	18	25358			
						Total	728	881651
						Developed	242	346087
						Other	486	535564
						Oth:Dev	2.01	1.55

It is of interest to see where these 728 vessels are authorized to fish. **Table 5** shows the current RFMO authorizations (the diagonal shows the number of authorizations in each RFMO). Seventeen percent of these vessels were registered in more than one tRFMO at the end of April, 2016. The largest number of authorizations –437– was in the WCPFC. However, several sources suggest that the number of active large-scale tropical tuna vessels in that region was slightly over 300 at this time. The difference, about 120 vessels, are authorized to fish in the WCPFC area but are not currently doing so. For the most part, the RFMOs do not maintain lists of vessels that are actively fishing in their 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) registration in the tRFMOs

	CCSBT	IATTC	ICCAT	IOTC	WCPFC
CCSBT	**2**			1	1
IATTC		**216**	4	2	31
ICCAT			**89**	37	34
IOTC				**138**	74
WCPFC					**437**

It is also of interest to examine changes in flagging between developed country economies and developing ones. We looked at this with the available data, which does not always indicate the years when flags changed, and therefore these results reflect changes that took place over several decades. **Table 6** summarizes the available information on these vessel´s previous flags: 136 flag changes (43%) were from developed to developing economies, and 145 (46%) were between developing economies. Relatively fewer flag changes (11%) ended in 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	13	136
	Other	20	145

A fraction 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 provide vessel owners with 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 reflect the positive steps each vessel is taking in implementing a series of commitments designed to improve tuna fishing practices (More info in http://iss-foundation.org/knowledge-tools/databases/proactive-vessel-register/). There has been a notable increase in the number of large scale PS vessels targeting tropical tuna that have registered in the PVR since 2015. Specifically, 481 vessels, with a combined FHV of 662,300 m^3 are now registered in the PVR; which represents 66% of the global fleet in number and a 75% in FHV of the total of 728 vessels included in this category.

3.6.1 Changes since 2015

Justel-Rubio and Restrepo (2015) estimated that there were 759 large-scale vessels fishing for tropical tunas at the end of March 2015. The estimate of 728 in 2016 represents a 4% decrease. One of the main reasons for this reduction is the quality control work that all tuna RFMOs have performed in their records of authorized vessels under the umbrella of the

CLAV update carried out since March 2015. **Table 7** summarizes all changes that took place in the interim.

A total of 30 recently-constructed (between 2012 and 2016) large-scale vessels have been added to the tropical tuna authorized purse seine lists since 2015 (**Table 7**). There are also 2 large-scale purse seiners that were constructed prior to 2012 which have been authorized by the RFMOs since 2015, and an additional vessel that was authorized during this past year but whose year of construction is unknown from public records. Using the available data, it is not possible to determine the fisheries in which these 3 vessels participated before, if any.

As shown in Section 3.2, there is considerable variability in the relationships between different vessel dimensions used here to determine if a vessel is large-scale or not in terms of Fish Hold Volume. The RFMO records are updated regularly, and reported dimensions can change, or missing dimensions can be reported when they were not reported before. Because of these newly reported data and the recalculation of some relationships between vessel dimensions, a number of vessels were re-classified (**Table 7**): Seven vessels that were estimated to be large-scale in Justel-Rubio and Restrepo (2015) were no longer so in this study. And, vice-versa for one vessel that we estimated now to be 335 m^3 or greater in FHV.

Several other factors explain the differences between the estimates in the previous snapshot (Justel-Rubio and Restrepo, 2015) and this study. Forty vessels either sank or somehow are no longer authorized in the RFMO records. Twenty-five vessels changed name and/or flag (**Table 7**). And, we detected thirteen vessels that were no longer listed as purse seiners in the RFMO vessel records. Without Unique Vessel Identifiers (UVIs), it is difficult to track vessel changes. Fortunately, the situation seems to be 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 2012 to 91% in 2016. This probably comes as a result of the recent adoption of mandatory requirements for UVIs by the four tropical tuna RFMOs (IATTC, ICCAT, IOTC and WCPFC).

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

	2014	**2015**	**2016**
Vessels deleted			
Sank or no longer found in tRFMOs records	39	23	40
No longer classified as Large	12	16	7
No longer classified as targeting trop. tuna	13	1	5
Duplicate records	3	-	-
Different vessel type	-	1	13
Total	**67**	**41**	**65**
Vessels added			
New in the RFMO records and built before 2012	24	46	2
New in the RFMO records and built in 2012 or after	24	33	30
New in the RFMO records (year unknown)	12	12	1
Now classified as Large	22	2	1
Now classified as targeting trop. tuna	-	14	-

Total	**82**	**107**	**34**
Vessels changed			
Changed flag	49	24	19
(Of which changed flag AND name)	(30)	(12)	(11)
Changed name only	11	10	6
Total	**60**	**34**	**25**
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%

3.6.2 Vessels constructed in recent years

The number of large-scale tropical tuna purse seine vessels constructed during the 2010-2016 period according to tRFMO records is summarized in **Table 8**. It is worth noting that the total number of new vessels by year almost doubled from 2013 to 2014.

Table 8. Large-scale tropical tuna purse seine vessels built in recent years

		2010	2011	2012	2013	2014	2015	2016	
Developed	Chinese Taipei	1		4	4	3	2		14
	France	2		2				1	5
	Japan				2	2			4
	Korea, Rep.	1		4	1	4	1	1	12
	Spain				1	1	1		3
	USA						1		1
Other	Cape Verde					1			1
	China, P.R.		3	3		3	4		13
	Curaçao						1		1
	Ecuador	1				1			2
	Fed. States Micronesia	3[2]						1	4
	Kiribati					1			1
	Marshall Islands	2							2
	Mauritius				2				2
	Mexico				2	4	2		8
	Panama					1	1		2
	Papua New Guinea				2	5	4		11
	Philippines	2		1	1	2		1	7
	Seychelles					4	3		7

[2] Of these three vessels, one was originally flagged to Japan and two were originally flagged to Republic of Marshall Islands.

	Solomon Islands					1	2		**3**
	Venezuela					1			**1**
	Grand Total	**12**	**3**	**14**	**15**	**34**	**22**	**4**	**104**

4. Conclusions

Using updated information available from both the tRFMOs and the supporting databases, we estimate that, towards the end of April 2016, there were 1,644 purse seine vessels authorized to fish for tunas worldwide, with a combined fish hold volume of almost 1,100,000 cubic meters. This represents a 16% decrease in the number of vessels compared to that of Justel-Rubio and Restrepo (2015), due in great part to some vessel removals from the RFMO authorized vessels lists, predominantly of medium size. Restricting the list to large-scale vessels, defined here as ≥335 m^3 FHV, reduces the number of purse seiners to 849, with a combined FHV of over 940,000 m^3.

Focusing on large-scale purse seine vessels that target tropical tunas brings the number down to 728 vessels with about 880,000 m^3 of combined FHV. Nearly twice as many of these vessels are flagged to developing countries than are flagged to developed countries. More than half of these vessels (66% in number, 75% in FHV) are registered in ISSF's Proactive Vessel Register. About 17% of these vessels are authorized to fish in two or more RFMOs, indicating that there is a large potential mobility of these fleets at a global level. We recommend that RFMOs consider extending their 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 and Restrepo, 2015), using the same (but updated) data sources and methods, shows that once more there were numerous changes in the RFMO vessel records (**Table 7**). Several vessels that appeared on the records at the beginning of 2015 can no longer be found. Other (older) vessels that were not on the records are now listed; and some records changed in dimensions. The quality of the data in RFMO records has been undoubtedly improving in recent years, but there are still substantial gaps and opportunities for improvement. We recommend that RFMO members exercise greater quality control of the data submitted to the RFMOs for the vessel records.

Since Justel-Rubio and Restrepo (2015), 30 recently-constructed (between 2012 and April 2016), large-scale purse seine vessels and one vessel with unknown date of construction have been added to the RFMO records.

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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 ft^3 = 2.83 m^3).

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.