Netting Billions: a global valuation of tuna

an update

February 2020 (Final)

POSEIDON
AQUATIC RESOURCE MANAGEMENT

Report Information

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Acronyms used

ALB.............. Albacore
BB................. Pole and line
BET............... Bigeye
BFT............... Atlantic bluefin
CCSBT .... Commission for the Conservation of Southern Bluefin Tuna
CIF................ Carriage Insurance and Freight
C&F .... Carriage and Freight
EEZ............... Economic Exclusion Zone
e.g................. Exempli gratia in Latin meaning ‘for instance’/’for example’
EPO .... Eastern Pacific Ocean
ETRO............ East Tropical Atlantic
EUMOFA ...... The European Market Observatory for Fisheries and Aquaculture Products
FAO .... Food and Agriculture Organisation (of the United Nations)
FFA............... Forum Fisheries Agency
FOB .... Free On Board
GN .... Gillnet
GOFM........... Gulf of Mexico
HL................. Handline
IATTC .... Inter-American Tropical Tuna Commission
ICCAT........... International Commission for the Conservation of Atlantic Tunas
IOTC............. Indian Ocean Tuna Commission
LL.................. Longline
NE................. North East
NMFS .... National Marine Fisheries Service
NOAA .... National Oceanic and Atmosphere Administration
NW................ North West
NWC............. North West Central
OTH.............. Other
PBF............... Pacific bluefin
PFMC .... Pacific Fishery Management Council
PS................. Purse seine
RFMO........... Regional Fisheries Management Organisation
SAFE .... Stock Assessment and Fishery Evaluation
SBT............... Southern Bluefin tuna
SKJ .... Skipjack
SW................ South West
T .... tonnes
TR................. Troll
TROP............ Tropical Atlantic
WCP(O)........ Western Central Pacific (Ocean)
WCPFC......... Western and Central Pacific Fisheries Commission
WTRO........... West Tropical Atlantic
YFT............... Yellowfin

1. Background and introduction

Taken together, seven important tuna species (skipjack, albacore, bigeye, yellowfin, Atlantic bluefin, Pacific bluefin, and southern bluefin[1]) are among the most economically valuable fish on the planet.[2]

In a previous study[3] completed in 2016 by Poseidon Aquatic Resource Management Limited (Poseidon) on behalf of The Pew Charitable Trusts (Pew), analysis of landed volumes and prices for these species at different points in the supply chain, enabled an estimate of first sale ex-vessel values of tuna of US$ 12.2 billion in 2012 and US$ 9.8 billion in 2014. Final consumed values of these seven species were estimated at US$ 33.4 billion in 2012 and at US$ 33.0 billion in 2014. The estimates of final consumed values increased to US$ 41.6 billion in 2012 and US$ 42.2 billion in 2014 when using the total price of tuna cans rather than the drained weight of the tuna in canned products.[4]

The Poseidon 2016 study adopted an overall methodology (explained fully in that report and so not repeated here) that involved:

- Collection of catch statistics for the seven oceanic tunas from relevant Regional Fisheries Management Organisations (RFMOs), and compilation into a single MS Excel spreadsheet to allow for identification of catches by ocean basin, species, gear used, and fishing fleet flag[5].
- Mapping of the flow of tuna from each ocean basin to end markets for different species and gear combinations. The main markets included: canning/loining (whether canned in a country in which tuna is landed or transhipped); fresh sashimi markets; frozen sashimi markets; for ranching (bluefin tuna species only); and domestic markets (either in fresh or processed form i.e. sales of tuna not traded internationally, and which do not enter the canning, ranching or sashimi market value chains). The mapping was based on extensive literature reviews and consultations with industry experts to assign proportions (in percentages) of the catch of each species and gear combination for each ocean basin destined or different markets.
- Collection of first sale ex-vessel prices for tuna species caught by different gears in different ocean basins and destined for different end markets, and multiplication by the relevant catch volumes to generate dock/first sale ex-vessel sales values in 2012 and 2014.
- Collection of final prices of tuna species sold in different types of end markets (canned tuna, sashimi tuna, 'domestic' consumption in producing countries, and by-products of canning), and using appropriate conversion rates back to whole live weight of catch, multiplication by the relevant catch volumes to generate final consumed sales values in 2012 and 2014.

[1] Skipjack tuna *Katsuwonus pelamis* (SKJ); Bigeye tuna *Thunnus obesus* (BET); Yellowfin tuna *Thunnus albacares* (YFT); Albacore tuna *Thunnus alalunga* (ALB); Atlantic bluefin tuna *Thunnus thynnus* (BFT); Pacific bluefin tuna *Thunnus orientalis* (PBF); and southern bluefin tuna *Thunnus maccoyii* (SBT).
[2] Pew, 2016. Netting Billions: a global valuation of tuna
[3] Contract ID #27517; August 2014 to October 2015.
[4] Macfadyen G., Huntington T., Caillart B. and Defaux V. (2016). Estimate of the global sales values from tuna fisheries.
[5] The 2016 Poseidon study commented on issues of potential reliability of RFMO databases.

The 2016 Poseidon study was used by Pew as the basis for its report 'Netting Billions: a global valuation of tuna', published in May 2016[6]. The 2016 Pew report and the underlying estimates provided by Poseidon served as an important advocacy tool to highlight the economic importance of the sector and therefore the need for its sustainable management. The Pew report noted the potential for increased financial benefits that could be generated if currently overfished stocks were exploited at sustainable levels allowing overall stock biomass, and therefore catches, to increase over time. As the report stated, '*Improved management of tuna stocks is critical to sustaining the health and well-being of marine ecosystems, as well as the industries and coastal peoples who rely on them for income and food*'.

In 2019, Pew commissioned Poseidon to complete a study[7] to provide an update of the dock/first sale ex-vessel and final consumed values of tuna for the years 2016 and 2018. This report represents the output of the study.

The purpose of this report and the underlying data files are to provide the data, information and basis for Pew to prepare an updated 'Netting Billions' report. The style and approach to this report has therefore been to prepare it more as a technical document than an interpretive report.. On the basis that Pew's Netting Billions report will include graphics, this report includes key data tables only, rather than figures/graphs. with All relevant data files were provided to Pew to enable it to develop its own figures/graphs and complete additional analysis.

Each section of this report does however provide some key findings from the data which appear to the consultants as important.

This report has a number of sections as follows:

- Study methodology (section 2)
- Tuna landings (section 3)
- Dock/first sale ex-vessel values of tuna (section 4)
- Final consumed values of tuna (section 5)

[6] Both the Poseidon and Pew reports from 2016 focus on providing gross values linked to economic activity rather than valuation in the sense of net economic benefits

[7] Contract ID 32896; March 2019 to March 2020

2. Study methodology

In completing this study, several steps were undertaken in line with the terms of reference:

1. The Poseidon team first discussed the methodology to be used with Pew staff and Pew's project review group.
2. Landings data by ocean and species for 2016 and 2018 was compiled and analysed.
3. Dock/first sale ex-vessel tuna prices applicable in 2016 and 2018 were collected.
4. Final/end consumed prices for tuna in 2016 and 2018 were collected.
5. The earlier study model was updated for 2016 and 2018, using the data from steps 2-4 above.
6. A draft version of this report was prepared, and all data files and primary and secondary sources of information were provided to Pew, to allow Pew to complete a data and fact check.
7. Following the data check and fact check by Pew, and provision of comments on ways to improve the study outputs, a final version of the study report was prepared.

Methodological issues with the 2012 and 2014 estimates identified in the 2016 report, were numerous and were discussed and documented in detail in the Poseidon 2016 report (see Annex 1). Pew's 2016 report also contains a section explaining the methodology used.

The methods review meeting at the outset of the study agreed that the overall approach taken should be to repeat the methodology used in the previous study to maintain comparability. As the same general methodology has been followed, the main text of this report does not present again in detail the methodology used and the reader is referred to the information in the Annex.

However, in line with agreement at the methods review meeting, the methodology used in this study has been improved to address where possible some of the concerns raised in the 2016 study report, through:

- Increasing where possible the robustness of the data used, in particular in relation to the price data collected.
- Increasing the transparency of the appropriateness of the assumptions by clearly identifying the relative robustness of data used and therefore the estimates provided.

For all price data used, and for the estimates of values, the supporting MS Excel spreadsheets providing an indication of our assessment over the reliability and robustness of the data, based on the following scale:

(green)	Very Strong
(light green)	Strong
(yellow)	Acceptable
(orange)	Weak
(red)	Very weak

This study has reviewed the many methodological assumptions made in the 2016 study. It has attempted to tread a careful line between improving the robustness of the data where possible, while also attempting to repeat the methodology used in the previous study such that data from the two studies may be broadly comparable and allow for the tracking of any major trends.

In each of the following sections of this report we therefore provide a short section to discuss methodological issues. This allows for documentation and transparency over whether and how the previous methodology has been improved (if at all), consideration of any differences in data sources (which may impact on comparability of results with the 2016 study), and information on any changes in methodological assumptions. Having presented these methodological issues, each section then presents the results of the data collection and the related analysis.

In presenting the results, each of the following three sections provides the data for 2012 and 2014 from the old study, along with 2016 and 2018 from this study. All calculated values are in nominal terms and have not been adjusted for inflation.

3. Tuna landings

3.1 Methodological issues

Collecting and analysing data on tuna landings followed the same methodology as the previous study. Data were obtained either from accessing publicly available data from RFMO websites, or through direct personal communication with RFMO database managers, and compiled into a consolidated MS Excel file. Relevant RFMOs were:

- International Commission for the Conservation of Atlantic Tunas (ICCAT)
- Indian Ocean Tuna Commission (IOTC)
- Western and Central Pacific Fisheries Commission (WCPFC)
- Inter-American Tropical Tuna Commission (IATTC)
- Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

As in the 2016 study, this entailed standardising gear and country codes across the different RFMOs, as well as allocating sub-Oceans where possible. This time a new 'Ocean code' was added to simplify data aggregation into the main master files. Data on landings in the north Pacific Ocean were also provided by the International Scientific Committee (ISC) for Pacific Bluefin tuna only (as in the previous study).

The Poseidon landings MSExcel database from the earlier study has been updated, with all RFMO data for 2016, 2017 and 2018 added into a single data file, to allow for easy analysis of trends across the years. This file can be considered to contain the best estimate possible of global landings of the seven species of tuna[8]. Given that the same processes were followed for compiling the 2016 and 2018 landings data as used to compile the data for 2012 and 2014 in the previous study, the data for different years in the database can be expected to be comparable[9].

Data from Poseidon's landings database was then entered into the '2016 volumes' and '2018 volumes' worksheets in two master files (one for 2016 and one for 2018) used to generate the final estimates of dock and consumed values. An individual total landings figure was provided for each combination of species, gear, and ocean basin, where the landings database showed a landings figure.

This process revealed some cells in the master files in different ocean basins (but particularly in the WCPO and EPO) for which there had been no landings in 2012 and 2014, but which contained landings in 2016 and/or 2018. While the total volumes of these 'new' gear/species combination landings were small (for example 5 404 tonnes in 2016 and 3 373 tonnes in 2018, representing around 0.1% of global landings), it required an estimation of the proportion of the landings for these different gear/species combinations destined for different markets (loining/canning, fresh sashimi, frozen sashimi, ranching). These estimations were guided by market flows for similar gear/species combinations which had been made in the 2016 study. The '2016 volumes', '2018 volumes' and 'market flow'

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[8] FAO's downloadable database (FishStat J) also categorises landings by sub-ocean. A cross-check of data for 2016 (FAO data are not available for 2018) between the FAO dataset and the Poseidon catch database compiled based on data provided by RFMOs, reveals that the global landings of the seven tuna species that are the focus of this study is just over 100 000 tonnes (*c.* 2%) lower in the FishStat J database than in the Poseidon-compiled database. This is likely because the FAO data submissions were under-estimates, especially in the Atlantic Ocean (*c.* 69 000 t difference) and the Pacific Ocean (24 000 t difference). The differences are spread across all species.

[9] RFMOs are continuously updating and making small corrections to their reported landings data as new or revised data are received. The Poseidon landings database has not updated 2012 and 2014 landing data from the 2016 study.

worksheets in the 2016 and 2018 'master files' have been colour-coded (in orange) to highlight these 'new' gear/species landings, and the assumptions about the proportion of each landings figure destined for the main market types.

Other assumptions about market flows for other gear/species combinations of landings for the different ocean basins have generally been kept constant. This is because: i) the study 'deliverables' did not require or provide time for a revision/re-working of the assumptions made in the 2016 study[10], and the level of approximation inherent in the proportions assumed means that it would be difficult to justify any changes with any great certainty; ii) keeping the assumptions of the proportions going to different markets the same allows for better comparability across the years for the dock and final consumed estimates; and iii) one would not expect very significant changes in the proportion of landings from different gear/species combinations over the time period concerned. However, in line with the recommendations of the methods review meeting which suggested consideration of the most critical assumptions, given that the WCPO accounts for such a significant (and largest) proportion of total global landings, some minor modifications were made to the market flow assumptions made for this ocean basin based on expert opinion[11].

3.2 Results

The table below (Table 1) provides the landings for the seven tuna species by ocean basin, species, and gear type, in each case for 2012, 2014, 2016 and 2018.

[10] Section 3 of the Phase 1 report of the 2016 study provides extensive text about market flows of different species caught with different gears in different ocean basins, to different end market types. This description was used to inform the market flow proportions used in the 'market flow' worksheets in the master files.

[11] Most changes reflect small modifications to the percentages used in the 2016 study and don't involve any 'new' markets for specific gear/species combinations. However a 'new' market flow not assumed in the 2016 is a small proportion (5%) of purse seine catches of yellowfin tuna being deep frozen for low grade sashimi markets.

Table 1: Tuna landings of selected species 2012, 2014, 2016 and 2018 (tonnes)

Ocean Basin	2012	2014	2016	2018
Western Central Pacific Ocean	2 656 607	2 848 992	2 704 555	2 731 142
Eastern Pacific Ocean	632 513	665 367	733 804	675 957
West Indian Ocean	570 968	708 846	788 266	932 270
East Indian Ocean	272 815	295 160	218 629	234 374
East Atlantic Ocean	378 739	385 719	462 449	506 346
West Atlantic Ocean	89 372	70 011	92 850	86 600
Antarctic	10 261	11 911	14 445	17 150
Gear	**2012**	**2014**	**2016**	**2018**
Pole and line	438 965	378 730	390 451	289 811
Gill net	186 747	244 291	208 216	239 036
Handline	148 383	271 574	265 738	255 929
Longline	615 175	565 954	555 942	580 449
Other	218 512	43 862	211 295	271 518
Purse seine	2 932 763	3 357 711	3 297 293	3 476 817
Troll	70 730	123 884	86 063	70 279
Species	**2012**	**2014**	**2016**	**2018**
Albacore	265 233	260 742	224 636	234 919
Bigeye	460 885	433 668	407 622	406 257
Atlantic bluefin	12 602	14 876	21 032	29 784
Pacific bluefin	16 267	17 065	26 187	20 713
Southern bluefin	10 261	11 911	14 445	17 150
Skipjack	2 538 271	2 878 358	2 867 828	2 997 626
Yellowfin	1 307 756	1 369 386	1 453 249	1 477 390
Grand Total	**4 611 275**	**4 986 006**	**5 014 999**	**5 183 839**

Source: Poseidon compilation and analysis of landings from RFMO databases.

Table 1 highlights that:

- Total landings show an increasing trend over 2012 to 2018, rising by 12.4% over the period to 5.18 million tonnes in 2018.
- As a proportion of total landings, the WCPO accounted for a declining share over the period, while the West Indian Ocean shows a significant increase from 12.4% of the total in 2012 to 18.0% in 2018. However, the WCPO still accounted for more than half (52.7%) of total landings in 2018. Landings in the East Atlantic Ocean have also increased over the period as a proportion of total global landings from 8.2% to just under 10%.
- Purse seine landings dominate as a proportion of global landings, accounting for more than 67% in both 2014 and 2018. Longline landings are the next most important gear accounting for just over 11% of global landings in 2014, 2016, and 2018, with pole and line, gillnet, handline, and 'other' each accounting for around 5% of global landings in 2018, but with the proportion of global landings made by pole and line vessels falling from 9.5% in 2012 to 5.6% in 2018.
- Skipjack retained its predominance in terms of the contribution of different species to global landings, at 57-58% of the total in each of 2014, 2016 and 2018. Yellowfin tuna contributions were also fairly stable at between 27.5% and 29% of total landings in each of 2012, 2014, 2016 and 2018. Both albacore and bigeye landings declined between 2012 and 2018 as a proportion of total landings (albacore from 5.8% in 2012 to 4.5% in 2018, and bigeye from 10.0% to 7.8%) as well as in absolute volume terms. However, the combined catches of Atlantic bluefin, Pacific bluefin, and Southern

bluefin rose from 39 130 tonnes in 2012 to 67 647 in 2018 (an increase of 73%), with increases for all three individual species in volume terms.

When looking at different tuna species and the gears that are used to catch them (see Table 2), purse seines are the dominant method for bigeye, Atlantic bluefin, Pacific bluefin, skipjack and yellowfin, as well as being the dominant fishing method overall and accounted for 67.1% of total landings of the seven species in 2018. Longlines were the dominant catching method for albacore and southern bluefin in volume terms in 2018 and accounted for 11.2% of total global landings of the seven species.

Table 2: 2018 landings of selected tuna species by gear (tonnes, and %)

	Albacore	Bigeye	Atlantic bluefin	Pacific bluefin	Southern bluefin	Skipjack	Yellowfin	Grand Total
Pole and line	32 183	9 890	749	94	9	217 217	29 668	289 811
Gill net	217	5 394	5	690		148 799	83 931	239 036
Handline	714	7 170	1 952	514		48 884	196 695	255 929
Longline	169 018	165 589	4 935	2 187	11 760	15 644	211 315	580 449
Other	9 820	7 275	5 006	1 542	14	170 072	77 788	271 518
Purse seine	3 499	208 862	17 136	14 458	5 367	2 372 145	855 351	3 476 817
Troll	19 468	2 076		1 228	0	24 865	22 642	70 279
Grand Total	**234 919**	**406 257**	**29 784**	**20 713**	**17 150**	**2 997 626**	**1 477 390**	**5 183 839**
	Albacore	**Bigeye**	**Atlantic bluefin**	**Pacific bluefin**	**Southern bluefin**	**Skipjack**	**Yellowfin**	**Grand Total**
Pole and line	13.7%	2.4%	2.5%	0.5%	0.1%	7.2%	2.0%	5.6%
Gill net	0.1%	1.3%	0.0%	3.3%	0.0%	5.0%	5.7%	4.6%
Handline	0.3%	1.8%	6.6%	2.5%	0.0%	1.6%	13.3%	4.9%
Longline	71.9%	40.8%	16.6%	10.6%	68.6%	0.5%	14.3%	11.2%
Other	4.2%	1.8%	16.8%	7.4%	0.1%	5.7%	5.3%	5.2%
Purse seine	1.5%	51.4%	57.5%	69.8%	31.3%	79.1%	57.9%	67.1%
Troll	8.3%	0.5%	0.0%	5.9%	0.0%	0.8%	1.5%	1.4%

Source: Poseidon compilation and analysis of landings from RFMO databases.

The table below (Table 3) shows landings in 2018 for countries which accounted for more than 1% of global landings of the seven tuna species. Landings for other countries are grouped and provided under the row ‘Other’ in the table. Indonesia accounted for the largest share of total landings of the seven tuna species at just under 11%. Six other countries (Japan, Papua New Guinea, Taiwan China, Spain, Ecuador and Korea) each accounted for more than 5% but less than 10% of global landings of the seven species in 2018. Countries showing large increases in landed volumes between 2012 and 2018 are Papua New Guinea, Ecuador, Kiribati, France, the Maldives, Seychelles, Vietnam and Federates States of Micronesia, Iran and the Solomon Islands. Countries showing significant decreases in landings over the six-year period are Japan, the USA, and the Philippines.

Table 3: Landings by flag state of selected tuna species, 2012, 2014, 2016, and 2018 (tonnes)

	2012	2014	2016	2018	2018 (%)
Indonesia	566 153	621 278	657 449	568 170	10.96%
Japan	454 654	425 104	365 439	369 696	7.13%
Papua New Guinea	240 054	236 823	288 982	328 712	6.34%
Taiwan, China	341 005	337 275	326 054	324 210	6.25%
Spain	275 629	144 341	250 094	309 240	5.97%
Ecuador	249 543	265 897	287 859	298 834	5.76%
R. of Korea	306 476	306 178	309 661	298 402	5.76%
USA	296 368	317 737	282 184	241 807	4.66%
Kiribati	76 957	114 526	169 593	193 749	3.74%
Philippines	236 729	300 588	214 803	153 016	2.95%
France	78 119	137 910	130 631	152 001	2.93%
Maldives	98 369	120 784	125 790	147 760	2.85%
Seychelles	62 048	7 047	117 064	132 698	2.56%
Mexico	120 327	135 794	114 248	125 605	2.42%
Vietnam	65 556	78 630	123 076	120 535	2.33%
Federated States of Micronesia	38 983	40 870	77 145	118 714	2.29%
Iran	63 660	82 632	87 337	112 314	2.17%
China	114 424	118 478	81 340	100 518	1.94%
Ghana	69 853	74 822	80 295	93 517	1.80%
Panama	67 112	71 374	86 716	88 714	1.71%
Sri Lanka	100 857	101 197	85 249	83 595	1.61%
Marshall Islands	72 422	75 887	61 786	74 580	1.44%
India	47 434	68 867	56 548	74 486	1.44%
Solomon Islands	24 400	71 600	56 483	60 754	1.17%
Other	544 145	730 370	579 175	612 210	11.81%
Grand total	**4 611 275**	**4 986 006**	**5 014 999**	**5 183 839**	

Source: Poseidon compilation and analysis of landings from RFMO databases. Species included: albacore, bigeye, Atlantic bluefin, Pacific bluefin, Southern bluefin, skipjack, and yellowfin.

Also important to note is that, as agreed based on the terms of reference, this study excludes those species that are more prevalent in the shallower waters of continental shelves or coastal fringes (i.e. neritic species[12]), as well as other billfish and tuna-like species of commercial importance which are under the mandate of RFMOs. Neritic tuna have an important role in the small-scale fisheries, livelihoods and food security of coastal areas, but are less prevalent in the international value chain than the oceanic species. In volume terms, according to FAO (FishStat J) the global neritic tuna catch in 2016 and 2017 was in excess of 1 million tonnes, as shown in the table below[13]. Other large oceanic billfish species such as swordfish also account for significant volumes of landings and are important commercially in international value chains.

The seven main tuna species that are the focus of this study represent only around 65% of the total global landings of this larger groups of tuna, tuna-like and billfish species.

[12] Neritic tuna species include, for example, bullet tuna (*Auxis rochei*), frigate tuna (*Auxis thazard*), kawakawa (*Euthynnus affinis*), and longtail tuna (*Thunnus tonggol*).
[13] FishStat J was used for this analysis as not all RFMOs record data on landings of these species.

Even accounting for typically low sales prices of neritic tuna, the global values of these species is likely to be very significant, and when considering their contributions to food security in many tuna producing nations, suggests that the need for improved management of these tuna may be a ‘hidden’ requirement that is worthy of more international advocacy and concern.

Table 4: Landings of tuna, tuna-like species and billfish in 2016 and 2017 (tonnes, and % of total yearly landings)

Species	2016		2017	
Skipjack tuna	2 817 124	36.58%	2 827 762	35.90%
Yellowfin tuna	1 443 598	18.75%	1 476 741	18.75%
Tuna-like fishes nei	458 442	5.95%	482 951	6.13%
Bigeye tuna	390 707	5.07%	472 934	6.00%
Seerfishes nei	415 658	5.40%	414 642	5.26%
Kawakawa	367 752	4.78%	348 369	4.42%
Narrow-barred Spanish mackerel	277 272	3.60%	347 636	4.41%
Frigate and bullet tunas	320 269	4.16%	317 014	4.02%
Longtail tuna	238 002	3.09%	281 613	3.57%
Albacore	208 533	2.71%	232 390	2.95%
Swordfish	116 634	1.51%	111 171	1.41%
Eastern Pacific bonito	79 359	1.03%	102 304	1.30%
Japanese Spanish mackerel	56 462	0.73%	53 606	0.68%
Blue marlin	41 228	0.54%	50 321	0.64%
Indo-Pacific king mackerel	49 798	0.65%	47 310	0.60%
Little tunny (=Atl.black skipj)	25 439	0.33%	36 484	0.46%
Atlantic bonito	55 967	0.73%	34 159	0.43%
Indo-Pacific sailfish	33 498	0.44%	31 078	0.39%
Atlantic bluefin tuna	21 100	0.27%	27 475	0.35%
Black marlin	19 316	0.25%	19 638	0.25%
Pacific bluefin tuna	10 961	0.14%	17 732	0.23%
Marlins,sailfishes,etc. nei	13 707	0.18%	16 037	0.20%
Pacific sierra	13 882	0.18%	16 014	0.20%
King mackerel	13 914	0.18%	15 501	0.20%
Frigate tuna	112 509	1.46%	13 845	0.18%
Bullet tuna	26 901	0.35%	13 801	0.18%
Southern bluefin tuna	14 200	0.18%	13 226	0.17%
Atlantic Spanish mackerel	10 466	0.14%	10 488	0.13%
Striped marlin	9 521	0.12%	8 924	0.11%
West African Spanish mackerel	4 800	0.06%	7 274	0.09%
Striped bonito	10 019	0.13%	6 840	0.09%
Black skipjack	7 157	0.09%	5 568	0.07%
Wahoo	3 847	0.05%	5 423	0.07%
Atlantic sailfish	3 403	0.04%	3 291	0.04%
Serra Spanish mackerel	2 380	0.03%	2 338	0.03%
Blackfin tuna	1 613	0.02%	1 517	0.02%
Dogtooth tuna	1 383	0.02%	1 390	0.02%
Shortbill spearfish	596	0.01%	558	0.01%
Plain bonito	807	0.01%	490	0.01%
Atlantic white marlin	582	0.01%	470	0.01%
Longbill spearfish	80	0.00%	372	0.00%
Cero	253	0.00%	263	0.00%
Slender tuna	178	0.00%	234	0.00%

Species	2016		2017	
Streaked seerfish	28	0.00%	85	0.00%
Mediterranean spearfish	12	0.00%	14	0.00%
Butterfly kingfish	16	0.00%	7	0.00%
Roundscale spearfish	0	0.00%	0	0.00%
Australian bonito	8	0.00%	0	0.00%
Broad-barred king mackerel	878	0.01%	0	0.00%
Grand Total	**7 700 259**	**100.00%**	**7 877 301**	**100.00%**
Seven main tuna species	**4 906 223**	**63.7%**	**5 068 260**	**65.8%**

Source: FAO FishStat J. Note: ‘nei’ = not easily identifiable.

4. Dock / first sale ex-vessel values

4.1 Methodological issues

This section sets out i) the approach that was taken to collect dock/first sale ex-vessel tuna prices; ii) how these collected prices were allocated as a representative of a given species, for a given market flow, for a given gear type, and within a given fisheries management region; and iii) how the prices were used in combination with the landings data to generate dock / first sale ex-vessel values.

The methodology was broadly consistent with that employed during the 2016 study, however in this study we have used a more systematic approach, and therefore provide additional detail on the methodology used for the sake of full transparency.

4.1.1 Collection and manipulation of dock / first sale ex-vessel prices

Identification of sources for data extraction

The first step completed was to identify appropriate sources of dock / first sale ex-vessel values for tuna, which could provide price data for the years 2016 and/or 2018. The sources used to extract this data fall within two categories: i) online sources such as databases and literature and ii) domestic sources that are of limited public access.

With regards to online sources, these were identified in three ways: Firstly, the sources used in the 2016 study were considered; Secondly, members of the project team were able to provide additional sources that they knew would be of relevance to the project and; Thirdly, internet searches were performed to identify new potential sources. These internet searches used search terms including 'tuna prices', 'ex-vessel tuna prices' and '*country* customs' but also systematically reviewed the other resources of already recognised data sources.
The following online sources were identified and used for data extraction, and represent a slightly expanded list of sources of information compared to the 2016 study, thus improving the robustness of the price estimates:

- ATuna.com (new source for this study)
- COMEXT (Eurostat's database for detailed statistics on international trade in goods)
- Sustainable Fisheries Partnership Agreement evaluation reports
- The European Market Observatory for Fisheries and Aquaculture Products (EUMOFA) (new source for this study)
- Forum Fisheries Agency (FFA) Compendium of Economic and Development Statistics 2017 & 2018
- Globefish
- Japanese Customs
- Japanese Fisheries Agency for port data (new source for this study)
- National Oceanic and Atmospheric Administration (NOAA) Commercial Fisheries Database
- NOAA Stock Assessment and Fishery Evaluation (SAFE)
- Pacific Fisheries Management Council
- Thai Customs
- Tokyo Metropolitan Central Wholesale Market
- US National Marine Fisheries Services (NMFS)
- World Bank Pacific Islands Regional Oceanscape Program Forum Fisheries Agency

Domestic price information was dependent upon identifying persons known to the research team who potentially could provide access to domestic ex-vessel price data. Despite concerted efforts to retrieve data from these sources, data was only received from Australia and Pakistan through this collection method, which whilst imperfect served to augment the other readily available online sources. The low return rate was generally due to an inability of country contacts to share commercially sensitive information.

Collection of price-determining information

Once relevant data sources had been identified and accessed, relevant data was extracted and classified. The recorded information pertained to the following: catch origin; species type; gear type; preservation method; first landing location; market flow.

- The catch origins were the different ocean basins being considered by the study.
- Species type was inclusive of the seven major types of tuna forming the focus of the study, but also included Swordfish and Kawakawa.
- Gear types were identified including gillnet, longline, poll-and-line, purse seine and trawling.
- The preservation method related to whether tuna was landed fresh or frozen.
- The first landing location identified the port and country where the tuna was landed or delivered for sale i.e. the point at which the price data was obtained.
- The market flow referred to the expected use of the tuna once sold, which were categorised as 'loining/canning, 'domestic (fresh or processing)', 'fresh sashimi', 'frozen sashimi', 'ranching'.

All available information that was referenced in the data regarding these variables was recorded for each price.

Collection and manipulation of price data for comparability

The large range of price data associated with various combinations of the possible categorisations described in the previous section needed to be standardised to arrive at a US$ per metric tonne (mt) value. A four-step process was taken to arrive at consistent US$/mt values:

1. Prices that were given relative to a kilo or a pound were converted to metric tonnes;
2. Prices that were in Euros or Japanese Yen were converted to US$ using a mid-year exchange rate for both 2016 and 2018 price data;
3. Tuna that had undergone preparation for selling that would have resulted in a reduced total weight (such as gilling and gutting) had the price adjusted to reflect the whole 'green' weight;
4. Prices that included costs such as freight and insurance had these costs removed from the final price.

The price conversion to whole weight equivalent applied the same assumptions made in the 2012-2014 study and were as follows: tuna for canneries was given no price deduction; for tuna that had been gilled and gutted a 6% price reduction was applied; for tuna that had been headed and gutted a 16% price reduction was applied and; for tuna that had been loined, a 40% price reduction applied.

With regards to costs that were included in the price data from some sources where prices were not actual dock-side prices, the value of these was based on the estimation of the value of a cost type (such as freight or insurance) that was largely reflective of the previous study's estimated costs, but based on minor modifications based on current information available to the study team. For example, where customs/import data were used as a source of prices, the costs of freight and insurance had to be accounted for. Costs and freight (carriage and freight) were estimated to be $250/mt and insurance was estimated to be $50/mt. If the price data made reference to other costs then these were also deducted from the price. Similarly, if the price data made reference to the value of C&F and/or insurance, then these were used instead of the generalised $250/mt and $50/mt values that were otherwise applied. With regards to an air-freight cost, none of the price data sources made explicit reference to the catch being air-freighted to its landing point. Instead, an assumption was made that any prices data that made reference to the catch being used for fresh sashimi consumption and were either bigeye, bluefin, pacific bluefin, southern bluefin or yellowfin, should be considered as an air-freighted product and have that respective cost removed. For that reason a cost of US$2,200 was deducted for all of the fresh sashimi prices that applied to those species, based on the consultants' knowledge from industry contacts of typical costs applicable for air freighted tuna. The only exception to this cost being applied was where the source had already referenced costs greater to US$2,200, for which it was assumed that the air-freight cost was included in that total cost.

Through this four-stage process, original source prices were transformed into comparable figures. Where the source did not provide information pertaining to a weight deduction or costs, it was assumed that the price was already in a whole green weight equivalent and that the price was exclusive of any associated costs. All sources, however, made reference to the currency and weight measurement associated with the price data so it was always possible to convert the price into US$/mt if the price was not already expressed in that way.

4.1.2 Allocation of dock / first sale ex-vessel prices to landings data

Following the extensive data collection phase it was necessary to identify the most appropriate price to apply to each cell in the 'vessel prices' worksheet in the 2016 and 2018 master files. Each cell was characterised by four criteria describing the fish species, the gear used, the market flow and the fisheries management region. Criteria were ordered based on the likely influence on the price of the product, which led to a priority order of:

1. Fish species
2. Market flow
3. Gear type
4. Fisheries management region

Where the market flow was loining/canning but we had no appropriate price, a 'frozen' form was used as an acceptable proxy. Equally, where the market flow was domestic but no appropriate price could be found, a proxy of 'fresh' product form was accepted. The use of both proxies also depended upon each line not being sashimi form.

Each individual price cell in the 'vessel prices' worksheets in the 2016 and 2018 master files is colour coded based on the multi-criteria analysis above to allow for a systematic assessment of the robustness of the price data used in the study model. The colour shown below is used in the 2016 and 2018 master files and indicates the number of characteristics met by the price which is allocated to that specific cell.

(green)	Very strong	All four criteria are met
(light green)	Strong	Three out of four criteria are met
(yellow)	Acceptable	Two out of four criteria are met
(orange)	Weak	One out of four criteria are met
(red)	Very weak	No criteria are met

Use of this method provided all of the required cells for the 2016 vessel prices sheet with a price and a level of confidence associated with that price. Duplicating this methodology for the 2018 vessel prices provided 2018 equivalent prices for most of the cells in the 2018 vessel prices sheet but left a significant proportion (38.5% of cells) unfilled due to the reduced availability of ex-vessel price data for 2018 relative to 2016 (for 2018 and 2016, 77 and 147 prices were respectively collected).

For the 2018 vessel price cells that required, but were missing, a representative price, the 2016 price was multiplied by an index that reflected the average price change from 2016 to 2018 for each species/market flow combination. This index was calculated for each species/market flow combination by: firstly, taking each of the available 2018 prices for that combination; secondly, dividing each 2018 price by its respective 2016 price to determine the value change and; lastly, averaging all of the value changes to arrive at a final index value.

For the following species/market flow combinations, none of the 2016 prices used for the 2016 vessel price sheet were available for 2018:

- Albacore used for fresh sashimi;
- Skipjack used for fresh sashimi and;
- Skipjack used for frozen sashimi.

To calculate the 2018 prices for these combinations an average index was applied to the 2016 prices. These average indexes were created for each market flow by taking each of the available indexes (one for each species) that was associated with that market flow. For example, a 2018 price for a cell referencing Skipjack used for frozen sashimi was calculated by taking the cell's 2016 price and multiplying it by the average frozen sashimi price index.

This same issue of not having 2018 data available from the same source that had been used for the 2016 data also applied to all bluefin, pacific bluefin and southern bluefin cells that were for frozen sashimi markets. Rather than using the described indexation method here, it was recognised that these species were high value and the average change in price according to the frozen sashimi market flow may not reflect the change in price for these species. For this reason, a source that provided 2018 prices but not 2016 prices was used and the 2016 prices were estimated by applying the fresh sashimi 2018/2016 price ratio to the frozen sashimi 2018 price.

For all 2018 prices that were calculated by use of an index, the cell was downgraded by one colour to reflect the reduced confidence in that price relative to its comparative 2016 figure.

4.1.3 Reality Check

Once the described methodology had been completed, prices allocated to the cells were reviewed and two actions were agreed and taken to further improve the reliability of the data.

Firstly, it was recognised that domestic prices were often much higher than cannery prices, which did not reflect the used assumption that domestic consumption of tuna caught by lower quality gear types, represented catch that had been rejected for cannery use due to poor quality. Therefore, for each species/market flow that had been caught by either pole-and-line, gillnet, or 'other' and had domestic prices higher than cannery prices, domestic prices were made equal to the cannery price. The only circumstance in which this change was not made, was where a 'strong' level of confidence had been allocated to that price.

Where changes were made, the confidence level was re-evaluated using the same method described in section 4.1.2. Where the 2018 price was missing, indexation was applied using the same method described in section 4.1.2. Bluefin, pacific bluefin and southern bluefin had no prices for canneries or domestic consumption so were not changed at this stage in the methodological approach.

Secondly, it was recognised that the allocated consumption prices (discussed later) could be expected to be approximately two to three times the value of the allocated dock / ex-vessel prices, and that observing such a ratio would suggest that the dock / ex-vessel prices were generally estimated correctly. Prices were compared and it was observed that, on average, the consumption prices were indeed two to three times the value of the vessel prices.

4.1.4 Generating dock / first sale ex-vessel values

The approach used to generate the dock / first sale ex-vessel values in the master 2016 and 2018 files, was the same as that employed in the 2016 study. All cells with a volume of landings in the '2016 volumes' and '2018 volumes' worksheets, also have a price figure in the '2016 vessel prices' and '2018 vessel prices' worksheets. Multiplication of these cells provides the dock / first sale ex-vessel values of landings shown in the worksheets '2016 total ex vessel values' and '2018 total ex vessel values' in the two corresponding master files.

4.2 Results

The results of the analyses to estimate dock / first sale ex-vessel values for 2016 and 2018 are presented below. The total values of US$ 11.3 billion in 2016 and US$ 11.7 billion in 2018, compare with estimations made in the 2016 study of US$ 12.2 billion in 2012 and US$ 9.8 billion in 2014. The increase in 2018 over 2016 may reflect both the slightly larger total landings globally in 2018, as well as inflation given that all prices are in nominal values.

When comparing data in Table 5 and Table 6 there are no striking differences between years in the total values or relative contributions by species, market destination, ocean area or gear. However of note is that:

- Two species (yellowfin and skipjack) account for 70% of the total values.
- The value of landings destined for the canning sector account for more than half the total annual values.
- The Pacific Ocean (WCPO and EPO) accounts for more than 60% of the total value of dock / first sale ex-vessel landings.
- Purse seine is the dominant gear in terms of the values of landings at first sale, accounting for almost half total global values, with longline being the next most important gear at just under 30% of total values.

Table 5: Dock / first sale ex-vessel values of landings of selected tuna species in 2016 (in US$)

Species	US$	% of species total	Market destination	US$	% by market flow
ALB	$ 626 434 175	6%	Canning	$ 5 908 191 417	52%
BET	$ 2 066 137 953	18%	Domestic	$ 738 226 738	7%
BFT	$ 247 785 534	2%	Fresh sashimi	$ 1 587 705 477	14%
PBF	$ 261 941 147	2%	Frozen sashimi	$ 2 829 108 736	25%
SBF	$ 178 605 231	2%	Ranching	$ 256 311 151	2%
SKJ	$ 3 939 383 920	35%			
YFT	$ 3 999 255 559	35%			
Total	**$ 11 319 543 520**		**Total**	**$ 11 319 543 520**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$ 5 384 982 922	48%	Pole and line	$ 692 421 397	6%
EPO	$ 1 526 085 234	13%	Gillnet	$ 330 121 206	3%
WIO	$ 2 057 314 728	18%	Handline	$ 1 110 147 282	10%
EIO	$ 691 014 984	6%	Longline	$ 3 145 349 454	28%
EAO	$ 1 133 144 746	10%	Other	$ 643 808 866	6%
WAO	$ 348 395 676	3%	Purse seine	$ 5 181 039 151	46%
Antartic	$ 178 605 231	2%	Troll	$ 216 656 165	2%
Total	**$ 11 319 543 520**		**Total**	**$ 11 319 543 520**	

Source: Poseidon analysis

Table 6: Dock / first sale ex-vessel values of landings of selected tuna species in 2018 (in US$)

Species	US$	% of species total	Market destination	US$	% by market flow
ALB	$ 649 902 914	6%	Canning	$ 6 065 681 757	52%
BET	$ 1 891 001 588	16%	Domestic	$ 597 440 754	5%
BFT	$ 359 780 808	3%	Fresh sashimi	$ 1 304 299 184	11%
PBF	$ 223 060 005	2%	Frozen sashimi	$ 3 424 997 741	29%
SBF	$ 218 650 194	2%	Ranching	$ 320 887 628	3%
SKJ	$ 3 986 994 690	34%			
YFT	$ 4 383 916 864	37%			
Total	**$ 11 713 307 063**		**Total**	**$ 11 713 307 063**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$ 5 747 170 166	49%	Pole and line	$ 493 974 719	4%
EPO	$ 1 376 300 013	12%	Gillnet	$ 258 701 543	2%
WIO	$ 2 060 405 630	18%	Handline	$ 1 214 793 768	10%
EIO	$ 681 078 506	6%	Longline	$ 3 433 077 839	29%
EAO	$ 1 282 978 366	11%	Other	$ 745 661 589	6%
WAO	$ 346 724 188	3%	Purse seine	$ 5 393 727 044	46%
Antarctic	$ 218 650 194	2%	Troll	$ 173 370 561	1%
Total	**$ 11 713 307 063**		**Total**	**$ 11 713 307 063**	

Source: Poseidon analysis

The average values in US$ per tonne of whole round landed weight have been calculated using the landings data and the value data in the tables above, and are presented below for 2016 and 2018 (see Table 7). The data serve to highlight:

- Very different values per tonne for different species, with high values per tonne of the three bluefin species compared to other species, and with skipjack having the lowest value per tonne at just 10-12% of the dock prices paid for bluefin species.
- Less significant differences in values per tonne between ocean basins (due to the relative proportions of landings made by different gears and of different species), but with the West Atlantic showing the highest prices per tonne (at almost double those for the WCPO and EPO).
- Significant differences in values per tonne for landings made by different gears due to the relative quality of catch that results from those different gears (but recognising the variable reliability of data), with long line and handline gear showing the highest prices per tonne, and gillnet and purse seine the lowest. The value of gillnet catches per tonne is on average only 18% of the value of longline catches, while purse seine catches are on average 26% of the value of longline catches per tonne.

Table 7: Dock / first sale ex-vessel values of landings of selected tuna species in 2016 and 2018 (in US$ of whole round landed weight)

Ocean Basin	2016 landings	Average value	2018 landings	Average value
Western Central Pacific Ocean	2 704 555	$ 1 991	2 731 142	$ 2 104
Eastern Pacific Ocean	733 804	$ 2 080	679 138	$ 2 027
West Indian Ocean	788 266	$ 2 610	932 270	$ 2 210
East Indian Ocean	218 629	$ 3 161	234 374	$ 2 906
East Atlantic Ocean	462 449	$ 2 450	503 165	$ 2 550
West Atlantic Ocean	92 850	$ 3 752	86 600	$ 4 004
Antarctic	14 445	$ 12 364	17 150	$ 12 749
Gear	**2016 landings**	**Average value**	**2018 landings**	**Average value**
Pole and line	390 451	$ 1 773	289 811	$ 1 704
Gill net	208 216	$ 1 585	239 036	$ 1 082
Handline	265 738	$ 4 178	255 929	$ 4 747
Longline	555 942	$ 5 658	580 449	$ 5 915
Other	211 295	$ 3 047	271 518	$ 2 746
Purse seine	3 297 293	$ 1 571	3 476 817	$ 1 551
Troll	86 063	$ 2 517	70 279	$ 2 467
Species	**2016 landings**	**Average value**	**2018 landings**	**Average value**
Albacore	224 636	$ 2 789	234 919	$ 2 766
Bigeye	407 622	$ 5 069	406 257	$ 4 655
Bluefin	21 032	$ 11 781	29 784	$ 12 080
Pacific bluefin	26 187	$ 10 003	20 713	$ 10 769
Southern bluefin	14 445	$ 12 364	17 150	$ 12 749
Skipjack	2 867 828	$ 1 374	2 997 626	$ 1 330
Yellowfin	1 453 249	$ 2 752	1 477 390	$ 2 967

Source: Poseidon analysis

5. Final consumed end values

5.1 Methodological issues

The reader is referred to section 2.2 in the Phase 2 report of the 2016 study provided in the Annex, which discusses important methodological issues associated with the estimation of final consumed end values. This section considers methodological issues, and where appropriate improvements, only on those issues of methodology which differed to that employed in the 2016 study for each of the four main end markets.

5.1.1 Canned tuna

In the 2016 study, a survey of prices in retail outlets in the USA and Europe conducted in July 2015 was used to generate end prices for use in the model, with prices deflated by 0.75% to account for inflation of processed foods in the European area between 2014 and 2015, and with the same retail canned prices being used in the 2012 and 2014 estimates. The survey was acknowledged as being 'opportunistic' rather than stratified and was based on 365 price records from the UK, Germany, France, Italy and Spain (major markets for canned tuna in Europe given their populations) and the USA – with 90% of price records being obtained from Europe.

In this study a new survey of retained canned tuna prices was completed in September 2019 with data entered into a dedicated MS Excel file 'Retail store check Sep 2019', with the resulting prices applied to the volumes of landings in 2018 destined for consumption as canned product, adjusted to account for conversion back to whole weight, and deflated to account for inflation of processed foods[14]. This approach of using price data collected in 2019 with 2018 landings data seems justified given that prices of canned tuna in retail stores fluctuate little in the short-term due to inventories and a desire by retailers to have consistent shelf prices (as noted in the 2016 study).

Given the large share of total end values attributed to sales of canned tuna shown in the 2016 study (60% of total end values in 2014), for this update of the 'Netting Billions' report it was considered especially important to improve the robustness of the canned price data compared to the data collected in 2015 and used in the 2016 study. This was achieved through two main approaches:

1. The sample frame was drastically increased in terms of the number of price records collected, with 721 individual price records obtained and added into a single MS Excel file i.e. double the sample frame in the 2016 study. In some cases and where possible, prices were collected from the same retailers as in the 2016 study to increase comparability, but generally given the expanded data collection and the need to ask data collectors in different countries to collect data from retailers near to them, this was not possible.
2. An attempt was made to improve stratification given that the 2016 study reported that the EU, the USA and Asia contribute around 30%, 19%, and 15% respectively to total global consumption of canned tuna. The sample frame for this study was thus expanded not just in terms of numbers of price records collected, but also in terms of country coverage with data collection in 12 countries (up from six in the 2016 study). All countries from which data were collected for the 2016 study were included to improve comparability, but Poland was added to the European countries on the basis of population size. Data were also collected from four Asian countries (Indonesia, Lao

[14] Data on harmonised indices of consumer prices available from the following weblink by clicking on 'Database': https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Inflation_in_the_euro_area

PDR, Malaysia and the Philippines) and from Liberia in Africa[15]. The result, while not perfect, was a sample frame that is more representative even if not completely stratified based on global consumption by region, with 28% of the 721 price records obtained from the USA, 60% from Europe, 11% from Asia, and 1% from Africa.

A methodological choice then had to be made for 2016 as to whether to use: i) the canned tuna prices collected in 2019 but deflated to 2016 prices, on the basis that the price data collected are more robust than the data collected in the 2016 study due the expanded sample frame, or ii) the data collected in July 2015, inflating it and applying it to the 2016 volumes, on the basis that the data collected in 2015 related closer in terms of time period to 2016. There is generally a strong interdependence of global production/landings of tuna and dock/first sale prices, but this relationship is reduced in terms of its impacts on final canned prices due to inventories of raw material product held by canning plants. However, and in addition, as Table 1 showed, while landings of skipjack (the species predominantly used in the canning industry) rose significantly between 2012 and 2014, they rose only slightly between 2014, 2016, and 2018, while landings of albacore, another species often destined for canning, declined in 2018 compared to earlier years. A decision was therefore made to use option i) and the price data collected in September 2019, deflating it[16] to derive canned tuna prices for 2016.

In the 2016 Poseidon study, data were presented for the consumed end value of canned tuna, both when:

1. The price of cans per kg was adjusted downwards to reflect the fact that the tuna in the can typically represents just over two-thirds of the weight of the can, and
2. No such adjustment was made.

Across the 721 price records obtained during this study the drained weight of tuna was on average 72.3%[17] of the total canned weight. In this report we thus multiply the average price per can by 72.3%, and present results adjusting for the value of the can that can be considered to comprise tuna. Consideration was given to utilising species-specific adjustment figures, but this idea was rejected as the difference between canned weight and the drained weight is likely to be more strongly correlated with the 'preparation' i.e. whether the tuna is sold in oil, water, or a prepared sauce, than with the species being canned.

In Pew's 2016 report, emphasis was made of the canned figure without adjusting for the fact that tuna only represents part of the can contents. While this served to increase the overall consumed end values, this approach could be construed as being misleading given that oils (olive oil, vegetable oil), water (brine, spring), or other sauces also represent part of the canned product and its value (as well as the production cost). Nevertheless, the data files were provided to Pew to enable it to present results without adjusting for the fact that tuna only represents part of the value of the can, should it wish to do so in its updated Netting Billions report.

The 2016 study made no attempt to rate/colour code the robustness of end prices contained in the worksheet 'consumed prices' and used in the 2016 and 2018 master files. In this study to provide better transparency, we have colour-coded the robustness of species-specific prices used in the worksheet 'consumed prices' in the master files, based on two criteria:

1. The number of price points obtained in the survey.

[15] Either on the basis of Poseidon knowing consultants based in those countries, or through travel to them by members of the study team on other projects.

[16] By rates applicable to processed food products in the EU, as in the 2016 study, available by clicking on 'Database' at the following website: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Inflation_in_the_euro_area

[17] This compared to 68% in the sample collected in 2015.

2. The time period of the data.

The approach taken was to categorise all prices based on the scale below, but with all canned price data for 2016 in the 2016 master file in the 'consumed prices' worksheet downgraded by one category due the data collected in 2019 being less reliable as a measure of 2016 prices than of 2018 prices.

	Very Strong	>250 species specific samples
	Strong	100-250 species specific samples
	Acceptable	51-99 species-specific samples
	Weak	1-50 species-specific samples
	Very weak	No species-specific samples

Skipjack tuna is the most commonly used species in canned tuna products and contributes the most to volumes of raw material for the canning sector. Skipjack accounts for 65% of canned raw material in 2016 based on the data in the worksheet '2016 volumes' in the master file. For this species the 2019 survey successfully obtained 382 individual price records (53% of the total[18]), thereby providing a good degree of confidence in the data used and the final estimates of consumed values of canned tuna.

5.1.2 Sashimi grade tuna i.e. high value non-canned tuna

Section 2.2.2 of the Phase 2 report from the 2016 study considers a range of methodological issues associated with the prices in the mode for sashimi-grade tuna. The same basic approach has been applied in this study and it is likewise assumed that:

- Japanese prices can be used a proxy for all sashimi tuna prices. The 2016 reported, with supporting evidence, that Japanese prices were fairly equivalent to prices in Europe and the USA. During this study some limited price data for fresh yellowfin tuna was collected in the USA and Europe from fresh fish counters in multiple retailers while completing the survey of canned tuna prices in retail outlets, and are broadly in line with (but slightly above) the prices used in the model for this study[19]. However, fresh yellowfin prices are far more volatile in retail outlets than canned tuna prices, being strongly impacted by season, availability of landings, etc. Given the small number of price records collected through the survey during a specific month in 2019 (rather than in 2016 and 2018), it was not considered appropriate to use prices collected from the 2019 survey in association with more complete price time series from Japan with monthly prices available/used specifically related to 2016 and 2018. Rather only the prices obtained for the Japanese retail market have been used on the basis that Japan still represents the dominant global market for sashimi grade tuna at perhaps 70-75% of global consumption.

[18] An additional method of improving the robustness of the sample frame only considered after data collection, would have been to stratify by species contributions to total product volumes destined for the canned tuna market. This was not possible during the study however as data on landed volumes had not been provided by RFMOs and compiled into the Poseidon landings database until after the survey of retailed canned tuna had been completed. Ideally, additional records of prices of canned yellowfin tuna would have been collected to stratify better for species as yellowfin canned prices accounted for 14% of the 721 price records obtained, but for example 26% of landings destined for canning in 2016. Price data for albacore tuna was over-represented in our sample given landings of albacore destined for canning.

[19] Data from 23 records in the EU and Asia in September 2019 suggested average retail prices of around US$22 000 when converted back to whole round weight from loins sold in retailers.

- Estimates of final consumed end values in the model are likely to be conservative given the lack of any data specific to restaurants and the food service sector, for which end prices are likely higher than for the retail sector.

As with all other prices, this 2019 study has attempted to improve the robustness of the price data used for the sashimi market. With respect to the price data on end consumed values of sashimi-grade tuna, weaknesses in the 2016 study were that retail prices were only collected for Tokyo and Osaka, with data only available for some species in those cities. For species for which retail prices were not available a raising factor of 1.75 was used from wholesale market prices in Japan to arrive at retail prices (based on the difference between wholesale and retail prices for the species for which both sets of data were available).

For this study a wider range of retail price data have been collected and used. The following data have been incorporated into the average prices used in the model, with all sources providing monthly data over 2016 to 2018, which have been used to generate average yearly prices for different species (converted into US$/tonne using average exchange rates for the year concerned, and into whole round landed weight):

- Retail prices from a consumer price index survey for Tokyo and Osaka (as in the 2016 study), but also for Sapparo, Nagoya, and a basket price for 81 Japanese cities.
- Prices from household expenditure survey data (not part of the 2016 study)
- Supermarket price data in Tokyo, Osaka, and Sapparo (not part of the 2016 study).

These price series provided data for all species required in the model, without the need to use a raising factor from wholesale Japanese prices.

Wholesale Japanese prices in 2016 and 2018 have however been examined to compare against the *retail* prices collected and used in the model. The average difference was found to be 1.52 i.e. wholesale prices are on average across all species 65-67% of retail prices (with none being less than 47%). This compares to the 1.75 raising factor used in the 2016 study, suggesting that the 2016 study may have slightly over-estimated sashimi prices and therefore the end consumed values (notwithstanding other aspects which mean that the model may underestimate total consumed values). Indeed a comparison of the prices used in the old study and applied to 2014, compared with the prices used in this study for 2016 and 2018, showed that 2014 prices in the old model were higher for Pacific bluefin than both 2016 and 2018 prices in the new model, higher for southern bluefin than the prices in this new model for 2018, and higher for albacore than the prices in this model for 2016. Other prices used in this study for 2016 and 2018 for different years and species were higher than the 2014 prices used in the old model.

Analysis of the wholesale prices compared to the retail prices used in the model, shows that for all species in all years, retail prices are above wholesale prices (as would be expected). The wholesale prices have also been compared to the dock / ex vessel prices of landings destined for sashimi markets used in the model (i.e. mainly longline and handline catches). This comparison revealed that, again as would be expected, dock prices are in almost all cases lower than the wholesale prices, which as just noted are lower than the retail prices. This logical price transmission through the different stages of the value chain provides additional confidence in the overall model results.

The 2016 study differentiated in the model between retail prices for sashimi from frozen fish as opposed to fresh fish. This was because the study needed to use wholesale market data, which was available for frozen and fresh product. However, the wholesale price data for 2012 and 2014 used in the model, as well as the 2016 and 2018 wholesale prices collected this time, show there is no clear relationship between fresh and frozen product across years or species - some fresh prices are higher than frozen prices, while others are not. As the improved retail price data used in this study does not differentiate between product that was imported/landed in frozen of fresh form, it has therefore been decided to use the same price for a particular species whether or not the landings of that product in the model are of frozen or fresh product. This approach is considered valid given that processes employed on vessels and rapid freezing to very low temperatures can result in higher quality fish than when fish is kept on ice and landed and then sold in fresh form.

For the purpose of assessing and colour coding the robustness of the price data used (using the same five-point colour scale as for dock values and other end market prices), given the comments made above, the improved data, the use of year-specific data, and the large number of price points used to obtain the average species-specific retail prices used, all end consumption price data for sashimi product are rated as 'Acceptable'. A higher rating is not considered appropriate given the lack of differentiation for retail prices for product landed/imported in fresh or frozen product, and because prices are not gear specific. The price in 2016 for albacore is downgraded by one level to 'Weak' as no price data were available for 2016, so an index was used of the change in sashimi prices between 2016 and 2017 for all other species. Likewise prices for Southern bluefin in 2018 are categorised as 'Weak' – prices in the source data appear too low to be feasible so prices used in the model have been indexed to the difference between 2018 and 2016 prices for Pacific bluefin.

As with the 2016 study, it should be noted the overall estimates of the value of consumed sashimi grade tuna in the model are likely to be conservative and to underestimate the actual values given the likely higher prices for sashimi-grade tuna used in the food service/restaurant sector than sold through the retail sector.

5.1.3 Domestic consumption of tuna in producing countries

Quantities of tuna sold on domestic markets in producing countries are relatively small at around 7-10% of the total global catch and 6-8% of the dock / first sale ex vessel values, depending on the year. Tuna are typically sold on domestic markets in whole round form in local markets in producing countries when species values are low (e.g. skipjack) and/or the quality is not good enough for the product to enter other higher value marketing chains.

The robustness of domestic price data in 2016 was poor, relying on few data points, but with a focus on prices in countries with important landings and known domestic consumption notably Indonesia, Sri Lanka and the Maldives. The 2016 study noted that domestic prices were typically around double those of ex-vessel prices.

A recent study by Poseidon for the IOTC on socio-economic indicators in tuna fisheries, attempted to obtain retail price data for tuna in all IOTC member countries, and asked for information about whether such data are collected at national level. Most countries in the Indian Ocean do not collect such data or could not provide them as part of that study, Oman and Sri Lanka being two exceptions.

Efforts have been made to widen the collection of data for 2016-2019 for domestically consumed tuna in producing countries through the use of Poseidon's network of government contacts in individual countries and consultants known to have worked in tuna producing countries. However, this has not proved very successful and data remain limited, relying on prices in Sri Lanka, Oman, Kiribati, and the Maldives. As in the last study, given the lack of data points, an approach has been adopted whereby all data for a single species in a given year are averaged, and then yearly averages are themselves averaged. The resulting average species prices are applied to both 2016 and 2018 in the model. This approach is considered the most valid as it serves to smooth out variations in the species-specific prices collected that are more likely to be result of the few data points used than changes in actual species prices paid by consumers. However the prices used, being based on sales of whole round fish, almost certainly underestimate the final consumed values for this market chain, as do not account for any local processing of tuna, for example into 'Maldive fish' in the Maldives for sale to Sri Lanka, of dried/smoked tuna in some countries, etc.

All of the above discussion indicates that the robustness of price data, and therefore the final estimates of consumed values for this market segment can be considered 'Weak' in this study, as in the last. However, on a more positive note:

- The prices used make intuitive sense given that, like the 2016 study, they are typically in the order of double the dock / ex vessel prices, and
- Given the small volumes and low values compared to other market flows, any discrepancies between the actual situation and the assumptions made for the domestically marketed prices and resulting values of tuna are unlikely to impact significantly on the validity of the overall global estimate of all market segments.

5.1.4 By-products of canning

Section 2.2.4 of the Phase 2 report from the 2016 study considers methodological issues associated with the value of by-products from canning (55% of total whole fish weight, with 45% of whole fish weight being used in cans), and the model accounts for processing sector by-products that are discarded (blood/water in the form of 'drip weight'; around 20% of the whole weight of fish) and other processing waste (heads, guts, etc) that can be sold for use as either fish meal or pet food (around 35% of the whole weight of fish). Investigations completed during the last study found that canning by-products destined for fish meal and pet food generated almost identical prices, and that the dried:wet ratio for fish meal was typically 1:4. These proportions are used again in this study, and applied to average yearly fishmeal prices for 2016 and 2018 from the same source as used in the last study[20], converted into US$ using mid-year exchange rates.

The 2016 study made no attempt to rate/colour code the robustness of end prices for canning by-products. The last study obtained similar estimates from a variety of industry sources about the proportions of whole weight: i) going into cans; ii) being discarded; and iii) being destined for fish meal/pet food markets. While fish meal price data was only sourced from one supplier in this study (the same single source as used in the 2016 study), the 'commodity nature' of the product, coupled with the fact that fish meal prices have been obtained for both years, mean that the overall robustness of the fish meal price used in the model can be considered as 'Acceptable' for both 2016 and 2018.

As shown below for 2016 and 2018, sales of canning by-products are a tiny proportion of the global total final consumed end values, so the overall estimates are not sensitive to the assumptions made about prices for canning by-products.

5.2 Results

The results of the analyses to estimate final consumed end values for 2016 and 2018 are presented below[21]. The total values of US$ 31.0 billion in 2016 and US$ 33.7 billion in 2018, compare with estimations made in the 2016 study of US$ 33.4 billion in 2012 and US$ 33.0 billion in 2014. Values across all four years (2012, 2014, 2016 and 2018) are remarkably consistent when considering the improved methodology used in the this study compared to the last one, and make intuitive sense given the relatively small increases in landings over 2014 – 2018 and the fact that prices are known to be sensitive to supply volumes (with increases in supply depressing market prices).

[20] www.thaifeedmill.com

[21] In line with the general methodological approach taken and specific examples provided earlier in this report (for example in relation to final sales values of fresh/frozen product), all estimates are considered conservative and potentially thus underestimate true values.

When comparing data in Table 5 and Table 6 there are no striking differences between years in the total values or relative contributions by species, market destination, ocean area or gear. However, of note is that:

- Two species (yellowfin and skipjack) account for 75% of the total end values.
- Sales of canned tuna account for 55% of the total annual end values, with sashimi product representing around 40% of end values.
- The Pacific Ocean (WCPO and EPO) accounts for more than 60% of the total value of dock / first sale ex-vessel landings.
- Purse seine is the dominant gear in terms of contributions to final end values, accounting for just over half total global values, with longline being the next most important gear at 23-24% of total values.
- When taking the sales values of canned tuna, not just the value of the drained tuna in the cans, the final end consumed values of canned tuna rise to US$ 23.6 billion in 2016 and US$ 25.8 billion in 2018, with total global end values thus rising to US$ 37.5 billion in 2016 and US$ 40.9 billion in 2018 (compared to US$ 41.6 billion in 2012 and US$ 42.2 billion in 2014 estimated in the 2016 study).

Table 8: Final consumed end values of selected tuna species in 2016 (in US$)

Species	US$	% of species total	Market destination	US$	% by market flow
ALB	$ 1 437 238 134	5%	Canning	$ 17 081 437 992	55%
BET	$ 4 083 770 509	13%	Fish meal/pet food	$ 314 466 227	1%
BFT	$ 749 911 786	2%	Domestic	$ 1 308 236 228	4%
PBF	$ 973 024 535	3%	Fresh sashimi	$ 3 680 849 379	12%
SBF	$ 493 376 427	2%	Frozen sashimi	$ 8 569 134 370	28%
SKJ	$ 10 805 502 600	35%			
YFT	$ 12 411 300 205	40%			
Total	**$ 30 954 124 196**		**Total**	**$ 30 954 124 196**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$ 15 819 174 871	51%	Pole and line	$ 1 555 658 481	5%
EPO	$ 4 124 243 651	13%	Gillnet	$ 930 430 864	3%
WIO	$ 5 168 041 278	17%	Handline	$ 3 207 010 975	10%
EIO	$ 1 335 840 267	4%	Longline	$ 7 110 685 462	23%
EAO	$ 3 058 446 577	10%	Other	$ 1 596 094 764	5%
WAO	$ 955 001 125	3%	Purse seine	$ 16 077 148 820	52%
Antartic	$ 493 376 427	2%	Troll	$ 477 094 830	2%
Total	**$ 30 954 124 196**		**Total**	**$ 30 954 124 196**	

Source: Poseidon analysis. Note that canned sales are based on the value of the drained weight of tuna in the can, not the value of the whole can.

Table 9: Final consumed end values of selected tuna species in 2018 (in US$)

Species	US$	% of species total	Market destination	US$	% by market flow
ALB	$ 1 646 455 637	5%	Canning	$ 18 672 802 660	55%
BET	$ 3 973 413 031	12%	Fish meal/pet food	$ 448 409 349	1%
BFT	$ 1 095 117 460	3%	Domestic	$ 1 119 486 859	3%
PBF	$ 817 187 594	2%	Fresh sashimi	$ 3 177 199 015	9%
SBF	$ 604 042 012	2%	Frozen sashimi	$ 10 279 739 881	31%
SKJ	$ 11 924 928 675	35%			
YFT	$ 13 636 493 355	40%			
Total	**$ 33 697 637 765**		**Total**	**$ 33 697 637 765**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$ 17 385 556 121	52%	Pole and line	$ 1 234 663 207	4%
EPO	$ 3 989 275 673	12%	Gillnet	$ 1 062 334 185	3%
WIO	$ 5 722 423 256	17%	Handline	$ 3 614 172 302	11%
EIO	$ 1 441 243 409	4%	Longline	$ 7 970 516 997	24%
EAO	$ 3 595 067 092	11%	Other	$ 1 918 733 012	6%
WAO	$ 960 030 202	3%	Purse seine	$ 17 494 521 512	52%
Antarctic	$ 604 042 012	2%	Troll	$ 402 696 550	1%
Total	**$ 33 697 637 765**		**Total**	**$ 33 697 637 765**	

Source: Poseidon analysis. Note that canned sales are based on the value of the drained weight of tuna in the can, not the value of the whole can.

The average values in US$ per tonne of whole round landed weight have been calculated using the landings data and the end consumed value data in the tables above, and are presented below for 2016 and 2018 (see Table 10 and Table 11). The data serve to highlight:

- Price transmission through the value chain from the point of landing to final consumption is such that final consumed values are on average 2.74 times those paid to vessels at the point of first sale. This ratio rises to just over 3 when using the whole value of tuna cans, not just the value of drained tuna in cans.
- Very different values per tonne for different species, with high values per tonne of the three bluefin species compared to other species, and with skipjack having the lowest value per tonne at just 10-11% of the dock prices paid for bluefin species.
- Less significant differences in values per tonne between ocean basins (with differences due to the relative proportions of landings made by different gears and of different species), but with the West Atlantic showing the highest prices per tonne (at almost double those for the WCPO and EPO).
- Significant differences in values per tonne for landings made by different gears (due to the relative quality of catch that results from those different gears), with long line and handline gear showing the highest prices per tonne.

Table 10: Final consumed end values of selected tuna species in 2016 and 2018 (in US$/tonne of whole round landed weight, landings in tonnes)

Ocean Basin	2016 landings	Average end value	2018 landings	Average end value
Western Central Pacific Ocean	2 704 555	$ 5 849	2 731 142	$ 6 366
Eastern Pacific Ocean	733 804	$ 5 620	679 138	$ 5 874
West Indian Ocean	788 266	$ 6 556	932 270	$ 6 138
East Indian Ocean	218 629	$ 6 110	234 374	$ 6 149
East Atlantic Ocean	462 449	$ 6 614	503 165	$ 7 145
West Atlantic Ocean	92 850	$ 10 285	86 600	$ 11 086
Antarctic	14 445	$ 34 155	17 150	$ 35 221
Gear	**2016 landings**	**Average end value**	**2018 landings**	**Average end value**
Pole and line	390 451	$ 3 984	289 811	$ 4 260
Gill net	208 216	$ 4 469	239 036	$ 4 444
Handline	265 738	$ 12 068	255 929	$ 14 122
Longline	555 942	$ 12 790	580 449	$ 13 732
Other	211 295	$ 7 554	271 518	$ 7 067
Purse seine	3 297 293	$ 4 876	3 476 817	$ 5 032
Troll	86 063	$ 5 544	70 279	$ 5 730
Species	**2016 landings**	**Average end value**	**2018 landings**	**Average end value**
Albacore	224 636	$ 6 398	234 919	$ 7 009
Bigeye	407 622	$ 10 019	406 257	$ 9 781
Bluefin	21 032	$ 35 656	29 784	$ 36 769
Pacific bluefin	26 187	$ 37 157	20 713	$ 39 453
Southern bluefin	14 445	$ 34 155	17 150	$ 35 221
Skipjack	2 867 828	$ 3 768	2 997 626	$ 3 978
Yellowfin	1 453 249	$ 8 540	1 477 390	$ 9 230

Source: Poseidon analysis. Note that canned sales are based on the value of the drained weight of tuna in the can, not the value of the whole can.

Table 11: Ratio of final consumed end values to dock values of selected tuna species in 2016 and 2018

Ocean Basin	2016	2018	Average
Western Central Pacific Ocean	2.94	3.03	2.98
Eastern Pacific Ocean	2.70	2.90	2.80
West Indian Ocean	2.51	2.78	2.64
East Indian Ocean	1.93	2.12	2.02
East Atlantic Ocean	2.70	2.80	2.75
West Atlantic Ocean	2.74	2.77	2.75
Antarctic	2.76	2.76	2.76
Gear	**2016**	**2018**	**Average**
Pole and line	2.25	2.50	2.37
Gill net	2.82	4.11	3.46
Handline	2.89	2.98	2.93
Longline	2.26	2.32	2.29
Other	2.48	2.57	2.53
Purse seine	3.10	3.24	3.17
Troll	2.20	2.32	2.26
Species	**2016**	**2018**	**Average**
Albacore	2.29	2.53	2.41
Bigeye	1.98	2.10	2.04
Bluefin	3.03	3.04	3.04
Pacific bluefin	3.71	3.66	3.69
Southern bluefin	2.76	2.76	2.76
Skipjack	2.74	2.99	2.87
Yellowfin	3.10	3.11	3.11

Source: Poseidon analysis. Note that ratios use values of canned sales based on the value of the drained weight of tuna in the can, not the value of the whole can.

Annex 1: Poseidon 2016 report

Separate pdf file

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ESTIMATE OF THE GLOBAL SALES VALUES FROM TUNA FISHERIES

STUDY FOR
PEW CHARITABLE TRUSTS

Photo: bluefin tuna Sakaiminato port, Japan. Courtesy of Yasuhiro Sanada

PHASE 1-3 REPORTS

MARCH 2016

BY

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Macfadyen, G., Huntington, T., Defaux, V., Caillart, B. (2016). **Study of the global estimate of the value of tuna fisheries - Phase 1-3 reports**. Poseidon Aquatic Resource Management Ltd, Windrush, Warborne Lane, Portmore, Lymington, Hampshire SO41 5RJ, UK Tel/Fax: +44 (0)1590 610168 Email: graeme@consult-poseidon.com URL: http://www.consult-poseidon.com

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Information about this report

This document provides the consolidated outputs from a three-phase project completed by Poseidon Aquatic Resource Management Ltd (Poseidon) of the UK, for Pew Charitable Trusts.

The study provided estimates of the global sales values from tuna fisheries at two points in the value chain: first sale, or ex-vessel values; and final consumed values.

Each phase of the project was accompanied by a separate report, and the three reports have been combined and are presented in this single pdf document.

When the study commenced, catch data available from the tuna Regional Fisheries Management Organisations (RFMOs) was only available for 2012, hence the decision to complete the analysis during Phase 1 and 2 to derive estimates for 2012. However, RFMO 2014 catch data became available at the end of 2015, so Phase 3 of the study generated estimates for 2014.

The study phases and focus of work were thus as follows:

Phase 1: i) collected and analysed tuna landings data by ocean, vessel flag, gear, and species; ii) mapped product flows; and iii) assessed the first sale, or ex-vessel, value of catch in 2012. Phase 1 was completed in the early part of 2015, and updated in February 2016 following peer review comments.

Phase 2 was completed towards the end of 2015, and generated 2012 estimates of final consumer sales values. Like the Phase 1 report, the Phase 2 report was updated in February 2016 following peer review comments.

The Phase 3 work to update the ex-vessel and final consumed values to provide estimates for 2014, was finalised in February 2016.

The estimates generated by the analysis are summarised below. All assumptions and methodologies underpinning the estimates are described in the Phase 1-3 reports contained as part of this single pdf document, so as to allow for full transparency in the way that the estimates were generated.

2012 and 2014 ex -vessel and final consumed values

	2012 (Phase 1 and 2 estimates)	2014 (Phase 3 estimates)
Ex vessel values	$ 12.21 billion	$ 9.76 billion
Final consumed values (using drained weight value of canned tuna)	$ 33.36 billion	$ 32.96 billion
Final consumed values (using total canned tuna sales price)	*$ 41.63 billion*	*$42.21 billion*

Source: Poseidon analysis. Notes: Prices are in nominal terms and have not been adjusted for inflation.

Pew Charitable Trusts used the technical content of the Phase 1-3 reports prepared by Poseidon as the basis for their own advocacy document, arguing for improved tuna fisheries management given the large global value of tuna fisheries. The Pew report can be found at: http://www.pewtrusts.org/en/research-and-analysis/reports/2016/05/netting-billions-a-global-valuation-of-tuna?utm_campaign=2016-05-06+ION&utm_medium=email&utm_source=Pew .

ESTIMATE OF GLOBAL SALES VALUES FROM TUNA FISHERIES

STUDY FOR
PEW CHARITABLE TRUSTS

PHASE 1 REPORT

FEBRUARY 2016

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Macfadyen G., Huntington T., Caillart B. and Defaux V. (2016). **Estimate of global sales values from tuna fisheries – Phase 1 Report**. Poseidon Aquatic Resource Management Ltd, Windrush, Warborne Lane, Portmore, Lymington, Hampshire SO41 5RJ, UK Tel/Fax: +44 (0)1590 610168 Email: graeme@consult-poseidon.com URL: http://www.consult-poseidon.com
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Version: Final Phase 1 Report	Report ref: 1059-GBR/R/01/E	Date issued: 29 February 2016 (update of Phase 1 report previously issued in 2015, following peer review comments)

Table of Acronyms

ALB	Albacore
AZOR	Azores Islands Area
BB	Pole and line
BET	Bigeye
BFT	Atlantic bluefin
CANA	Canary Islands area
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CIF	Carriage Insurance and Freight
C&F	Carriage and Freight
CVER	Cape Verde area
EAO	East Atlantic Ocean
EEZ	Economic Exclusion Zone
e.g.	*Exempli gratia* in Latin meaning 'for instance'/'for example'
EIO	East Indian Ocean
EPO	Eastern Pacific Ocean
ETRO	East Tropical Atlantic
FAO	Food and Agriculture Organisation (of the United Nations)
FOB	Free On Board
GN	Gillnet
GOFM	Gulf of Mexico
HL	Handline
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
i.e	*Id est* in Latin meaning 'that is'
IOTC	Indian Ocean Tuna Commission
LL	Longline
MDRA	Madeira Islands area
NE	North East
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmosphere Administration
NW	North West
NWC	North West Central
OTH	Other
PBF	Pacific bluefin
PFMC	Pacific Fishery Management Council
PS	Purse seine
RFMO	Regional Fisheries Management Organisation
SBT	Southern Bluefin tuna
SKJ	Skipjack
SW	South West
T	tonnes
TR	Troll
TROP	Tropical Atlantic
ULT	Ultra Low Temperature

WAO	West Atlantic Ocean
WCP(O)	Western Central Pacific (Ocean)
WCPFC	Western and Central Pacific Fisheries Commission
WIO	West Indian Ocean
WTRO	West Tropical Atlantic
YFT	Yellowfin

1 BACKGROUND AND PURPOSE OF STUDY

This document provides the outputs from Phase 1 of a three-phase project, to complete a study to provide an ***estimate of the global sales values from tuna fisheries***. The study was completed by **Poseidon Aquatic Resource Management Ltd** (Poseidon) of the UK, for **Pew Charitable Trusts** ('Pew').

The purpose of the study as a whole was to provide an estimate of the global sales values from tuna fisheries. This is done at two levels. Firstly at the ex-vessel stage i.e. the first sale value, by multiplying landed volumes by first sale prices obtained by vessels to obtain a global ex-vessel, or first sale value of the volume of tuna caught. Secondly at the final consumer stage, by multiplying the consumed volumes by final sales prices paid by consumers for tuna in different product forms. This study does not make any assessment of the costs of inputs at different stages of the value chain, or of net profits, and should thus not be considered as a value chain analysis. In this regard the values presented therefore represent sales revenues at two stages in the value chain only; first sale, and final consumer sales. This methodological choice i.e. valuing sales at two points in the flow of tuna from catch to plate, rather than a full value chain analysis, was necessitated both by the resources available for this study, and by the complexities that would have resulted from trying to undertake a value chain analysis of the complete global tuna industry.

The study phases were as follows, with one report prepared for each Phase:

- Phase 1 focused on: collecting and analysing tuna landings data by ocean, vessel flag, gear, and species; mapping product flows; and assessing the first sale value of landed catch in 2012 by multiplying landed volumes with ex-vessel/first sale prices.
- Phase 2 focused on: generation of 2012 data on final consumer sales values, based on the volumes of sales and final sale prices
- Phase 3 focused on: updating the Phase 1 and Phase 2 outputs to arrive at estimates for 2014

The purpose of this report is to provide the outputs of Phase 1. The report is based on work completed primarily during the first half of 2015, but with the report finalised early in 2016 to address peer review comments provided by Pew in February 2016 before the study outputs and all three reports associated with the three phases were finalised.

2 GENERATION & ANALYSIS OF LANDINGS DATA BY OCEAN, AND SPECIES

2.1 METHODOLOGY AND APPROACH

The first step was to collect catch statistics for major oceanic tunas from around the world. These are disaggregated where possible by location of capture, species, gear used and the fishing fleet flag. These data were obtained from regional (tuna) fisheries management organisations RFMO statistical databases and compiled in a single spreadsheet for pivot analysis and re-aggregation to inform the subsequent product flow mapping and estimation of first sale landed values.

The methodological approach to a number of key variables is considered below.

2.1.1 Timescale

A reference year of 2012 was selected for the study, being the last year for which catch figures were available from all the regional fisheries management organisations (RFMOs) at the time the study commenced. The use of the most recent year of data, rather than an average of a series of years, was agreed with the client, in order to obtain the most up to date estimate possible. While there may be some limitations from the use of a single year, it was agreed at the outset of the study that estimating a global ex vessel value of landings over a series of years would be outside the scope of the study given the timeframe and budget, and it was noted that total values between years may be strongly determined by volumes (potentially with lower volumes of catches resulting in higher unit prices and vice versa). However, additional comment is provided later on in this report about the potential robustness of the estimate provided for 2012, and about other factors impacting on the reliability of the 2012 estimate. In addition, a time series of global catches of tuna species considered in this study is provided in Appendix 2 so as to contextualise the volume of catches in 2012 compared to other years.

2.1.2 Geographic area

While the overall scope of this study is global, in reality it is restricted by the geographical distribution of the tuna species being covered (see next section). It therefore covers the Atlantic Ocean (including the Mediterranean & Black Seas), the Pacific Ocean, the Indian Ocean, and the southern Antarctic Ocean (in fact extensions of the Atlantic, Pacific and Indian Oceans). The Arctic is not considered separately, as it is presumed that the northern-most distribution of tuna is limited to the other oceans. For obvious reasons, no freshwater bodies have been included.

Within these ocean areas, catches have been disaggregated where possible into different sub-areas. These are as follows:

Table 1: Ocean and sub-ocean areas covered in this study

Ocean	Sub-ocean	Comment
Atlantic	Atlantic Northwest	ICCAT NW & NWC statistical areas
	Atlantic Northeast	ICCAT AZOR & NE statistical areas
	Atlantic Western Central	ICCAT GOFM & WTRO statistical areas
	Atlantic Eastern Central	ICCAT CANA, CVER, ETRO & MDRA statistical areas
	Atlantic Southwest	ICCAT SW statistical areas
	Atlantic Southeast	ICCAT NAMI & SE statistical areas
	Mediterranean	Includes Mediterranean and Black Sea
	Atlantic other	ICCAT EAST, NORT, SOUT, WEST & TROP
Indian	West Indian Ocean	Under jurisdiction of IOTC, S to 45°S
	Eastern Indian Ocean	Under jurisdiction of IOTC, S to 50°S
Pacific	Western Pacific	Under jurisdiction of WCPFC, S to 60°S
	Eastern Pacific	Under jurisdiction of IATTC, S to 50°S
Antarctic / Southern	Atlantic Antarctic	CCSBT west of -70°W and east of 30°W
	Indian Antarctic	CCSBT west of 30°W and east of 150°W
	Pacific Antarctic	CCSBT west of 150°W and east of -70°W

Source: Poseidon analysis from RFMO's competency areas

As can be noted from the comments above, these areas are based upon the reporting areas of the five RFMOs responsible for managing tuna stocks from around the world:

1. International Commission for the Conservation of Atlantic Tunas (ICCAT)
2. Indian Ocean Tuna Commission (IOTC)
3. Western and Central Pacific Fisheries Commission (WCPFC)
4. Inter-American Tropical Tuna Commission (IATTC)
5. Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

FAO's downloadable catch database (FishStat J) also categorises catch by sub-ocean[1]. These sub-ocean areas are broadly compatible with RFMO reporting areas and have been used to verify our RFMO-derived catch statistics, but RFMO databases have been used as the source data for our analysis as requested by Pew.

The catch figures used have not been disaggregated into catches in particular Economic Exclusion Zones (EEZs) as opposed to the high seas. Whilst potentially interesting, it is not particularly pertinent to the study objectives or within the scope of the study.

2.1.3 Tuna species

This study covers the seven oceanic tuna species that form the majority of the international tuna trade as follows:

- Skipjack tuna *Katsuwonus pelamis* (SKJ);
- Bigeye tuna *Thunnus obesus* (BET);
- Yellowfin tuna *Thunnus albacares* (YFT);

[1] See http://www.fao.org/fishery/area/search/en .

- Albacore tuna *Thunnus alalunga* (ALB);
- North Atlantic bluefin tuna *Thunnus thynnus* (BFT);
- Pacific bluefin tuna *Thunnus thynnus orientalis* (PBF); and
- Southern bluefin tuna *Thunnus maccoyii* (SBT)

Those species that are more prevalent in the shallower waters of continental shelves or coastal fringes (i.e. neritic species[2]) have been excluded. Whilst it is recognised that these have an important role in the small-scale fisheries, livelihoods and food security of coastal areas, they are less prevalent in the international value chain than the oceanic species. In volume terms, according to FAO (FishStat J) the global neritic tuna catch in 2012 was just over 1 million tonnes, compared with the 4.6 million tonnes of the seven oceanic tuna species included in the study.

2.1.4 Fishing gear

The study disaggregates catching methods into the following major gear types. It should be noted that where possible, records were first disaggregated into minor gear types, which are also noted below and included in the database.

- **Purse seine** (PS): includes the standard industrial purse seine (PS), small-scale purse seines (PSS) and the ring net (RIN);
- **Longline**: incudes surface and deep-set longlines (LL), coastal longlines (LLCO), longline / troll combinations (LLTR) and longlines attached to gillnets (LG). Also includes longline catches for the fresh markets (FLL, where recorded);
- **Pole and line** (BB): also known as bait boat fisheries, includes mechanised bait boats (BBM) and non-mechanised bait boats (BBN).
- **Gillnet** (GN): includes surface and bottom-set gillnets (GILL), trammel nets (TRAM), offshore gillnets (GIOF) and gillnets operated attached to a longline (GL).
- **Handline** (HL): includes hand lines (HL), combined hand and toll lines (HATR), small-scale hand-lines (HLSS) and hook and lines (HOOK).
- **Troll (TR)[3]:** troll line (TROL), mechanised troll (TROLM), and trolling non-mechanised (TROLN)
- **Other** (OTH): includes traps (TRAP), trawl (TRAW), cast nets (CN) and beach seines (BS).

2.1.5 Fishing flag

The catch assessment disaggregates data by the flag state of the fishing vessel. This is the state under whose laws the vessel is registered. Whilst it is recognised that some vessels may operate under flags of convenience, the majority are registered to their home nation, and show particular patterns in behaviour when fishing in different oceans (e.g., fishing in certain areas and landing in particular ports). Analysis of the combination of flag state, fishing method, and species caught provides a key starting point in considering the product flows from each ocean area.

[2] Neritic tuna species include, for example, bullet tuna (*Auxis rochei*), frigate tuna (Auxis thazard), kawakawa (*Euthynnus affinis*), and longtail tuna (*Thunnus tonggol*).

[3] Sport fishing has been excluded

2.1.6 Database structure

Data were entered into an Excel spreadsheet with 12 fields as follows:

Table 2: List of database fields and their descriptions

Field name	Field description
Key	Unique record identified key
Ocean	Major ocean of catch e.g., Atlantic, Indian, Pacific or Antarctic
Sub-ocean	Sub-area of major oceans
Flag	Flag state of the fishing vessel e.g., under whose laws the vessel is registered or licensed
RFMO	Regional Fisheries Management Organisation responsible for fishery
Species	Tuna species e.g., ALB, BET, BFT, PBF, SBT, SKJ or YFT
Gear	Main fishing gear group
Sub-gear	Minor fishing gear type
Volume	Volume of landings over 2012 in tonnes
Source	Source of data
Comment	Any comments on how the data were derived
URL	Original of the data (normally a URL or reference)

Source: Poseidon analysis

The database comprises of 1,201 individual records with each record being an annual volume of catch by flag state, species caught and sub-gear in a particular ocean area.

2.1.7 Data sources and data robustness

The primary data sources were the RFMOs and their catch databases. All this information is in the public domain, although catch data for 2012 for IATTC was not available online, but was readily supplied on request. Each RFMO data set was extracted, sorted and then entered into the study database. This was relatively straight forward, although coding for both gears and flag states had to be standardised as there were small but critical differences in coding between the different RFMOs.

In order to check the database we assembled, sub-ocean catches in the database were compared for each species against those in FAO's FishStat J database, and indicated a broad agreement between the two data sets. The total catch recorded in our database (4.6 million tonnes) based on RFMO data was 262,534 tonnes less than the catch recorded in FAO's data, meaning that our final estimates of sales values as presented later in this report and in the Phase 2 and Phase 3 reports could be conservative totals. Catch totals for each species showed the main differences between FAO's data and the data in the excel database we established was for skipjack, with a difference of 288,664 tonnes, while RFMO recorded catches of albacore and bigeye tuna were slightly less than those in the FAO data. The difference in tonnes in value terms represents only around 1% of the estimates of final consumed values provided in the Phase 2 and 3 reports.

The skipjack differences are due primarily to catch data in our database for the Eastern Pacific Ocean (EPO) – according to FAO FishStatJ there are 419,038 t of skipjack caught in the Eastern Central (214,793 t) and Southeast (204,245 t) Pacific areas, yet according to IATTC the whole EPO catch is only 258,009 t. This accounts for the majority of the 262,534 tonnes difference between the grand totals of FAO data and our catch data based on RFMO records. The difference may be explained by the fact that IATTC provide FAO with purse seine sample data which can be allocated to FAO areas 77 and 87 whereas the IATTC data provided to us are the Best Scientific Estimates from IATTC which are based on this sample data. In a relevant IATTC Fishery Status Report[4], the total 2012 EPO catch

[4] See table A-2a, page 32 of http://www.iattc.org/PDFFiles2/FisheryStatusReports/FisheryStatusReport12.pdf

of SKJ for all gears is 271,231 t, less 3,511 t discarded at sea, for a total retained catch of 267,720 t. According to IATTC this figure is in line with the 2013 total, as well as the totals for the previous years, so the figures we have used represent the official IATTC estimate of SKJ for 2012.

2.2 A BRIEF DESCRIPTION OF TUNA CATCH VOLUMES; THE TUNA SPECIES BEING CAUGHT, WHERE, BY WHOM AND FISHING METHODS USED

Some brief analysis of the data is presented below and provides some interesting results as shown in the following tables.

Table 3 below shows global catches in our database by major ocean area, species and gear type. For the sake of presentation, data by sub-ocean area are not provided in this report but as noted in the methodology are contained in the database.

The data show that in volume terms, and for the 7 major species included in the total 4.6 million tonnes caught in 2012:

- The Pacific accounts for more than 71% of global tuna catches, the Indian Ocean 18%, and the Atlantic 10%.
- Skipjack accounts for 55% of global catches, yellowfin 28%, bigeye tuna 10%, and albacore 6%. The three bluefin tunas combined account for 1% of global catches.
- Purse seine fishing accounts for 64% of global catches, longline fishing 13%, pole and line fishing 10%, gillnets 4%, hand lines 3%, trolls 1.5% and 'other' 5%.

Table 3: Global catches of selected tuna species by ocean and fishing method, 2012 (tonnes)

Gear/Species/ Ocean	Antarctic	Atlantic	Indian	Pacific	Grand Total
BB		**109,241**	**86,033**	**243,691**	**438,965**
ALB		15,527		33,783	49,310
BET		10,017	716	3,932	14,665
BFT		282			282
PBF				113	113
SKJ		75,778	68,725	170,806	315,309
YFT		7,637	16,592	35,057	59,287
GN		**5,626**	**158,590**	**22,527**	**186,743**
ALB		6	114	34	153
BET		1	3,124	365	3,490
PBF				4	4
SKJ		4,993	92,709	21,094	118,796
YFT		627	62,643	1,030	64,300
HL		**6,994**	**89,424**	**51,965**	**148,383**
ALB		239	561	378	1,177
BET		616	184	3,037	3,836
BFT		1,142			1,142
SKJ		1,294	7,320	11,051	19,666
YFT		3,703	81,360	37,499	122,562
LL	**5,811**	**83,335**	**199,209**	**326,023**	**615,175**
ALB		23,516	30,933	122,947	177,396
BET		38,353	87,163	111,142	236,658

BFT		2,449			2,449
PBF				211	211
SBT	5,811				5,811
SKJ		817	8,239	2,135	11,191
YFT		18,200	72,873	89,588	180,661
OTH	**0**	**10,002**	**7,857**	**199,389**	**217,248**
ALB		6,865	208	1,543	8,616
BET		33	1,532	8,770	10,335
BFT		2,622			2,622
PBF				2,753	2,753
SBT					0
SKJ		144	5,055	123,668	128,867
YFT		338	1,062	62,655	64,055
PS	**4,444**	**256,556**	**269,405**	**2,402,358**	**2,932,763**
ALB		598	1,297	13	1,907
BET		21,469	22,049	147,261	190,779
BFT		6,107			6,107
PBF				10,550	10,550
SBT	4,444				4,444
SKJ		157,666	111,292	1,648,779	1,917,737
YFT		70,716	134,767	595,755	801,238
TR	**6**	**6,236**	**33,266**	**31,222**	**70,730**
ALB		5,914	549	20,209	26,673
BET		29	821	273	1,123
PBF				570	570
SBT	6				6
SKJ		129	20,341	6,235	26,705
YFT		164	11,554	3,935	15,654
Grand Total	**10,261**	**477,990**	**843,784**	**3,277,175**	**4,609,209**
% of total	**0.2%**	10.4%	18.3%	71.1%	
ALB total		52,664	33,662	178,907	265,233 (6%)
BET total		70,516	115,589	274,780	460,885 (10%)
BFT total		12,602			12,602 (0.3%)
PBF total				14,201	14,201 (0.3%)
SBT total	10,261				10,261 (0.2%)
SKJ total		240,821	313,682	1,983,768	2,538,271 (55%)
YFT total		101,386	380,851	825,519	1,307,756 (28%)

Source: Poseidon analysis from RFMO databases

The fishing method used to catch different types of species and the flag state of vessels making catches (along with the ocean area in which fish is caught) are major determinants of the processing locations, product flows, and end markets for tuna, as explained more fully later. Here it is sufficient just to note that for the major fishing methods, purse seine catches generally go to canneries, longline and handline catches to sashimi[5] markets (apart from albacore which generally goes to

[5] Throughout this report, the term 'sashimi' markets is taken to include product destined for consumption as both sashimi and sushi (see Miyake et al, 2010)

canning), gillnet catches to canneries or domestic[6] markets in fresh of smoked or dried form, and pole and line catches to a mix of canning, processed (e.g. *katsubushi*) and fresh markets.

With respect to the fishing method most commonly used to catch different species, the table below (Table 4) shows that:

- More than 75% of global skipjack catches are made by purse seines, with pole and line fishing accounting for 12%, 'other' gear 5%, and gillnets 5%. Purse seines are also the predominant method of fishing for yellowfin (61% of yellowfin catches), Pacific bluefin (75%), and Atlantic bluefin (49%, with longlines and 'other' gear accounting for around 20% each).
- Longline fishing is the predominant method of fishing for albacore, southern bluefin, and bigeye tuna, with pole and line fishing also accounting for a significant proportion (19%) of albacore catches.

Table 4: Global catches of selected tuna species by fishing method, 2012 (%)

Species / Gear	ALB	BET	BFT	PBF	SBT	SKJ	YFT
Pole and line	18.6%	3.2%	2.2%	0.8%	0.0%	12.4%	4.5%
Gillnet	0.1%	0.8%	0.0%	0.0%	0.0%	4.7%	4.9%
Handline	0.4%	0.8%	9.1%	0.0%	0.0%	0.8%	9.4%
Longline	66.9%	51.3%	19.4%	1.5%	56.6%	0.4%	13.8%
Other	3.2%	2.2%	20.8%	19.4%	0.0%	5.1%	4.9%
Purse seine	0.7%	41.4%	48.5%	74.3%	43.3%	75.6%	61.3%
Troll	10.1%	0.2%	0.0%	4.0%	0.1%	1.1%	1.2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Poseidon analysis from RFMO databases

In terms of the contribution of total catches made by vessels from different flag states, the top ten tuna fishing nations account for 67% of global tuna landings. Table 5 overleaf shows that in global terms the top tuna fishing nations are:

- ***Indonesia*** accounts for 12% of global catches, with a strong reliance on catches using 'other' gears (32% of Indonesia's total catch of 566,153 t in 2012), pole and line (24% of its total), and purse seine (23% of its total). 77% of Indonesia's catch is in the Western Central Pacific, although much of its long line catch originates in the Eastern Indian Ocean (and much of it is juvenile);
- ***Japan's*** distant water fleets and vessels fishing in its EEZ, account for 10% of global catches and tend to use either purse seine (50% of its total catch of 454,654 t in 2012) with long lines (23% of its total) and pole and line (24% of its total). 91% of Japan's catch is in the Western Central Pacific, although its long line operations are spread more globally and its pole and line vessels tend to fish in the Japanese EEZ;
- ***Taiwan*** (7% of global catches) bases its 341,005 t catch on purse seine (59% of its total) and long lines (41% of its total). Like Japan, Taiwan's long line catch is much more globally spread than its purse seine catch, which is almost entirely in the Western Central Pacific[7];

[6] In this report, 'domestic' sales are sales of product not traded internationally, and which do not enter the canning or sashimi market value chains.

[7] Note that Taiwan has many vessels flagged in other countries (e.g. Vanuatu), and catches recorded in RFMO catch databases reflect the flag of the vessel, not necessarily the beneficial ownership.

- The ***USA*** (7% of global catches) catch is mainly (88% of its total) based upon purse seines, and mainly in the Western Central Pacific, but there are a number of other smaller US tuna fisheries, such as the albacore-directed troll fishery on the west coast of the USA and a pole and line fishery from San Diego (EPO). This is also a longline bigeye tuna fishery based out of Honolulu (and sometimes American Samoa)
- ***South Korea*** (6% of global catches) is predominantly dependent (87% of its catch of 306,476 t in 2012) upon purse seines in the Western Central Pacific, with the balance being caught by long lines, again on a wider geographic scale;
- The ***EU*** tuna fleets (mainly ***Spain*** - 6% of global catches- and ***France -*** 2% of global catches) are mostly purse seine specialists (85% of Spanish catches), operating in the WCPO, EPO, Western Indian Ocean and the Eastern central Atlantic. They also operate a pole and line fleet in the Atlantic, and long liners in the Mediterranean, north east Atlantic, the WCPO, and the Western Indian Ocean. There is also a significant troll fishery in the north East Atlantic;
- ***Ecuador*** (5% of global catches) is an important fishing nation in the EPO with catch of 249,543 t, solely using purse seines (largely with FADs) and with skipjack representing 67% of its catch, bigeye 20% and yellowfin 13%.
- The ***Philippines*** and ***Papua New Guinea*** (both 5% of global catches) also both caught just under 250,000 t in 2012. In the case of PNG catches are made almost exclusively using purse seines, although the Philippines catch is made by multiple gear types but predominantly purse seines, handlines, hook and line, and ring nets.

In summary, Indonesia is unique in its mixture of catching methods, reflecting its position between the Indian and Pacific Ocean, as well as its huge archipelagic nature i.e. waters falling outside RFMO Convention areas, and with much of its archipelagic catch recorded as being 'other gear' (and made by Pelagic Danish seine (payang), and vertical hand line). The Asian fleets of Japan, Taiwan, South Korea and China all operate purse seine fleets in their adjacent Western Central Pacific waters, but have longline fleets operating globally. The US, Ecuadorian and EU fleets are mainly dependent upon purse seine fisheries to provide the main volume of their tuna landings, but also have a number of geographically disperse specialist fleets using other gears. Other distinctive flag-based fishing patterns include the Maldives with a large pole and line fishery (63% of its total catches of 98,000 t in 2012) and hand line (36% of its total) reflecting their ban on purse seine and gillnet fisheries in their EEZ. Ghana has significant pole and line catch (30% of its catch of 70,000 t in 2012) as well as a purse seine fleet. Some countries e.g., Sri Lanka, Vietnam, Oman, Yemen and Iran have large gillnet tuna fisheries, which may reflect the relatively low level of technical input into tuna fishing in these countries (although Vietnam also has significant handline, longline and purse seine catches).

Table 5: Catches of tuna species included in this study by flag state and fishing method, 2012, tonnes (countries with over 10,000 t included)

Flag state	BB	GN	HL	LL	OTH	PS	TR	Total
Indonesia	135,938	10,870	24,930	69,583	180,899	132,419	11,514	566,153
Japan	106,846	129		105,363	4,108	230,346	7,064	453,856
Taiwan				140,348	4	200,653		341,005
Korea S				40,008		266,468		306,476
USA		22	3,858	14,863	1,031	259,762	15,563	295,100
EU Spain	31,282		25	2,341	1,143	234,975	5,863	275,629
Ecuador						249,543		249,543
Papua New Guinea				3,892		236,162		240,054
Philippines			35,521	3,676	4,368	193,164		236,729

Flag state	BB	GN	HL	LL	OTH	PS	TR	Total
Mexico	564			1,490		118,273		120,327
China				65,276		49,148		114,424
Sri Lanka	6,421	64,252	1,513	26,637			2,034	100,857
Maldives	62,030		34,950	113			1,275	98,369
EU France	1,899	9	214	1,068	3,335	71,544	49	78,119
Kiribati	160			1,456	12,967	62,374		76,957
Marshall Islands				465		71,957		72,422
Ghana	20,840					49,013		69,853
Panama				519		66,593		67,112
Vietnam		22,385		16,232		26,939		65,556
Iran Islamic Rep.		60,748				2,885	28	63,660
Seychelles			0	11,111		50,937		62,048
Venezuela	914	66		1,037		50,056		52,074
India	14,933	5,106	2,948	11,254	446	93	12,654	47,434
Vanuatu				19,761		24,835		44,596
Federated States of Micronesia				2,750		36,233		38,983
Colombia						38,557		38,557
Brazil	32,330		711	3,571	342	10		36,965
Yemen			35,669	85				35,754
France OT			109	35		29,016	677	29,836
Other	139			15		26,224		26,378
Solomon Islands	2,135					22,265		24,400
Curacao						22,485		22,485
New Zealand				422		18,499	2,740	21,661
Belize				1,140		19,907		21,047
Fiji				14,978				14,978
Tuvalu				2,296		8,217	3,119	13,632
Côte D'Ivoire		5,517				7,589		13,107
Nicaragua						12,722		12,722
French Polynesia	542			8,645	3,401			12,588
Pakistan		11,588						11,588
El Salvador						11,411		11,411
EU Portugal	9,826		1	789	250	11		10,878
Cape Verde	77		1,178			9,596		10,850

Source: Poseidon analysis from RFMO databases

3 MAPPING PRODUCT FLOWS

3.1 INTRODUCTION

This section provides a general description and graphic of product flows from different ocean areas from the point of catching to end markets, where possible describing the main processing locations. A focus is provided on the main gear types and flag states catching particular species in different oceans, as these factors play a strong determinant in the final marketing arrangements, and therefore prices. The output presented in this section of the report provides important information to inform later analysis about the extent to which different marketing arrangements and product flows may result in different prices, which will need to be incorporated into later analysis of landed and end market values. The regional summaries are therefore important as they provide the basis for determining the proportion of product flows from different fishing methods and for different species in each ocean area, to different end markets: canning/loining (whether canned in a country in which tuna is landed or transshipped); fresh sashimi markets; frozen sashimi markets; for ranching (bluefin tuna species only); and domestic markets (either in fresh or processed forms) i.e. sales of tuna not traded internationally, and which do not enter the canning, ranching or sashimi market value chains.

This mapping of product flow is in turn is critical for the prices then applied to catch volumes in arriving at the ex-vessel sales values (in the Phase 1 report) and the final consumed values (in the Phase 2 report).

Information presented below is derived from many sources. The database established provides landings by flag, ocean, gear-type and species, which in many cases provides a good starting point for assessing product flow given the predominance of some gear types for particular marketing channels e.g. purse seine catches to canneries. However, in addition, a wide range of other reports and data sources have been accessed to contribute to our understanding of the marketing flows. Poseidon staff were involved in the preparation of a number of these reports, with the reports themselves being based on very extensive primary research with contacts and consultants in different countries/regions. This study has also involved some additional communication with consultants and industry contacts to provide further information on market flows.

The necessity to engage in such primary research is reflective of the fact that while landings data are readily available from RFMO databases, data on market flows are not routinely collected or published by any individual organisation at a global level.

A 'static' description is largely presented below, although some comments on trends are made where relevant. For more detailed information about trends in tuna marketing over time, Miyake et al. (2010) provides a useful, if already slightly out-of-date, review.

3.2 WESTERN CENTRAL PACIFIC OCEAN (WCPO)[8]

3.2.1 Introduction – area and key catch data

This section describes catches and product flows from the Western Central Pacific Ocean, and from the Convention Area of the WCPFC. It is understood that it does not include the South China Sea. In the east, the Convention Area adjoins, or overlaps in part of the area, the area of competence of the Inter-American Tropical Tuna Commission. The southern boundary extends to 60 degrees south and the northern boundary extends to Alaska and the Bering Sea.

A summary table of catches by gear and species is provided below. Key observations are:

[8] Primary references used in this section are Gillett 2011, Hamilton et al., 2011, Poseidon et al 2013, http://www.wcpfc.int/west-pacific-east-asia-oceanic-fisheries-management-project, and consultant research with contacts in the region.

- The WCPO accounts for 58% of total catches in the study database, but proportionally to global catches is especially important in terms of catches using 'other' gears (90% of the global total) and purse seines (64% of global purse seine catches), and catches of skipjack (68% of the global skipjack catch, and reflecting the importance of purse seine gear).
- In the WCPO, skipjack and yellowfin are the two main species by volume (65% and 23% of the WCPO catch respectively), with purse seine (70% of total catch), longline (10% of total catch), and pole and line (9% of total catch) being the main gear types.
- Catches of albacore are strongly dominated by longline and pole and line fishing methods; bigeye by longline and purse seine; skipjack by purse seine; yellowfin by purse seine but also by longline, 'other', handline and pole and line; and Pacific bluefin by purse seine and 'other' gears.

Table 6: WCPO catches by gear and species (2012), tonnes

	ALB	BET	PBF	SKJ	YFT	Total	% of total
Pole and line	33,783	3,932	113	170,503	34,657	242,988	9.1%
Gillnet	26	365		21,093	1,030	22,518	0.8%
Handline	378	3,037		11,051	37,499	51,965	2.0%
Longline	100,422	79,420	210	1,973	79,632	262,455	9.9%
Other	425	8,762	2,715	122,629	62,127	197,311	7.4%
Purse seine	13	71,530	3,883	1,392,275	397,738	1,865,439	70.2%
Troll	3,575	273	570	6,235	3,935	14,588	0.5%
Total	**138,622**	**167,319**	**7,491**	**1,725,759**	**616,618**	**2,655,809**	
% of total	5.2%	6.3%	0.3%	64.9%	23.2%		

Source: Poseidon analysis from WCPFC database

Tuna trading is highly competitive in the region with traders bearing much of the risk of price and supply fluctuations, and the benefits of economies of scale have resulted in considerable consolidation over the years, so that trading in the region is now dominated by three companies: Tri Marine; Itochu; and FCF Fishery Co. Ltd.[9]

3.2.2 Pole and line catches and product flows

Pole and line catches by flag state in 2012 were dominated by Indonesia (133,305 t) and Japan (106,846 t). Other countries making very small catches are Solomon Islands (2,135 t), French Polynesia (542 t) and Kiribati (160 t).

Skipjack is the dominant species for the Indonesian pole and line fleet (70% of catches) with yellowfin and albacore each accounting for 14%. For Japan, skipjack accounts for 63% and albacore for 32%, with the balance being bigeye and yellowfin, and the seasonal albacore/skipjack fishery east of Japan is largely an extension of the Japan home-water fishery.

In Indonesia, reliable data are hard to come by, but based on a number of recent reports estimates are that for Pacific tuna catch around 50-60% of total catch is exported (in canned (Africa and Middle East), loined or *katsubushi* form to Japan), and 40-50% is sold locally. Other data sourced direct from the Ministry in Indonesia suggests around 65% of catch goes to domestic canneries, 15% to domestic fresh markets, 10% to domestic smoked/dried/salted sales, and 10% is loined for export to canneries elsewhere. Export of catch takes place from North Sulawesi (Bitung Ocean Fishing Port), Surabaya and Jakarta. For total exports the product mix may be around 50%-80% in canned form with balance

[9] Detailed information on all three trading companies is provided in Hamilton et al., 2011, including their main market linkages to canneries and brands in different countries (e.g. Thailand, USA, etc).

in loined frozen form. Product flows from the point of landing through 'primary processors' (who freeze and hold product), pre-cooked loin processors, and/or canneries. Canneries are located in both Indian Ocean and Pacific Ocean areas, and product caught in the WCP may be traded out of Indian Ocean canneries for export.

Table 7: Indonesian tuna cannery production (tons)

Ocean	No.	Tuna Cannery Name	Aproximate yearly production/throughout (tons)
Indian	1	PT. Medan Tropical Canning	1,728
	2	PT. Juifa International Foods	10,080
	3	PT. Aneka Tuna Indonesia	25,747
	4	PT. Avila Prima Intra Makmur	3,456
	5	PT. Gema Ista Raya	3,744
	6	PT. Maya Muncar	1,440
	7	PT. Rex Canning	864
	8	PT. Bali Maya Permai	4,896
Pacific	9	PT. Deho Canning Company	4,320
	10	PT. International Alliance Food Indonesia	2,880
	11	PT. Samudera Santosa	10,080
	12	PT. Sinar Pure Foods International	11,520
	13	PT. Citra Raja Ampat Canning	8,640
	14	PT. Delta Pacific Indo Tuna	5,760

Source: DG Fisheries Product Processing and Marketing, MMAF 2012, and canneries

The largest of the canneries is PT. Aneka Tuna Indonesia [ATI] in Surabaya, with an installed canning capacity of 175 MT per day and actual capacity of 140 MT/day, amounting to approximate 33,600 tonnes per year. About 50% of exports from this cannery are to Japan, and the balance of product goes to the Middle East, Europe, North America and Africa. Other canneries are shown in the table above. Exports are truly global in terms of destination and include markets in Japan, Korea, USA, China, Europe, South Africa, Singapore, Africa, and the Philippines. A detailed breakdown of canned tuna exports as a whole (not specific to gear or ocean area, is provided in Appendix 1.

The majority, but not all, of the catch from the Japanese domestic and distant water pole and line fleet is canned in Japan and destined for the Japanese market. The exception is the small catch of Pacific bluefin tuna (113 t) representing the total pole and line caught bluefin in the WCPO, which is destined for fresh sashimi sales.

3.2.3 Gillnet catches and product flows

Gillnet catches in 2012 were made predominantly by Vietnamese vessels (22,385 t) comprised almost entirely skipjack (20,998 t), with much smaller catches by Japan (129 t with 95 t being skipjack).

At a national level, most Vietnamese tuna catch is mostly sold for export (around 95%), with around 5% sold domestically[10], but given the strong dependence of tuna catches nationally on longline/handline (more obviously of export quality), catches by gillnets may show a higher dependency on some domestic fresh sales, although may also be sold to canneries in Vietnam of which there are three. In Binh Dinh Province in Vietnam there are three main landing sites at Qui Nhon (the most important), De Gi, and Tam Quan Bac, with around 20 buying companies one of

[10] https://www.wcpfc.int/system/files/PLI-VNM-03-%5BConsultancy-report-(Y3)-Vietnam-Tuna-Fishery-Profile-Nov2012%5D.pdf

which has processing capacity. In Phu Yen Province the main harbours for tuna landings are Ward 6, Dan Phouc, and Tien Chau, and there are 10 tuna traders, 3 of which have processing plants. This may be especially the case in a third Province bordering the Pacific, Khanh Hoa Province, which has a stronger dependency on gillnet catches than the other two Provinces mentioned above. Khanh Hoa Province has 6 main fishing harbours, and 7 large tuna traders.

Japan's small catch is likely to be sold domestically.

3.2.4 Hand line catches and product flows

Handline catches in 2012 were made by just three countries, Philippines (35,521 t with 22,849 t of yellowfin, 11,039 t of skipjack, 1,508 t of bigeye, and 125 t of albacore), Indonesia (15,500 t, with 14,269 t of yellowfin and the balance bigeye), and USA (944 t, with 381 t of yellowfin, 298 t of bigeye, 253 t of albacore, and 12 t of skipjack). Indonesian reported catches may be an underestimate in the WCPFC database, and some of the yellowfin catch recorded as being caught by 'other' gear is in fact caught by handline; however this fact should not impact on the global estimate of ex-vessel[11] values given that catch volumes are recorded under 'other' rather than handline.

For Philippines, 2011 data show exports of frozen/fresh/chilled tuna of 22,027 t which would represent 65% of Philippines handline catch and all of the yellowfin handline catch (in 2012), so it can be assumed that around 65% of total catch is exported and 35% sold domestically, with almost all yellowfin and bigeye exported, and other species predominantly sold locally. Sashimi quality grade tuna for export is packed whole/fresh and mainly exported to Japan with some sales also to USA. Second-grade product is sold to companies processing/cutting and freezing for export, or to canneries (also mainly export orientated). Third grade quality fish is for transport (generally in whole form) to markets in the Philippines (e.g. in Manila). Remaining fish are sold locally for fresh domestic consumption.

Marketing channels in the case of Indonesia are for all handline catches to go for export, with around 70% in frozen loined form and 30% in whole fresh form. Yellowfin is exported in loined form to the USA (70%), Spain (25%), and the balance to Japan. Indonesian bigeye catches are exported to Japan (>92%), Singapore (5 %), and Malaysia, Thailand and the USA (3%).

3.2.5 Longline catches and product flows

Longline tuna catches in the WCPO (262,455 t) are dominated by albacore (100,422 t) with roughly equal catches of yellowfin, bigeye (around 80,000 t). Japan (51,478 / 20%), Taiwan (42,739 / 16%), China (42,423 / 16%) and Korea (28,103 / 11%) are the dominant countries. Vietnam, Indonesia, Fiji, Vanuatu and the USA all catch over 10,000 t.

Longline catches of albacore, are made by South Pacific island domestic fleets in tropical waters, by 'distant-water' vessels operating in the South Pacific from Taiwan, mainland China and Vanuatu operating in the south Pacific, and by Japanese, Taiwan and Vanuatu vessels in North Pacific waters. Catches are principally (about 80% of longline albacore catch) shipped to the canned tuna market, mainly in the USA, with a proportion of the catch loined in the Pacific region, most notably in Fiji (Hamilton et al., 2011). However, Ultra Low Temperature (ULT) sea freight container transport has changed the dynamics of the sashimi trade, allowing access for albacore whole or partially processed (headed and gutted) and loin type products (tataki [loins, slightly seared on the outside] and saku blocks [pre-cut loins that are frozen and later sliced into sashimi]) to benefit from relatively low cost sea freight. These changes have allowed for a switch of some albacore from canning to sashimi markets (in Japan and the USA), and around 20% of albacore may now be destined for lower grade sashimi markets.

[11] i.e. first sale price

For longline catches of yellowfin and bigeye tuna there are two main sub-categories: fresh (50% of longline yellowfin and bigeye catch) and frozen (50% of longline yellowfin and bigeye catch). The prime quality fresh tuna from many of the different longline fleets (e.g. Japan, Taiwan, Korea, China, Indonesia) is primarily destined for Japan (usually in whole gilled and gutted form, but also as saku blocks or tataki for slightly lower quality yellowfin and bigeye) which is the world's principal market for fresh-chilled and frozen sashimi-grade tuna accounting for 80 % (308,000 mt) of global consumption. Sashimi markets (typically for headed and gutted, but also in loin form with product cold smoked in carbon monoxide and vacuum packed) in Hawaii and mainland USA are of secondary importance. Frozen longline tuna is divided into high-value sashimi quality which is almost all for Japanese markets (gilled and gutted), and lower-value cannery grade tuna which is mostly for the North American, and EU market e.g. in Vietnam one tuna processor is based in Qui Nhon (Hoai Nhon Fishery Joint Stock Company, established in 2010), selling mainly frozen bigeye and yellowfin tuna for canning based on based on domestic purchases for sales in the EU and USA markets. Other catch may be processed in Spain, American Samoa and Bangkok before sales are made in EU/USA markets.

The longline fleet in the WCPO either lands its catch directly into ports in the region or transships at sea. The fleet is comprised of both local longline fleets with smaller vessels and no ULT facilities which tend to land more into local ports, and the large Asian longliners which predominantly transship (but also land/tranship product in the regions ports). Countries in the region typically have defined designated ports, but regional hubs have developed over a period of decades, such as Suva in Fiji (used by Chinese ULT longline vessels for example) which is buoyed by its direct air freight linkages to key market destinations of Los Angeles (USA), Australia and New Zealand[12], and its role as a hub for container shipments, supported by a relatively constant traffic backload (i.e. inwards freight to Fiji), and large consignments of outgoing fish. Guam is also an important hub for air freighted tuna to Japan from the Japanese offshore vessels. Taiwanese longline vessels fishing in the western portion of the WCPFC Convention Area utilize bases in Taiwan, Indonesia, (Bitung), Philippines (Toril), Guam, Palau, and Port Moresby. The bulk of Korean longline catch is either transshipped at sea to ULT carriers or unloaded in Busan at the end of a voyage. The American longline fleet is based in Hawaii and American Samoa. Pago Pago is also an important hub for air freight of longline caught tuna.

With regards to Pacific bluefin tuna, catches by longline are low and made by Taiwan (210 t).

3.2.6 Other gear catches and product flows

Catches by 'other gears' are primarily made by Indonesia (173,524 t from a total of 197,311 t), with other less important countries being Kiribati (12,967 t), Philippines (4,368 t), French Polynesia (1,673 t), and Japan (4,108 t).

For Indonesia roughly two-thirds of the catch is skipjack and one-third yellowfin but with some small quantities of bigeye. These catches are caught using pelagic Danish seine (payang), and vertical hand lines i.e. should be recorded under handline catches (outputs from the West Pacific East Asia Oceanic Fisheries Management Project make no mention of any gear types which could be classified as 'other'). The main marketing channels are through suppliers and local traders mostly to processing plant for export, as described for handline catches above.

The Japanese catch is mostly Pacific bluefin (2,711 t of this species), and is made by a variety of gears but mainly by artisanal jigging and set nets with catch destined for fresh sashimi markets.

[12] Fiji no longer has direct flights to Japan as was previously the case.

3.2.7 Purse seine catches and product flows

The purse seine fleet predominantly catches skipjack tuna, with some yellowfin tuna and very small quantities of bigeye tuna. Main catching nations are Korea, USA[13], PNG, Japan and Taiwan, which each caught around or in excess of 200,000 t in 2012 (up to 262,192 t in the case of Korea). Philippines caught 193,164 t, and Indonesia, Marshall Islands, and China all caught between 50,000 t and 100,000 t. Nine other countries caught less than 50,000 t in 2012. The geographical distribution of the purse seine fishery is tightly concentrated in the equatorial band, with the highest catches in the zone 5N - 10S.

An issue not shown in the database is the dependence on free schools of tuna as opposed to setting on on floating objects such as FADs (drifting or anchored), logs, whale sharks, and other drifting objects. Korea, Taiwan, Japan, Vanuatu, China, and the Philippines all demonstrate relatively high dependence on free schools or natural FADs compared to other flag vessels, which may indicate a price premium given different size and species mix of catches compared to drifting and anchored FADs.

It can be assumed for the sake of this study that almost, but not all, purse seine catches are destined for the canned tuna market[14]. The exceptions are twofold. Firstly, some large bigeye (around 20% of bigeye catches) are picked out of the catch and deep frozen for low grade sashimi ('purse seine special'), much of it from the Eastern Pacific (and perhaps form Spanish vessels) and shipped through Vietnam. Secondly is bluefin caught by Japanese (8,331 t) and Korean (670t) vessels. Most of the purse seine caught fish is thought to go to Japan as high grade frozen sashimi although some bluefin catch is for ranching (but troll catches – see below – supply most of the bluefin aquaculture ranching sector in Japan).

But for the majority of purse seine catch, which is ultimately destined for the canned tuna market, catches are 1) transshipped out of the region for canning elsewhere, 2) loined in the region for canning outside the region, or, 3) canned in the region. There has been a trend over recent years towards loining/canning in developing countries given the lower labour costs compared to developed countries. And it should be noted that EU and US tariff regimes profoundly influence the location of processing activities, and therefore of trade flows (Campling, L., 2016).

With respect to processing within the WCPO, the major loining/canning facilities in the Pacific islands countries in the region and the main markets they supply are:

- PNG: Three major processing plants have been in operation for some time. RD in Madang (daily throughput of around 130 t; loins and cans for EU markets, and Philippine-owned), Frabelle in Lae (70-80 t/day for loins and cans for EU, and Philippine-owned), and South Seas in Wewak (around 40t/day for loins for USA). A fourth plant has recently been opened;
- Solomon Islands: The Soltai cannery in Noro with a throughput of around 10 000 t per year for loins for the EU, and cans for EU and regional markets;
- Fiji: The Pafco facility in Levuka is a major supplier of loins for canning in the USA. Some canning occurs for domestic and regional markets. The daily throughput is about 120 t. There are a few small canneries in the Suva area that also occasionally process tuna;
- Marshall Islands: The Pan Pacific loining plant in Majuro has a throughput capacity of about 100 t per day but is currently operating at less than half capacity. Marshalls has also developed recently into a center for services and transhipment;

[13] Note that the recent US withdrawal from their multilateral treaty has the potential to impact significantly on market flows, but this issue is not explored in detail in this report given that it focusses on the 2014 situation.

[14] Note that the global canned tuna business is becoming increasingly concentrated by a number of large players, such as Thai Union (see Miyake et al, 2010).

- American Samoa: Two large canneries (Chicken of the Sea International, and Starkist) have operated for decades, at one point supplying about half of the USA market. Total annual throughput was previously about 200 000 t, but Starkist recently scaled-down production and Chicken of the Sea International relocated to the American mainland in 2009, and in 2010 raw material processing capacity for Starkist was 84 000 t of whole round tuna, and 11 000 of frozen loins. Tri-Marine is in the process of opening a cannery and fresh tuna processing facility in the old Chicken of the Sea plant;

With respect to other mainland continental processing facilities, all of the main WCP catching nations have canneries/loining plants, and in addition to transshipments to Thai canneries, fleets can be expected to show a strong link with canneries in their country of origin. Canneries exist in:

- Indonesia. Canneries have been provided above. Around 60 % of Indonesian catch goes to domestic canneries, 20 % to other canneries in whole form e.g. Thailand and Philippines, and around 20 % is loined in Indonesia for canning elsewhere in ASEAN Countries, EU and other countries.
- Philippines. There are 7 tuna canneries in the Philippines, six in General Santos (Alliance, Celbes, GenTuna, Ocean, Philbest, and Seatrade, with a combined estimated daily throughput of more than 600 t) and one in Zamboanga (Permex Canning Corporation).
- Japan.
- Korea.
- Taiwan.

Given total catches by purse seine vessels in the WCPO in 2012 of 1.9 million tonnes, and given the figures provided above on the canning/loining capacity/throughput in the region, an approximate estimation of the flow of purse seine product to different sources from the WCPO could be approximately: 35 % transshipped to Thai canneries (for global sales); 20 % transshipped to canning or loining plants in Ecuador and other South American countries (which have been increasing in importance as a canning location in recent years[15], with product mainly destined for USA, EU, and South American markets); 15 % loined or canned in the Pacific Island countries (mainly for EU and USA markets), and 30% in other mainland countries based in the WCPFC Convention Area i.e. Japan (mainly for Japanese markets), Philippines (for EU, Asian and USA markets, with around 60% of canned production for export and 40% for domestic consumption), and Korea (almost exclusively for Korean market although some enters the Thai canning sector).

3.2.8 Troll catches

Trolled catches are small (14,588 t in 2012), with 7,064 t caught by Japan (mainly skipjack and yellowfin), 3,119 t by Tuvalu (main skipjack and some yellowfin), 2,740 t by New Zealand (mainly albacore), 1,425 t by the USA (around half of which is yellowfin), and 229 t by Tokelau (skipjack and yellowfin). It is assumed that skipjack catches are destined for canneries and domestic consumption, yellowfin for sashimi, and Pacific bluefin which is exclusively caught by Japanese vessels for ongrowing in the aquaculture sector (around 1,000 cages), and ultimately the high quality sashimi market.

[15] A recent news article on www.atuna.com (26 March 2013), reported that ‘Although no official statistics exist, it is estimated that about 200 000 t of whole round frozen tuna was transported by frozen carrier vessels from the WCPO catching grounds to tuna ports in Ecuador, Mexico and Colombia over last year. The 200 000 t amounts to about 8.5 % of the total WCPO catch, making Latin American canneries increasingly competitors of the American Samoan, Korean, Japanese, Philippine and especially Thai canneries, which rely heavily on the WCPO catches.

3.3 EASTERN PACIFIC OCEAN (EPO)

3.3.1 Introduction – area and key catch data

This section describes catches and product flows from the Eastern Pacific Ocean (EPO), and from the Convention Area of the IATTC. This large sea area extends from the west coasts of the Americas from 50°N (the northern tip of Vancouver Island in Canada) down to 50°S (north of the Magellan Straits in Chile) and extends westwards out to longitude 150°W.

A summary table of catches by gear and species is provided below. Key observations are:

- The EPO accounts for 13.4% of total catches in the study database, but proportionally to global catches is especially important in terms of catches using purse seines (86% of EPO purse seine catches). Longline (10% of total catch) and to a much lesser extent troll (2.6%) are the main gear types.
- In the EPO, skipjack and yellowfin are the two main species by volume (42% and 34% of the EPO catch respectively).
- Catches of albacore are strongly dominated by longline and troll fishing methods; bigeye by purse seine and longline; Pacific bluefin by purse seine, skipjack by purse seine; and yellowfin by purse seine but also by longline.

Table 8: EPO catches by gear and species (2012), tonnes

Gear	Species					Total	% of total
	ALB	BET	PBF	SKJ	YFT		
Pole and line				303	400	703	0.1%
Gill net	8		4	1		13	0.0%
Longline	22,525	31,722	1	162	9,956	64,366	10.4%
Other	1,118	8	38	1,039	528	2,731	0.4%
Purse seine		75,731	6,667	256,504	198,017	543,586	87.5%
Troll	16,634					16,634	2.7%
Total	**40,285**	**107,461**	**6,710**	**258,009**	**208,901**	**621,366**	**100.0%**
% of total	6.5%	17.3%	1.1%	41.5%	33.6%	100%	

Source: Poseidon analysis from IATTC database

3.3.2 Pole and line catches and product flows

Until about 1960, fishing for tunas in the EPO was dominated by pole-and-line vessels operating in coastal regions and in the vicinity of offshore islands and banks. During the late 1950s and early 1960s most of the larger pole-and-line vessels were converted to purse seiners, and by 1961 the EPO fishery was dominated by these vessels. From 1961 to 2012 the number of pole-and-line vessels decreased from 93 to 3 with a catch in 2012 of only 703 tonnes, mostly (564 t) from Mexico. This small fishery is now certified by MSC with landings (mainly yellowfin with some skipjack) and is landed and canned in Matancitas in Mexico. It is currently sold in Mexico, but it is intended to target the EU, U.S. and Canadian markets for canned certified tuna[16]. There is also a pole and line fishery for north pacific albacore based out of San Diego, which is also MSC-certified.

[16] See http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/pacific/mexico_baja_california_pole_line_yellowfin_skipjack_tuna accessed 4 Nov 2014

3.3.3 Gillnet and handline catches and product flows

Tuna caught by gillnets make a negligible (13 t) contribution to trade flows of the major tuna species in the Eastern Pacific.

There are no recorded catches by handlines.

3.3.4 Longline catches and product flows

Longline catches in the EPO predominately target bigeye (49%), ALB (35%) and yellowfin (15%), with Japan (17,787 t), China (14,462 t), and Taiwan (11,072 t) the three most important countries.

Longline catches of *albacore* in the EPO (c. 22,525 t) are mainly made by the distant water fleets of China (7,485 t), Taiwan (5,366 t) and Japan (2,062 t), from 40°N to 35°S, but mainly in the southern EPO between 5° and 35°S. Vanuatu also has longline catches of ALB (4,780 t), but these are mainly from Taiwanese-owned, but Vanuatu-flagged vessels. Like the Western Central Pacific, catches are principally shipped to the canned tuna market, mainly in the USA (but also some to the EU) having been processed elsewhere, with a proportion of the catch loined in the Pacific region, most notably in Pago Pago in American Samoa (Hamilton et al., 2011) where Chinese and Taiwanese landings are increasing. Likewise most of the Taiwan albacore fleet operating in the southern EPO utilizes Pago Pago in American Samoa and Suva and Levuka in Fiji as primary unloading and re-supply ports, where canning-grade albacore is marketed primarily to trading companies (see earlier comment about the three main companies), even when delivery is directly to canneries, as is the case in Fiji and American Samoa. There are also a small number of US longline vessels based out of San Francisco and San Diego, California, that fish under the Western Pacific Fishery Management Council's Pelagic Fisheries Plan.

The longline catches of *bigeye* (31,722 t) and *yellowfin* (9,956 t) tuna from the EPO is mainly frozen. The quality can vary from ULT (<-60°C) sashimi grade (mainly the Japanese catch) to lesser value sashimi through storage at <-35°C (e.g., the larger Korean and Taiwanese vessels) to canning grade at temperature of <-25°C (e.g., the smaller and older vessels, esp. from Taiwan). The prime quality fresh tuna is primarily destined for Japan (usually in whole gilled and gutted form, but also as saku blocks or tataki for slightly lower quality yellowfin and bigeye). The Chinese catch in the EPO is mainly destined for the canneries in Levuka (Fiji) and American Samoa, with most of the catch transhipped in Suva by container (see below).

Given that, like the WCPO, much of the Asian longline catch from the southern EPO is landed directly into ports into Fiji or American Samoa, regional hubs such as Suva in Fiji in the WCPO (used by Chinese ULT longline vessels for example) benefit from direct air freight linkages to key market destinations of Los Angeles (USA), Australia and New Zealand, and their role as a hub for container shipments, supported by a relatively constant traffic backload (i.e. inwards freight to Fiji), and large consignments of outgoing fish. Guam is also an important hub for air freighted tuna to Japan from the Japanese offshore vessels.

3.3.5 Other gear catches and product flows

Only 2,731 t of tuna (mainly *albacore* and *skipjack*) are caught by 'other gears' in the EPO. Catches are made predominantly by French Polynesia (1,728 t). It is presumed this mainly enters local domestic markets as whole fish or loins for fresh consumption or frozen storage.

3.3.6 Purse seine catches and product flows

Purse seine catches in the EPO are predominantly skipjack (48%) and yellowfin (37%), with some bigeye tuna (14%) and a little bluefin tuna caught be Mexico only (1.2%). The USA purse seine fleet left the EPO in the 1990s for the WCPO in order to catch tuna on sets that are not associated with dolphins[17], and because of failed access agreements between the USA and Latin American countries.

The purse seine catch of yellowfin (198,017 t) is predominantly caught by Ecuador (42%), Mexico (23%), Panama (9%), Venezuela (8%) and Colombia (7%). Ecuador also dominates the skipjack and bigeye tuna catches (151,280 and 45,633 t respectively), taking around 60% of the EPO's purse seine catch of these two species. No distant water catches from the Asian distant water fleets are recorded by IATTC in the EPO.

It is presumed that all purse seine catches are destined for canning, either directly as whole fish or as loins (especially when being transported long distances, such as to the EU). Both the Mexican and Ecuadorian vessels primarily supply domestic processing industries, which are the two largest processing countries in the EPO. Ecuador is the second largest producer of canned tuna after Thailand and is the number one supplier (by volume) of tuna loins into the European Union; loins go primarily to Spain and Italy for further processing into cans for the EU market. Ecuador has massive cold storage capacity (85,500 t in 2010) and imports material from outside the EPO, explaining the imbalance of Ecuadoran landings and its product output[18]. One other interesting feature of the Ecuadorian processing industry is the high level of integration into its purse seining operations.

Mexico is more dependent upon its own landings and produces around 20% of EPO canned tuna production (against Ecuador which provides over 50%) and largely supplies the Mexican market (although sales are also made to the USA market, for example under the Delores brand, but are limited due to the dolphin issue). Otherwise Latin American processors supply several markets. Loins and cans enter the EU market duty free under GSP+ from Ecuador, Colombia, Costa Rica, El Salvador and Guatemala. Some firms exporting to the EU express concern that restrictive rules of origin, coupled with low catches, limit supply that qualifies for the EU market. Ecuador exports tuna in pouches to the US market duty free through the Andean Trade Preferences Act. In addition to EU and US markets, there are several large, and growing markets for canned tuna in Latin America. In 2009, Argentina, Uruguay, Chile, Ecuador, Panama and Colombia had per capita tuna consumption between 0.5kg and 0.75kg/capita[19]. In Ecuador, per capita consumption was 2.8kg. Exports of cooked tuna loins from Ecuador to the USA have declined from almost 32,000 t in 2000 to under 1,000 t in 2009. The Mexican bluefin tuna production (predominately from ranched bluefin off Ensenada (just south of San Diego)) is sold in Japan as sashimi-grade fish, with increasing volumes fattened in farms before harvesting.

3.3.7 Troll catches

The USA and Canada are the only countries trolling for tuna on a commercial scale in the EPO, catching 14,137 and 2,497 tonnes of albacore tuna respectively. USA albacore trolling vessels, which are also often called 'jig vessels', operate in the North Pacific are in two general size classes. Smaller vessels, which range mostly from about 10m to 15m in length with hold capacities that vary from about 5 to 30 short tons, mainly comprise the fleet that operates in near-shore waters within about 200 miles of the North American coast[20]. Vessels chiefly from about 17m to 30m in length, with hold capacities from about 40 to 100+ short tons, form the fleet that operates on the high seas, as well as

[17] Note that in 2015, some US vessels began fishing one trip in the EPO, with most landing in Pago Pago but some landing in Mexico, under the IATTC Capacity Management Program (Resolution 02-03). Mexico and Venezuela are the major dolphin set countries.

[18] In 2010, over 89% of raw material imports to the Eastern Pacific region originated from the WCPO. The volume of WCPO product destined for canning in Ecuador, for example, is variable based on environmental conditions and catch rates.

[19] Hamilton et al., 2011

[20] During some times of the year, some of these vessels switch to fishing for salmon.

in near-shore waters. Most vessels have refrigerated fish holds employing various types of refrigeration, but some smaller vessels may use ice to keep catches fresh. The bulk of the catch is canned and marketed as 'white meat' tuna, mainly in North America. A relatively small amount of the catch is marketed in the fresh and fresh-frozen trade (Moody Marine, 2007) direct from boats or in small but growing local fishermen's markets along the coast from San Diego to Washington. Troll caught albacore is smaller than longline-caught albacore and has higher oil content.

3.4 WESTERN INDIAN OCEAN (WIO)

3.4.1 Introduction – area and key catch data

This section describes catches and product flows from the Western Indian Ocean (WIO), from the area of competence of the Indian Ocean Tuna Commission (IOTC), i.e. 20° east to 80° east (and 77° east north of the equator), and north of the Antarctic Convergence at 45° south.

A summary table of catches by gear and species is provided below. Key observations are:

- The WIO accounts for 12.3% of total catches in the study database, but proportionally to global catches is especially important in terms of catches of bigeye (16% of the database catches) and yellowfin (23% of global catches);
- In the WIO, yellowfin and skipjack are the two main species by volume (52% and 33% of the WIO catch respectively), with purse seine (40% of total catch) being the dominant gear type. Pole and line, gillnets, handlines (all important in coastal fisheries) and longlines all catch around the same volume; and
- Catches of albacore and bigeye are strongly dominated by longline; skipjack by purse seine and pole and line; yellowfin by purse seine but also by handlines and gillnets; and southern bluefin by longlines.

Table 9: WIO catches by gear and species (2012), tonnes

	ALB	BET	SKJ	YFT	Total	% of total
Pole and line		716	61,374	13,864	75,955	13.3%
Gill net		1,491	30,302	48,549	80,342	14.1%
Handline	221	69	2,457	73,307	76,054	13.3%
Longline	9,474	53,652	1,552	23,323	88,001	15.4%
Other			40	80	121	0.0%
Purse seine	1,297	17,071	82,416	130,276	231,059	40.5%
Troll	8	148	10,592	8,688	19,437	3.4%
Total	**11,000**	**73,147**	**188,733**	**298,088**	**570,968**	
% of total	1.9%	12.8%	33.1%	52.2%		

Source: Poseidon analysis from IOTC database

3.4.2 Pole and line catches and product flows

All catch from the Maldivian pole-and-line fleet (62,030 t), which is made exclusively by domestic vessels as there is no foreign fishing of any kind allowed in Maldives, is landed fresh in the Maldives given that most fishing trips are day trips only, and product thereafter enters one of three main marketing channels[21]. It is:

- Consumed by the domestic population throughout the atolls and more than 200 inhabited islands in the country, with an estimated 50,000 t consumed domestically in 2012 in fresh or dried form – see discussion on Maldive Fish below;
- Processed into 'Maldive Fish'[22] by small-scale processors (often home-based in the islands), before being transported to Malé and then exported to Sri Lanka or being consumed by the domestic market. Maldive Fish processors purchase around 10 000 t of the skipjack landed in the Maldives each year. Exports of Maldive Fish in 2012 were 1 440 t; and
- Sold to one of five large industrial/buying companies, each of which is allowed to buy skipjack tuna in specific zones of the EEZ. These companies typically freeze product for export to canneries overseas, for example in Thailand (17 706 t of frozen skipjack tuna were exported from the Maldives in 2012), or sell to the Felivaru or Maandhoo tuna canneries in the Maldives. The two canneries exported 2 003 t of canned tuna in 2012, with around half (982 t) destined for the EU market (with the UK an especially important market with a premium for pole and line-caught catch), with the balance sold to other markets primarily in the Middle East and North America.

There is also a small Indian pole and line fishery (under 14,000t). Marketing channels are thought to include a mix of fresh domestic sales, production of 'Maldive Fish', and perhaps some export to canneries in Iran (see gill net description to follow).

3.4.3 Gillnet catches and product flows[23]

The gillnet fishery for tuna is concentrated in the northern countries in the WIO. Tuna catches in Oman (2,310 t), India (1,982 t), Pakistan (11,588 t), Iran (60,748 t), Tanzania (3,558 t) are landed in fresh/chilled form, having been caught by artisanal or semi-industrial fleets. Comoros and Kenya also landed less than 100 t each in 2012.

In Pakistan and Iran, much of the landed product is destined for tuna canneries in Iran. Pakistani tuna catch by vessels based in Gwadar, Pasni and Sur is transshipped at sea to carrier vessels that are reported to have fishing authorisations from both Pakistan and Iran, and which declare catch to be of Iranian origin when landing at Iranian factories. Construction of the coastal highway has also opened up a land route from Karachi to Iran. Other catch in Pakistan not sold to Iran follows a number of different marketing channels. Some quantities are marketed locally in fresh/chilled form (much of which is consumed by the large Bangladeshi population in Karachi), some is procured by a factory in Karachi fish harbour producing raw material for Korean surimi plants, and small tuna (such as kawakawa and frigate tuna) are processed in curing yards in Karachi and Gwadar for export to Sri Lanka in salted/dried form. Wet salted tuna landed by vessels operating in offshore waters of Pakistan is also processed before export to Sri Lanka in salted/dried form. In Iran, it is assumed that catches not destined for local canneries are consumed locally.

[21] Ex-vessel/landed prices paid by canneries may be slightly higher than on the local market as they generally take the fresher fish, but landed prices are thought to be fairly uniform for different marketing channels.

[22] Maldives Fish is produced by de-heading and gutting, boiling, sometimes wood smoking, and then sun-drying skipjack loins, and requires around 3-5 kg of wet fish to produce 1 kg of processed product. An important by-product of the boiling process is the production of '*rihaakuru*', a fish paste that has a high value on the domestic market.

[23] Text based on Poseidon et al, 2014.

In Oman, Dhofar Fisheries and Food Industries Co SAOG, purchase product from the local Omani artisanal fleet for processing/canning, but most locally caught product is sold in fresh form, or smoked locally for local roadside sales.

In India, a significant proportion of tuna catches is destined for export markets, with most fish exported in frozen form, much of it to canneries in Iran (skipjack and yellowfin) or to the United Arab Emirates (yellowfin loins and whole skipjack). Some whole frozen skipjack is also exported to Tunisia for canning.

Tanzanian catches are sold on the domestic market.

3.4.4 Hand line catches and product flows

There are two significant artisanal handline fisheries in the WIO, in the Maldives and Yemen, each catching around 35,000 t almost all of which is yellowfin.

In the Maldives, the artisanal handline fishery is almost entirely focused on the export market, with processing taking place near the capital Malé near the necessary air transport connections, although very small quantities are sold to the tourist island resorts in the country. In 2012 the Maldives exported 3 252 t of fresh yellowfin loins, 1 673 t of fresh/chilled yellowfin chunks, 6 001 t of fresh/chilled yellowfin, and 5 501 t of frozen yellowfin. The EU is the main market for handline caught yellowfin, although other important markets include the Middle East (Saudi Arabia, Iran, Qatar and Iran) North America (USA and Canada) and Asia (Japan, China, and South Korea). Some exports from the Maldives are known to be traded through Sri Lanka before ending up in final destination markets.

Handline fisheries in Yemen also produce volumes of fresh yellowfin for export, typically in whole round, loined, headed and gutted, or gilled and gutted form, with most product sold in regional Middle Eastern markets.

A much smaller artisanal handline fishery for tuna in Oman (3,268 t) provides catches of higher quality product than that caught by the gillnet fleet described above, and catches are purchased by trading/processing/export companies. In 2009 9 786 t of large pelagics were exported from Oman from the gillnet and handline fisheries (including 285 t of yellowfin tuna, and 603 t of skipjack tuna). Almost all tuna exports in 2009 were to the UAE (with exports by road).

Comoros, India, Mauritius and Reunion also have very small handline fisheries for a mix of export and domestic markets.

3.4.5 Longline catches and product flows

Asian vessels dominate longline catches in the WIO, with Taiwan (47,967 t), Seychelles (11,110 t), India (7,010 t), Japan (5,919 t), mainland China (2,283 t), Philippines (2,658 t), Oman (2,240 t) and Mozambique (2,187 t) accounting for 93% of total longline catches in the region.

Asian longline fleets rely heavily on landing product in Port-Louis, Mauritius, and around 50 % of longline catch in the WIO is transshipped in Port-Louis, with some loining taking place (at the Thon des Mascareignes plant). Asian vessels' frozen catch of yellowfin and bigeye tuna are predominantly destined for the Asian sashimi market. Albacore may be traded to canneries outside the WIO, or in the case of ultra-low-temperature vessels, also sold to sashimi markets in Asia.

Other countries making catches, again strongly focussed on bigeye and yellowfin, but with some catches of albacore, are Seychelles (11,100 t), India (7,010 t), Oman (2,240), Mozambique (2,187 t) amongst others. Market destination, having landed mainly in home country ports, is primarily in frozen form for the EU sashimi market.

3.4.6 Purse seine catches and product flows

Spain is the main catching nation (108,604 t in 2012 representing 47% of total purse seine catches of 231,059 t). Seychelles (50,937 t), France (37,141 t), French overseas territories (29,016 t) are the other main catching nations, with much smaller catches of around 2,000 t by Iran and Korea. Overall, there is a large dependency on the schools associated with floating objects, especially by fleets from Spain and Seychelles (for these vessels around 80 % of the catch comes from sets associated with floating objects). The French fleet has a lower, but significant, dependency on floating objects (65 % of the catch) (Poseidon et al, 2014).

Seychelles is the main regional hub for the purse seine fleet in the WIO. The vast majority of the frozen purse seine catch in the WIO (around 80 %) is either landed for processing in Seychelles at the Indian Ocean Tuna planned owned by Thai Union (around 30 % of landings in Seychelles), or transshipped through Victoria for processing elsewhere (around 70 % of landings in Seychelles), although at some times of the year vessels land product direct to processing plants in Mauritius. Newly established deep frozen tuna processing plants with a capacity of 30 000 tonnes in Mauritius will also intensify the visits to Port Louis of the new generation of purse seiners vessels. Their characteristics enable the storage on board at -40 °C of dry deep frozen fish, supplied to the processing plants who export fillets, steaks and saku (frozen sashimi grade) blocks to markets in Asia and Europe.

Catches from the purse seine fleet in the WIO are predominantly destined for processing plants within the region. Canneries in Mauritius and Seychelles buy very significant proportions of overall catches made by vessels in the WIO. Where fish is landed directly to processors, vessels (or their agents) negotiate directly with the processing plants in the region. However, where transshipment takes place, tuna trading companies are typically involved in the sale of product from vessels to processing plants.

The Indian Ocean Tuna cannery in Port Victoria, Seychelles (selling mainly John West, Petit Navire, and Mareblu) produces around 1.3 million cans of tuna per day, from an annual supply of tuna of around 70-80 000 t. It is one of the largest tuna canneries in the world, with seven cold stores to store 25 days' supply of fish. The factory has an associated fishmeal production factory, which uses the cannery's by-products and bycatch from the fleet. A subsidiary company, Ocean Products Seychelles, extracts fish oil from tuna heads.

In Mauritius there are two large canneries, Princes Tuna[24] and Thon des Mascareignes, which have a combined annual capacity of over 100 000 t, and purchase product landed in Port-Louis, or transshipped from Seychelles.

Smaller canneries and loining plants in Kenya and Madagascar also purchase product from the purse seine fleet, either from landings made in the countries (to Mombasa [primarily by part of the Spanish fleet] or to Diego Suarez, respectively) or with product transshipped from other landings locations. Some landings made in Madagascar may also be transshipped to other processing locations. The main processing plant in Kenya (Wananchi Marine Products Ltd) processes product into semi-processed (cooked) tuna loins, mainly for export to Italian and Spanish canneries, with residual tuna offal and waste processed into fishmeal and oil and sold locally, but some processing also takes place for ready-to-eat products in jars.

Only small proportions of overall purse seine catches are transshipped and processed outside the WIO either in the EU (Italy and Spain), or in Thailand, Iran, Tunisia and Turkey. Canned and loined/pouched tuna products from all the processing plants in the region are predominantly destined for the EU market, with only very small volumes (< 10 %) being sold to other markets, for example in Africa, Middle East, North America and Asia.

[24] For brands see: http://www.princesgroup.com/brands/

3.4.7 Troll catches and product flows

Troll catches in the WIO are small at 19,437 t in 2012, with India catching 12,374 t of the total. Other countries include Comoros (3,498 t in 2012), Madagascar (1,536 t), the Maldives (1,275) and Reunion (677). Catches are split roughly equally between skipkack and yellowfin, with only very small catches of bigeye, and are thought to be predominantly landed fresh for the domestic market.

3.5 EAST INDIAN OCEAN (EIO)

3.5.1 Introduction – area and key catch data

This section describes catches and product flows from the East Indian Ocean (EIO), and the area of competence of the Indian Ocean Tuna Commission (IOTC), i.e. 80º east and 150º east and north of the Antarctic Convergence at 55º south (but east of 77º east north of the equator, and 129 º east and 8 º south in the area between NW Australia and Indonesia).

A summary table of catches by gear and species is provided below. Key observations are:

- The EIO accounts for just 6% of total catches in the study database;
- In the EIO, yellowfin and skipjack are the two main species by volume (45% and 30% of the EIO catch respectively), but unlike the WIO where purse seine is the dominant gear type, in the EIO longline and gillnets are the two main fishing methods. This is because of the dominance of Indonesia and Sri Lanka in EIO catches (respectively 132,643 t and 47% of total EIO catches, and 100,857 t and 36% of total EIO catches) and the common use of these two gear types in that country;
- An unknown proportion of Sri Lankan catches recorded in the EIO area are actually caught in the WIO. The same may apply to Indian catches recorded in the EIO area (11,499 t);
- Catches of albacore, bigeye and yellowfin are strongly dominated by longlines; skipjack by gillnets; and southern bluefin by purse seines and longlines.

Table 10: EIO catches by gear and species (2012), tonnes

	ALB	BET	SBT	SKJ	YFT	Total	% of total
Pole and line				7,350	2,728	10,079	4%
Gillnet	114	1,633		62,408	14,093	78,248	28%
Handline	340	115		4,863	8,052	13,370	5%
Longline	21,459	33,512	2,110	6,687	49,550	113,318	41%
Other	208	1,532		5,014	981	7,736	3%
Purse seine		4,978	4,492	28,877	4,492	42,838	15%
Troll	541	673		9,749	2,866	13,829	5%
Total	**22,662**	**42,442**	**6,602**	**124,948**	**82,763**	**279,417**	
% of total	8%	15%	2%	45%	30%		

Source: Poseidon analysis from IOTC database

3.5.2 Pole and line catches and product flows

Pole and line catches are comprised of around 75% of skipjack and 25% yellowfin, and made by Sri Lanka (6,421 t), Indonesia (2,633 t), and India (1025 t).

Sri Lankan pole and line catch is all destined for the local market, mainly in fresh form, but with some drying/salting. The same is likely to be true in India. In Indonesia however around 80% is for canning (either in Indonesia or for export in loined form to canneries elsewhere) with the balance being for domestic sales.

3.5.3 Gillnet catches and product flows

Eighty percent of gillnet catches are skipjack tuna, with 18% yellowfin and the balance bigeye and albacore. Sri Lanka (64,252 t) accounts for 82% of the total gillnet catch of 78,248 t[25], with Indonesia (10,870 t / 14%) and India (3,125 t / 4%) accounting for the balance.

Sri Lankan gillnet catch is all destined for the local market, mainly in fresh form. However in the last couple of years the government has supported the development of local tuna canning capacity in an effort to reduce the dependence on imports of canned tuna. An atuna.com article in 2012 reported on the opening of a small[26] cannery in Galle which is a joint venture between the Government-owner Ceylon Fisheries Corporation (CFC) and Happy Cook Lanka Food Pvt Ltd, to produce cans for domestic sales. In the longer term the government expects to produce 40,000 fish cans per day from three factories. Indonesia's and India's gillnet catch is also assumed to be primarily for the domestic market in fresh form, although some Indonesian product may enter the canning value chain.

Indonesia gillnet catches are all destined for canneries (70% of catches canned in Indonesia and the 30% balance in other overseas canneries such as Thailand).

3.5.4 Hand line catches and product flows

Handline catches totalled 13,370 t in 2012 with 8,052 t of yellowfin (60% of the total) and skipjack, (36%) being the most common species caught. Indonesia (9,430 t) accounts for 71% of the EIO total catch by this fishing method, India (2,423 t) 18%, and Sri Lanka (1,513 t) 11%.

Around 75% of Indonesian catches are for export (70% in frozen loined form to the USA, and 30% in whole fresh form to Japan, and mainly yellowfin), with 10% for domestic fresh sales and 15% for domestic processed sales being mostly skipjack.

3.5.5 Longline catches and product flows

Longline catches show the involvement of the greatest number of countries in the EIO compared to other gear types, with 16 countries recording longline catches. But Indonesia (55,156 t / 49% of the EIO total longline catch), Sri Lanka (26,637 t / 24%) and Taiwan (12,988 t / 11%) are the most important countries. Other Asian fleets (Japan 6,321 t, China 1,955 t and Korea 669 t) also make catches, along with India (4,244 t) and a number of other countries catching very small volumes.

Yellowfin (44% of the total longline catch), bigeye (30%) and albacore (19%) are the main species, but Sri Lanka's focus on yellowfin is more marked (84% of its catch), while bigeye represents 41% of Indonesia's catch, and 62% of Japan's longline catch. In the case of the albacore, Taiwan while only accounting for 11% of total longline catch takes 30% of the EIO albacore catch and this species represents 51% of Taiwan's catch. Chinese dependence/focus on albacore is also noticeable, with albacore (1,597 t) representing 82% of its total longline catch.

Indonesian catch is all exported through export processors, with around 60% loined and 40% sold fresh/frozen. Frozen albacore mostly goes to Spain for canning, with bigeye tuna to Japan.

In Sri Lanka, catches made by vessels when longlining are destined for either the local market or export. For most of the mixed-gear multi-day vessels that longline (as well as using gillnets) and which represent the majority of longline catches, fish traders play an important role in the supply chain between the vessels and processors/exporters; fish traders buy the whole catch unsighted, and then divide the catch based on quality, with the high quality fish (about 20% of total catches) being sold/offered to processors/exporters for fresh exports to the EU and Japan, and the remainder

[25] The fact that many Sri Lankan multi-day boats have licences for both gillnets and longline gear may result in some mis-reporting between these two gear types. The typical pattern is to fish for yellowfin using longlines over the period October to April, and then to switch to gillnets targeting skipjack.

[26] Initial production of 10,000 cans per day, but expected to double.

being sold on the domestic market. For a few specialist longline vessels, almost all tuna (yellowfin and bigeye) is of exportable quality, while the remainder of the catch e.g. other billfish is sold on the domestic market. There are more than 20 companies with export licences for tuna (most with EU approval), and a number of other companies that process tuna loins for export to the EU under contract with one of the EU-approved factories. The principal exports markets are the EU and Japan, but some product is also sold to the USA. Generally product exported to Japan is in fresh bullet form and sold on the auction market. Most exports to the EU are sold under contract at prices agreed prior to shipment, and are exported in fresh loin form. However, some exports of bullets and frozen loins to the EU also take place, the latter when product quality is high enough for export in fresh form. Exports to the USA are normally in fresh bullet form. Generally speaking, and with respect to exported catch, the very best quality fish is exported to Japan (about 15%), second grade product is sold fresh to the EU mostly in loined form (60%) or in bullet form to the USA (5%), and third grade product in frozen form to the EU (20%).[27]

Asian fleets are thought to transship product from Indonesian ports mainly to Asian sashimi markets, but some land into two main harbours in Sri Lanka (Mutuwal/Colombo and Galle) with fish sold to local processing/export companies under leasing arrangements[28], or transshipped.

3.5.6 Other gear catches and product flows

Catches by ‘other’ gears are small at 7,736 t, with 7,375 t of that caught by Indonesia (mainly skipjack and bigeye using Pelagic Danish seine (payang), and vertical hand lines) and the remaining small balance by India (yellowfin).

The main marketing channels are through suppliers and local traders to processing plants for export.

3.5.7 Purse seine catches and product flows

Purse seine catches in the EIO totalled 42,838 t in 2012, with Indonesia accounting for 35,665 t (predominantly skipjack with smaller bycatches of bigeye and yellowfin), Australia 4,492 t (skipjack only), Japan 1,970 t (with 1,262 t of skipjack and the balance of bigeye and yellowfin). Korea, India, and Malaysia show very small catches (with a mix of skipjack and yellowfin).

As with purse seine catches in other sub-ocean areas, catch is destined exclusively for the canning sector. For Indonesia, 70% of purse seine catch goes to domestic canneries, and 10% to other canneries in whole form e.g. Thailand, and around 20% is loined in Indonesia for export to EUcanneries (Spain , Italy and Portugal).

3.5.8 Troll catches

Trolled catches are small at 13,829 t in 2012, with Indonesia accounting for 11,514 t. Sri Lanka (2,034 t), India (280 t) also make small catches. 70% of catches are skipjack and 20% yellowfin, with only small catches of albacore and bigeye (both only by Indonesia).

In Indonesia 70% of product is destined for local canneries and 30% for export to canneries overseas. In Sri Lanka and India it is assumed that sales of product takes place in domestic markets.

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[27] Of relevance is that previous work by the consultants in Sri Lanka in 2008 showed that landed prices paid to dedicated longline vessels for fish of top export quality to Japan or large tuna of good quality for fresh exports to the EU were around 3 times the price paid for lower quality product needing to be exported in frozen form to the EU. Smaller good quality fish exported to EU received prices around 50% higher than the lowest quality product. Prices paid to multi-day multi-gear vessels landed fish for sale on the domestic market were similar to the price paid to dedicated longliners for their lowest quality product.

[28] Previous work by the consultants indicated that landed prices paid to Taiwanese vessels were similar to prices paid to domestic vessels for good quality fish for export.

3.6 EAST ATLANTIC OCEAN (EAO)

3.6.1 Introduction – area and key catch data

This section describes catches and product flows from the Eastern Atlantic Ocean (EAO). For the purpose of this study, the Eastern Atlantic Ocean includes four FAO areas[29]: the Northeast Atlantic (FAO 27); the Eastern Central Atlantic (FAO 34); the Southeast Atlantic (FAO 47); and the Mediterranean (FAO 37). The write up in this section does not include the BFT fishery which overlaps the North East Atlantic and the Mediterranean as that is dealt with in section 3.8 due to its inherent specificities. Likewise, the small catches of SBT by longlines in the southern EAO is covered in the write up in Section 3.9.

The following table summarises catches by gears.

- In the EAO, the main tuna species exploited are skipjack (52%), yellowfin (21%) and bigeye (15%). Purse seining is the dominant gear type with 61% of total catches. The two other main gears are pole and line (19% of total catches) and longline (14%). Catches by other gears are relatively minor by comparison.
- Purse seine and pole and line are the main segments targeting skipjack and yellowfin. Bigeye is exploited mainly by longliners (48% of catches) with the purse seine segment catching another 36% of total catches of this species, mainly during fishing operations under FADs.

Table 11: EAO catches by gear and species (2012), tonnes

	ALB	BET	SKJ	YFT	Grand Total	% of total
Pole and line	14,558	9,541	45,086	6,529	75,714	19%
Gillnet	6	0	4,946	604	5,556	1%
Handline	165	267	982	1,338	2,752	1%
Longline	21,335	28,324	348	6,803	56,810	14%
Other	6,865	0	138	8	7,011	2%
Purse seine	577	21,383	156,084	67,414	245,457	61%
Troll	5,911	28	20		5,960	1%
Grand Total	**49,417**	**59,544**	**207,602**	**82,696**	**399,259**	
% of total	12%	15%	52%	21%		

Source: Poseidon analysis from ICCAT database

3.6.2 Pole and line catches and product flows

The pole and line technique is utilised mainly by fleets based in Senegal (flagged to Senegal and to the EU) and in Ghana (flagged to Ghana). Catches landed in these two countries represent approximately 45,000 tonnes per year (15,000 tonnes in Dakar and 30,000 tonnes in Tema). Tuna caught are kept frozen in brine onboard and intended for the processing industry. Pole and line catches landed in Senegal are mostly transhipped on reefers for processing in Europe and in Cote d'Ivoire. The tuna processing industry in Senegal is currently expanding with one major cannery now operated by Korean interests (Dongwon). According to information available, the domestic tuna processing unit has capacity to absorb 20 000 t of tuna per year. In Ghana, pole and line catches are sold to the two canneries operating in the country (PFC and Cosmo).

Other pole and line activities in the EAO include:

- A pole and line fisheries targeting skipjack and yellowfin by vessels based in Canarias, Azores and Madeira. The activity is seasonal and targets skipjack, yellowfin and bigeye for direct

[29] http://www.fao.org/fishery/area/search/en

consumption on the EU market, mainly Spain and Portugal. The quantities concerned are in the region of 10,000t tonnes per year;

- Pole and line fisheries targeting albacore in the North East Atlantic, with the main fleet based in the North of Spain. Vessels target albacore during the summer season for fresh sales on the EU market. The corresponding catches are around 8,000 tonnes. In the South East Atlantic, a separate fleet based in South Africa and Namibia targets albacore also on a seasonal basis with catches nearing 6,000 tonnes, which complement catches of albacore caught in the WIO. Albacore catches from the South Atlantic fishery are largely canned in South Africa (Hout Bay) and Namibia) and destined for export to the canning market.

3.6.3 Gillnet catches and product flows

Gillnet catches in the EAO are relatively marginal compared to gillnet catches in the Indian Ocean. In 2012, they represented only 5,556 t, with skipjack and other neritic species as the main target species. The EAO gillnet fishery is poorly documented and is essentially of artisanal nature. According to information available, tuna gillnets are deployed in the Gulf of Guinea by artisanal vessels from Cote d'Ivoire and Ghana. Catches are landed in fishing villages spread along the coast and sold in domestic markets. Tuna landed are generally subject to artisanal processing (drying, smoking) before distribution, both domestically and for inland regional trade.

3.6.4 Hand line catches and product flows

Use of handlines for catching tuna is also relatively marginal in the EAO representing less than 1% of total catches in this area (2,752 t in 2012 mostly yellowfin). The main handline fishery is operated by artisanal vessels of Cape Verde around a network of anchored FADs. The vessels target large yellowfin used to supply the domestic market. In other regions / countries, handline catches are anecdotal.

3.6.5 Longline catches and product flows

Asian vessels dominate longline catches in the EAO, with Taiwan (25,712 t) and Japan (25,462 t) accounting for 61% of longline catches in the region. The Asian fleet targets bigeye and yellowfin in the tropical area, and albacore in the southern latitudes of the Atlantic. The Asian longline fleet targets large specimens in the deeper layers of the ocean.

Most catches of the Asian longline fleet are transhipped at sea on dedicated reefers which also have a support function (refuelling, provision of consumables including bait). Longline catches of yellowfin and bigeye (35,128 t in 2012) are held frozen onboard and sold on the Asian sashimi market. Longline catches of albacore (21,335 t in 2012) are also frozen onboard and sold to canneries outside the EAO mostly for the US market (white meat tuna). The main ports used by Asian longliners are Cape Town (South Africa), Walvis Bay (Namibia) in the South, and Dakar (Senegal) and Mindelo (Cape Verde) in the North. However, as outlined above, transshipment at sea is the norm and is integral to the economic viability of the Asian distant water fleets engaged in this fishery. Globally, the Asian longline fleet has few economic interactions with Coastal States bordering the EAO.

A longline fleet mostly composed by EU vessels targets swordfish and oceanic sharks using surface gears. Catches of tuna are relatively marginal and in 2012 were less than 4,500 t of tuna sold on the EU market for fresh consumption.

3.6.6 Other gear catches and product flows

According to ICCAT statistics, catches of tuna by other gears represented 7,011 t in 2012, with species composition dominated by albacore (6,865 t).

The main 'other gears' fishery is a pair-trawl fishery operated by vessels registered in the EU (France, Ireland, United Kingdom). This fleet exploits albacore during the summer season in the Bay of Biscay and further offshore. Catches are unloaded in European ports and sold on the EU domestic market for fresh consumption in the form of loins or steaks.

3.6.7 Purse seine catches and product flows

With 245,457 t of tuna caught in 2012, the purse seine segment represents most of the tuna catches in the EAO (61%). By species, the purse seine segment is at the origin of 82% of yellowfin catches (67,414 t in 2012), 75% of skipjack catches (156,084 t) and 36% of bigeye catches (21,383 t).

Since ICCAT conservation and management measures prohibit transhipment at sea for purse seiners, the fleet extensively uses West African ports for their unloading operations. The main ports are as follows:

- Abidjan (Cote d'Ivoire) is the main regional hub used by all purse seiners operating in the EAO. Data communicated by IRD indicate that the total quantities transiting through Abidjan are in the region of 200,000 t per year. This includes mostly catches from purse seiners unloaded / transhipped in the port, and also about 20,000 t sent by reefer from Ghana. In 2013, there were three tuna processing factories active in Abidjan: Castelli owned by Italian investors, and PFCI and Scodi both owned by Lebanese interests. The total quantity of whole round product processed was 55,000 t, obtained both from direct landings from tuna vessels plus quantities imported from Ghana. The Cote d'Ivoire processing units mostly supply the EU market with secondary markets in the Middle East and in the subregion. Raw material exported from Abidjan is processed in the EU when in compliance with the various EU customs, sanitary and IUU regulations governing imports of fisheries products. Raw material also supplies processing units based in Turkey, Egypt or other North African countries.
- Tema (Ghana) is the port used by Ghanaian purse seiners and pole and liners, with occasional unloading operations by purse seiners of other nationalities. Total quantity of raw material transiting through Tema is estimated at 70 000 t per year. In 2013, there were two tuna processing units in activity: PFC owned by Thai-Union through MW Brands, and Cosmo jointly owned by the Korean company Shila and the Taiwanese company FCF. The two units have processed an estimated 50,000 t, a tonnage bound to increase after the modernisation of one cannery by Korean-Taiwanese investors. Most raw material is sourced from purse seiners and pole and liners unloading locally, but complementary sources are used. This includes raw material imported from Abidjan and when necessary, tuna caught in the Indian Ocean.
- Dakar (Senegal) is used by purse seiners sporadically during the summer season, when the skipjack resource is abundant in the Mauritania-Senegal zone. Purse seine catches transiting through Dakar are estimated to be around 40,000 t per year. In general, catches are transhipped for processing in the EU. The local cannery SNDCS owned by the Korean company DongWon has so far only used tuna unloaded directly by pole and liners.

3.7 WEST ATLANTIC OCEAN (WAO)

3.7.1 Introduction – area and key catch data

The West Atlantic Ocean (WAO) groups for the purpose of this study three FAO areas: The North West Atlantic (FAO area 21), the Central Western Atlantic (FAO area 31) and the South West Atlantic (FAO area 41)[30].

As shown in the following table, tuna catches in the WAO (and excluding catches of bluefin tuna which are discussed in section 3.8) are relatively low (66,128 t in 2012, *i.e.* 1% of global tuna catches). The main salient points are:

[30] http://www.fao.org/fishery/area/search/en

- Purse seine catches (less than 5,000 t) are insignificant compared to catches in other areas (e.g. WCPO, EPO, WIO or EAO). This is a consequence of the prevailing oceanographic conditions which make purse seine tuna species less abundant and less available for large scale vessels compared to the Eastern Atlantic area and other productive fishing grounds, and to a lesser extent levels of overfishing.
- The dominant gear is pole and line (33,245 t) which represents 50% of total catches in this area. The second most important gear is longline, with 2012 catches of 24,076 t representing 36% of total catches.
- The main species exploited is skipjack (50%) of total tuna catches. The pole and line segment is the origin of 92% of total catches of this species. Catches of yellowfin and bigeye are obtained mostly by the longline segment.
- Catches by other gears than pole and line and longline are relatively marginal.

Table 12: WAO catches by gear and species (2012), tonnes

Row Labels	ALB	BET	SKJ	YFT	Grand Total	% of total
Pole and line	969	475	30,693	1,108	33,245	50%
Gillnet		0	46	23	70	0%
Handline	73	349	313	2,365	3,100	5%
Londline	2,181	10,028	470	11,397	24,076	36%
Other	0	33	7	330	370	1%
Purse seine	21	87	1,582	3,302	4,992	8%
Troll	3	0	109	164	276	0%
Grand Total	**3,247**	**10,972**	**33,219**	**18,690**	**66,128**	
% of total	5%	17%	50%	28%		

Source: Poseidon analysis from RFMO databases

3.7.2 Pole and line catches and product flows

In the WAO, two main pole and line fleets operate.

In Brazil, vessels based in Rio de Janeiro, Itajaí and Rio Grande exploit skipjack throughout the year in particular around oil and gas offshore platforms which have an aggregating effect on tuna schools. Total catches were close to 32,300 t in 2012 including 95% skipjack. Production is sold to canneries in the country, with Gomes da Costa owned by Spanish investors and based in Itajaí as main output. The cans are sold on the domestic and subregional markets (MERCOSUR).

In Venezuela, a pole and line fleet based in Cumaná targets principally yellowfin and also skipjack year round. The number of vessels has decreased substantially over the past few year and catches are now around 1,500 t per year compared to 10,000 t and more 10 years ago. Tuna are sold mostly on the domestic market for fresh consumption.

3.7.3 Gillnet catches and product flows

Gillnet catches in the WAO are minimal (less than 100 t in 2012), with artisanal vessel catches sold on the domestic markets.

3.7.4 Hand line catches and product flows

In the Western Atlantic Ocean, tunas are targeted by handline mainly by artisanal fishermen in the Caribbean. The main species targeted is yellowfin and catches are sold on the domestic market. The total catches by artisanal vessels are poorly documented.

Catches in the ICCAT database also include tuna catches by recreational fishermen, in particular in the USA. The US sport fishery targets mainly yellowfin and bigeye.

3.7.5 Longline catches and product flows

Longline catches originating from the Western Atlantic amounted to slightly less than 25,000 t in 2012 with Japan and Korea as main fishing entities. The West Atlantic longline fishery is a continuation of the Eastern Atlantic longline fishery with vessels exploring the whole width of the ocean to catch large yellowfin and bigeye. As in the Eastern Atlantic, most catches are transhipped at sea onto reefers with few catches unloaded in the ports of the region.

In addition to this high-sea longline fishery exploited mostly by Asian vessels, there are small localised longline fisheries. One of these is the Mexican longline fishery in the Gulf of Mexico which exploits yellowfin for sale on the America market (1,500 tonnes in 2012). There is also a US longline fishery and Brazil has a longline fishery, both of which are not high seas fisheries.

3.7.6 Other gear catches and product flows

Catches by other gears are minimal (less than 500 t in 2012). According to information available, the vessels using other gears to catch tuna are artisanal vessels of various nationalities with catch sold on the domestic markets.

3.7.7 Purse seine catches and product flows

In 2012, purse seine catches in the Western Atlantic (mainly yellowfin and skipjack) were less than 5,000 t. The Western Atlantic Ocean purse seine fishery is the western extension of the purse seine fishery concentrating its effort in the Eastern Atlantic area, as well as a Venezuelan-based purse seine fleet. Purse seiners catching tuna in this area keep the catches onboard and unload in the ports located in Venezuela, West Africa (Côte d'Ivoire, Ghana, Senegal).

3.7.8 Troll catches

Troll catches in the Western Atlantic are low (less than 300 t in 2012) but are probably underreported. According to information available, the troll fishery concentrates in the Caribbean. Vessels using this technique are artisanal vessels trolling lines around anchored FADs. Most catches consist of yellowfin sold on the domestic markets.

3.8 THE ATLANTIC BLUEFIN TUNA FISHERY

3.8.1 Introduction – area and key catch data

The Northern bluefin tuna fishery extends over an area covering the Mediterranean, the Eastern Atlantic and the Western Atlantic. On the East side of the Atlantic, the Mediterranean fishery and the Eastern Atlantic fishery (principally in the North Eastern Atlantic) form a continuum with exploitation of the same species on both sides of the Gibraltar Strait. The Western Atlantic fishery is different, and is considered as exploiting a separate stock for conservation and management purposes. However there may be some mixing of the two stocks even though the spawning areas are discrete.

As shown in the table below, BFT catches originate mostly from the Eastern side of the Atlantic including the Mediterranean (10,806 t including 7,019 t caught in the Mediterranean). By comparison, catches on the Western side of the Atlantic are low (1,786 t) representing 14% of all BFT catches. The main features of the fisheries are as follow:

- In the Eastern Atlantic and in the Mediterranean, purse seiners represent 56% of catches in the area (6,106 t in 2012). The activity of the purse seine fleet targeting BFT concentrates in the Mediterranean.

- Other main gears operated in the Eastern Atlantic and Mediterranean are longline (1,715 t in 2012) and other gears (2,522 t) with comprise mostly the trap fishery. FAO area-wise, most BFT catches by longlines (66%) and by traps (94%) originate from the North Eastern Atlantic.
- By comparison, catches by other gears (pole and line, handline) in the E Atlantic are low. Pole and line catches (282 t in 2012) are obtained in the North Eastern Atlantic. Handline catches (191 t in 2012) are from the Mediterranean.
- In the Western Atlantic, BFT is caught by longline (734 t) and by handline (951 t). Catches by other gears are less important.

Table 13: Catches of Northern bluefin tuna by gear and species (2012), tonnes

	Eastern Atlantic and Mediterranean	Western Atlantic	Total	% of total
Pole and line	282		282	2%
Handline	191	951	1,142	9%
Longline	1,715	734	2,449	19%
Other	2,522	100	2,622	21%
Purse seine	6,106	2	6,108	48%
Total	**10,816**	**1,786**	12,602	
% of total	86%	14%		

Source: Poseidon analysis from RFMO databases

3.8.2 Pole and line catches and product flows

The BFT pole and line fishery in the Eastern Atlantic is operated by Spanish and French vessels also targeting albacore during the summer season. The vessels unload their catches (282 t in 2012) in their ports of origin (mainly in the Basque country in the case of Spain) for commercialisation on the domestic market.

3.8.3 Hand line catches and product flows

In the Eastern Atlantic and in the Mediterranean, handline catches (191 t in 2012) are obtained by small scale coastal vessels based in an EU Member State or in Morocco. The catches are sold on the EU market for direct consumption.

In the Western Atlantic, handline catches (951 t) includes commercial catches and some small amounts of recreational catches by US sport fishermen[31]. Commercial catches are obtained by vessels from the USA and from Canada. BFT are sold on local markets for direct consumption on a sashimi / sushi market.

3.8.4 Longline catches and product flows

In the East and in the West Atlantic, the main fishing entity targeting BFT with longline is Japan (1,382 t of total catches for both areas). Catches are held frozen onboard (some as ULT) and transhipped at sea to be sold on the domestic sashimi market. The fishing areas exploited by Japanese longliners cover the whole Northern Atlantic, in particular in the high latitudes.

Other longline fisheries in the Mediterranean include a small-scale fishery exploited by artisanal vessels registered in the EU (mainly in France, Malta and Italy). In France and Italy (400 t for both countries), BFT are sold on the domestic market. In Malta (136 t in 202) longline bluefin are sold to the local fishing companies exploiting cages for ranching and sale on the Japanese sashimi market.

[31] Which are therefore included in the global ex vessel values provided later in this report, but which, due to the very low level of catches represent only a tiny fraction of the total global value.

On the Western side of the Atlantic, the USA is the most important catching nation (292 t in 2012). Catches are sold primarily on the national sashimi / sushi markets although some may be sold in Japan.

3.8.5 Other gear catches and product flows

The main other gear fishery is the trap fishery which catches tuna during its migration in and out of the Mediterranean. In 2012, there were 19 traps officially registered with ICCAT, including 10 in Morocco, 5 in Spain, 3 in Portugal and 1 in Italy. The majority of BFT trap catches are from Spain (1,110 t in 2012) and from Morocco (990 t).

BFT trapped are slaughtered on site and sold directly to Japanese freezer transport vessels for sale on the Japanese sashimi market.

3.8.6 Purse seine catches and product flows

The fleet of purse seiners targeting BFT operates in the Mediterranean. Catches (6,106 t in 2012) are kept alive in the seines, transferred into transport cages and delivered to other cages where tuna are fattened until they are marketed. The main fishing entities targeting BFT with purse seine are Italy (1,374 t in 2012), Tunisia (1,017 t), Spain (1,034 t), Libya (763 t) and France (678 t).

In 2012, there were 54 farming facilities officially registered with ICCAT for a total nominal capacity in excess of 50,000 t. Most farms are located in Italy (14 units for 12,600 t capacity), Spain (10 units of 12,000 t capacity), Malta (8 units, 12,000 t capacity), Croatia (4 units, 8,000 t capacity) and Turkey (6 units, 6,000 t capacity). Not all farms are active and nominal capacity is probably well above current holdings, but data on stocks of BFT held in cages are not in the public domain. Large tuna caught in the Western Mediterranean are fattened during a 5-7 month period and sold on the Japanese sashimi market when domestic demand is high (usually at the end of the year). BFT is sold fresh to specific freezer carrier vessels which transport them to the final destination (Japan), but some valuable specimen may be exported by plane. ICCAT uses a cross-board fattening ratio of 25% for these large fish to estimate the increase in weight between capture and ex-farm commercialisation. In the Eastern Mediterranean (Adriatic), BFT caught by purse seiners are generally smaller (less than 60 kg). BFT can be fattened during a period of 2 to 3 years during which initial weight can be doubled (fattening ratio of 100%).

3.9 ANTARCTIC

3.9.1 Introduction – area and key catch data

This final section describes the catches of the only tuna species to be caught on a commercial basis in the Antarctic Ocean, the southern bluefin tuna (SBF). SBF are large, fast swimming tunas found throughout the southern hemisphere, mainly in the cooler waters between 30 and 50 degrees south but only rarely in the eastern Pacific. The only known breeding area is in the warmer waters of the Indian Ocean, south-east of Java, Indonesia.

The catch data are supplied by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). Unlike the RFMOs described above, the Convention for the Conservation of Southern Bluefin Tuna sets no geographic limits of competence; it extends over all national waters and the high seas, where southern bluefin tuna are found. Originally signed in 1993 between Australia, Japan and New Zealand, and has been joined by Korea, Indonesia and Taiwan since then, with the Philippines, South Africa and the European Union as Cooperating Non-Members.

A summary table of catches by gear and ocean sub-area is provided below. Key observations are:

- Longline (57% of total SBF catch) and purse seine (43% of SBF catch) are the two key gears used.
- The majority (78%) of SBF catch is to the south of the Indian Ocean, with relatively little in the Pacific (16%) and the Atlantic (6%).

Table 14: Antarctic catches of Southern bluefin tuna by gear and sub-ocean area (2012), tonnes

Gear	Catch by sub-ocean (t)			Total catch (t)	% of total
	Atlantic Antarctic	Indian Antarctic	Pacific Antarctic		
Longline	611	3575	1625	**5,811**	57%
Other			<1	**<1**	<1%
Purse seine		4,444		**4,444**	43%
Troll			6	**6**	<1%
Total	**611**	**8,019**	**1,631**	**10,261**	**100%**
% of total	6%	78%	16%	100%	

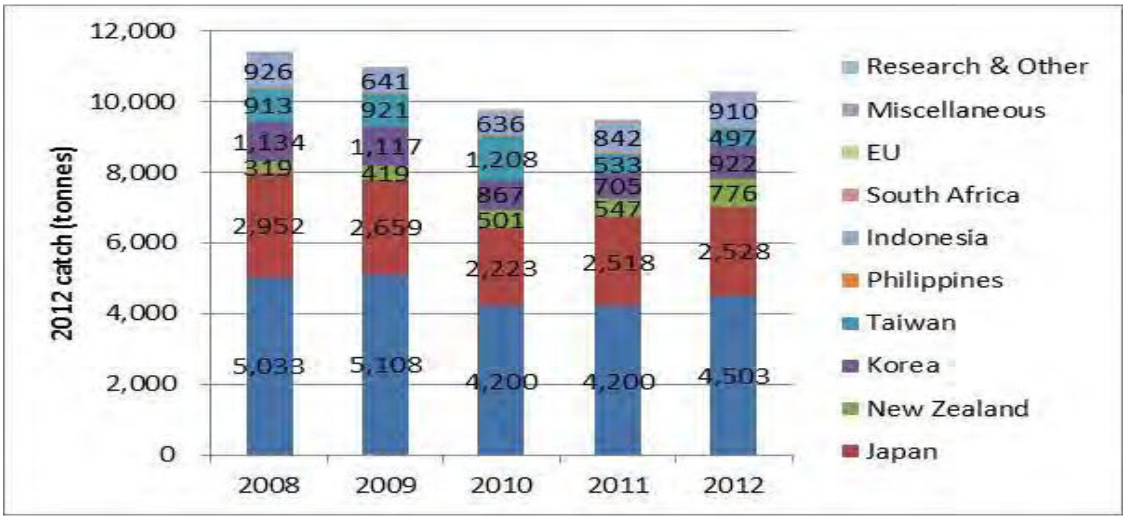
Source: Poseidon analysis from RFMO databases

The catch of southern bluefin tuna was around 12,000 to 15,000 tonnes in the 1950s, and was used mostly for canning. When Japanese longliners adopted super-cold freezers and started fishing for the sashimi market, southern bluefin tuna acquired a high value in their market, as a substitute for (northern) bluefin tuna. Consequently the catch increased suddenly to a peak of 80,000 tonnes in 1961, after which it gradually decreased to about 40,000 tonnes in the early 1980s, due mostly to a decline in the catch rate. In the early 1980s a quota system was introduced under a trilateral agreement among Australia, Japan and New Zealand. The annual quota has been reduced since then, as reflected by a sharp decline of the catch, and by the early 1990s had been reduced to less than 10,000 tonnes (Miyake et al, 2004). Quotas in recent years have been increased again, with the TAC for 2014 12,449 tonnes, and the TAC for 2015 to 2017 14,647 tonnes.

Looking at the catch by flag (the CCSBT do not provide catch data combining both flag and gear) over the past five years (see Figure 1 overleaf) the key observations are:

- Total catches have varied between 11,395 t in 2008 and 9,444 t in 2011, with the 2012 catch being 10,261 t.
- The proportion of catches between the different flag states fishing SBF has remained fairly consistent over the period 2008 – 2012. Australia catches around 40% of SBF, Japan 23% and Korea, Taiwan and Indonesia all around 7 to 8%, with New Zealand 4%.

Figure 1: Catch of SBF by flag over the period 2008 – 2012, tonnes



Source: CCSBT

3.9.2 Longline catches and product flows

As stated above, long lining is one of the two main methods used for catching SBF in the Antarctic and is practised by all the fleets, including domestic Australian vessels (numbering around 15). The SBF caught are mainly frozen at ultra-low temperatures (-60°C) and either unloaded at intermediate ports and shipped to markets in Japan or unloaded directly at markets in Japan. Japan consumes around 95% of the global catch of SBF, traditionally destined for the sashimi market, although this has declined (for all species) from a peak in 2002 at 609,000 tonnes to average 383,000 tonnes in the last five years (Port Lincoln Times, 2013).

In 2012 4,874 t (91%) of the SBF longline catch was exported to Japan, 228 t (4%) to the USA, 132 t (2%) to Taiwan and 103 t (2%) to Korea (CCSBT Catch Documentation Scheme data[32]).

3.9.3 Purse seine catches and product flows

The second main method for catching SBF in the Antarctic is the purse seine. Mainly used by Australia (which has four registered purse seiners) fish are kept alive and towed to waters near the Australian mainland and stocked into floating cages 10 - 20 km seaward of Port Lincoln. Following stocking in December to early April the fish are fed until late August, where most fish will double their weight and with low mortality (typically 2-4%) results in a harvest of around 9,000 tonnes (Clarke and Ham, 2008). In 2012 Australia produced 8,468 t of SBF from their tuna ranches, of which 8,407 t (99%) was exported to Japan as ULT sashimi grade frozen tuna.

3.10 SUMMARY OF PRODUCT FLOWS

From the analysis and information provided in the text in the preceding sections, a summary of product flows can be estimated, as shown in the table overleaf. The table provides an estimate of the proportion of the volume of each species caught in each sub-ocean area by a different fishing method/gear, destined for one of five main market destinations:

- Canning/loining (whether canned in a country in which tuna is landed or transshipped);
- Domestic markets (either in fresh or processed forms) i.e. sales of tuna not traded internationally, and which do not enter the canning, ranching or sashimi market value chains;
- Fresh sashimi markets;
- Frozen sashimi markets; and
- For ranching (bluefin tuna species only).

Blank cells in the table indicate that in some sub-ocean areas there is no recorded catch of some species.

[32] See http://www.ccsbt.org/userfiles/file/data/CDS_Report.xls

Table 15: Estimation of the proportion of landed product by species and sub-ocean area going to different market destinations (%)

BB/P&L	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	100%	100%		100%		100%	100%
For loining/canning	70%	70%		0%		70%	70%
For domestic (fresh or processing)	30%	30%		0%		30%	30%
For fresh sashimi	0%	0%		100%		0%	0%
For frozen sashimi	0%	0%		0%		0%	0%
For ranching	0%	0%		0%		0%	0%
EPO						100%	100%
For loining/canning						100%	100%
For domestic (fresh or processing)						0%	0%
For fresh sashimi						0%	0%
For frozen sashimi						0%	0%
For ranching						0%	0%
WIO		100%				100%	100%
For loining/canning		25%				25%	25%
For domestic (fresh or processing)		75%				75%	75%
For fresh sashimi		0%				0%	0%
For frozen sashimi		0%				0%	0%
EIO						100%	100%
For loining/canning						15%	15%
For domestic (fresh or processing)						85%	85%
For fresh sashimi						0%	0%
For frozen sashimi						0%	0%
EAO	100%	100%	100%			100%	100%
For loining/canning	100%	100%	0%			100%	100%
For domestic (fresh or processing)	0%	0%	0%			0%	0%
For fresh sashimi	0%	0%	75%			0%	0%
For frozen sashimi	0%	0%	25%			0%	0%
For ranching	0%	0%	0%			0%	0%
WAO	100%	100%				100%	100%
For loining/canning	95%	95%				95%	95%
For domestic (fresh or processing)	5%	5%				5%	5%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	0%	0%				0%	0%
For ranching	0%	0%				0%	0%
Antarctic							
For ranching							
For frozen sashimi							

GN	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	100%	100%				100%	100%
For loining/canning	90%	90%				90%	90%
For domestic (fresh or processing)	10%	10%				10%	10%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	0%	0%				0%	0%
For ranching	0%	0%				0%	0%
EPO							
For loining/canning							
For domestic (fresh or processing)							
For fresh sashimi							
For frozen sashimi							
For ranching							
WIO		100%				100%	100%
For loining/canning		80%				80%	80%
For domestic (fresh or processing)		20%				20%	20%
For fresh sashimi		0%				0%	0%
For frozen sashimi		0%				0%	0%
EIO	100%	100%				100%	100%
For loining/canning	5%	5%				5%	5%
For domestic (fresh or processing)	95%	95%				95%	95%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	0%	0%				0%	0%
EAO						100%	100%
For loining/canning						100%	0%
For domestic (fresh or processing)						0%	100%
For fresh sashimi						0%	0%
For frozen sashimi						0%	0%
For ranching						0%	0%
WAO						100%	100%
For loining/canning						0%	0%
For domestic (fresh or processing)						100%	100%
For fresh sashimi						0%	0%
For frozen sashimi						0%	0%
For ranching						0%	0%
Antarctic							
For ranching							
For frozen sashimi							

HL	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	100%	100%				100%	100%
For loining/canning	0%	0%				0%	0%
For domestic (fresh or processing)	100%	0%				100%	0%
For fresh sashimi	0%	100%				0%	0%
For frozen sashimi	0%	0%				0%	100%
For ranching	0%	0%				0%	0%
EPO							
For loining/canning							
For domestic (fresh or processing)							
For fresh sashimi							
For frozen sashimi							
For ranching							
WIO	100%	100%				100%	100%
For loining/canning	0%	0%				0%	0%
For domestic (fresh or processing)	0%	0%				0%	0%
For fresh sashimi	85%	85%				85%	85%
For frozen sashimi	15%	15%				15%	15%
EIO	100%	0%				100%	100%
For loining/canning	0%	0%				0%	0%
For domestic (fresh or processing)	100%	0%				100%	0%
For fresh sashimi	0%	0%				0%	30%
For frozen sashimi	0%	0%				0%	70%
EAO	100%	100%	100%			100%	100%
For loining/canning	0%	0%	0%			100%	0%
For domestic (fresh or processing)	100%	100%	0%			0%	100%
For fresh sashimi	0%	0%	75%			0%	0%
For frozen sashimi	0%	0%	25%			0%	0%
For ranching	0%	0%	0%			0%	0%
WAO	100%	100%	100%			100%	100%
For loining/canning	0%	0%	0%			0%	0%
For domestic (fresh or processing)	100%	100%	0%			100%	0%
For fresh sashimi	0%	0%	100%			0%	100%
For frozen sashimi	0%	0%	0%			0%	0%
For ranching	0%	0%	0%			0%	0%
Antarctic							
For ranching							
For frozen sashimi							

LL	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	100%	100%		100%		100%	100%
For loining/canning	80%	0%		0%		100%	0%
For domestic (fresh or processing)	0%	0%		0%		0%	0%
For fresh sashimi	0%	50%		0%		0%	50%
For frozen sashimi	20%	50%		100%		0%	50%
For ranching	0%	0%		0%		0%	0%
EPO	100%	100%					100%
For loining/canning	100%	20%					20%
For domestic (fresh or processing)	0%	0%					0%
For fresh sashimi	0%	30%					30%
For frozen sashimi	0%	50%					50%
For ranching	0%	0%					0%
WIO	100%	100%				100%	100%
For loining/canning	80%	0%				100%	0%
For domestic (fresh or processing)	0%	0%				0%	0%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	20%	100%				0%	100%
EIO	100%	100%				100%	80%
For loining/canning	100%	0%				0%	0%
For domestic (fresh or processing)	0%	0%				100%	50%
For fresh sashimi	0%	50%				0%	25%
For frozen sashimi	0%	50%				0%	5%
EAO	100%	100%	100%			100%	100%
For loining/canning	100%	0%	0%			100%	0%
For domestic (fresh or processing)	0%	0%	10%			0%	0%
For fresh sashimi	0%	0%	30%			0%	0%
For frozen sashimi	0%	100%	60%			0%	100%
For ranching	0%	0%	0%			0%	0%
WAO	100%	100%	100%			0%	100%
For loining/canning	100%	0%	0%				0%
For domestic (fresh or processing)	0%	0%	10%				0%
For fresh sashimi	0%	0%	30%				0%
For frozen sashimi	0%	100%	60%				100%
For ranching	0%	0%	0%				0%
Antarctic					100%		
For ranching					0%		
For frozen sashimi					100%		

Other	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	100%	100%		100%	0%	100%	100%
For loining/canning	100%	0%		0%		0%	0%
For domestic (fresh or processing)	0%	0%		0%		100%	0%
For fresh sashimi	0%	100%		100%		0%	0%
For frozen sashimi	0%	0%		0%		0%	100%
For ranching	0%	0%		0%		0%	0%
EPO	100%			100%		100%	100%
For loining/canning	50%			0%		10%	50%
For domestic (fresh or processing)	50%			0%		90%	50%
For fresh sashimi	0%			100%		0%	0%
For frozen sashimi	0%			0%		0%	0%
For ranching	0%			0%		0%	0%
WIO						100%	100%
For loining/canning						100%	100%
For domestic (fresh or processing)						0%	0%
For fresh sashimi						0%	0%
For frozen sashimi						0%	0%
EIO	100%	100%				100%	100%
For loining/canning	50%	0%				50%	0%
For domestic (fresh or processing)	50%	0%				50%	0%
For fresh sashimi	0%	50%				0%	50%
For frozen sashimi	0%	50%				0%	50%
EAO	100%		100%			100%	
For loining/canning	0%		0%			100%	
For domestic (fresh or processing)	100%		0%			0%	
For fresh sashimi	0%		0%			0%	
For frozen sashimi	0%		100%			0%	
For ranching	0%		0%			0%	
WAO	100%	100%	100%			100%	100%
For loining/canning	0%	0%	0%			0%	0%
For domestic (fresh or processing)	100%	100%	0%			100%	100%
For fresh sashimi	0%	0%	100%			0%	0%
For frozen sashimi	0%	0%	0%			0%	0%
For ranching	0%	0%	0%			0%	0%
Antarctic							
For ranching							
For frozen sashimi							

PS	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO		100%		100%		100%	100%
For loining/canning		80%		0%		100%	100%
For domestic (fresh or processing)		0%		0%		0%	0%
For fresh sashimi		0%		100%		0%	0%
For frozen sashimi		20%		0%		0%	0%
For ranching		0%		0%		0%	0%
EPO		100%		65%		100%	100%
For loining/canning		100%		0%		100%	100%
For domestic (fresh or processing)		0%		0%		0%	0%
For fresh sashimi		0%		0%		0%	0%
For frozen sashimi		0%		65%		0%	0%
For ranching		0%		35%		0%	0%
WIO	100%	100%				100%	100%
For loining/canning	100%	100%				100%	100%
For domestic (fresh or processing)	0%	0%				0%	0%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	0%	0%				0%	0%
EIO		100%				100%	100%
For loining/canning		100%				100%	100%
For domestic (fresh or processing)		0%				0%	0%
For fresh sashimi		0%				0%	0%
For frozen sashimi		0%				0%	0%
EAO	100%	100%	100%			100%	100%
For loining/canning	100%	100%	0%			100%	100%
For domestic (fresh or processing)	0%	0%	0%			0%	0%
For fresh sashimi	0%	0%	0%			0%	0%
For frozen sashimi	0%	0%	0%			0%	0%
For ranching	0%	0%	100%			0%	0%
WAO	100%	100%	0%			100%	100%
For loining/canning	100%	100%	0%			100%	100%
For domestic (fresh or processing)	0%	0%	0%			0%	0%
For fresh sashimi	0%	0%	0%			0%	0%
For frozen sashimi	0%	0%	0%			0%	0%
For ranching	0%	0%	100%			0%	0%
Antarctic					100%		
For ranching					100%		
For frozen sashimi					0%		

TR	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	100%	100%		100%		100%	100%
For loining/canning	100%	0%		0%		70%	0%
For domestic (fresh or processing)	0%	0%		0%		30%	0%
For fresh sashimi	0%	50%		0%		0%	50%
For frozen sashimi	0%	50%		0%		0%	50%
For ranching	0%	0%		100%		0%	0%
EPO	100%						
For loining/canning	90%						
For domestic (fresh or processing)	10%						
For fresh sashimi	0%						
For frozen sashimi	0%						
For ranching	0%						
WIO	100%	100%				100%	100%
For loining/canning	0%	0%				0%	0%
For domestic (fresh or processing)	100%	100%				100%	100%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	0%	0%				0%	0%
EIO	100%	100%				100%	100%
For loining/canning	90%	90%				90%	90%
For domestic (fresh or processing)	10%	10%				10%	10%
For fresh sashimi	0%	0%				0%	0%
For frozen sashimi	0%	0%				0%	0%
EAO	100%						
For loining/canning	50%						
For domestic (fresh or processing)	50%						
For fresh sashimi	0%						
For frozen sashimi	0%						
For ranching	0%						
WAO						100%	100%
For loining/canning						0%	0%
For domestic (fresh or processing)						100%	0%
For fresh sashimi						0%	100%
For frozen sashimi						0%	0%
For ranching						0%	0%
Antarctic							
For ranching							
For frozen sashimi							

Source: Poseidon analysis.

Key: BB/P&L = pole and line, GN = gillnet, HL = handline, LL = longline, Other = other, PS = purse seine, TR = troll

4 ASSESSMENT OF A GLOBAL EX-VESSEL VALUE OF TUNA CATCHES

4.1 METHODOLOGY

This Phase 1 report, as noted in the introduction, provides a global ex-vessel/first sale value of tuna, by multiplying landed volumes by landed/first sale prices for different species (with prices differentiated because prices paid to vessels differ based on variables such as the species caught and the value chain the catch will enter (e.g. canning, sashimi, etc). In arriving at a global ex-vessel value of selected tuna species (i.e., the species covered by this study), it was necessary to consider a number of methodological issues, which are reported below.

4.1.1 Data sources

The main sources of price data used in the study are provided in the table below[33].

Table 16: Main sources of 2012 data used to estimate ex-vessel catch values of selected tuna species

Data source[34]	Species/Products and notes
COMEXT (EU trade statistical database)	• EU exports of purse seine tuna by EU vessels for export to third country canneries for whole frozen skipjack, yellowfin, and bigeye • EU Exports of fresh, frozen, and live bluefin tuna (most notably from farms to Japanese carriers) • EU imports of purse seine caught whole frozen skipjack, yellowfin, and bigeye from 3rd countries to the EU
FFA (Fisheries Forum Agency) Fisheries Trade and News	• Ex vessel prices of fresh and frozen sashimi bigeye and yellowfin to the Japanese ports (origin Oceania) • 2012 fresh and frozen longline tuna ex vessel prices landed in main Japan ports
Globefish (/FAO fish trade database and newsletters)	• Frozen skipjack CIF prices in Thailand and Africa • Ex-vessel skipjack and yellowfin prices in Eastern Pacific (Manta), Indian Ocean (Mahé), and Atlantic (Abidjan)
Industry and ICCAT individuals	• Ex-vessel northern bluefin tuna prices in Mediterranean for purse seine caught fish to ranching
Japanese customs import data	• Fresh and frozen bluefin and southern bluefin tuna • Whole frozen longline albacore, yellowfin and bigeye

[33] Tuna prices published by EUMOFA were examined, but were deemed not to be especially useful for the purpose of the study (e.g., focusing on ex-vessel values).

It was also agreed with the client that direct interviews with the catching sector and first-sale buyers would be very time-consuming and not possible within the scope of the days available in the study budget. It was also acknowledged that industry contacts would in many cases be unlikely to be willing to provide highly accurate data due to confidentiality issues. This method of sourcing data was therefore not considered a priority for the study, except where there were no alternative published sources (e.g., bluefin prices for fish to ranches in the Mediterranean).

[34] Hyperlinks to data sources and databases used to collect or reconcile ex-vessel prices of whole tunas: COMEXT - http://epp.eurostat.ec.europa.eu/newxtweb/; FFA - https://www.ffa.int/trade_news ; Globefish - http://www.globefish.org/tuna-market-reports.html ; Japan customs - http://www.customs.go.jp/english/ ; NMFS and PFMC – ex-vessel prices on the East and West coasts and Japan ex-vessel prices - http://www.st.nmfs.noaa.gov/commercial-fisheries/fus/fus13/index , http://www.nmfs.noaa.gov/sfa/hms/documents/safe_reports/safe_report_archive.html, http://www.st.nmfs.noaa.gov/commercial-fisheries/market-news/related-links/market-news-archives/index and http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents/past-hms-safe-documents/; Thailand customs - http://search.customs.go.th:8090/Customs-Eng/Statistic/Statistic.jsp?menuNme=Statistic .

Data source[34]	Species/Products and notes
	• Fresh longline albacore, yellowfin and bigeye • Yellowfin loins (not species specific)
Maldives Government	• Fresh pole and line skipjack and yellowfin, ex-vessel • Fresh handline yellowfin, ex-vessel • Fresh longline bigeye and yellowfin, ex-vessel
Ministry of Fisheries, Indonesia	• Fishing ports ex-vessel prices for skipjack, yellowfin, bigeye (2014 converted to 2012 prices based on differences between 2012 and 2014 av. prices for Thai import values)
NMFS/NOAA Mainly NOAA Fisheries, 2014, 2013 and 2012 and NMFS, 2013 and 2014 and Pacific Fishery Management Council, (PFMC, 2013	• US imports fresh sashimi price for albacore, yellowfin, bigeye • US imports frozen loins • US imports super-frozen albacore and yellowfin • Ex vessel prices of tunas landed in Japan (from the Japan fisheries agency) • Ex vessel prices (in dressed weight mainly) of albacore, yellowfin, bigeye and bluefin tunas landed on the West Coast and the East coast (without specification whether it is a Pacific, Southern or Northern one) • Japan fisheries agency data: ex vessel prices in main landing ports in Japan for fresh and frozen albacore, yellowfin and bluefin tuna (without specification whether it is a Pacific, Southern or Northern one). Fresh products being landed whole, frozen products being landed gilled and gutted.
Published EU evaluation reports of Fisheries Partnership Agreement (original source of prices are interviews with catching sector)	• Spanish purse seine ex vessel prices in the Pacific for whole frozen skipjack, yellowfin and bigeye
Thai customs	• Whole frozen purse seine albacore, skipjack, yellowfin and bigeye

Source: Poseidon's own elaboration

In conclusion, from the above table, it can be seen that while there is no one source of data for all of the study's data needs, when taken together the data sources provide a wide range of data which have been accessed.

In all cases, where data from the above sources are not in US$ (for instance in euro or Japanese yen), prices have been converted to US$/tonne using the mid-2012 exchange rate as reported on www.oanda.com[35] . All prices are in nominal terms (not adjusted for inflation)

4.1.2 Price adjustments for product form and differences between traded/customs values and 'ex-vessel' prices

Prices collected and used in this study are 'ex-vessel' prices. But in some cases, for example prices based on trade/customs data, figures are traded values (e.g. 'import prices'). In such cases there are two principle methodological issues to consider:

The first one is the ***product form*** being traded, and whether estimating ex-vessel prices for whole round fish needs to account for any processing weight loss of tuna prior to it being traded.

Product destined for canneries is whole frozen fish so no conversion factors are necessary or used to amend prices to arrive at whole round values. However, for other product flows, for example for longline caught fish, prices of traded product may relate to tuna that have been:

[35] Some price data are available monthly from different sources, a check confirmed that there were no important differences between mid-year exchange rates for 2012 and an annual average of monthly exchange rates.

- Gilled and gutted: 6% weight loss (predominant fresh and frozen product form for Japanese sashimi markets[36]);
- Headed and gutted: 16% weight loss (predominant fresh and frozen product form for USA sashimi markets); and
- Loined: 40% weight loss.

These conversion factors from whole to traded/shipped product forms are based on recognized industry standards as determined by earlier Poseidon studies and confirmed through selected interviews with key respondents (consultants, industry experts), and have been used in this study (loin prices, hence the processing conversation rate above, were not used in estimating ex-vessel prices for canning/loining products).

Other processing conversion rates were used in the study such as RFMOs conversion rates. For instance, on the US East Coast, several ex-vessel prices of tuna products are converted into dressed weight[37] prices by the US agency NOAA; this conversion being a standard for their own time-series records for most of these tuna products are landed dressed[38]. In this case, the conversion ratio to estimate Western Atlantic whole round ex-vessel prices were applied (e.g. for northern bluefin tuna, the ICCAT conversion ratio from dressed weight to whole round weight is standard: 1.25[39]).

The second methodological issue to consider when using traded values and import/export prices to estimate ex-vessel values, is that traded values may include the ***costs of carriage, insurance and freight (CIF) and related agency fees and costs of stevedores, tariffs, and labour costs*** of any onshore processing prior to trade. For frozen transshipped/traded tuna destined for canneries in Thailand, South America, etc., *carriage and service costs* from earlier Poseidon studies of catches in the Pacific suggest fairly standard costs of around $250-300/tonne, and an average figure of $275/tonne has been assumed and deducted from all frozen traded/customs values.

The costs of carriage, insurance and freight (CIF) and related agency fees and costs of stevedores, tariffs, and labour costs for tunas not destined for canneries were estimated at US$ 6,600/t for fresh bigeye tuna and US$ 5,600/t for fresh YFT caught by longliners for the Japanese fresh sashimi markets to generate ex vessel prices from import prices, based on regularly collected and published FFA data and some earlier Poseidon work on unpublished studies.

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[36] There are some exceptions, which were also taken into account to convert collected prices into whole round ex vessel prices. For instance, fresh tunas landed in main Japanese ports caught using unknown fishing gear are whole round while frozen tunas are landed in the same ports gilled and gutted with the head on. Then both products are recorded as such by the Japanese fisheries authority (NOAA, pers. comm, 9 February 2015)

[37] Gilled, gutted, part of head off and fins off.

[38] NOAA, pers. comm, 23 January 2015. See also, NOAA Fisheries, 2014.

[39] http://www.iccat.int/Documents/SCRS/Manual/Appendices/Appendix%204%20V%20Product%20conversion%20factors.pdf, access: 16 February 2015.

Table 17: Total estimates of 2012 trade, processing and service costs to arrive at ex-vessel prices from import prices

Catching gear (code)	Species (code)	Preservation or processing state	Product destination	Import country	Estimate of costs (includes)
PS	YFT, BET, ALB, SKJ	Whole frozen	Canneries	Thailand and Ecuador (used as a global estimate in the study)	$ 275/t (carriage and service costs i.e. CIF costs)
LL	BET	Fresh	Fresh sashimi	Japan	$ 6,600/t (costs of carriage, insurance and freight (CIF) and related agency fees and costs of stevedores, tariffs, and labour costs)
LL	YFT	Fresh	Fresh sashimi	Japan	$ 5,600/t (costs of carriage, insurance and freight (CIF) and related agency fees and costs of stevedores, tariffs, and labour costs)

NB: only cost estimates used in generating ex vessel prices are given above

Source: Poseidon analysis

4.1.3 Other issues not accounted for in this study

Finally with regards to methodological issues, it is important to note that this study has *not* attempted to nuance data from different sources to account for a number of other factors which may hide differentials in prices being paid to particular vessels/fleets. For example, the data available both for ex-vessel values, and for traded/customs values, may hide important differences in actual prices paid to different fleets/vessels based on differences in:

- Quality of product;
- Size mix of catch and the fact that prices typically depend upon fish size. The use of traded data to estimate prices paid to vessels for different species should however reflect a mix of all sizes, and thus be broadly representative;
- Whether fish may have an eco-label such as the MSC, which *may* generate increased prices;
- In the case of purse seine fishing whether Fish Aggregating Devices are used (and their type) or not, because of the impact on both size and species mix of catches;
- Vessel flag (due to actual and perceptional differences in the factors bulleted above); and
- Ranched vs. wild-caught fish for trade/customs data (although note that we were able to identify a specific ex vessel price of purse seine caught Bluefin tuna in the Atlantic for ranching in the Mediterranean).

Such factors are not considered within our global estimate.

4.1.4 Applying price data to landed volumes to arrive at an ex vessel/landed value

With these methodological factors in mind, the following text describes how we have estimated the global ex-vessel value, and some issues related to the potential robustness of the study outputs.

Firstly, the estimations of the market flows of product provided in % terms as shown in Table 15 were applied to the catch volumes in the database constructed during the study, to arrive at the volume of catch going to different market destinations, for different oceans, gear types, and species. These volumes can be seen in Table 18**Error! Reference source not found.**. The blue shaded cells represent volumes of catch for which a price needed to be obtained in order to derive a value of catch (in a specific ocean area, using a specific gear, and for specific species).

Table 18: Estimation of volume of landed product by species, gear and sub-ocean area going to different market destinations in 2012 (tonnes)

Volumes in tonnes	BB/P&L							GN							HL							LL							Other							PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**33,783**	**3,932**		**113**		**170,503**	**34,657**	**26**	**365**				**21,093**	**1,030**	**378**	**3,037**				**11,051**	**37,499**	**100,422**	**79,420**		**210**		**1,973**	**79,632**	**425**	**8,762**		**2,715**		**122,629**	**62,127**		**71,543**		**3,883**		**1,392,275**	**397,738**	**3,575**	**273**		**570**		**6,235**	**3,935**
For loining/canning	23,648	2,752		0		119,352	24,260	23	329				18,984	927	0	0				0	0	80,338	0		0		1,973	0	425	0		0		0	0		57,234		0		1,392,275	397,738	3,575	0		0		4,365	0
For domestic (fresh or processing)	10,135	1,180		0		51,151	10,397	3	37				2,109	103	378	0				11,051	0	0	0		0		0	0	0	0		0		122,629	0		0		0		0	0	0	0		0		1,871	0
For fresh sashimi	0	0		113		0	0	0	0				0	0	0	3,037				0	0	0	39,710		0		0	39,816	0	8,762		2,715		0	0		0		3,883		0	0	0	137		0		0	1,968
For frozen sashimi	0	0		0		0	0	0	0				0	0	0	0				0	37,499	20,084	39,710		210		0	39,816	0	0		0		0	62,127		14,309		0		0	0	0	137		0		0	1,968
For ranching	0	0		0		0	0	0	0				0	0	0	0				0	0	0	0		0		0	0	0	0		0		0	0		0		0		0	0	0	0		570		0	0
EPO						**303**	**413**															**22,525**	**31,722**					**10,119**	**1,126**			**38**		**1,039**	**528**		**75,731**		**6,667**		**256,504**	**198,017**	**16,634**						
For loining/canning						303	413															22,525	6,344					2,024	563			0		104	264		75,731		0		256,504	198,017	14,971						
For domestic (fresh or processing)						0	0															0	0					0	563			0		935	264		0		0		0	0	1,663						
For fresh sashimi						0	0															0	9,517					3,036	0			38		0	0		0		0		0	0	0						
For frozen sashimi						0	0															0	15,861					5,060	0			0		0	0		0		4,334		0	0	0						
For ranching																						0	0					0	0			0		0	0		0		2,333		0	0	0						
WIO		**716**				**61,374**	**13,864**		**1,491**				**30,302**	**48,549**	**221**	**69**				**2,457**	**73,307**	**9,474**	**53,652**				**1,552**	**23,323**						**40**	**80**	**1,297**	**17,071**				**82,416**	**130,276**	**8**	**148**				**10,592**	**8,688**
For loining/canning		179				15,344	3,466		1,193				24,242	38,839	0	0				0	0	7,579	0				1,552	0						40	80	1,297	17,071				82,416	130,276	0	0				0	0
For domestic (fresh or processing)		537				46,031	10,398		298				6,060	9,710	0	0				0	0	0	0				0	0						0	0	0	0				0	0	8	148				10,592	8,688
For fresh sashimi		0				0	0		0				0	0	188	59				2,088	62,311	0	0				0	0						0	0	0	0				0	0	0	0				0	0
For frozen sashimi		0				0	0		0				0	0	33	10				369	10,996	1,895	53,652				0	23,323						0	0	0	0				0	0	0	0				0	0
EIO						**7,350**	**2,728**	**114**	**1,633**				**62,408**	**14,093**	**340**	**115**				**4,863**	**8,052**	**21,459**	**33,512**				**6,687**	**49,550**	**208**	**1,532**				**5,014**	**981**		**4,978**				**28,877**	**4,492**	**541**	**673**				**9,749**	**2,866**
For loining/canning						1,103	409	6	82				3,120	705	0	0				0	0	21,459	0				0	0	104	0				2,507	0		4,978				28,877	4,492	487	606				8,774	2,579
For domestic (fresh or processing)						6,248	2,319	108	1,551				59,288	13,388	340	0				4,863	0	0	0				6,687	29,730	104	0				2,507	0		0				0	0	54	67				975	287
For fresh sashimi						0	0	0	0				0	0	0	0				0	2,416	0	16,756				0	17,343	0	766				0	491		0				0	0	0	0				0	0
For frozen sashimi						0	0	0	0				0	0	0	0				0	5,636	0	16,756				0	2,478	0	766				0	491		0				0	0	0	0				0	0
EAO	**14,558**	**9,541**	**282**			**45,086**	**6,529**						**4,946**	**604**	**17**	**267**	**191**			**982**	**1,337**	**2,471**	**16,796**	**1,715**			**347**	**5,395**	**3,302**		**2,522**			**146**		**265**	**21,383**	**6,106**			**152,464**	**67,414**	**5,959**						
For loining/canning	14,558	9,541	0			45,086	6,529						4,946	0	0	0	0			982	0	2,471	0	0			347	0	0		0			146		265	21,383	0			152,464	67,414	2,980						
For domestic (fresh or processing)	0	0	0			0	0						0	604	17	267	0			0	1,337	0	0	172			0	0	3,302		0			0		0	0	0			0	0	2,980						
For fresh sashimi	0	0	212			0	0						0	0	0	0	143			0	0	0	0	515			0	0	0		0			0		0	0	0			0	0	0						
For frozen sashimi	0	0	71			0	0						0	0	0	0	48			0	0	0	16,796	1,029			0	5,395	0		2,522			0		0	0	0			0	0	0						
For ranching	0	0	0			0	0						0	0	0	0	0			0	0	0	0	0			0	0	0		0			0		0	0	6,106			0	0	0						
WAO	**969**	**475**				**30,693**	**1,108**						**52**	**23**	**222**	**349**	**951**			**313**	**2,366**	**21,045**	**21,556**	**734**			**470**	**12,805**	**3,564**	**33**	**100**			**7**	**330**	**333**	**87**	**2**			**5,202**	**3,302**						**136**	**164**
For loining/canning	921	451				29,158	1,053						0	0	0	0	0			0	0	21,045	0	0			0	0	0	0	0			0	0	333	87	0			5,202	3,302						0	0
For domestic (fresh or processing)	48	24				1,535	55						52	23	0	349	0			313	0	0	0	73			0	0	3,564	33	0			7	330	0	0	0			0	0						136	0
For fresh sashimi	0	0				0	0						0	0	0	0	951			0	2,366	0	0	220			0	0	0	0	100			0	0	0	0	0			0	0						0	164
For frozen sashimi	0	0				0	0						0	0	0	0	0			0	0	0	21,556	440			0	12,805	0	0	0			0	0	0	0	0			0	0						0	0
For ranching	0	0				0	0						0	0	0	0	0			0	0	0	0	0			0	0	0	0	0			0	0	0	0	2			0	0						0	0
Antarctic																										**5,811**														**4,444**									
For ranching																										0														4,444									
For frozen sashimi																										5,811														0									

Source: Poseidon analysis based on catch database assembled during the study and Table 15

Prices available from the various data sources listed in Table 16 were then carefully extracted, noting in each case the origin of the data, whether already ex-vessel prices or not, the ocean region (and country where relevant) and fleet types to which price data applies (where possible), the product form (e.g., fresh/frozen), and the assumed market flow (e.g., to canning, domestic sales, fresh sashimi markets, frozen sashimi markets). In some circumstances the prices for specific ocean regions, fleet types and species were assumed by comparing available prices with similar ones (noting assumptions in the spreadsheet constructed and provided to the client along with this report). For instance, for tuna landed and sold for domestic markets, as price data were generally lacking, the ex-vessel prices of tuna for canneries was used as a proxy for domestic prices[40].

These data, and the adjustment factors discussed above in Section 4.1 where necessary, were used to generate ex-vessel prices for all of the blue shaded cells in Table 18, as shown for the corresponding cells in Table 19. Cells in Table 19 have been colour-coded by the authors to indicate where we feel prices estimates are robust (green), less robust (orange), or may be subject to considerable margins of error (red) (due to lack of data, uncertainties over data, or assumptions that have been made in generating the ex-vessel values). This colour-coding is acknowledged as being necessarily subjective.

[40] Collection of ex vessel values of tuna catches destined for domestic sales was not possible given the timeframe/budget of this study, but other Poseidon studies and past experience has demonstrated that ‘cannery’ prices paid to vessels are often very close to the prices paid for fish destined for domestic markets. A later table in the this report (Table 23) shows that domestic sales are in any case a very small proportion of total global tuna catches so this assumption is unlikely to make a material difference to the estimates of global ex vessel values provided.

Table 19: Estimation of ex-vessel prices by species, gear, and sub-ocean area for 2012 (US$/tonne)

Ex vessel prices in $	BB/P&L							GN							HL							LL							Other							PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																																																	
For loining/canning	3,452	1,932				1,564	2,262	3,452	1,932				1,564	2,262								3,452					1,564		3,452								1,932				1,574	2,262	3,452					1,574	
For domestic (fresh or processing)	3,452	1,932				1,564	2,262	3,452	1,932				1,564	2,262	3,452					1,564														1,574														1,574	
For fresh sashimi				36,184												6,265							6,265					4,920		6,265		36,184							36,184					6,265					4,920
For frozen sashimi																					5,869	3,828	10,853		26,937			5,869							5,869		10,485							10,485					5,869
For ranching																																														12,534			
EPO																																																	
For loining/canning						1,574	2,262															3,452	1,938					2,262	3,452					1,574	2,262		1,938				1,574	2,262	3,452						
For domestic (fresh or processing)																													3,452					1,574	2,262								3,452						
For fresh sashimi																							6,265					4,920				36,184																	
For frozen sashimi																							10,853					5,869											16,848										
For ranching																																							12,534										
WIO																																																	
For loining/canning		2,005				1,564	1,852		2,005				1,564	1,852								3,531	2,005				1,564							1,517	1,852	3,531	2,005				1,517	1,852							
For domestic (fresh or processing)		2,005				1,564	1,852		2,005				1,564	1,852																													3,531	1,927				1,834	2,262
For fresh sashimi															4,691	6,265				4,987	4,522																												
For frozen sashimi															3,828	10,853				1,517	5,869	3,828	10,853					5,869																					
EIO																																																	
For loining/canning						1,834	2,262	3,452	2,005				1,564	1,852								3,452							3,531					1,834			1,927				1,834	2,262	3,531	1,927				1,834	2,262
For domestic (fresh or processing)						1,834	2,262	3,452	2,005				1,564	1,852	3,452					1,564							1,564	1,852	3,531					1,834									3,531	1,927				1,834	2,262
For fresh sashimi																					4,920		6,265					4,920		6,265					4,920														
For frozen sashimi																					5,869		10,853					5,869		10,853					5,869														
EAO																																																	
For loining/canning	3,452	1,932				1,564	2,262						1,564							1,564		3,452					1,564							1,754		3,531	1,927				1,754	2,262	3,531						
For domestic (fresh or processing)														1,852	3,452	1,938	2,005				1,852			1,938					3,452														3,531						
For fresh sashimi			36,184														36,184							36,184																									
For frozen sashimi			12,534														12,534						6,265	12,534				5,869			12,534																		
For ranching																																						12,534											
WAO																																																	
For loining/canning	3,452	1,932				1,564	2,262									1,938	2,005					3,452														3,531	1,927				1,754	2,262							
For domestic (fresh or processing)	3,452	1,932				1,564	2,262						1,564	1,852		1,938				1,564				10,366					3,452	1,927				1,754	2,262													1,834	
For fresh sashimi																	10,366				4,920			10,366							10,366																		4,920
For frozen sashimi																							6,265	10,366				5,869																					
For ranching																																						12,534											
Antarctic																																																	
For ranching																																								12,534									
For frozen sashimi																										12,534																							

Source: Poseidon analysis and estimations. Note: Cells in Table 19 have been colour-coded by the authors to indicate where we feel prices estimates are robust (green), less robust (orange), or may be subject to considerable margins of error (red) (due to lack of data, uncertainties over data, or assumptions that have been made in generating the ex-vessel values)

The final step in the analysis was to estimate the ex-vessel value of catches by multiplying the data in Table 18 by the data in Table 19, to arrive at the ex-vessel values shown in Table 20.

Data in Table 20 have been formatted using the Excel 'conditional formatting' function using a graded colour scale from blue, through light green to yellow, and through orange to red to highlight increasing values. This formatting allows for easy identification of the species, gear, ocean areas that contribute the highest values to the resulting global ex-vessel estimate. Note therefore that the colour coding in Table 20 refers to increasing values, and is different to the colour coding in Table 19, which refers to uncertainty/robustness.

Table 20: Estimation of the ex-vessel values of product by species, gear and sub-ocean area in 2012 (US$)

Total ex vessel values in $	BB/P&L							GN							HL							LL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																												
For loining/canning	81,633,241	5,318,325				186,724,573	54,875,894	80,777	634,744				29,699,714	2,096,874								277,325,395					3,086,729	
For domestic (fresh or processing)	34,985,675	2,279,282				80,024,817	23,518,240	8,975	70,527				3,299,968	232,986	1,304,856					17,289,124								
For fresh sashimi				4,088,782												19,027,424							248,791,241					195,909,698
For frozen sashimi																					220,094,836	76,881,000	430,981,302		5,656,868			233,694,125
For ranching																												
EPO																												
For loining/canning						476,913	934,206															77,756,300	12,295,447					4,577,836
For domestic (fresh or processing)																												
For fresh sashimi																							59,623,438					14,936,786
For frozen sashimi																							172,142,897					29,695,987
For ranching																												
WIO																												
For loining/canning		358,850				24,004,676	6,419,343		2,391,266				37,925,620	71,933,683								26,762,155					2,428,081	
For domestic (fresh or processing)		1,076,551				72,014,028	19,258,029		597,816				9,481,405	17,983,421														
For fresh sashimi															881,148	367,454				10,414,710	281,766,042							
For frozen sashimi															126,895	112,331				559,185	64,539,690	7,253,098	582,296,873					136,890,900
EIO																												
For loining/canning						2,021,434	925,610	19,676	163,688				4,881,819	1,305,075								74,076,468						
For domestic (fresh or processing)						11,454,791	5,245,126	373,852	3,110,069				92,754,562	24,796,425	1,173,680					7,608,091							10,461,711	55,062,628
For fresh sashimi																					11,885,661		104,979,754					85,331,624
For frozen sashimi																					33,082,016		181,856,527					14,541,320
EAO																												
For loining/canning	50,254,216	18,435,597				70,536,372	14,768,598						7,737,943							1,536,324		8,529,892					542,876	
For domestic (fresh or processing)														1,118,662	58,684	517,446	0				2,476,244			332,367				
For fresh sashimi			7,652,897														5,183,345							18,616,621				
For frozen sashimi			883,680														598,521						105,230,362	12,897,969				31,665,155
For ranching																												
WAO																												
For loining/canning	3,177,739	871,928				45,617,802	2,380,981									0	0					72,647,340						
For domestic (fresh or processing)	167,249	45,891				2,400,937	125,315						81,353	42,598		676,362				489,684				760,874				
For fresh sashimi																	9,858,195				11,641,610			2,282,623				
For frozen sashimi																							135,052,732	4,565,246				75,157,054
For ranching																												
Antarctic																												
For ranching																												
For frozen sashimi																										72,835,074		

Continued overleaf

Total ex vessel values in $	Other							PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																					
For loining/canning	1,467,100								110,591,169				2,191,399,141	899,683,356	12,340,900					6,869,592	
For domestic (fresh or processing)						193,014,372														2,944,111	
For fresh sashimi		54,895,715		98,239,310							140,502,115					855,200					9,680,840
For frozen sashimi							364,645,241		150,030,979							1,431,253					11,547,950
For ranching									0									7,144,380			
EPO																					
For loining/canning	1,943,476					163,535	597,168		146,766,678				403,729,612	447,914,454	51,678,511						
For domestic (fresh or processing)	1,943,476					1,471,819	597,168								5,742,057						
For fresh sashimi				1,374,989																	
For frozen sashimi											73,011,625										
For ranching											29,247,462										
WIO																					
For loining/canning						60,690	148,167	4,579,707	34,223,087				125,046,203	241,282,841							
For domestic (fresh or processing)															28,248	285,122				19,420,432	19,652,256
For fresh sashimi																					
For frozen sashimi																					
EIO																					
For loining/canning	367,224					4,596,585			9,590,117				52,945,980	10,160,904	1,719,244	1,166,881				16,087,312	5,834,603
For domestic (fresh or processing)	367,224					4,596,585									191,027	129,653				1,787,479	648,289
For fresh sashimi		4,799,146					2,413,445														
For frozen sashimi		8,313,565					2,878,917														
EAO																					
For loining/canning						256,133		935,715	41,194,350				267,472,677	152,490,468	10,520,615						
For domestic (fresh or processing)	11,398,504														10,520,615						
For fresh sashimi																					
For frozen sashimi			31,611,933																		
For ranching										76,535,473											
WAO																					
For loining/canning								1,175,823	167,606				9,126,042	7,469,124							
For domestic (fresh or processing)	12,302,928	63,575				12,280	746,460													249,356	
For fresh sashimi			1,036,614																		806,942
For frozen sashimi																					
For ranching										25,069											
Antarctic																					
For ranching												55,701,096									
For frozen sashimi																					

Source: Poseidon analysis. Note: Data in Table 20 have been formatted using the Excel 'conditional formatting' function using a graded colour scale from blue, through light green to yellow, and through orange to red to highlight increasing values.

4.2 ISSUES RELATING TO THE ROBUSTNESS OF THE GLOBAL EX-VESSEL VALUE RESULTING FROM THE METHODOLOGY USED

4.2.1 Reference period for prices used and issues of periodicity

Catch data in the database assembled using RFMO data sources is for 2012. It was logical therefore to access and use 2012 price data (rather than more recent data that are available) to value catches.

However, in considering the potential robustness of the global estimate of ex-vessel values for 2012 made by this study, and its use for advocacy purposes by the client, annual fluctuations in price have been considered. These fluctuations can be considerable as shown in Table 21.

Table 21: Yearly average price trends for selected species/products, 2007 to 2013 (US$/tonne)

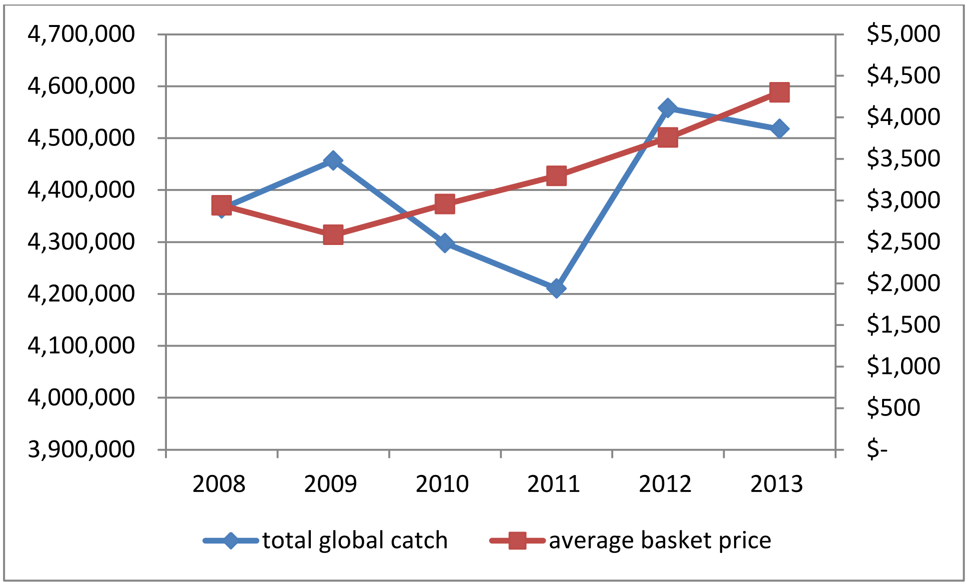
Year	Ecuador canning price froz skipjack	Ecuador canning price froz yellowfin	Ecuador canning froz price bigeye	Thai globefish canning price froz skipjack	Seychelles globefish canning price froz skipjack	Thai import canning price froz skipjack	Thai import canning price froz alabacor e	Thai import canning price froz yellowfin	Thai import canning froz bigeye	Japan import price fresh albacore	Japan import price fresh yellowfin	USA import price fresh sashimi albacore
2008	$ 1,509	$ 2,188	$ 1,727	$ 1,690	$ 1,631	$ 1,622	$ 1,803	$ 2,019	$ 1,803	$ 7,323	$ 8,125	$ 3,849
2009	$ 994	$ 1,463	$ 1,273	$ 1,170	$ 1,135	$ 1,017	$ 1,017	$ 1,254	$ 2,730	$ 6,874	$ 8,451	$ 3,626
2010	$ 959	$ 1,644	$ 1,315	$ 1,283	$ 1,058	$ 953	$ 2,573	$ 1,467	$ 2,573	$ 8,254	$ 9,186	$ 4,181
2011	$ 1,397	$ 2,283	$ 1,777	$ 1,750	$ 1,320	$ 2,156	$ 3,075	$ 2,200	$ 1,604	$ 8,304	$ 9,832	$ 3,846
2012	$ 1,582	$ 2,405	$ 1,899	$ 2,142	$ 1,868	$ 2,022	$ 3,806	$ 2,566	$ 2,213	$ 7,981	$ 9,401	$ 7,180
2013				$ 2,034	$ 2,037	$ 2,138	$ 2,558	$ 2,405	$ 2,195	$ 8,304	$ 9,832	$ 7,193
Average	$ 1,288	$ 1,997	$ 1,598	$ 1,678	$ 1,508	$ 1,651	$ 2,472	$ 1,985	$ 2,186	$ 7,840	$ 9,138	$ 4,979
2012 as % of average	123%	120%	119%	128%	124%	122%	154%	129%	101%	102%	103%	144%

Source: Poseidon analysis based on various data sources listed in Table 16. All prices CIF except for Seychelles globefish price. All prices in nominal terms (i.e. not inflation-adjusted)

Annual price fluctuations may be influenced by many factors. Perhaps most important may be the impact of tuna supplies/catches on global prices (although others of course include fuel price, costs of labour, and the costs of other fishing inputs and trading of fish). Figure 2below suggests that tuna prices in recent years are broadly characterized by an inverse relationship with tuna supply. Data in Figure 2 suggest that 2012 was something of an anomaly in that it is the only recent year for which a change in volume compared to the year before does not result in an inverse change in price (the basket price for 2012 rose compared to 2011 along with an increase in the volume of catches). One thing that is clear is that tuna prices are likely to remain volatile.

This of course is because there are also many other factors impacting on average annual tuna prices apart from supply/catches, and therefore on global ex-vessel values. These factors include economic conditions globally and in specific countries impacting on purchasing power, processing/storage inventories, prices of competitor products (either fish or other sources of protein), costs of fishing, exchange rates affecting trade/demand, etc. This suggests that care needs to be taken in using the 2012 global ex-vessel value provided in this report and assuming that it is valid for later years. Table 21 suggests that 2012 prices were in general slightly higher than long-term average nominal prices. The extent to which the 2012 figure calculated is robust and applicable to more recent years is however unclear: the basket price shown above shows a significant increase in tuna prices in 2013 compared to 2012 and only a small decline in catches, however some of the individual time series data (e.g., canning prices of skipjack and yellowfin) show that 2013 prices were slightly lower than 2012. And the Globefish time series show a considerable fall in 2014 to less than 70% of 2012 levels. It is difficult to predict whether falls in price in 2014 will continue as a long-term trend in the future, and how representative 2012 figures might be in terms of long-term averages.

Figure 2: Global tuna catches (selected species in tonnes) and a 'basket price' in US$ of selected tuna species/products, 2008 to 2013



Source: Poseidon analysis based on price data in Table 21 to generate an average price (i.e. not an ex-vessel price), and global catches of albacore, bigeye, skipjack and yellowfin as reported in WCPFC Tuna Fishery Yearbook 2013. Volumes in tonnes, prices in nominal values (i.e., does not account for inflation).

We have also examined monthly price fluctuations to consider the impact of taking an average annual price for 2012. Based on an analysis of 2012 price data from some sources where monthly prices are available, price fluctuations during the course of any one year can be significant, as shown in the table below.

Table 22: Monthly price variations over 2012 for selected species/products

	Price fluctuations in 2012 around 2012 average	% of global estimate of ex vessel value represented by species/product
Thai frozen skipjack C&F canning prices[41]	10%/+7%	28%
Abidjan frozen skipjack C&F canning prices[42]	-18%/+19%	
Thai frozen skipjack C&F canning prices[43]	-11%/+6%	
Thai frozen yellowfin C&F canning prices[44]	-4%/+7%	16%
fresh longline bigeye tuna imported to Japan[45]	-15%/+8%	4%
fresh longline yellowfin tuna imported to Japan[46]	-15%/+13%	6%
fresh longline yellowfin tuna imported to the USA[47]	-22%/+26%	

Source: Poseidon analysis based on references provided in footnotes. Note %s do not reflect the % of the global market represent by the location, only by the combination of species and product type (originating from all ocean areas combined).

However, the RFMO catch data in the database are for 2012 as a whole (as countries are generally not required to report catch at a higher than annual frequency), and not all price data collected was monthly in periodicity. For this reason we have used average annual prices to estimate average yearly values of catch (by species, gear, and ocean area), and it was not possible to estimate monthly values of catches.

4.2.2 Reliability of ex-vessel prices

The price data collected enabled many of the shaded cells in Table 19 to be completed with a high degree of confidence (in green). However, in other cases no price data were available which directly related to the shaded cells, and this applied in particular for many catches destined for local markets. In such cases, assumptions had to be made (and included in the excel workings provided to the client along with this report for the sake of transparency).

However, in considering the robustness of the prices used to generate the final global ex-vessel value of catches, it can be noted that the analysis on market flows resulted in estimations that 76% of catches are destined for canning, with less than 10% for domestic markets, around 5% for fresh sashimi, 9% for frozen sashimi, and less than 0.5% for ranching. The large % of global catches destined for canning, and the assumed low value of many catches sold in local markets compared to exported sashimi product, mean that assumptions about the prices to vessels for fish sold in domestic markets is probably not that important in affecting the validity of the global ex-vessel values. Much more important are assumptions about prices of catch for canning.

[41] Globefish time series.

.[42] Globefish time series.

[43] Thai customs data.

[44] Thai customs data.

[45] Japan customs data.

[46] Japan customs data.

[47] NMFS data.

Assumptions about prices paid to vessels for catches for sashimi may also be less important than first thought given the large % of catch going to canning, even though ex-vessel prices of different species for sashimi markets certainly have higher unit values than fish for canning. This is because while the *traded/customs values* per tonne of purse seine and sashimi grade fish are very different, the differences *in ex-vessel prices* paid to different vessel/gear types may not be as great as would be first imagined when examining trade/customs data. This is due to the processing that takes place prior to trading/import of longline caught fish, and the labour and transport costs involved, as discussed earlier. These factors mean that the differences in ex-vessel prices for fish for canning, as compared to fish for sashimi, may be smaller than expected when considering both trade values, and the final end consumer values, of canned and sashimi products. Again, these factors mean that given the volumes going to canning, perhaps most important in terms of the robustness of our global ex-vessel value estimate, are assumptions about ex-vessel prices of purse seine caught fish.

This is all 'good news' for the potential robustness of the study estimate, given the commodity nature of canned tuna, and the availability of data on prices of tuna to canneries that can be considered robust.

It is acknowledged that this study has in some cases made assumptions about how to derive ex-vessels values from traded/customs values based on data/information from the Pacific region, and has in some cases applied similar adjustments to catches from other ocean regions. Applying such Pacific conversion factors to other areas will of course have resulted in some inaccuracies, however it can be noted that i) not all data sources used in this study relate to traded/customs values and many ex-vessel values have been used, and ii) given the predominance of Pacific catches in global terms (<70% in 2012), it is fortunate that data are available for the Pacific region which can be applied globally, rather than having to use data from other regions to apply to the Pacific. Both factors suggest that errors in the global ex-vessel value of catches made in the study when applying these conversion factors globally, may be rather small.

The conditional formatting in Table 20 using colour coding is useful as it serves to highlight the relative importance of the assumptions and need for data robustness for certain cells. Supporting the statements made above, given catch data and market flows and estimated prices, by far the greatest contributions to global ex vessel values are catches of skipjack and yellowfin tuna made by purse seiners in the WCPO destined for canneries. The colour coding used in Table 19 shows that we are confident in the prices used for these particular products, supporting the view that the overall estimate should be fairly robust.

4.3 RESULTS

In reviewing and analysing the data provided in Table 20, figures can be generated for the contributions of different species, market destinations, and ocean areas to the global ex-vessel value (Table 23).

The global estimate resulting from the analysis completed during Phase 1 for the ex-vessel value of tuna catches in 2012 is US$ 12.2 billion. Considering the global value (and volume) of major tuna species, catch destined for canning represents over 50% of total global ex vessel values, and the Western Central Pacific Ocean is the most important region also accounting for more than 50% of the total ex vessel value. Skipjack and yellowfin tuna are the most important species in terms of global sales together representing 65% of the global ex vessel values.

Table 23: Summary of ex-vessel values of tuna by species, market segment, and ocean area (US$)

Species	$	% of species total
ALB	924,700,704	7.6%
BET	2,653,810,223	21.7%
BFT	172,841,426	1.4%
PBF	359,265,530	2.9%
SBF	128,536,170	1.1%
SKJ	4,036,805,178	33.1%
YFT	3,930,108,869	32.2%
Total	**12,206,068,100**	

Market segment	$	% by market segment
Canning	6,563,934,810	53.8%
Domestic	792,873,338	6.5%
Fresh sashimi	1,407,843,366	11.5%
Frozen sashimi	3,272,763,107	26.8%
Ranching	168,653,480	1.4%
	12,206,068,100	

Ocean Area	$	% by ocean
WCPO	6,496,898,718	53.2%
EPO	1,538,621,840	12.6%
WIO	1,822,570,002	14.9%
EIO	855,705,787	7.0%
EAO	962,510,252	7.9%
WAO	401,225,331	3.3%
Antartic	128,536,170	1.1%
	12,206,068,100	

Source: Poseidon analysis

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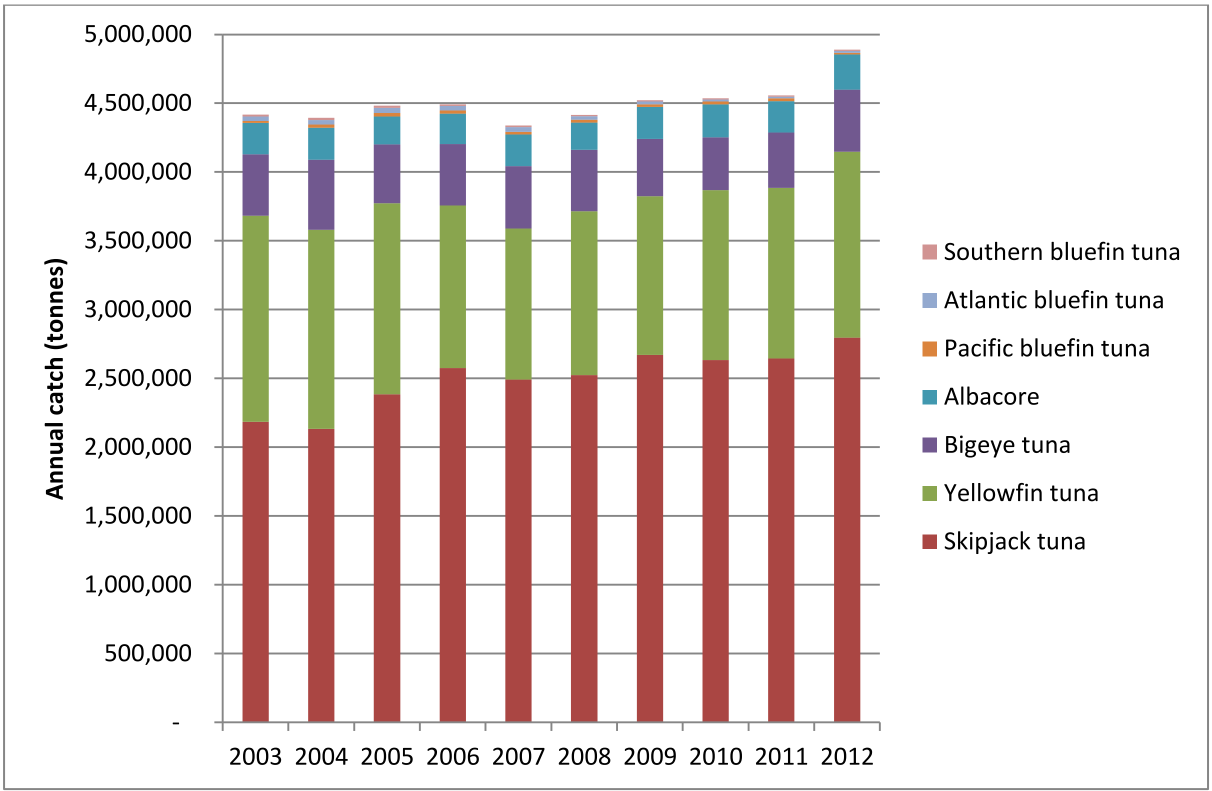
Appendix 1: Indonesian canned tuna exports

Source: MMAF Indonesia

No	Destination	2012			
		Volume (kg)	%	Value (US$)	%
1	Indonesia	22,970,239	24	42,112,105	17
2	ASIA	34,270,689	36	34,270,689	14
	1604141100	28,058,467		146,692,519	
	1604141900	263,539		955,317	
	1604149000	5,948,683		32,853,884	
3	Europe	20,354,728	21	89,058,126	36
	1604141100	13,855,454		57,106,235	
	1604141900	1,320,636		4,957,094	
	1604149000	5,178,638		26,994,797	
4	Africa	4,735,906	5	18,687,048	8
	1604141100	2,650,382		10,511,089	
	1604141900	340,440		929,559	
	1604149000	1,745,084		7,246,400	
5	America (including USA)	10,353,107	11	50,837,586	21
	1604141100	10,113,519		49,964,431	
	1604141900	239,040		868,464	
	1604149000	548		4691	
6	Australia and Pacific Islands	2,470,331	3	12,450,401	5
	1604141100	2,062,891		10,215,440	
	1604141900	1,104		882	
	1604149000	406,336		2,234,079	
World-total export (2+3+4+5+6)		72,184,761	76	205,303,850	83
Estimated Total Indonesian tuna canning		95,155,000		247,415,955	

Appendix 2: Global tuna trends in tuna catches (tonnes)



Source: FAO

ESTIMATE OF GLOBAL SALES VALUES FROM TUNA FISHERIES

STUDY FOR
PEW CHARITABLE TRUSTS

Photo: bluefin tuna Sakaiminato port, Japan. Courtesy of Yasuhiro Sanada

PHASE 2 REPORT

FEBRUARY 2016

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Disclaimer and Report Information

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Table of Acronyms

ALB	Albacore
AZOR	Azores Islands Area
BB	Pole and line
BET	Bigeye
BFT	Atlantic bluefin
CANA	Canary Islands area
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CIF	Carriage Insurance and Freight
C&F	Carriage and Freight
CVER	Cape Verde area
EAO	East Atlantic Ocean
EEZ	Economic Exclusion Zone
e.g.	*Exempli gratia* in Latin meaning ‘for instance’/’for example’
EIO	East Indian Ocean
EPO	Eastern Pacific Ocean
ETRO	East Tropical Atlantic
FAO	Food and Agriculture Organisation (of the United Nations)
FOB	Free On Board
GN	Gillnet
GOFM	Gulf of Mexico
HL	Handline
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
i.e	*Id est* in Latin meaning ‘that is’
IOTC	Indian Ocean Tuna Commission
LL	Longline
MDRA	Madeira Islands area
NE	North East
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmosphere Administration
NW	North West
NWC	North West Central
OTH	Other
PBF	Pacific bluefin
PFMC	Pacific Fishery Management Council
PS	Purse seine
RFMO	Regional Fisheries Management Organisation
SBT	Southern Bluefin tuna
SKJ	Skipjack
SW	South West
T	tonnes
TR	Troll
TROP	Tropical Atlantic
ULT	Ultra Low Temperature

WAO	West Atlantic Ocean
WCP(O)	Western Central Pacific (Ocean)
WCPFC	Western and Central Pacific Fisheries Commission
WIO	West Indian Ocean
WTRO	West Tropical Atlantic
YFT	Yellowfin

1 BACKGROUND

This document provides the outputs from **Phase 2** of a three-phase project, to complete a study to provide an ***estimate of the global sales values from tuna fisheries***. The study was completed by **Poseidon Aquatic Resource Management Ltd** (Poseidon) of the UK, for **Pew Charitable Trusts** ('Pew').

The study phases were as follows:

Phase 1 focused on: collecting and analysing tuna landings data by ocean, vessel flag, gear, and species; mapping product flows; and assessing the first sale value of landed catch in 2012 by multiplying landed volumes with ex-vessel/first sale prices.

Phase 2 focused on: generation of 2012 data on final consumer sales values, based on the volumes of sales and final sale prices.

Phase 3 focused on: updating the Phase 1 and Phase 2 outputs to arrive at estimates for 2014.

The Phase 1 report made a global estimation of landed volumes and values at the first point of sale for tuna fisheries globally, by multiplying tuna catches for different species and fishing methods from Regional Fisheries Management Organisation (RFMO) catch databases, with ex-vessel prices. A global estimate for 2012 of first sale ex vessel values was calculated at US$12.2 billion (see Table 1).

Table 1: Summary of ex-vessel values of product by species, end market segment, and ocean area (US$)

Species	$	% of species total	Market segment	$	% by market segment	Ocean Area	$	% by ocean
ALB	924,700,704	7.6%	Canning	6,563,934,810	53.8%	WCPO	6,496,898,718	53.2%
BET	2,653,810,223	21.7%	Domestic	792,873,338	6.5%	EPO	1,538,621,840	12.6%
BFT	172,841,426	1.4%	Fresh sashimi	1,407,843,366	11.5%	WIO	1,822,570,002	14.9%
PBF	359,265,530	2.9%	Frozen sashimi	3,272,763,107	26.8%	EIO	855,705,787	7.0%
SBF	128,536,170	1.1%	Ranching	168,653,480	1.4%	EAO	962,510,252	7.9%
SKJ	4,036,805,178	33.1%		**12,206,068,100**		WAO	401,225,331	3.3%
YFT	3,930,108,869	32.2%				Antartic	128,536,170	1.1%
Total	**12,206,068,100**						**12,206,068,100**	

Source: Poseidon analysis

Phase 2, and the purpose of this report, is to provide an estimate of the final consumed global sales values of tuna for 2012.

2 METHODOLOGY AND APPROACH USED DURING PHASE 2

2.1 INTRODUCTION - FOUR MAIN PRODUCT CATEGORIES TO BE VALUED

Building on the work completed during Phase 1, global sales values have been estimated separately for four main market segments or product categories (which combined should account for all final tuna trade) as follows: (figures below extracted from the Phase 1 analysis)

1. Tuna catches which are destined for canneries (3.5 million tonnes in 2012, 75% of global landed volumes).
2. Tuna catches destined for the sashimi market i.e. non-canned tuna sold in whole, loined, steak of fresh form, either fresh or frozen at the point of catching prior to transport to end markets (<700,000 tonnes in 2012, 14% of global landed volumes).
3. Tuna catches made by vessels from particular countries which are not destined for global trade, but which are either consumed fresh in the domestic markets in which catches are landed (generally at low value i.e. not for sashimi/canning) or which are the subject of domestic/small-scale traditional processing (e.g. smoking, drying, etc) for domestic consumption (450,000 tonnes in 2012, 10% of global landed volumes).
4. By-products of canning destined for fish meal or pet food. The ex-vessel value of this product category was not considered separately during the Phase 1 analysis as at that stage of the value chain values were attributed to the catches destined for the 'canning' market segment. Given an estimated processing yield conversion factor from whole tuna to tuna in cans of an average of 40-45% depending on the species processed (IATTC, 2007)[1], from the 3.5 million tonnes destined for canneries in 2012, an estimate of around 2.1 million tonnes of processing waste (i.e. product not used in cans of tuna) can be made. A small proportion of this material may be discarded, but most is sold for use in fish meal or pet food[2].

The following text provides an explanation of how price data have been generated and applied to the volumes caught globally as recorded in catch database established during Phase 1.

2.2 APPROACH USED TO GENERATE PRICES FOR EACH OF THE FOUR PRODUCT CATEGORIES

Two main issues impact on the approach taken to each of the four market segments/product categories: i) the point in the value chain which should/can be valued, and ii) the need for selective sampling of data in each product category to be applied globally (and where possible supported by triangulation of data) to catches estimated during Phase 1 as destined for sale through the different market segments/product categories.

2.2.1 Canned tuna

Retailed canned prices collected and interviews completed

For canned tuna prices, there are no problems in accessing 'final' consumer values, as canned prices can be obtained from retail stores. However, given the inability during the study to collect canned tuna prices in all global markets, a sample-based approach has been necessary. While the sample frame was far from being 'stratified' in a statistical sense, the following text provides some rationale for the approach used. It is acknowledged that given the 'opportunistic' approach to the sampling,

[1] Exact yields vary by species and size of fish

[2] It is noted that in the Pacific there are small domestic markets for the red meat product coming from PNG and Solomon Island canning plants, and this may be the case in other geographical areas, but this separate marketing channel is not estimated/analysed in this study.

some sampling bias may be involved in the final numbers generated and used, although the 'commodity' nature of canned tuna (as discussed below) should serve to reduce the impact of any such bias.

Hamilton et al, 2011[3] suggests that the contributions of the EU, the USA and Asia to total global consumption of canned tuna are around 30%, 19%, and 15% respectively, and combined represent 64% of global consumption of canned tuna. Given these data and the importance of the EU and USA markets in global terms, canned tuna price data were collected from a number of EU markets, namely the UK, France, Italy, Spain and Germany as these are the largest country markets in the EU[4], and the USA. Due to expected difficulties in obtaining detailed historical time series for price data from supermarket buyers, data were instead collected during June and July 2015 based on visits to stores and by accessing online sales of canned tuna products. A total of 365 individual price records for cans of tuna were entered into a database, and converted into US$ using June/July 2015 exchange rates (from www.oanda.com). Each individual entry/record in the database captured information on: the price and weight of the can, the tuna species, the tuna preparation (e.g. in oil, water, flakes, crumbs, etc), whether the can was own brand or not, where possible the canning location, and in most cases the drained weight of tuna as a % of the total canned weight. The breakdown of the number of individual records entered by country is shown below, along with the retailers from which price data were obtained.

- France: 64 records, from Carrefour, Leclerc, and Intermarche;
- Germany: 12 records from REWE;
- Italy: 78 records from Coop and Conad;
- Spain: 33 records from Hyercor and Alcampo;
- UK: 141 records from Asda, Sainsburys, Tesco, and Morrisons;
- USA: 37 records from Walmart, Safeway/Albertsons, Trader Joe's, and Costco.

Interviews with supermarket buyers in the UK (Asda) and Italy (Conad) confirmed that online sales and in-store sales prices are identical with retailers utilising a 'single price' list, validating the approach of accessing price data in some cases through the sales websites of the retailers. Promotional sales prices for canned tuna may represent an important share of total sales, and while this study has not been able to account specifically for reduced promotional prices and while it was not noted when collecting price data whether prices were promotional prices or not, it is likely that the price records collected included some product on promotion.

Methodological issues

The results from the data collected have been examined to determine if at first sight they appear sensible, and intuitively they do indeed provide for some confidence in the data collected given that the data show as would be expected that: (i) prices for tuna in oil are higher than for tuna in water; (ii) prices are lower for skipjack tuna than for other species; and (iii) retailer own brand cans of tuna are lower priced than branded cans. The average price of tuna cans collected during the study (in June/July 2015) was US$ 18.15/kg.

Important methodological issues then relate to: (i) the extent to which it is valid to use the retail canned price data collected June/July 2015 for the different species of tuna to apply to volumes of different tuna species landed/sold in 2012 from the Phase 1 analysis (and in 2014 for the Phase 3 analysis); (ii) the extent to which data for the EU and USA could be applied more globally; (iii) whether to use the sales prices of canned tuna in the global estimate, or just the value of the tuna

[3] Hamilton et al., 2011. Market and industry dynamics in the global tuna supply chain.

[4] FAO tuna commodity update, 2012

contained within the can; (iv) processing conversion rates i.e. the proportion of whole round fish that is canned, as opposed to discarded or sold as by-product; and (v) the issue of branding and non-canned products.

Validity of using 2015 price data and applying it to 2012 catch volumes (and to 2014 catch volumes for the Phase 3 analysis)

For the first issue, some historical data on tuna prices of canned tuna in France (see Table 8 and Table 9 in Appendix 1) demonstrate only small year-on-year changes in canned tuna prices, suggesting that given the overall margins of error inherent in the final global estimated value of tuna sales and given the many assumptions in the study, 2015 canned tuna prices could be applied to 2012 and 2014 catch data. Applying the 2015 data collected would if anything result in a conservative estimate of 2012 values given that canned prices may have fallen very slightly since 2012. However, canned tuna prices in retail stores vary little between years in the short term because of: (i) retailers viewing it as desirable where possible to maintain fairly constant prices (which may in some cases be the reason for tuna being sold as a 'loss leader'); and (ii) inventories/stores of canned tuna. Both factors mean that variations in ex-vessel prices do not necessarily feed through the supply chain immediately into similar levels of change in canned tuna prices on supermarket shelves.

2015 prices collected were however reduced by 1.75%[5] to account for average monthly European inflation of processed food over the period mid-2012 to mid-2015.

Validity of using EU and USA sales price data as applicable for sales prices in other markets

With respect to canned tuna prices in other markets globally for which price data were not obtained, two approaches were taken to assessing how applicable canned tuna price data in EU and the USA might be to prices in other countries.

Firstly, Thai export data for canned tuna for 2012 and 2014 was accessed to consider any such price differentials. This analysis (shown in Table 10 in Appendix 1) suggests that prices in some markets for which retail canned prices were not obtained from retail stores during the study (e.g. Brazil, South Africa) were lower than in EU and USA markets, but that prices in other markets (e.g. Australia, Nigeria) may be higher than in EU and USA markets[6]. While the reliability of the data cannot be accurately determined and it is surprising that data show canned prices higher in Nigeria than in the EU/USA, it has been assumed in this study that the price data collected for canned tuna in EU and USA markets is representative of prices globally; given that canned tuna is a global commodity product. This assumption may be supported by the fact that concentration of processors and traders (see Phase 1 report) at the global level means that information is rapidly transmitted from one location to another. Tuna markets for canned products have been found to be well integrated at the world-wide level, forming a single global and interdependent market (Jiménez-Toribio et al. 2010). Although our collection of data did demonstrate some differences in average prices of canned tuna in different markets (with average prices in Germany, Italy and Spain higher than the average of US$18.15/kg shown below, prices in France, the US and the UK slightly lower).

Secondly, a small number of tuna canneries (MW Brands with canneries in Ghana, Seychelles and Portugal, PT. Samudera Santosa in Indonesia, and Thai Union in Thailand) were interviewed for their views about price differentials between markets. These interviews confirmed that differences in canned tuna prices are more strongly determined by branding (e.g. multiple retailer own brands vs tuna canning brands) and type of canned tuna product (e.g. particularly whether tuna is in oil or water, but also tuna species, flakes vs crumbs, etc.) than by the country of final sales.

[5] Source; Eurostat

[6] Northern Africa and Middle East are also now important markets for canned tuna but Thailand customs data was not examined for these countries.

The average retail canned tuna prices per kg in US$ for whole cans of different tuna species presented in **Error! Reference source not found.** are therefore assumed representative of other arkets.[7]

Table 2: Average prices of tuna cans collected during the study (US$/kg, June/July 2015)

Tuna species	oil	other	water	Branded	Retail store own brand	Grand Total
albacore	23.47	23.72	16.95	21.46	17.61	20.35
bigeye tuna	19.91		8.35	17.98		17.98
skipjack	16.92	17.81	14.34	18.03	9.28	15.83
yellowfin	24.48		17.41	24.52	16.35	22.06
unspecified	15.18	13.53	17.16	17.97	9.85	15.13
Grand Total	20.58	16.30	15.93			**18.15**

Source: Poseidon survey and analysis. Notes: (1) blank cells mean no records contained in the database of prices established; (2) 'branded' = product branded by tuna producers/canners/wholesalers (e.g. Bumble Bee, Princes). 'Retail store own brand' = cans with retail brands/labels (e.g. Carrefour); (3) prices in grand totals are weighted averages; (4) 'unspecified' represent entries in the survey database for which the specific species was not recorded by the surveyor, but which are most likely to be skipjack tuna.

Canned vs drained weight

A further important methodological issue was whether it is valid to use the canned price recorded during the retail store data collection process, or just the part of the canned price comprised of tuna. Data collected on retail prices included data on the canned weight and the 'drained' weight of tuna i.e. the tuna without oil/water. On average across all 365 samples of canned tuna, the drained weight of tuna in cans was 68% of the canned product weight. Discussions with Indian Ocean Tuna cannery in the Seychelles (Pers. Comm., November 2015) also provided an indication that for canneries 'around 55% of the production cost of a can of tuna is the tuna product itself, with 25% being the can and non-tuna contents e.g. oil, and the remaining 20% being other costs (e.g. labour and operational costs)'. When considering these figures, and while recognising that cost structures may differ in different locations, tuna costs as a proportion of the combined tuna and can/filling costs (i.e. excluding operational costs) re 68.75%, which provides good triangulation with the 68% drained weight estimate from our retail survey. In order to provide final estimates that are conservative and cannot be criticized of trying to inflate global values by using the retail sales prices of the can (tuna, can, and liquid contents), it was decided therefore to apply 68% to the retail sales values of canned tuna[8] rather than taking the final total canned price, so as to estimate the value of the tuna alone.

Processing yields

In applying the prices of canned tuna of different species to the volumes in the catch database from Phase 1 it is necessary to account for the fact that there is a processing yield conversion factor from whole tuna to tuna in cans of an average of 40-50% (IATTC, 2007) i.e. for every 1 tonne of tuna caught and processed, the weight of tuna available for canning is 400-500kg. Processing yields are lower for skipjack than for other species. In order to ensure global sales values are not over-estimated, a conversion factor of 40% is therefore used for skipjack with a factor of 45% applied as

[7] It is known that pole and line caught canned tuna can fetch market premiums of around 5-10%, but: (i) data collected during the study on canned tuna prices did not include details of fishing method, and (ii) some pole and line caught tuna is likely to have been included in the 365 canned tuna samples for which price data were collected, meaning that any such price premiums will have been incorporated into the average prices.

[8] It is noted that the USA Hydrolyzed fat represents an important component of canned tuna.

the conversion factor for other species. Thus when canned tuna prices are applied to the catch volumes (of whole round fish) in the Phase 1 database, prices need to be multiplied by 40% in the case of skipjack tuna or 45% in the case of other species.

Final prices selected for use in the analysis of canned tuna

Given the above discussion, prices for individual species used in the Phase 2 analysis are thus those shown in Table 3[9].

Table 3: Value/prices of tuna in cans (drained weight) in US$/tonne of whole landed weight equivalent used in the estimation of consumed values of canned tuna

Species	$/tonne landed weight
albacore	6,118
bigeye tuna	5,406
skipjack	4,230
yellowfin	6,632

Source: Poseidon analysis. Note: prices are the individual species prices taken from the survey of canned prices in retail stores, multiplied by 1,000 to arrive at a value figure per tonne, multiplied by 68% to account for the drained weight of tuna in cans, and multiplied by 40% (for skipjack) and 45% (for other species) to derive a price per tonne of whole landed weight. Prices also reduced by 1.75% to account for inflation of processed foods between 2012 and 2015.

Branding and non-canned products

The lack of detailed data for product on promotion is an acknowledged flaw in the method used in this study. Promotion of branded product is significant in the US and UK markets in particular. However, the price samples collected from retailers may be expected to have included some product on promotion, and the range of prices obtained for individual cans support this view. Also acknowledged as a weakness is the lack of consideration of other sub- segments in shelf-stable products such as tuna in jars, tuna in pouches, etc. These have not been examined, and their omission may result in the global estimate being an under/precautionary estimate of the true value of sales.

[9] The analysis also assumes that all product estimated in Phase 1 as being destined for canning is sold in the retail sector rather than being used in the food service sector. It was agreed with Pew during the study that trying to value canned tuna as part of sandwiches or other food preparations used in the food service sector would be too problematic in terms of distinguishing what proportion of the final product/plate cost pertained to tuna.

2.2.2 Sashimi grade tuna i.e. high value non-canned tuna

Sashimi prices collected and interviews completed

Japan has historically dominated global sashimi consumption. However in recent years, other markets have grown rapidly especially for product such as tuna loins, steaks, etc., and data (in Hamilton et al., 2011) suggest that around 20% or more of global consumption is now in other markets; primarily the USA, other Asian markets of Korea, China and Taiwan (which are already greater than the EU market), the EU, and other growing markets in South America, Eastern Europe and Australia/New Zealand. Nevertheless Japan remains by far the largest market, and may still account for around 75-80% of the global market. As a result, Phase 2 has used Japanese sashimi prices to estimate the consumed values of the tuna destined for sashimi markets.

The first step in the analysis was to examine retail and wholesale data available from a number of different sources, so as to make a determination of their reliability and which data should be used in the global estimate.

Time series of retail sashimi grade tuna prices are available and have been accessed for yellowfin (Osaka, 2010-2014), bigeye (Tokyo, 2010-2014) and bluefin tuna (Tokyo, Osaka and Sapporo, 2014 only), and are presented in Table 11, Table 12, and Table 13 in Appendix 1, with prices in Japanese Yen converted to US$ at mid-year values. The tables also provide the average round weight equivalent prices, based on our calculations and an assumption that the retail marketed weight is 45% of the whole weight (an average of information provided by prominent middlemen in Tsukiji fish market suggesting 50% of whole weight is edible, and Forum Fisheries Agency indicators of loined to whole weight of 40% used in Phase 1).[10]

Data on wholesale prices at the Tsukiji market in Tokyo for both fresh and frozen bluefin, bigeye, yellowfin, albacore, and southern Bluefin tuna are provided in Table 14 and Table 15 in Appendix 1 (2012 to 2014) with prices in Japanese Yen converted to US$. Table 16 again provides the average round weight equivalent prices based on our calculations and assuming that landed weight is 1.15 of the wholesale marketed weight (based on estimations by both Tsukiji middlemen and FFA/Phase 1, and recognising that some product is sold gilled and gutted form and some as headed and gutted product).

Table 17 in Appendix 1 shows that retail prices were on average 1.75 times the wholesale prices on the Tsukiji market in both 2012 and 2014, for species where prices are comparable.

Methodological issues

Whether to use wholesale or retail prices from Japan and how applicable retail prices are to prices in the food service sector

This question relates to: (i) the balance of total sales which are retail and those which are in the food service sector i.e. restaurants; (ii) relative sashimi prices in retail and restaurant markets; and (iii) whether to apply wholesale prices from the Tsukiji market to the proportion of sales assumed to be made through restaurants.

Based on interviews with middlemen at the Tsukiji fish market and confirmed by the Japan Fisheries Information Centre and other Japanese fish trade experts, there appear to be no data available on: (i) the proportion of sashimi-grade tuna that is sold to a) the retail sector, and b) the food service sector; or (ii) price differentials for tuna sold through retail and restaurant market outlets.

In the case of the food service sector, the range of sales outlets and their different emphasis on quality and margins make it impossible (at least within this study, and perhaps at all) to obtain data on the final sales value of tuna. However, it seems likely that restaurant prices are considerably

[10] The analysis of sashimi prices in this study does not account for differences in quality grades of sashimi tuna.

higher on average than retail prices. At the same time using wholesale prices from the Tsukiji market, while providing reliable data, would grossly under-estimate the final value of consumed sashimi grade tuna as the wholesale process are so far from the end point in the value chain.

For this reason, where retail prices are available as shown in Table 17 in Appendix 1 they are used, but where not it seems reasonable to apply a raising factor of 1.75 to wholesale Tsukiji price data (based on Table 17 showing that retail prices were on average 1.75 times the wholesale prices on the Tsukiji market), and to use the resulting prices to apply to the Phase 1 catch volumes. It should be stressed that even allowing for this raising factor, the resulting estimates of the value of consumed sashimi grade tuna are still likely to be conservative and to underestimate the actual values given the likely higher prices in the food service/restaurant sector than in the retail sector.

Validity of using Japanese price data as applicable for sales prices in other markets

A final methodological issue is the validity of applying Japanese prices to all global sales of sashimi grade tuna. The average price of yellowfin tuna sold in Europe based on an admittedly small number of 6 records from online retailer sales in June/July 2015 suggests that there may be only small differences between retail prices in Japan and other markets (see footnote to Table 11). Some other studies e.g. FAO, 2008, have also demonstrated little difference between average Japanese and EU wholesale/contract market prices for longline caught sashimi tuna. The reason for this being the fact that while higher-grade tuna may be destined for Japan, auction sales prices in Japan are unreliable with no price guarantees, meaning that while some tuna can sell for very high prices, when product is not deemed to be of sufficient quality then sales prices can be very low covering little more than handling costs. Sales to Europe on the other hand are typically negotiated prior to export and are based on agreed contract prices. Unpicking these complex marketing issues to determine any assumed difference between Japanese prices and prices of sashimi product elsewhere would be extremely problematic.

It is acknowledged that using Japanese price data and applying them to all sashimi product may slightly over-estimate global consumed values if prices are lower in other markets, but in the absence of better information, and given the (continuing, even if declining) dominance of Japan in terms of global consumption of sashimi tuna and the fact that other Asian markets are more important than the USA and EU in terms of sashimi consumption, the study has deemed it justifiable and necessary to apply the consumed prices of sashimi grade tuna in Japan to all quantities of tuna estimated during the Phase 1 study as destined for sashimi markets. This assumption is supported by the fact that the international market for longline caught tuna for sashimi trade is strongly integrated and dominated by the Japanese market (Sun 2010, Sun and Hsu 1998, Miyake 2010).

Final prices selected for use in the analysis of sashimi tuna

Given the above discussion, the final prices used in the Phase 2 estimates of consumed values of sashimi grade tuna are therefore those provided in the table below for 2012. As with the assumed canned prices, these prices are nuanced by species, but not by the ocean area or fishing gear (although most can be assumed to be longline caught) as market data provide no basis on which to distinguish between different methods of catching.

Table 4: Prices of sashimi grade tuna in US$/tonne of whole landed weight equivalent, used in the estimation of consumed values of sashimi grade tuna

Fresh sashimi prices	2012	2013	2014
bluefin	$ 53,773	$ 44,080	$ 46,666
yellowfin	$ 18,806	$ 13,635	$ 14,724
bigeye	$ 22,089	$ 21,649	$ 17,438
albacore	$ 11,421	$ 9,583	$ 13,856
southern bluefin	$ 49,042	$ 34,124	$ 34,480
Frozen sashimi prices	**2012**	**2013**	**2014**
bluefin	$ 74,169	$ 56,984	$ 57,645
yellowfin	$ 18,321	$ 13,222	$ 14,254
bigeye	$ 18,770	$ 14,516	$ 15,124
albacore	$ 17,290	$ 14,543	$ 15,114
southern bluefin	$ 47,042	$ 32,638	$ 32,162

Source: Poseidon analysis.Notes: (1) frozen prices are in some cases higher than fresh prices, possibly due to the high quality of frozen tuna when Ultra Low Temperature freezing of catch takes places immediately after fish have been brought on to vessels; (2) bluefin tuna prices are likely to be a combination of Atlantic and Pacific species but are not identified separately, or as such, in the Japanese price data; (3) prices for fresh tuna provided in the table are weighted averages of 'domestic', 'imported' and 'juvenile' data on monthly sales volumes and values as provided in the Japanese price data; (4) Japanese price data in Yen per kg are converted to US$/tonne using average mid-year exchange rates; (5) 2012 data only used in the analysis of 2012 consumed values, but data for 2013 and 2014 are provided for interest.; (6) where retail prices are available (fresh yellowfin and fresh bigeye) they are used, but where not a raising factor of 1.75 is applied to wholesale Tsukiji price data.

2.2.3 'Domestic' consumption of tuna

Sample frame of data collected

Tuna caught and consumed in 'domestic' markets[11] mostly in fresh but also in smoked/dried form, was estimated during Phase 1 to be just 450,000 tonnes in 2012, representing under 10% of catch volumes and only 6% of the ex-vessel values. Of the 450,000 tonnes around 200,000 was from the WCPO, 100,000 from the WIO, and 127,750 from the EIO. Other ocean area catches destined for domestic consumption are small in comparison. Product is typically sold on domestic markets when the quality is not good enough for the product to enter other higher value marketing chains.

From the Phase 1 database on catches by gear type and flag and the market flow descriptions, and noting that there are other countries with important catch volumes going to domestic consumption (eg. gillnet catches in Yemen, Pakistan) the countries/gears providing the largest proportions of fresh or traditionally processed product for domestic consumption in the three ocean areas important in terms of domestic consumption are:

- EIO: Indonesia and Sri Lanka 'gill net' catches (75,122 tonnes in 2012);
- WCPO: Indonesian pole and line and 'other' gear catches (306,829 tonnes in 2012); and
- WIO: Maldivian 'pole and line' catches (62,030 tonnes).

It was therefore decided to examine prices in these countries and apply them globally.

For Sri Lanka, retail prices for whole round unprocessed tuna are available from the Ministry of Fisheries (Sri Lanka Ministry of Fisheries, 2014), and are shown in Table 18 in Appendix 1 along with wholesale market prices and price differentials between wholesale and retail prices. For Indonesia, communication with the Ministry of Maritime Affairs and Fisheries[12] confirmed that no retail price

[11] i.e. product generally sold fresh/dried/smoked and excluding product for canned and sashimi markets.

[12] Pers. Comm., September 2015

data are collected/available in Indonesia. Research completed during Phase 1 did however generate some sales prices for traders buying fish from Indonesian fish landing sites in the Eastern Indian Ocean known to be selling to domestic markets, and these are presented in Table 19.

For the Maldives, the consultants' own field notes from working in Maldives in 2012 suggest: a) retail fish prices of a similar magnitude to those provided for Sri Lanka and Indonesia in Appendix 1, and b) only very small margins being made from any processing of tuna into traditional processed fish products (e.g. smoked/dried fish).

Final prices selected for use in the analysis of domestic sales

While admittedly not strongly empirically based, and drawing from a non-random sample and small sample size that could lead to bias in the prices used, given the above discussion and data limitations faced during Phase 2 it has been assumed that all domestic retail sales prices (whole round weight equivalents) in all oceans are as follows:

Table 5: 'Domestic' retail sales prices (whole fish equivalent) assumed in Phase 2 analysis

Species	Sales price (US$/tonne)
Albacore	$3,000
Skipjack	$3,500
Yellowfin	$5,500
Bigeye	$4,000

Source: Poseidon analysis

In most cases these prices represent roughly double the ex-vessel prices used in Phase 1, which is line with the Sri Lankan price differentials shown in Table 18 and the consultants' own experience of working in developing countries.

It should also be remembered that given the small volumes and low values compared to other market flows, any discrepancies between the actual situation and the assumptions made for the domestically marketed sales of tuna are unlikely to materially impact on the validity of the overall global estimate of all market segments.

2.2.4 By-products of canning

Data collected and interviews completed

The fourth and final type of product flow considered during Phase 2 is the sales value generated from by-products from canning tuna. Given that the Phase 1 analysis estimated that 76% of global catches are destined for canning, and that processing waste and by-products represent 60% of the whole round wet weight of tuna, processing waste and by-products represented around 2.1 million tonnes in 2012.

Interviews completed with canneries during Phase 2 provided some information about what happens to processing waste. Interviews with Thai Union suggested that *of the by-products*: 40% (i.e. 22% of the whole round weight of fish) is discarded; 25% (i.e. 14% of the whole round weight of fish) is sold for fish meal; and 35% (i.e. 19% of the whole round weight of fish) is sold for pet food. The Indonesian cannery interviewed reported that of the whole fish, around 30% goes to fish meal, 45% to the can, and a similar proportion of the whole round weight of the fish (25%) is discarded with no sales value. The Indonesian cannery did not report any sales into the pet food value chain. The Indian Ocean Tuna cannery in the Seychelles, also reported that around 20% of the whole weight of fish is totally 'wasted' and not sold as a by-product. The explanation for these figures and the proportion of the whole weight discarded without sale is that the weight represents 'drip loss', which is the weight of the blood and water.

Despite the figures provided by Thai Union on sales of pet food, in global terms, the amount of tuna processing by-products going to pet food is probably far smaller than that destined for fish meal (especially given that legal requirements to label pet food as 'tuna' require only very small proportions of the final product to be comprised of tuna (e.g. 4% in Europe[13]).

Fish meal prices have been obtained from the Thai Feed Mill Association[14] (see Table 20 in Appendix 1) and when converted to US$ were on average US$1,005 per tonne in 2012, US$934 in 2013 and US$1,015 in 2014. The dried weight of fish meal product is around 25% of the wet weight of the processing by-products, so a price of 25% of the price for a tonne of fish meal is used in the analysis and applied to the volume of whole landed tuna ending up as sales of fish meal.

For canning by-products destined for the pet food industry, heads and red meat are typically sold by canneries in brine or frozen blocks, but may then be re-processed and sold to pet food manufactures either in wet/frozen form to be used in canned pet food, or in dehydrated form (PAT - protein animal transformed) in dry pet food. Given the small proportions of the final product comprised of tuna as mentioned above, pricing pet food cans or dried pet food and using those prices in the Phase 2 model makes little sense. Some data have been obtained from Thai Union on prices of by-products sold in cans (red meat in brine) and exported to the USA for use in pet food (US$ 2,600/tonne).[15] Given that red meat as a proportion of whole tuna weight may be around 10% (our estimate), a sales value of US$ 260/tonne of product caught for pet food is used in the analysis.

The fact that the assumed sales values of tuna used for fish meal (US$250/tonne) and pet-food (US$ 260/tonne) are so similar, means that the analysis is not sensitive to the assumption made about the volume of processing waste being sold for fish meal (or for pet food).

Final prices selected for use in the analysis of values of sales of canned tuna processing by-products, and assumptions about the volumes involved

Given the above discussion, for the Phase 2 analysis it is assumed that of the global landed catch destined for canning, 40% of the weight of catch is canned for human consumption, 20% is waste, and 40% is marketed as by-products of the canning process. Of the 40% of whole weight that is marketed as processing byproducts, it is assumed for the analysis based on the consultations with canneries that 90% is sold as fish meal and 10% as pet food (but given the small price difference between the fish meal prices assumed [US$250/tonne]and the pet food prices assumed [US$ 260/tonne] this % is not critical for the estimation of the sales values of by-products).

Given these data on the proportions of byproducts that are sold for fish meal and pet food, and the prices stated above, a weighted price of US$ 251 is applied to the 40% of the whole round weight of fish that is estimated to be sold into the fish meal and pet food value chains (see Table 6).

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[13] Pers. Comm., October 2015, FACCO (association of pet food manufacturers in France; http://www.facco.fr/).

[14] http://www.thaifeedmill.com/tabid/78/Default.aspx.

[15] French pet food manufacturers were approached however they do not have a mandate to collect price information on behalf of their members and, then, were reluctant or unable to provide price data on the costs of tuna inputs to pet food.

Table 6: Volumes (in tonnes), whole round equivalent prices (US$/tonne) for sales of by-products from tuna canning as fish meal and pet food, and resulting sales values of by-products (US$)

	volume	unit value	sales value
Total catch for canning	3,502,466		
Total catch canned	1,400,986		
Unsold waste	700,493		
Marketed by-products of canning	1,400,986		
Fish meal sales	*1,260,888*	$ 250	$ 315,221,945
Pet food sales	*140,099*	$ 260	$ 36,425,647
Total			**$ 351,647,591**
weighted price of by-products		$ 251	

Source: Poseidon analysis

3 PHASE 2 RESULTS AND DISCUSSION

Phase 2 of this study has used the prices assumed for the different market segments as discussed above, and applied them to the 2012 catch data collected and presented during Phase 1 of this study.

The resulting analysis showing the assumed final values per tonne (by species and market segment), and the resulting sales values by species, gear types, ocean area and market segment are provided in Table 21 and Table 22 in Appendix 1.

The analysis is summarised in the table below, which estimates a **final global value of sales of tuna products of US$ 33.36 billion in 2012.** This value is based on the methodology described earlier whereby only the value of tuna in the can is included, rather than the full retail price of canned tuna i.e. the price of the tuna, the can, and the liquid contents.

Using the drained weight value of canned tuna, has a very important impact on the final global sales value estimated given the importance of canned tuna in total global sales. Using the total canned sales price in the analysis rather than the value of the drained tuna (i.e. without reducing prices by 68%) results in an increase in the global estimate of canned tuna of US$ 8.27 billion, and a **final global value of sales of tuna products of US$ 41.63 billion in 2012** (see Table 23 in Appendix 1). The rest of this section of the Phase 2 report provides some observations and conclusions based on the lower and more conservative estimate of US$ 33.36 billion.

Table 7: Global sales value of tuna in 2012 by species, market segment, ocean area, and fishing gear (US$)

Species	US$	% of species total	Market segment	US$	% by market segment
ALB	$ 1,826,487,972	5.5%	Canning	$ 17,574,003,397	52.7%
BET	$ 5,946,861,172	17.8%	fish meal/pet food	$ 263,586,449	0.8%
BFT	$ 873,600,924	2.6%	Domestic	$ 1,756,022,309	5.3%
PBF	$ 903,627,794	2.7%	Fresh sashimi	$ 4,686,386,077	14.0%
SBF	$ 491,301,000	1.5%	Frozen sashimi	$ 9,084,529,608	27.2%
SKJ	$10,674,453,267	32.0%			
YFT	$12,648,195,712	37.9%			
Total	**$33,364,527,841**		**Total**	**$ 33,364,527,841**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$17,415,671,287	52.2%	Pole and line	$ 2,016,194,730	6.0%
EPO	$ 4,279,997,819	12.8%	Gillnet	$ 875,312,321	2.6%
WIO	$ 5,023,295,234	15.1%	Handline	$ 2,490,363,045	7.5%
EIO	$ 2,183,794,187	6.5%	Longline	$ 9,091,631,363	27.2%
EAO	$ 2,860,327,128	8.6%	Other	$ 2,222,896,295	6.7%
WAO	$ 1,110,141,186	3.3%	Purse seine	$ 16,230,625,352	48.6%
Antartic	$ 491,301,000	1.5%	Troll	$ 437,504,735	1.3%
Total	**$33,364,527,841**		**Total**	**$ 33,364,527,841**	

Source: Poseidon analysis Notes: Canned sales values reflect only the value of tuna in cans, not the retail canned price. 'Domestic' sales are typically fresh, smoked, dried tuna in the same country from which vessels are based (and excludes product for canning or sashimi markets).

Some observations and comments on the results are:

- As with the ex-vessel value estimated during Phase 1 of this study, the estimation of the final global sales value of tuna is underpinned by many assumptions and data limitations which could impact on the validity of the final estimate. This report has attempted to be as transparent as possible with regards to these assumptions and to the workings used to arrive at the estimate provided.

- Wherever possible a conservative approach has also been taken to the assumptions made so that if the final estimate generated is more likely to be an under-estimate than an over-estimate;

- The estimated global sales value of tuna of US$33.36 billion for 2012 (when using the value of tuna in cans not the retail value of cans) compares with the figure of US$ 12.2 billion for 2012 calculated for the ex-vessel value of tuna catches made during Phase 1 of the study i.e. final sales values are 2.73 times the ex-vessel values. This cross-references will with known and often-stated multipliers between the catching sector and upstream and downstream activity of around 1:3;

- By species, final sales values are dominated by two species, skipjack (32% of total global sales values) and yellowfin (38% of total global sales values);

- Tuna catches from one ocean area, the WCPO, account for more than half of the global sales value of tuna resulting in sales of US$17.5 billion a year;

- Likewise, one gear type, purse seine fishing, accounts for almost 50% of the global sales value of tuna (valued at almost US$ 16.2 billion), but longline fishing is also important contributing 27% (and over US$ 9 billion) of global sales values. Other gear types are less important and individually each contribute less than 8% of the total sales value; and

- Canned tuna accounts for 53% of global sales values with a sales value of just over US$17.5 billion a year, while fresh and frozen sashimi tuna products combined represented sales of 41% of global sales values (at just under US$ 14 billion).

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Note: other references related to data sources are provided underneath the data tables themselves in Appendix 1

Appendix 1: Additional data tables

Table 8: Indexed Average Monthly Selling Prices In French Metropolis – Canned Tuna In Water (160 G)

		Indexed prices
Year	Month	
2015	6	2
2015	5	2.01
2015	4	2.01
2015	3	2.01
2015	2	2
2015	1	2
2014	12	2.01
2014	11	2.01
2014	10	2.02
2014	9	2.01
2014	8	2.02
2014	7	2.03
2014	6	2.02
2014	5	2.02
2014	4	2.01
2014	3	2.02
2014	2	2.02
2014	1	2.02
2013	12	2.03
2013	11	2.05
2013	10	2.05
2013	9	2.04
2013	8	2.04
2013	7	2.04
2013	6	2.04
2013	5	2.06
2013	4	2.05
2013	3	2.03
2013	2	2.03
2013	1	2.04
2012	12	2.02
2012	11	2
2012	10	1.98
2012	9	1.96
2012	8	1.96
2012	7	1.96
2012	6	1.96
2012	5	1.96
2012	4	1.94
2012	3	1.95
2012	2	1.95
2012	1	1.95

Source: French statistical agency (INSEE)

Table 9: 2012 – 2014 variations in French canned tuna prices

Preserved canned tuna products	2012	2014	Variation 2012/2014
tuna in water	9.50 €	8.18 €	-14%
tuna in oil	12.30 €	11.90 €	-3%
tuna crumbs/flakes	6.60 €	6.85 €	4%
tuna in sauce	7.30 €	7.75 €	6%
other tuna preparations	6.10 €	6.98 €	14%
Average	**8.36 €**	**8.33 €**	**-0.3%**

Source: French Kantar Worldpanel. In nominal terms

Table 10: Average FOB canned tuna prices from Thailand, June 2012 and June 2014

		UK	Germany	France	Italy	USA	UAE ('Dubai')	Australia	South Africa	Nigeria
June 2014	Volume (kg)	555,385	419,103	540,249	199,913	7,915,980	700,954	2,297,338	1,115,864	888
	FOB Value (THB)	79,180,702	60,747,896	87,168,588	31,265,710	1,001,843,260	91,182,785	360,579,775	113,300,255	133,867
	FOB Value (USD)	2,438,766	1,871,035	2,684,793	962,984	30,856,772	2,808,430	11,105,857	3,489,648	4,123
	FOB Price USD/kg	**4.39**	**4.46**	**4.97**	**4.82**	**3.90**	**4.01**	**4.83**	**3.13**	**4.64**
	Average all countries	4.35								
	Price compared to average	101%	103%	114%	111%	90%	92%	111%	72%	107%
June 2012	Volume (kg)	263,315	133,192	198,294	242,720	6,849,729	672,263.00	2,527,843.00	1,468,794.00	
	FOB Value (THB)	46,715,498	21,333,198	31,884,485	50,026,140	1,136,356,610	93,583,855	444,018,201	203,083,954	
	FOB Value (USD)	1,480,881	676,262	1,010,738	1,585,829	36,022,505	2,966,608	14,075,377	6,437,761	
	FOB Price USD/kg	**5.62**	**5.08**	**5.10**	**6.53**	**5.26**	**4.41**	**5.57**	**4.38**	
	Average all countries	5.24								
	Price compared to average	107%	97%	97%	125%	100%	84%	106%	84%	

Source: Thai customs - http://www.customs.go.th, extracted in August 2015. Notes: (1) prices for HS customs code 1604.1411.000 / canned tunas ('Prepared or preserved tunas and skipjack in vegetable oil or other'. (2) prices in THB (thai Baht) converted to US$ using mid-year exchange rates www.oanda.com. (3) values in nominal terms

Table 11: Retail prices of yellowfin tuna for sashimi in Osaka, 2010-2014 (US$/tonne)

	2010	2011	2012	2013	2014
January	$ 41,471	$ 40,959	$ 42,462	$ 34,680	$ 37,125
February	$ 36,838	$ 38,499	$ 42,084	$ 33,558	$ 36,432
March	$ 38,081	$ 40,467	$ 43,974	$ 31,824	$ 34,056
April	$ 38,872	$ 41,574	$ 42,966	$ 32,334	$ 35,145
May	$ 37,968	$ 41,820	$ 43,092	$ 33,558	$ 35,739
June	$ 40,341	$ 37,515	$ 38,178	$ 32,436	$ 35,244
July	$ 42,488	$ 40,467	$ 38,304	$ 31,518	$ 34,749
August	$ 38,307	$ 41,328	$ 40,446	$ 31,518	$ 34,155
September	$ 37,855	$ 41,697	$ 40,950	$ 31,926	$ 36,432
October	$ 38,194	$ 42,189	$ 42,714	$ 33,558	$ 37,422
November	$ 37,629	$ 43,911	$ 41,454	$ 34,782	$ 36,135
December	$ 36,160	$ 42,927	$ 44,856	$ 35,496	$ -
average	**$ 38,684**	**$ 41,113**	**$ 41,790**	**$ 33,099**	**$ 32,720**
av. Round weight	**$ 17,408**	**$ 18,501**	**$ 18,806**	**$ 14,895**	**$ 14,724**

Source: Statistics of Ministry of Internal Affairs and Communications. JAFIC, http://osakana-hiroba.jafic.jp/index.html. Notes: (1) recorded retail prices converted to whole round weight on basis that 45% of round weight is marketed; (2) prices in Yen converted to US$ using mid-year exchange rates from www.oanda.com; (3) the average price of yellowfin tuna sold in Europe based on a small number of 6 records from online retailer sales in June/July 2015 was $29,185/tonne, which while not statistically very reliable, suggests that there may be only small differences between retail prices in Japan and other markets (i.e. $29,185/tonne foe 2015 compares with $32,720 for 2014 in the table above); (4) prices in nominal terms

Table 12: Retail prices of bigeye tuna for sashimi in Tokyo, 2010-2014 (US$/tonne)

	2010	2011	2012	2013	2014
January	$ 45,539	$ 49,077	$ 50,652	$ 39,678	$ 37,125
February	$ 43,618	$ 49,077	$ 48,762	$ 38,454	$ 37,125
March	$ 43,844	$ 48,708	$ 49,392	$ 37,230	$ 37,323
April	$ 44,748	$ 50,922	$ 49,896	$ 36,924	$ 37,917
May	$ 43,957	$ 49,692	$ 49,518	$ 36,312	$ 38,808
June	$ 45,087	$ 48,708	$ 48,888	$ 35,904	$ 38,016
July	$ 44,296	$ 49,692	$ 49,896	$ 37,026	$ 37,323
August	$ 44,070	$ 48,216	$ 49,140	$ 35,904	$ 38,610
September	$ 43,505	$ 47,970	$ 49,896	$ 36,720	$ 39,897
October	$ 44,183	$ 49,077	$ 48,132	$ 35,904	$ 40,689
November	$ 44,296	$ 47,970	$ 48,006	$ 37,434	$ 40,194
December	$ 44,522	$ 48,462	$ 46,872	$ 38,862	$ 41,976
average	**$ 44,305**	**$ 48,964**	**$ 49,088**	**$ 37,196**	**$ 38,750**
av. Round weight	**$ 19,937**	**$ 22,034**	**$ 22,089**	**$ 16,738**	**$ 17,438**

Source: Statistics of Ministry of Internal Affairs and Communications. JAFIC, http://osakana-hiroba.jafic.jp/index.html. Notes: (1) recorded retail prices converted to whole round weight on basis that 45% of round weight is marketed; (2) prices in Yen converted to US$ using mid-year exchange rates www.oanda.com; (3) prices in nominal terms.

Table 13: Average retail price in Tokyo, Sapporo and Osaka of Bluefin tuna for sashimi, 2014

Yen/100gr	$/100gr	$/tonne	$/tonne landed weight
1,047	$ 10.37	$ 103,702	$ 46,666

Source: Japan Fisheries Information Center, Osakana Hiroba, http://osakana-hiroba.jafic.jp/index.html. Notes: (1) price based on average of 158 individual sales records over 2014 from Tokyo, Sapporo and Osaka; (2) recorded retail prices converted to whole round weight on basis that 45% of round weight is marketed; (3) prices in Yen converted to US$ using mid-year exchange rates www.oanda.com.

Table 14: Frozen tuna on Tsukiji market, 2012-2014 (US$)

$/kg of frozen tuna on Tsukiji market	2012	2013	2014
bluefin	$ 48.74	$ 37.45	$ 37.88
yellowfin tuna	$ 12.04	$ 8.69	$ 9.37
bigeye tuna	$ 12.33	$ 9.54	$ 9.94
albacore tuna	$ 11.36	$ 9.56	$ 9.93
southern bluefin tuna	$ 30.91	$ 21.45	$ 21.13
$/tonne whole round weight equivalent	**2012**	**2013**	**2014**
bluefin	$ 42,383	$ 32,562	$ 32,940
yellowfin tuna	$ 10,469	$ 7,555	$ 8,145
bigeye tuna	$ 10,726	$ 8,295	$ 8,642
albacore tuna	$ 9,880	$ 8,310	$ 8,637
southern bluefin tuna	$ 26,881	$ 18,650	$ 18,378

Source: Tokyo Metropolitan Central Wholesale Market, "Shijyo tokei jyoho (Information of market statistics)," http://www.shijou-tokei.metro.tokyo.jp/index.html. Notes: (1) prices on market converted to whole landed weight assuming landed weight 1.15 x marketed weight; (2) prices in Yen converted to US$ using mid-year exchange rates www.oanda.com; (3) bluefin tuna data likely to include Atlantic and Pacific species, although not distinguished in the trade/price data; (4) prices in nominal terms.

Table 15: Fresh tuna on Tsukiji market, 2012-2014 (US$)

	2012		2013		2014	
	$/kg	Weight (kg)	$/kg	Weight (kg)	$/kg	Weight (kg)
bluefin domestic	$ 44.78	2,666,516	$ 36.37	2,921,814	$ 33.28	3,757,664
bluefin imported	$ 43.61	792,276	$ 28.37	1,240,451	$ 28.24	1,041,605
bluefin juvenile	$ 14.57	1,296,770	$ 13.62	779,079	$ 12.69	1,576,776
bluefin weighted/total	**$ 35.34**	4,755,562	**$ 28.97**	4,941,344	**$ 25.43**	6,376,045
yellowfin domestic	$ 12.64	1,604,173	$ 11.17	1,202,625	$ 10.72	781,372
yellowfin imported	$ 14.71	68,197	$ 11.46	20,208	$ 17.43	13,127
yellowfin juvenile	$ 6.40	245,104	$ 5.74	93,897	$ 6.14	112,098
yellowfin weighted/total	**$ 10.12**	1,917,474	**$ 8.96**	1,316,730	**$ 9.11**	906,597
bigeye domestic	$ 22.28	1,382,900	$ 15.85	1,090,778	$ 19.33	844,462
bigeye imported	$ 17.39	1,151,203	$ 14.98	688,937	$ 15.66	528,174
bigeye juvenile	$ 11.75	409,538	$ 10.63	487,267	$ 10.54	627,650
bigeye weighted/total	**$ 18.00**	2,943,641	**$ 14.23**	2,266,982	**$ 14.86**	2,000,286
albacore	**$ 7.51**	1,207,383	**$ 6.30**	818,061	**$ 7.33**	627,650
southern bluefin domestic	$ 38.06	2,140	$ 26.60	79	$ 13.54	313
southern bluefin imported	$ 31.64	427,258	$ 22.42	525,612	$ 22.66	430,949
SBT weighted/total	**$ 32.23**	429,398	**$ 22.42**	525,691	**22.66**	431,262

Source: source: Poseidon analysis based on data from Tokyo Metropolitan Central Wholesale Market, "Shijyo tokei jyoho (Information of market statistics)," http://www.shijou-tokei.metro.tokyo.jp/index.html. Notes: (1) bluefin tuna data likely to include Atlantic and Pacific species, although not distinguished in the trade/price data; (2) prices in nominal terms.

Table 16: US$/tonne whole round weight equivalent for fresh tuna on Tsukiji market, 2012-2014 (US$)

$/tonne whole round weight equivalent	2012	2013	2014
bluefin	$ 30,727	$ 25,189	$ 22,113
yellowfin	$ 8,804	$ 7,791	$ 7,918
bigeye	$ 15,655	$ 12,371	$ 12,921
albacore	$ 6,526	$ 5,476	$ 7,918
southern bluefin	$ 28,024	$ 19,500	$ 19,703

Source: source: Poseidon analysis based on data from Tokyo Metropolitan Central Wholesale Market, "Shijyo tokei jyoho (Information of market statistics)," http://www.shijou-tokei.metro.tokyo.jp/index.html. Notes: (1) prices on market converted to whole landed weight assuming landed weight 1.15 x marketed weight; (2) prices in Yen converted to US$ using mid-year exchange rates www.oanda.com; (3) bluefin tuna data likely to include Atlantic and Pacific species, although not distinguished in the trade/price data; (4) prices in nominal terms.

Table 17: Analysis of differences between retail prices and wholesale Tsukiji prices

Tsukiji fresh prices	2012	2013	2014
bluefin	$ 30,727	$ 25,189	$ 22,113
yellowfin	$ 8,804	$ 7,791	$ 7,918
bigeye	$ 15,655	$ 12,371	$ 12,921
albacore	$ 6,526	$ 5,476	$ 7,918
southern bluefin	$ 28,024	$ 19,500	$ 19,703
Tsukiji frozen prices	**2012**	**2013**	**2014**
bluefin	$ 42,383	$ 32,562	$ 32,940
yellowfin	$ 10,469	$ 7,555	$ 8,145
bigeye	$ 10,726	$ 8,295	$ 8,642
albacore	$ 9,880	$ 8,310	$ 8,637
southern bluefin	$ 26,881	$ 18,650	$ 18,378
Retail prices (Tokoyo, Osaka, Sapparo)	**2012**	**2013**	**2014**
yellowfin	$ 18,806	n/a	$ 14,724
bigeye	$ 22,089	n/a	$ 17,438
bluefin	n/a	n/a	$ 46,666
Ratio retail price to fresh Tsukiji price	**2012**	**2013**	**2014**
yellowfin	2.14	n/a	1.86
bigeye	1.41	n/a	1.35
bluefin	n/a	n/a	2.11
average	1.77	n/a	1.77

Source: Poseidon analysis based on other data tables provided in this Appendix. Prices in nominal terms.

Table 18: wholesale and retail market prices for tuna, Sri Lanka, 2012-2013(US$)

retail market price	2012	2013
skipjack	$ 3,360	$ 4,180
yellowfin	$ 5,424	$ 5,670
wholesale market price	**2012**	**2013**
skipjack	$ 1,991	$ 2,067
yellowfin	$ 2,960	$ 3,093
retail vs wholesale difference	**2012**	**2013**
skipjack	169%	202%
yellowfin	183%	183%
average difference	**184%**	

Source: Sri Lanka Ministry of Fisheries, 2014. http://www.fisheries.gov.lk/elfinder-2.0-rc1/files/stat/Fisheries%20Statistices/Tables.pdf. Note: Sri Lankan Rupees converted to US$ using www.oanda.com. Prices in nominal terms.

Table 19: Sales prices of traders at Indonesian ports, 2014

Species / Price	IDR/kg	$/tonne
Albacore	29,816	$ 2,982
Skipjack	35,422	$ 3,542
Yellowfin	60,329	$ 6,033
Bigeye	40,915	$ 4,091

Source: Ministry of Maritime Affairs and Fisheries

Table 20: Fish Meal prices in Thai Baht/kg, 1998 to 2015

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Setp	Oct	Nov	Dec	Average	Lowest	Highest
1998	25.83	25.83	20.52	17.97	19.30	20.44	21.71	22.42	21.70	24.91	25.36	23.70	22.47	17.97	25.83
1999	19.02	16.48	18.22	17.30	18.45	18.15	18.55	21.07	20.93	17.13	16.50	16.60	18.20	16.48	21.07
2000	15.71	14.27	14.81	15.89	16.75	18.52	17.09	16.81	18.79	16.37	16.70	17.33	16.59	14.27	18.79
2001	18.76	19.60	19.60	19.79	20.40	22.69	24.02	21.15	20.23	18.64	17.60	17.95	20.04	17.60	24.02
2002	20.50	22.48	22.51	21.61	20.13	19.83	19.73	20.52	21.86	18.87	18.02	17.50	20.30	17.50	22.51
2003	17.54	20.13	19.90	19.90	19.80	20.63	19.68	20.96	20.33	19.73	21.43	20.52	20.05	17.54	21.43
2004	19.90	17.62	21.61	23.46	23.73	24.93	25.34	25.75	26.07	22.22	21.43	22.55	22.88	17.62	26.07
2005	22.03	20.40	21.09	23.06	21.50	21.32	21.80	21.28	22.18	21.60	21.80	23.08	21.76	20.40	23.08
2006	23.43	25.05	27.76	28.17	30.79	29.58	31.23	31.18	27.39	25.10	22.59	21.92	27.02	21.92	31.23
2007	21.64	23.40	22.47	24.11	23.99	21.86	23.18	23.25	23.95	23.91	24.08	25.62	23.45	21.64	25.62
2008	26.10	27.04	29.27	29.60	29.36	30.79	33.65	35.66	34.19	30.93	25.11	26.03	29.81	25.11	35.66
2009	29.61	26.84	25.69	29.08	33.5	34.19	34.58	36.04	34.58	33.29	29.96	31.80	31.58	25.69	36.04
2010	33.40	34.20	35.28	36.53	31.53	28.31	28.92	30.82	29.78	27.78	25.28	25.57	30.62	25.28	36.53
2011	25.00	28.91	37.98	31.77	32.09	31.29	32.32	32.58	31.42	28.86	28.46	27.50	30.68	25.00	37.98
2012	27.64	28.81	32.21	33.24	30.26	29.38	34.70	37.70	35.06	30.95	32.83	33.80	32.22	27.64	37.70
2013	32.49	31.30	31.30	29.94	26.74	24.80	29.84	30.78	29.00	31.90	26.59	24.72	29.12	24.72	32.49
2014	26.20	30.92	31.12	33.93	30.24	29.74	31.50	37.70	37.70	36.47	34.78	35.45	32.98	26.20	37.70
2015	37.14	39.83	42.26	42.74	37.58	36.70	36.85	36.70					38.73	36.70	42.74

Source: http://www.thaifeedmill.com/tabid/78/Default.aspx. Note : US$ 1 = Baht 35 (October 2015). Prices in nominal terms.

Table 21: Final sales prices (US$/tonne) used in the Phase 2 analysis

Final consumed prices in $	BB/P&L							GN							HL							LL							Other							PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																																																	
For loining/canning	6,227	5,502				4,305	6,750	6,227	5,502				4,305	6,750								6,227					4,305		6,227								5,502				4,305	6,750	6,227					4,305	
Canning byproducts	251	251				251	251	251	251				251	251								251					251		251								251				251	251	251					251	
For domestic (fresh or processing)	3,000	4,000				3,500	5,500	3,000	4,000				3,500	5,500	3,000					3,500														3,500														3,500	
For fresh sashimi				53,773												22,089							22,089					18,806		22,089		53,773							53,773					22,089					18,806
For frozen sashimi																					18,321	17,290	17,290		74,169			18,321							18,321		17,290							17,290					18,321
For ranching																																														53,773			
EPO																																																	
For loining/canning						4,305	6,750															6,227	5,502					6,750	6,227					4,305	6,750		5,502				4,305	6,750	6,227						
Canning byproducts						251	251															251	251					251	251					251	251		251				251	251	251						
For domestic (fresh or processing)																													3,000					3,500	5,500								3,000						
For fresh sashimi																							22,089					18,806				53,773																	
For frozen sashimi																							17,290					18,321											74,169										
For ranching																																							74,169										
WIO																																																	
For loining/canning		5,502				4,305	6,750		5,502				4,305	6,750								6,227	5,502				4,305							4,305	6,750	6,227	5,502				4,305	6,750							
Canning byproducts		251				251	251		251				251	251								251	251				251							251	251	251	251				251	251							
For domestic (fresh or processing)		4,000				3,500	5,500		4,000				3,500	5,500																													3,000	4,000				3,500	5,500
For fresh sashimi															11,421	22,089				11,421	18,806																												
For frozen sashimi															17,290	17,290				17,290	18,321	17,290	17,290					18,321																					
EIO																																																	
For loining/canning						4,305	6,750	6,227	5,502				4,305	6,750								6,227							6,227					4,305			5,502				4,305	6,750	6,227	5,502				4,305	6,750
Canning byproducts						251	251	251	251				251	251								251							251					251			251				251	251	251	251				251	251
For domestic (fresh or processing)						3,500	5,500	3,000	4,000				3,500	5,500	3,000					3,500							3,500	5,500	3,000					3,500									3,000	4,000				3,500	5,500
For fresh sashimi																					18,806		22,089					18,806		22,089					18,806														
For frozen sashimi																					18,321		17,290					18,321		17,290					18,321														
EAO																																																	
For loining/canning	6,227	5,502				4,305	6,750						4,305							4,305		6,227					4,305							4,305		6,227	5,502				4,305	6,750	6,227						
Canning byproducts	251	251				251	251						251							251		251					251							251		251	251				251	251	251						
For domestic (fresh or processing)														3,704	3,000	4,000	4,010				5,500			3,876					3,000														3,000						
For fresh sashimi			53,773														53,773							53,773																									
For frozen sashimi			74,169														74,169						17,290	74,169				18,321			74,169																		
For ranching																																						74,169											
WAO																																																	
For loining/canning	6,227	5,502				4,305	6,750															6,227														6,227	5,502				4,305	6,750							
Canning byproducts	251	251				251	251															251														251	251				251	251							
For domestic (fresh or processing)	6,904	4,000				3,500	5,500						3,500	3,704		4,000				3,500									6,904	4,000				3,500	5,500													3,500	
For fresh sashimi																	53,773				18,806			53,773							53,773																		18,806
For frozen sashimi																							17,290	74,169				18,321																					
For ranching																																						74,169											
Antarctic																																																	
For ranching																																								49,042									
For frozen sashimi																										47,042																							

Source: Poseidon analysis

Table 22: Final sales revenues (US$) estimated during the Phase 2 analysis for 2012

Total final sales values in $	BB/P&L							GN							HL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																					
For loining/canning	144,675,861	14,878,926				504,817,412	160,891,431	143,158	1,775,806				80,294,375	6,147,855							
Canning byproducts	1,780,702	207,256				8,987,213	1,826,770	1,762	24,736				1,429,473	69,803							
For domestic (fresh or processing)	30,404,700	4,718,400				179,028,150	57,184,050	7,800	146,000				7,382,550	566,500	1,134,000					38,678,500	
For fresh sashimi				6,076,343												67,085,432					
For frozen sashimi																					687,006,951
For ranching																					
EPO																					
For loining/canning						1,281,583	2,739,012														
Canning byproducts						22,816	31,099														
For domestic (fresh or processing)																					
For fresh sashimi																					
For frozen sashimi																					
For ranching																					
WIO																					
For loining/canning		967,638				64,897,609	22,986,480		6,448,039				102,533,443	257,581,212							
Canning byproducts		13,479				1,155,366	260,990		89,818				1,825,392	2,924,592							
For domestic (fresh or processing)		2,148,000				161,106,750	57,189,000		1,192,800				21,211,400	53,403,900							
For fresh sashimi															2,145,384	1,295,542				23,851,617	1,171,788,570
For frozen sashimi															573,166	178,952				6,372,258	201,455,046
EIO																					
For loining/canning						4,663,187	2,713,811	34,872	441,384				13,198,195	4,673,232							
Canning byproducts						83,018	30,813	429	6,148				234,966	53,060							
For domestic (fresh or processing)						21,866,250	12,753,400	324,900	6,205,400				207,506,600	73,635,925	1,020,000					17,020,500	
For fresh sashimi																					45,426,566
For frozen sashimi																					103,262,646
EAO																					
For loining/canning	89,063,865	51,576,744				190,697,925	43,300,267						20,919,841							4,153,515	
Canning byproducts	1,096,217	718,437				3,394,976	491,634						372,434							73,945	
For domestic (fresh or processing)														2,237,324	51,000	1,068,000	0				7,353,500
For fresh sashimi			11,372,979														7,702,975				
For frozen sashimi			5,228,949														3,541,593				
For ranching																					
WAO																					
For loining/canning	5,631,800	2,439,368				123,329,567	6,980,833														
Canning byproducts	69,317	33,979				2,195,624	79,261														
For domestic (fresh or processing)	334,499	95,000				5,371,275	304,700						182,000	85,196		1,396,000				1,095,500	
For fresh sashimi																	51,138,075				44,493,813
For frozen sashimi																					
For ranching																					
Antarctic																					
For ranching																					
For frozen sashimi																					

Continued overleaf

Total final sales values in $	LL							Other							PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																												
For loining/canning	491,494,514					8,345,096		2,600,092								309,397,757				5,888,833,649	2,637,794,707	21,871,364					18,460,300	
Canning byproducts	6,049,421					148,567		32,003								4,309,750				104,838,308	29,949,671	269,198					328,647	
For domestic (fresh or processing)													429,201,500														6,546,750	
For fresh sashimi		877,169,081					748,759,788		193,547,104		145,993,558							208,800,363					3,015,200					36,999,821
For frozen sashimi	347,260,804	686,588,921		15,575,593			729,455,953							1,138,208,508		247,396,783							2,360,095					36,045,926
For ranching																									30,650,581			
EPO																												
For loining/canning	137,804,887	34,296,562					13,421,823	3,444,357					439,460	1,750,846		409,386,690				1,084,921,719	1,313,246,897	91,588,095						
Canning byproducts	1,696,133	477,733					152,392	42,394					7,824	19,879		5,702,544				19,314,751	14,910,680	1,127,286						
For domestic (fresh or processing)								1,689,000					3,272,850	1,452,000								4,990,200						
For fresh sashimi		210,215,746					57,087,856				2,043,372																	
For frozen sashimi		274,237,897					92,693,450											321,417,190										
For ranching																		173,070,794										
WIO																												
For loining/canning	46,368,515	0				6,564,414							169,186	530,559	7,934,870	92,282,423				348,590,698	863,989,217							
Canning byproducts	570,714	0				116,866							3,012	6,024	97,664	1,285,446				6,205,925	9,809,783							
For domestic (fresh or processing)																						24,000	592,000				37,072,000	47,784,000
For fresh sashimi																												
For frozen sashimi	32,761,236	927,647,162					427,293,078																					
EIO																												
For loining/canning	131,283,244							636,258					10,603,728			26,910,076				122,139,555	29,790,902	2,978,788	3,274,293				37,111,358	17,106,557
Canning byproducts	1,615,863							7,831					188,777			374,843				2,174,438	338,248	36,664	45,609				660,690	194,229
For domestic (fresh or processing)						23,404,500	163,515,000	312,000					8,774,500									162,300	269,200				3,412,150	1,576,300
For fresh sashimi		370,129,568					326,134,384		16,920,461					9,224,098														
For frozen sashimi		289,712,515					45,389,470		13,244,198					8,986,291														
EAO																												
For loining/canning	15,117,242					1,467,688							617,529		1,621,234	115,592,236				644,869,105	447,089,019	18,228,176						
Canning byproducts	186,066					26,129							10,994		19,955	1,610,140				11,480,539	5,076,274	224,356						
For domestic (fresh or processing)			664,734					9,906,000														8,938,500						
For fresh sashimi			27,666,183																									
For frozen sashimi		290,404,118	76,320,404				98,840,036			187,055,452																		
For ranching																	452,878,901											
WAO																												
For loining/canning	128,750,449														2,037,249	470,305				22,002,631	21,898,833							
Canning byproducts	1,584,689														25,075	6,551				391,711	248,641							
For domestic (fresh or processing)			0					24,605,856	132,000				24,500	1,815,000													476,000	
For fresh sashimi			11,840,803							5,377,295																		3,084,102
For frozen sashimi		372,704,880	32,664,243				234,596,229																					
For ranching																	148,339											
Antarctic																												
For ranching																			217,942,275									
For frozen sashimi					273,358,725																							

Source: Poseidon analysis

Table 23: Global sales value of tuna in 2012 by species, market destination, ocean area, and fishing gear (US$), using total price for the retail sales values of canned tuna not just the value of tuna in cans

Species	US$	% of species total	Market segment	US$	% by market segment
ALB	$ 2,458,633,332	5.9%	Canning	$ 25,844,122,643	62.1%
BET	$ 6,450,455,640	15.5%	fish meal/pet food	$ 263,586,449	0.6%
BFT	$ 873,600,924	2.1%	Domestic	$ 1,756,022,309	4.2%
PBF	$ 903,627,794	2.2%	Fresh sashimi	$ 4,686,386,077	11.3%
SBF	$ 491,301,000	1.2%	Frozen sashimi	$ 9,084,529,608	21.8%
SKJ	$15,053,711,041	36.2%			
YFT	$15,403,317,356	37.0%			
Total	**$41,634,647,087**		**Total**	**$ 41,634,647,087**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$22,259,164,135	53.5%	Pole and line	$ 2,693,151,586	6.5%
EPO	$ 5,736,149,316	13.8%	Gillnet	$ 1,107,872,985	2.7%
WIO	$ 5,880,633,730	14.1%	Handline	$ 2,492,317,640	6.0%
EIO	$ 2,375,586,864	5.7%	Longline	$ 9,569,238,156	23.0%
EAO	$ 3,634,122,133	8.7%	Other	$ 2,232,680,773	5.4%
WAO	$ 1,257,689,908	3.0%	Purse seine	$ 23,002,766,421	55.2%
Antartic	$ 491,301,000	1.2%	Troll	$ 536,619,526	1.3%
Total	**$41,634,647,087**		**Total**	**$ 41,634,647,087**	

Source: Poseidon analysis

ESTIMATE OF THE GLOBAL SALES VALUES FROM TUNA FISHERIES

STUDY FOR
PEW CHARITABLE TRUSTS

Photo: bluefin tuna Sakaiminato port, Japan. Courtesy of Yasuhiro Sanada

PHASE 3 REPORT

FEBRUARY 2016

BY

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Disclaimer and Report Information

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Table of Acronyms

ALB	Albacore
AZOR	Azores Islands Area
BB	Pole and line
BET	Bigeye
BFT	Atlantic bluefin
CANA	Canary Islands area
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CIF	Carriage Insurance and Freight
C&F	Carriage and Freight
CVER	Cape Verde area
EEZ	Economic Exclusion Zone
e.g.	*Exempli gratia* in Latin meaning 'for instance'/'for example'
EPO	Eastern Pacific Ocean
ETRO	East Tropical Atlantic
FAO	Food and Agriculture Organisation (of the United Nations)
FOB	Free On Board
GN	Gillnet
GOFM	Gulf of Mexico
HL	Handline
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
i.e	*Id est* in Latin meaning 'that is'
IOTC	Indian Ocean Tuna Commission
LL	Longline
MDRA	Madeira Islands area
NE	North East
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmosphere Administration
NW	North West
NWC	North West Central
OTH	Other
PBF	Pacific bluefin
PFMC	Pacific Fishery Management Council
PS	Purse seine
RFMO	Regional Fisheries Management Organisation
SBT	Southern Bluefin tuna
SKJ	Skipjack
SW	South West
T	tonnes
TR	Troll
TROP	Tropical Atlantic
ULT	Ultra Low Temperature
WCP(O)	Western Central Pacific (Ocean)
WCPFC	Western and Central Pacific Fisheries Commission

WTRO	West Tropical Atlantic
YFT	Yellowfin

1 BACKGROUND

This document provides the outputs from **Phase 3** of a three-phase project, to complete a study to provide an ***estimate of the global sales values from tuna fisheries***. The study was completed by **Poseidon Aquatic Resource Management Ltd** (Poseidon) of the UK, for **Pew Charitable Trusts** (Pew).

The study phases were as follows:

Phase 1 focused on: collecting and analysing tuna landings data by ocean, vessel flag, gear, and species; mapping product flows; and assessing the first sale value of landed catch in 2012 by multiplying landed volumes with ex-vessel/first sale prices.

Phase 2 focused on: generation of 2012 data on final consumer sales values, based on the volumes of sales and final sale prices.

Phase 3 focused on: updating the Phase 1 and Phase 2 outputs to arrive at estimates for 2014.

The Phase 1 report made a global estimation of landed volumes and values at the first point of sale for tuna fisheries globally in 2012, by multiplying tuna catches for different species and fishing methods from Regional Fisheries Management Organisation (RFMO) catch databases, with ex-vessel prices. A global estimate for 2012 of ex vessel values was calculated at US$12.2 billion (see Table 1).

Table 1: Summary of ex-vessel values of product by species, end market type and sub-ocean area, 2012 (US$)

Species	$	% of species total
ALB	924,700,704	7.6%
BET	2,653,810,223	21.7%
BFT	172,841,426	1.4%
PBF	359,265,530	2.9%
SBF	128,536,170	1.1%
SKJ	4,036,805,178	33.1%
YFT	3,930,108,869	32.2%
Total	**12,206,068,100**	

Market segment	$	% by market segment
Canning	6,563,934,810	53.8%
Domestic	792,873,338	6.5%
Fresh sashimi	1,407,843,366	11.5%
Frozen sashimi	3,272,763,107	26.8%
Ranching	168,653,480	1.4%
Total	**12,206,068,100**	

Ocean Area	$	% by ocean
WCPO	6,496,898,718	53.2%
EPO	1,538,621,840	12.6%
WIO	1,822,570,002	14.9%
EIO	855,705,787	7.0%
EAO	962,510,252	7.9%
WAO	401,225,331	3.3%
Antartic	128,536,170	1.1%
Total	**12,206,068,100**	

Source: Poseidon analysis, Phase 1 report

The Phase 2 report made an estimation of the final global sales value of tuna for 2012. The outputs of the analysis are provided in Table 2 below, and revealed that the final consumed value of tuna in 2012 was estimated at just under US$ 33.36 billion when using a drained weight[1] value of canned tuna (and US$ 41.63 billion when using the total canned sales price in the analysis rather than the value of the drained tuna).

[1] Corresponding to the weight of the solid portion of the product with the liquid drained.

Table 2: Global sales value of tuna by species, value chain, ocean area, and fishing gear, 2012 (US$)

Species	US$	% of species total	Market segment	US$	% by market segment
ALB	$ 1,826,487,972	5.5%	Canning	$ 17,574,003,397	52.7%
BET	$ 5,946,861,172	17.8%	fish meal/pet food	$ 263,586,449	0.8%
BFT	$ 873,600,924	2.6%	Domestic	$ 1,756,022,309	5.3%
PBF	$ 903,627,794	2.7%	Fresh sashimi	$ 4,686,386,077	14.0%
SBF	$ 491,301,000	1.5%	Frozen sashimi	$ 9,084,529,608	27.2%
SKJ	$10,674,453,267	32.0%			
YFT	$12,648,195,712	37.9%			
Total	**$33,364,527,841**		**Total**	**$ 33,364,527,841**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$17,415,671,287	52.2%	Pole and line	$ 2,016,194,730	6.0%
EPO	$ 4,279,997,819	12.8%	Gillnet	$ 875,312,321	2.6%
WIO	$ 5,023,295,234	15.1%	Handline	$ 2,490,363,045	7.5%
EIO	$ 2,183,794,187	6.5%	Longline	$ 9,091,631,363	27.2%
EAO	$ 2,860,327,128	8.6%	Other	$ 2,222,896,295	6.7%
WAO	$ 1,110,141,186	3.3%	Purse seine	$ 16,230,625,352	48.6%
Antartic	$ 491,301,000	1.5%	Troll	$ 437,504,735	1.3%
Total	**$33,364,527,841**		**Total**	**$ 33,364,527,841**	

Source: Poseidon analysis, Phase 2 report. Notes: uses drained weight value of canned tuna

The assumptions and methodologies underpinning these estimate for 2012 sales values were described in the Phase 1 and Phase 2 reports to allow for full transparency in the way that the estimates were generated.

When the Phase 1 work on this study commenced, catch data available from the different RFMOs was only available for 2012, hence the decision to complete the analysis during Phase 1 and 2 to derive estimates for 2012. However, it was later agreed between Poseidon and Pew that it would be useful for a third and final Phase of this study to update the Phase 1 and Phase 2 estimates for 2014 because of:

1. The elapsed time since the beginning of the study.
2. The fact that the RFMO 2014 catch data were made available at the end of 2015.
3. The desire by Pew to release the outputs of the study early in 2016.

As well as providing more recent/current information about global values of tuna trade, the 2014 estimates also contribute to an assessment of the extent to which global values of tuna sales have changed in recent years.

2 METHODOLOGY AND APPROACH USED DURING PHASE 3

2.1 INTRODUCTION

The approach taken to Phase 3 has been to repeat the methodologies used during Phase 1 and Phase 2, so as to provide directly comparable results. Because the approach was fully documented in the Phase 1 and Phase 2 reports, it is not repeated here in detail. Only a summary of the methodology used is therefore provided below.

2.2 METHODOLOGY FOR ESTIMATING CATCHES AND EX VESSEL VALUES IN 2014 AND ASSOCIATED PRICE CHANGES

As with the Phase 1 analysis, catch data for 2014 was sourced from the relevant tuna RFMOs and entered/amalgamated into a database of global tuna catches so that catches for the main tuna species included in the study could be categorised by major and sub-ocean area, flag, species, and fishing method/gear. Catches in 2014 were as shown below (Table 3).

Table 3: Global catches of selected tuna species by ocean area and fishing method, 2014 (tonnes)

Ocean/ species	Pole and line	Gillnet	Handline	Longline	Other	Purse seine	Troll	Grand Total
Antarctic	**10**		**1**	**7,730**	**2**	**4,168**		**11,911**
SBF	10		1	7,730	2	4,168		11,911
Atlantic	**81,784**	**1,450**	**8,289**	**66,995**	**12,352**	**288,560**	**7,180**	**466,610**
ALB	12,082	4	172	14,371	9,203	91	6,671	42,593
BET	8,657	12	1,910	37,264	22	24,800	29	72,695
BFT	95	0	1,088	2,443	2,904	8,237	109	14,876
SKJ	51,010	1,216	626	118	191	179,434	222	232,818
YFT	9,940	219	4,492	12,798	32	75,998	149	103,629
Indian	**111,225**	**179,085**	**180,719**	**160,709**	**12,500**	**359,766**		**1,004,006**
ALB		67	1,847	38,193	122	752		40,981
BET	304	3,883	12,516	52,579	2,126	28,823		100,231
SKJ	87,323	109,352	49,630	2,889	7,619	175,653		432,467
YFT	23,598	65,783	116,726	67,049	2,633	154,538		430,327
Pacific	**185,712**	**63,756**	**82,564**	**330,520**	**19,007**	**2,705,217**	**116,306**	**3,503,081**
ALB	33,783	26	174	120,358	667	13	22,147	177,168
BET	4,529	2,504	8,099	106,999	297	132,128	6,186	260,743
PBF	5	1,920		1,195	500	12,024	1,023	16,667
SKJ	128,415	55,115	18,308	2,221	10,435	1,944,178	54,401	2,213,073
YFT	18,980	4,191	55,983	99,747	7,108	616,873	32,549	835,431
Grand Total	**378,730**	**244,291**	**271,574**	**565,954**	**43,862**	**3,357,711**	**123,486**	**4,985,608**

Source: Poseidon analysis based on data provided by RFMOs

The following table shows that while total catches rose from 4.6 million tonnes in 2012 to 4.99 million tonnes in 2014 (an increase of 8.1%), this increase was not evenly distributed between major ocean area, with catches in the Atlantic falling slightly (2%), while catches in the Antarctic, Indian Ocean and Pacific Ocean increased by 16%, 19% and 7% respectively. It was not the purpose of this study to explore the reasons for change in catches between the two years, but they may have included a combination of: (i) improved fisheries management; (ii) natural fluctuations in tuna stocks, and (iii) in the case of the Atlantic and Indian Oceans a move back to the Indian Ocean of some tuna fishing vessels which had been fishing in the Atlantic Ocean during 2012 due to the piracy problem in the Indian Ocean, which was significantly reduced over the 2012 to 2014 period.

Table 4: Comparison of tuna catches by major ocean area, 2012 and 2014 (tonnes)

Ocean / species	2012	2014
Antarctic	**10,261**	**11,911**
SBF	10,261	11,911
Atlantic	**477,990**	**466,610**
ALB	52,664	42,593
BET	70,516	72,695
BFT	12,602	14,876
SKJ	240,821	232,818
YFT	101,386	103,629
Indian	**843,784**	**1,004,006**
ALB	33,662	40,981
BET	115,589	100,231
SKJ	313,682	432,467
YFT	380,851	430,327
Pacific	**3,277,175**	**3,503,081**
ALB	178,907	177,168
BET	274,780	260,743
PBF	14,201	16,667
SKJ	1,983,768	2,213,073
YFT	825,519	835,431
Grand Total	**4,609,209**	**4,985,608**

Source: Poseidon analysis based on data provided by RFMOs

Ex vessel prices for 2014 used in the estimation of 2014 ex vessel values were obtained from similar sources as those used for the 2012 estimate, as provided in the Phase 1 report.

Prices of frozen purse seine-caught tuna for canning used in the analysis for 2014 were 75% of those in 2012 for skipjack, 76% for yellowfin, and 78% for bigeye, and prices for frozen longline caught albacore for canning also fell in 2014 to 74% of 2012 prices[2]. These prices are derived from Thai import/customs data in Thai Baht and converted to US$, but are not significantly impacted by exchange rates as the US$/Thai Baht only changed by 6% over the period from US$1 : 30.8 Thai Baht in January 2012 to US$1 : 32.6 Thai Baht in December 2014[3].

Ex vessel longline prices for product destined for sashimi markets used in the modelling also declined between 2012 and 2014 in US$ terms by 19% for frozen albacore and 5% for frozen yellowfin, but increased slightly for frozen bigeye tuna by 1%. Fresh tuna import prices also declined in US$ terms by 2% for both albacore and yellowfin and 13% for bigeye. However, these declines were more strongly driven by gradual and consistent changes in the US$/Japanese Yen exchange rate, with US$1 being equivalent to less than 80 Japanese Yen in January 2012 but 120 Japanese Yen

[2] Based on Thai customs data (http://www.customs.go.th).

[3] http://www.oanda.com/currency/historical-rates/

by December 2014, a change of 44% over the period[4]. Price trends in Japanese Yen for Japanese frozen and fresh import prices (used as the basis for estimating ex vessel values and accounting for carriage insurance and freight costs) are provided in Figure 4 in Appendix 1 and show more consistent prices over the 2012 to 2014 period.

The Phase 3 analysis assumes that the market flows described in the Phase 1 report, and the percentages of catch going from different oceans and fishing methods to different market segments (e.g. canning, sashimi, domestic sales, and canning by-products), remained unchanged between 2012 and 2014.

2.3 METHODOLOGY FOR ESTIMATING FINAL GLOBAL CONSUMED VALUES IN 2014 AND ASSOCIATED PRICE CHANGES

With respect to the 2014 estimate of final consumed values of tuna, the Phase 2 report (and relevant tables in the Appendix of that report) provided price data for 2012 and 2014, so the Phase 3 model draws on the 2014 prices in the Phase 2 report and they are not presented again in this report.

The tables in the Appendix of the Phase 2 report showed that retailed canned prices changed very little between 2012 and 2014 (Tables 8 and 9 in the Phase 2 report), due largely to inventories and a desire by retailers to have consistent shelf prices. However prices used in the calculation of 2014 sales values were reduced from the 2015 averages collected from the survey of retail store prices by 0.75% to account for inflation of processed foods in the European area between 2014 and 2015.

Sashimi prices declined considerably over the period 2012 to 2014 (see Tables 11, 12, 14, 15, 16 and 17 in the Phase 2 report) in US$ terms. However, these declines were more strongly driven by gradual and consistent changes in the US$/Japanese Yen exchange rate as discussed above. Figure 2 and Figure 2 in Appendix 1 provide prices for frozen and fresh sashimi-grade tuna in Japan at the Tokyo market in Japanese Yen, to demonstrate that in Japanese Yen, prices in 2014 compared well against those in 2012.

Fish meal prices also rose slightly over 2012 to 2014 (Table 20 of the Phase 2 report), but given the small share of total consumed values being contributed by by-products of canning, these rises make little difference to the final estimate of global sales values.

The volume of tuna sold domestically is relatively small and contributes little to the total global consumed values, so while the Phase 2 reported acknowledged the uncertainty associated with the prices used, as the estimates of prices in 2012 are in any case best estimates, similar prices are used for 2014.

[4] http://www.oanda.com/currency/historical-rates/

3 PHASE 3 RESULTS AND DISCUSSION

Table 5 and Table 6 below provide the two main table outputs of the Phase 3 analysis, to compare with Table 1 and Table 2 provided earlier in this report (from the Phase 1 and Phase 2 analysis respectively).

Table 5: Summary of ex-vessel values of product by species, end market type and sub-ocean area, 2014 (US$)

Species	$	% of species total	Market segment	$	% by market segment	Ocean Area	$	% by ocean
ALB	686,819,488	7.0%	Canning	5,068,299,669	51.9%	WCPO	5,049,825,028	51.7%
BET	1,861,348,662	19.1%	Domestic	535,471,274	5.5%	EPO	1,114,071,945	11.4%
BFT	189,860,316	1.9%	Fresh sashimi	1,702,350,463	17.4%	WIO	1,564,568,259	16.0%
PBF	280,780,062	2.9%	Frozen sashimi	2,286,847,180	23.4%	EIO	756,150,912	7.7%
SBF	139,243,422	1.4%	Ranching	171,716,662	1.8%	EAO	821,675,744	8.4%
SKJ	3,367,005,550	34.5%	**Total**	**9,764,685,249**		WAO	319,149,938	3.3%
YFT	3,239,627,748	33.2%				Antartic	139,243,422	1.4%
Total	**9,764,685,249**					**Total**	**9,764,685,249**	

Source: Poseidon analysis

Table 6: Global sales value of tuna by species, value chain, ocean area, and fishing gear, 2014 (US$)

Species	US$	% of species total	Market segment	US$	% by market segment
ALB	$ 1,751,564,069	5.3%	Canning	$ 19,662,994,021	59.7%
BET	$ 4,674,873,615	14.2%	fish meal/pet food	$ 299,864,791	0.9%
BFT	$ 816,490,378	2.5%	Domestic	$ 1,433,360,476	4.3%
PBF	$ 766,353,222	2.3%	Fresh sashimi	$ 4,479,324,174	13.6%
SBF	$ 453,015,101	1.4%	Frozen sashimi	$ 7,085,296,117	21.5%
SKJ	$12,507,099,630	37.9%			
YFT	$11,991,443,563	36.4%			
Total	**$32,960,839,578**		**Total**	**$ 32,960,839,578**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$17,221,155,033	52.2%	Pole and line	$ 1,726,890,574	5.2%
EPO	$ 4,239,804,969	12.9%	Gillnet	$ 1,136,957,291	3.4%
WIO	$ 5,430,251,028	16.5%	Handline	$ 3,313,064,935	10.1%
EIO	$ 1,980,297,633	6.0%	Longline	$ 7,115,673,180	21.6%
EAO	$ 2,776,478,018	8.4%	Other	$ 466,725,904	1.4%
WAO	$ 859,837,796	2.6%	Purse seine	$ 18,212,338,770	55.3%
Antartic	$ 453,015,101	1.4%	Troll	$ 989,188,924	3.0%
Total	**$32,960,839,578**		**Total**	**$ 32,960,839,578**	

Source: Poseidon analysis. Note: The corresponding table showing values when the retail canned price of tuna is assumed in the analysis (rather than just value of the drained weight of tuna) is provided in Table 10 in Appendix 1 and shows a total consumed value of US$ 42.21 billion.

A comparison of the estimates for 2012 and 2014 are summarised below.

Table 7: Comparison of 2012 and 2014 ex vessel and final consumed values

	2012 (Phase 1 and 2 estimates)	2014 (Phase 3 estimates)
Ex vessel values	$ 12.21 billion	$ 9.76 billion
Final consumed values (using drained weight value of canned tuna)	$ 33.36 billion	$ 32.96 billion
Final consumed values (using total canned tuna sales price)	*$ 41.63 billion*	*$42.21 billion*

Source: Poseidon analysis. Notes: the 2014 value is lower than the 2012 value if using the drained weight, but higher if using the total can price given the importance of canned tuna in the overall sales values and the fact that canned retailed prices did not decline over 2012 to 2014. All prices are in nominal terms and have not been adjusted for inflation.

Some observations and comments on the results for 2012 and 2014 when comparing ex vessel values and the final consumed values (using the drained weight value of canned tuna) are:

- Declines in ex vessel and final consumed values are strongly driven by changes in US$ exchange rates with the Japanese Yen, given the methodology used which sourced a number of data sets in Japanese Yen and converted them into US$. The exchange rate changes mask the fact that sashimi prices actually rose between 2012 and 2014 in Japanese Yen reflecting strong and increasing global demand for sushi/sashimi products, and that total catch volumes increased between 2012 and 2014. However commodity prices of frozen skipjack tuna for canning did decline significantly in US$ and Thai Baht terms, also contributing to the fall in ex vessel values.

- The increase in catches of tuna in 2014 (and a 13% increase in catches of skipjack, the main tuna species used in canning), did not result in significant declines in shelf prices of canned tuna, meaning that increased catches fed through into increased values of canned tuna sales, with a rise from US$ 17.6 billion in 2012 to US$ 19.7 billion 2014. This suggests that retailer margins on canned tuna increased over the 2 year period. The absolute levels of margin obtained by retailers has not been the focus of this study however, and it is possible that 2012 retailer margins may have been small compared to historic levels due to high tuna commodity prices during that year and a desire not to increase shelf prices of canned tuna, with margins in 2014 returning to more ‘normal’ levels.

- Declines in sashimi US$ prices between 2012 and 2014 were typically between 13% and 30% for different species and product forms (i.e. frozen and fresh). These significant declines in US$ terms meant that increases in catches destined for sashimi markets in 2014 were not sufficient to offset weaker prices, meaning that the total value of sashimi sales fell from US$ 13.7 billion in 2012 to US$ 11.5 billion in 2014.

- These occurrences combined together to result in the proportion of total global consumed values attributed to the canned tuna market rising from 53% in 2012 to 60% in 2014, while conversely the share of total global consumed values attributable to sashimi markets fell from 41% to 35%.

- The changes in the proportion of global catch by ocean area highlighted in Table 4 resulted in some minor changes in the share of total global consumed values being sourced from different oceans. The Atlantic Ocean’s contribution to total global consumed values fell from 12% in 2012 to 11% in 2014. The Pacific Ocean’s contribution remained roughly constant. The contribution to total global consumed values being sourced from the Indian increased from 21.6% to 22.5%.

- The contribution of skipjack to total global consumed values (being the main input for canned tuna, for which prices held more steady in US$ terms compared to sashimi species/products), rose from 32% in 2012 to 38% in 2014. The share of total consumed values originating from purse seine fisheries (which catch most skipjack tuna) also therefore increased from 49% to 55%, while the share of final consumed values attributable to long line vessels fell from 27.2% to 21.6%.

- Final consumed values fell by US$ 0.4 billion while ex vessel values fell by US$ 2.45 billion. The ratio of total global consumed values to ex vessel values changed from 2.73:1 in 2012 to 3.37:1 in 2014. These estimates/data suggest that the catching sector was disproportionally impacted by falling prices over the 2 year period compared to the retail sector (i.e. retailers passed on to canned tuna consumers little of the falling prices paid to vessels for skipjack tuna).

- Comparison of tuna price data for 2012 and 2014, and as part of longer term price trends (e.g. see Tables 11 and 12 in Phase 2 report, and Figure 1 in the Appendix to this report), suggest that 2012 was an anomalous year in terms of high prices (especially for frozen tuna for canning). The apparent inverse relationship between increased catch volumes and decreased prices (observable at least for 2012 and 2014), *suggests* (again, based on 2012 and 2014 data estimates) that increases in supply may result in decreases in prices, resulting in final consumed values that may not change significantly between years. However, it is perhaps more likely given declines in global commodity prices more generally as reported by both the World Bank (for commodity prices)[5] and FAO (in their food index made up of key food types)[6] that declines in frozen tuna prices are to some extent independent of volumes of catch and more strongly linked to global economic performance and demand. If so, then the overall estimates of the values of ex vessel and final consumed values in 2012 may represent a 'high point'.

[5] http://www.worldbank.org/en/research/commodity-markets

[6] http://www.fao.org/worldfoodsituation/foodpricesindex/en/

Appendix 1: Additional data tables

Table 8: Final sales prices (US$/tonne) used in the Phase 3 analysis for 2014

Final consumed prices in $	BB/P&L							GN							HL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																					
For loining/canning	6,227	5,502				4,305	6,750	6,227	5,502				4,305	6,750							
Canning byproducts	255	255				255	255	255	255				255	255							
For domestic (fresh or processing)	3,000	4,000				3,500	5,500	3,000	4,000				3,500	5,500	3,000					3,500	
For fresh sashimi				46,666												17,438					
For frozen sashimi																					14,254
For ranching																					
EPO																					
For loining/canning						4,305	6,750														
Canning byproducts						255	255														
For domestic (fresh or processing)																					
For fresh sashimi																					
For frozen sashimi																					
For ranching																					
WIO																					
For loining/canning		5,502				4,305	6,750		5,502				4,305	6,750							
Canning byproducts		255				255	255		255				255	255							
For domestic (fresh or processing)		4,000				3,500	5,500		4,000				3,500	5,500							
For fresh sashimi															13,856	17,438				13,856	14,724
For frozen sashimi															15,114	15,114				15,114	14,254
EIO																					
For loining/canning						4,305	6,750	6,227	5,502				4,305	6,750							
Canning byproducts						255	255	255	255				255	255							
For domestic (fresh or processing)						3,500	5,500	3,000	4,000				3,500	5,500	3,000					3,500	
For fresh sashimi																					14,724
For frozen sashimi																					14,254
EAO																					
For loining/canning	6,227	5,502				4,305	6,750						4,305							4,305	
Canning byproducts	255	255				255	255						255							255	
For domestic (fresh or processing)														3,704	3,000	4,000	4,010				5,500
For fresh sashimi			46,666														46,666				
For frozen sashimi			57,645														57,645				
For ranching																					
WAO																					
For loining/canning	6,227	5,502				4,305	6,750														
Canning byproducts	255	255				255	255														
For domestic (fresh or processing)	6,904	4,000				3,500	5,500						3,500	3,704		4,000				3,500	
For fresh sashimi																	46,666				14,724
For frozen sashimi																					
For ranching																					
Antarctic																					
For ranching																					
For frozen sashimi																					

Final consumed prices in $	LL							Other						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO														
For loining/canning	6,227					4,305		6,227						
Canning byproducts	255					255		255						
For domestic (fresh or processing)													3,500	
For fresh sashimi		17,438					14,724		17,438		46,666			
For frozen sashimi	15,114	15,114		57,645			14,254							14,254
For ranching														
EPO														
For loining/canning	6,227	5,502					6,750	6,227					4,305	6,750
Canning byproducts	255	255					255	255					255	255
For domestic (fresh or processing)								3,000					3,500	5,500
For fresh sashimi		17,438					14,724				46,666			
For frozen sashimi		15,114					14,254							
For ranching														
WIO														
For loining/canning	6,227	5,502				4,305							4,305	6,750
Canning byproducts	255	255				255							255	255
For domestic (fresh or processing)														
For fresh sashimi														
For frozen sashimi	15,114	15,114					14,254							
EIO														
For loining/canning	6,227							6,227					4,305	
Canning byproducts	255							255					255	
For domestic (fresh or processing)						3,500	5,500	3,000					3,500	
For fresh sashimi		17,438					14,724		17,438					14,724
For frozen sashimi		15,114					14,254		15,114					14,254
EAO														
For loining/canning	6,227					4,305							4,305	
Canning byproducts	255					255							255	
For domestic (fresh or processing)			3,876					3,000						
For fresh sashimi			46,666											
For frozen sashimi		15,114	57,645				14,254			57,645				
For ranching														
WAO														
For loining/canning	6,227													
Canning byproducts	255													
For domestic (fresh or processing)								6,904	4,000				3,500	5,500
For fresh sashimi			46,666							46,666				
For frozen sashimi		15,114	57,645				14,254							
For ranching														
Antarctic														
For ranching														
For frozen sashimi					32,162									

Final consumed prices in $	PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO														
For loining/canning		5,502				4,305	6,750	6,227					4,305	
Canning byproducts		255				255	255	255					255	
For domestic (fresh or processing)													3,500	
For fresh sashimi				46,666					17,438					14,724
For frozen sashimi		15,114							15,114					14,254
For ranching											53,773			
EPO														
For loining/canning		5,502				4,305	6,750	6,227						
Canning byproducts		255				255	255	255						
For domestic (fresh or processing)								3,000						
For fresh sashimi														
For frozen sashimi				57,645										
For ranching				57,645										
WIO														
For loining/canning	6,227	5,502				4,305	6,750							
Canning byproducts	255	255				255	255							
For domestic (fresh or processing)								3,000	4,000				3,500	5,500
For fresh sashimi														
For frozen sashimi														
EIO														
For loining/canning		5,502				4,305	6,750	6,227	5,502				4,305	6,750
Canning byproducts		255				255	255	255	255				255	255
For domestic (fresh or processing)								3,000	4,000				3,500	5,500
For fresh sashimi														
For frozen sashimi														
EAO														
For loining/canning	6,227	5,502				4,305	6,750	6,227						
Canning byproducts	255	255				255	255	255						
For domestic (fresh or processing)								3,000						
For fresh sashimi														
For frozen sashimi														
For ranching			57,645											
WAO														
For loining/canning	6,227	5,502				4,305	6,750							
Canning byproducts	255	255				255	255							
For domestic (fresh or processing)													3,500	
For fresh sashimi														14,724
For frozen sashimi														
For ranching			57,645											
Antarctic														
For ranching					49,042									
For frozen sashimi														

Source: Poseidon analysis

Table 9: Consumed sale values (US$) estimated during the Phase 3 analysis for 2014

Total final sales values in $	BB/P&L							GN							HL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO																					
For loining/canning	146,148,388	17,312,443				384,074,978	89,009,449	144,615	12,306,507				211,940,785	25,269,813							
Canning byproducts	1,805,856	242,096				6,864,370	1,014,568	1,787	172,093				3,787,906	288,036							
For domestic (fresh or processing)	30,404,700	5,434,800				134,835,750	31,317,000	7,800	1,001,600				19,290,250	2,305,050	522,000					64,078,000	
For fresh sashimi				233,330												141,227,224					
For frozen sashimi																					797,993,244
For ranching																					
EPO																					
For loining/canning						0	0														
Canning byproducts						0	0														
For domestic (fresh or processing)																					
For fresh sashimi																					
For frozen sashimi																					
For ranching																					
WIO																					
For loining/canning		415,022				85,723,144	36,801,984		9,873,165				149,353,020	303,315,474							
Canning byproducts		5,804				1,532,085	419,485		138,066				2,669,308	3,457,320							
For domestic (fresh or processing)		912,000				210,661,500	90,638,625		1,808,000				30,585,800	62,252,300							
For fresh sashimi															3,038,680	64,356,996				259,171,132	1,163,238,592
For frozen sashimi															584,919	9,843,865				49,888,127	198,730,722
EIO																					
For loining/canning						4,531,837	1,633,001	20,703	443,146				14,026,841	3,078,417							
Canning byproducts						80,995	18,614	256	6,197				250,694	35,089							
For domestic (fresh or processing)						21,036,225	7,596,875	190,950	6,167,400				218,312,850	48,017,750	4,767,000					96,687,500	
For fresh sashimi																					105,039,411
For frozen sashimi																					237,275,522
EAO																					
For loining/canning	74,019,445	46,526,199				98,032,788	63,296,799						4,883,694							2,187,621	
Canning byproducts	914,608	650,619				1,752,088	721,484						87,284							39,098	
For domestic (fresh or processing)														1,167,557	48,000	888,000	0				6,721,000
For fresh sashimi			3,324,951														8,329,878				
For frozen sashimi			1,369,058														3,429,850				
For ranching																					
WAO																					
For loining/canning	616,468	710,726				113,921,670	3,137,707														
Canning byproducts	7,617	9,939				2,036,062	35,765														
For domestic (fresh or processing)	27,132	27,400				4,911,550	135,575						255,500	44,268		6,752,000				399,000	
For fresh sashimi																	39,666,086				48,161,468
For frozen sashimi																					
For ranching																					
Antarctic																					
For ranching																					
For frozen sashimi																					

Continued overleaf

Total final sales values in $	LL							Other						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO														
For loining/canning	452,301,640					8,485,579		2,626,556						
Canning byproducts	5,588,783					151,658		32,455						
For domestic (fresh or processing)													33,309,500	
For fresh sashimi		626,986,795					679,472,769		4,777,906		23,286,326			
For frozen sashimi	276,538,094	543,445,433		68,885,229			657,803,123							92,224,716
For ranching														
EPO														
For loining/canning	178,451,322	38,320,769					10,298,459	818,868					392,234	2,137,138
Canning byproducts	2,205,001	535,875					117,386	10,118					7,010	24,360
For domestic (fresh or processing)								397,500					2,891,700	1,754,500
For fresh sashimi		183,550,053					33,950,080				46,666			
For frozen sashimi		265,155,605					54,778,916							
For ranching														
WIO														
For loining/canning	109,269,684	0				294,816							85,454	1,165,712
Canning byproducts	1,350,171	0				5,269							1,527	13,287
For domestic (fresh or processing)														
For fresh sashimi														
For frozen sashimi	66,807,696	488,067,080					290,429,458							
EIO														
For loining/canning	99,450,690							376,988					16,234,117	
Canning byproducts	1,228,844							4,658					290,144	
For domestic (fresh or processing)						9,870,000	154,020,900	183,000					13,298,250	
For fresh sashimi		176,869,704					240,520,963		18,536,182					18,102,881
For frozen sashimi		153,303,121					33,264,329		16,066,373					17,525,547
EAO														
For loining/canning	16,161,046					269,180							803,267	
Canning byproducts	199,691					4,811							14,356	
For domestic (fresh or processing)			751,295					20,130,000						
For fresh sashimi			25,297,629											
For frozen sashimi		230,642,377	62,498,214				27,296,805			160,597,698				
For ranching														
WAO														
For loining/canning	72,653,636													
Canning byproducts	897,732													
For domestic (fresh or processing)			0					12,883,824	48,000				10,500	110,000
For fresh sashimi			8,903,870							5,506,586				
For frozen sashimi		332,587,517	21,997,158				155,128,530							
For ranching														
Antarctic														
For ranching														
For frozen sashimi					248,608,395									

Total final sales values in $	PS							TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO														
For loining/canning		316,849,971				7,188,870,267	2,572,497,679	17,514,495					162,548,821	
Canning byproducts		4,430,804				128,482,897	29,322,434	216,415					2,905,150	
For domestic (fresh or processing)													57,065,400	
For fresh sashimi				315,508,712					53,934,535					226,135,098
For frozen sashimi		219,240,240							46,748,157					218,923,231
For ranching											55,009,727			
EPO														
For loining/canning		325,464,963				1,118,015,575	1,560,237,958	107,421,207						
Canning byproducts		4,551,276				19,981,704	17,784,263	1,327,331						
For domestic (fresh or processing)								5,793,900						
For fresh sashimi														
For frozen sashimi				197,199,101										
For ranching				106,184,131										
WIO														
For loining/canning	3,967,645	122,863,024				587,098,642	995,805,769							
Canning byproducts	49,025	1,718,107				10,492,905	11,350,622							
For domestic (fresh or processing)								0	0				0	0
For fresh sashimi														
For frozen sashimi														
EIO														
For loining/canning		35,134,926				163,409,343	39,527,002	0	0				0	0
Canning byproducts		491,324				2,920,529	450,546	0	0				0	0
For domestic (fresh or processing)								0	0				0	0
For fresh sashimi														
For frozen sashimi														
EAO														
For loining/canning	370,808	134,767,615				762,048,542	491,856,593	20,607,651						
Canning byproducts	4,582	1,884,579				13,619,693	5,606,393	254,635						
For domestic (fresh or processing)								10,003,500						
For fresh sashimi														
For frozen sashimi														
For ranching			472,397,034											
WAO														
For loining/canning	191,584	660,759				4,618,787	17,291,388							
Canning byproducts	2,367	9,240				82,549	197,095							
For domestic (fresh or processing)													630,000	
For fresh sashimi														2,149,671
For frozen sashimi														
For ranching			2,421,071											
Antarctic														
For ranching					204,406,706									
For frozen sashimi														

Source: Poseidon analysis

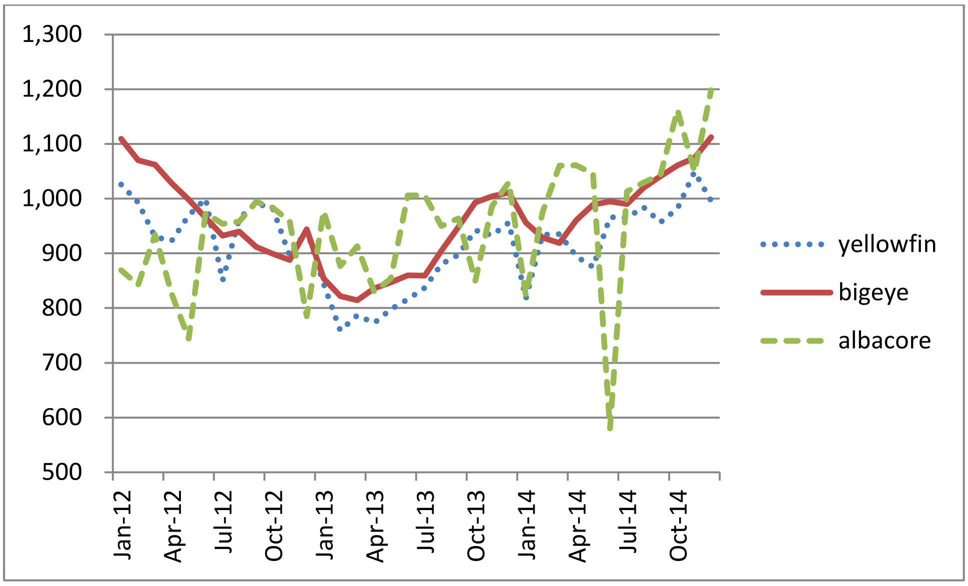
Table 10: Global sales value of tuna in 2014 by species, market segment, ocean area, and fishing gear (US$), using total retail price of canned tuna not just the value of the drained weight of tuna in cans

Species	US$	% of species total	Market segment	US$	% by market segment
ALB	$ 2,364,803,336	6%	Canning	$ 28,916,167,677	68%
BET	$ 5,174,473,255	12%	fish meal/pet food	$ 299,864,791	1%
BFT	$ 816,490,378	2%	Domestic	$ 1,433,360,476	3%
PBF	$ 766,353,222	2%	Fresh sashimi	$ 4,479,324,174	11%
SBF	$ 453,015,101	1%	Frozen sashimi	$ 7,085,296,117	17%
SKJ	$17,722,088,336	42%			
YFT	$14,916,789,605	35%			
Total	**$42,214,013,235**		**Total**	**$ 42,214,013,235**	
Ocean Area	**US$**	**% by ocean**	**Gear**	**US$**	**% by gear**
WCPO	$22,683,697,145	54%	Pole and line	$ 2,275,555,067	5%
EPO	$ 5,812,303,083	14%	Gillnet	$ 1,482,677,847	4%
WIO	$ 6,562,501,642	16%	Handline	$ 3,314,094,404	8%
EIO	$ 2,158,117,403	5%	Longline	$ 7,579,652,861	18%
EAO	$ 3,583,928,018	8%	Other	$ 478,321,355	1%
WAO	$ 960,450,843	2%	Purse seine	$ 25,949,538,224	61%
Antartic	$ 453,015,101	1%	Troll	$ 1,134,173,477	3%
Total	**$42,214,013,235**		**Total**	**$ 42,214,013,235**	

Figure 1: Purse seine frozen tuna import prices, Thailand (cif) 2005 to 2015 (US$/tonne)

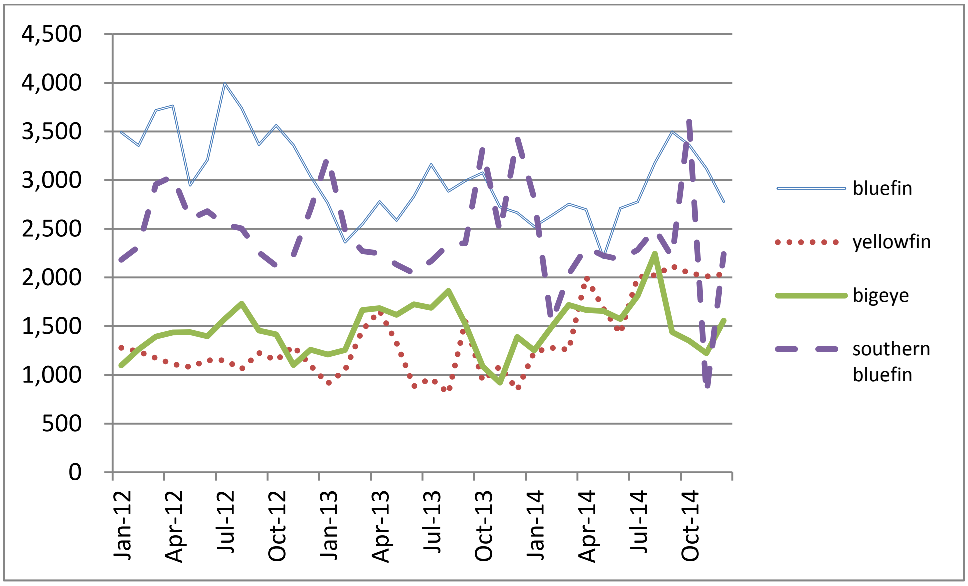
NB: prices based on weighted average value of imports to Thailand from various countries. Cif = carriage, insurance and freight (costs); source: http://www.customs.go.th. Prices in nominal terms

Figure 2: Prices of frozen tuna at Tokyo Tsukiji Market, 2012 – 2014 in Japanese Yen/kg



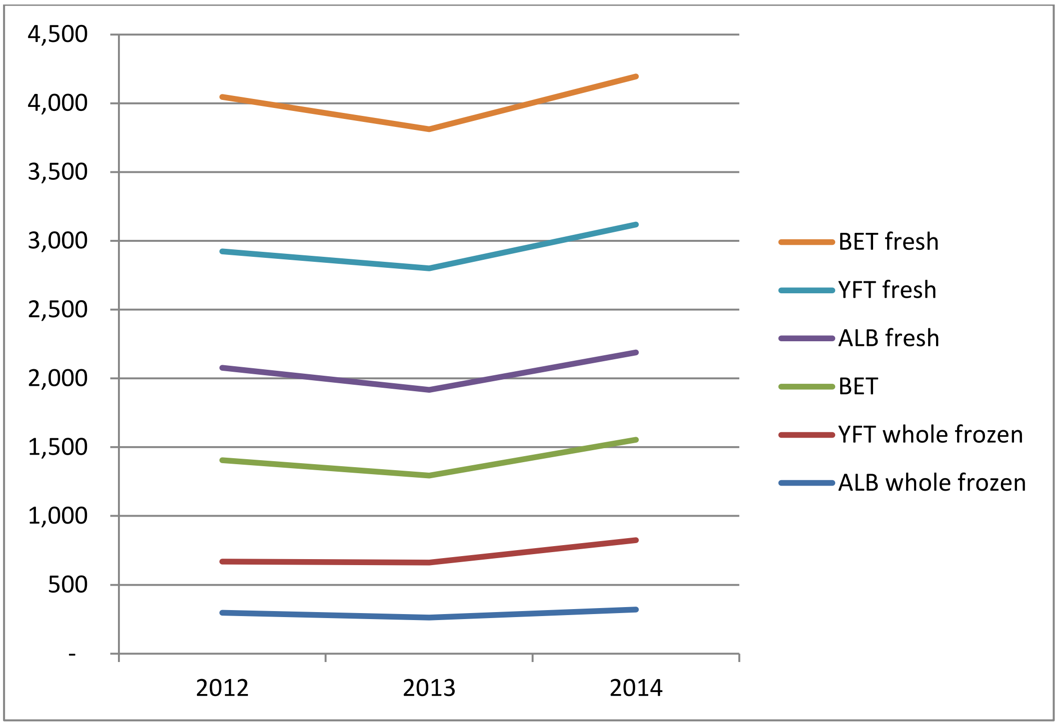
Source: http://www.shijou-tokei.metro.tokyo.jp/index.html. Prices in nominal terms.

Figure 3: Prices of fresh imported tuna at Tokyo Tsukiji Market, 2012 – 2014 in Japanese Yen/kg



Source: http://www.shijou-tokei.metro.tokyo.jp/index.html. Prices in nominal terms

Figure 4: Japanese tuna import prices in Japanese Yen/kg, 2012 to 2014



Source: http://www.customs.go.jp. Prices in nominal terms