Estimate of Global Sales Values from Tuna Fisheries

Study for
Pew Charitable Trusts

Phase 1 Report

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By

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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 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. 20º east to 80º east (and 77º east north of the equator), and north of the Antarctic Convergence at 45º 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.

[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%	

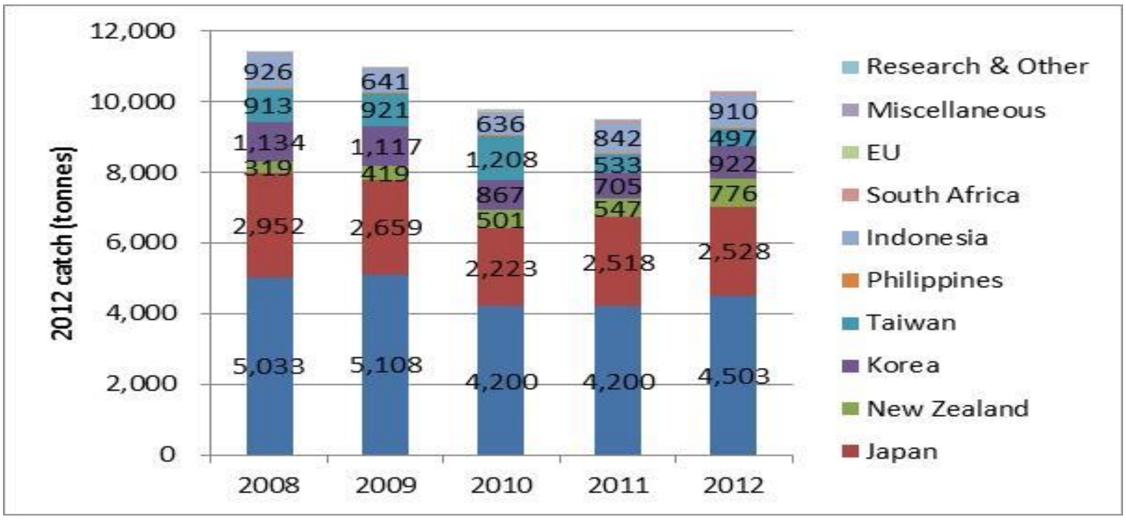
Source: Poseidon analysis from RFMO databases

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							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	**100%**	**100%**		**100%**		**100%**	**100%**	**100%**	**100%**				**100%**	**100%**	**100%**	**100%**				**100%**	**100%**	**100%**	**100%**		**100%**		**100%**	**100%**	**100%**	**100%**		**100%**	**0%**	**100%**	**100%**		**100%**		**100%**		**100%**	**100%**	**100%**	**100%**		**100%**		**100%**	**100%**
For loining/canning	70%	70%		0%		70%	70%	90%	90%				90%	90%	0%	0%				0%	0%	80%	0%		0%		100%	0%	100%	0%		0%		0%	0%		80%		0%		100%	100%	100%	0%		0%		70%	0%
For domestic (fresh or processing)	30%	30%		0%		30%	30%	10%	10%				10%	10%	100%	0%				100%	0%	0%	0%		0%		0%	0%	0%	0%		0%		100%	0%		0%		0%		0%	0%	0%	0%		0%		30%	0%
For fresh sashimi	0%	0%		100%		0%	0%	0%	0%				0%	0%	0%	100%				0%	0%	0%	50%		0%		0%	50%	0%	100%		100%		0%	0%		0%		100%		0%	0%	0%	50%		0%		0%	50%
For frozen sashimi	0%	0%		0%		0%	0%	0%	0%				0%	0%	0%	0%				0%	100%	20%	50%		100%		0%	50%	0%	0%		0%		0%	100%		20%		0%		0%	0%	0%	50%		0%		0%	50%
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%		100%		0%	0%
EPO						**100%**	**100%**															**100%**	**100%**					**100%**	**100%**			**100%**		**100%**	**100%**		**100%**		**65%**		**100%**	**100%**	**100%**						
For loining/canning						100%	100%															100%	20%					20%	50%			0%		10%	50%		100%		0%		100%	100%	90%						
For domestic (fresh or processing)						0%	0%															0%	0%					0%	50%			0%		90%	50%		0%		0%		0%	0%	10%						
For fresh sashimi						0%	0%															0%	30%					30%	0%			100%		0%	0%		0%		0%		0%	0%	0%						
For frozen sashimi						0%	0%															0%	50%					50%	0%			0%		0%	0%		0%		65%		0%	0%	0%						
For ranching						0%	0%															0%	0%					0%	0%			0%		0%	0%		0%		35%		0%	0%	0%						
WIO		**100%**				**100%**	**100%**		**100%**				**100%**	**100%**	**100%**	**100%**				**100%**	**100%**	**100%**	**100%**				**100%**	**100%**						**100%**	**100%**	**100%**	**100%**				**100%**	**100%**	**100%**	**100%**				**100%**	**100%**
For loining/canning		25%				25%	25%		80%				80%	80%	0%	0%				0%	0%	80%	0%				100%	0%						100%	100%	100%	100%				100%	100%	0%	0%				0%	0%
For domestic (fresh or processing)		75%				75%	75%		20%				20%	20%	0%	0%				0%	0%	0%	0%				0%	0%						0%	0%	0%	0%				0%	0%	100%	100%				100%	100%
For fresh sashimi		0%				0%	0%		0%				0%	0%	85%	85%				85%	85%	0%	0%				0%	0%						0%	0%	0%	0%				0%	0%	0%	0%				0%	0%
For frozen sashimi		0%				0%	0%		0%				0%	0%	15%	15%				15%	15%	20%	100%				0%	100%						0%	0%	0%	0%				0%	0%	0%	0%				0%	0%
EIO						**100%**	**100%**	**100%**	**100%**				**100%**	**100%**	**100%**	**0%**				**100%**	**100%**	**100%**	**100%**				**100%**	**80%**	**100%**	**100%**				**100%**	**100%**		**100%**				**100%**	**100%**	**100%**	**100%**				**100%**	**100%**
For loining/canning						15%	15%	5%	5%				5%	5%	0%	0%				0%	0%	100%	0%				0%	0%	50%	0%				50%	0%		100%				100%	100%	90%	90%				90%	90%
For domestic (fresh or processing)						85%	85%	95%	95%				95%	95%	100%	0%				100%	0%	0%	0%				100%	50%	50%	0%				50%	0%		0%				0%	0%	10%	10%				10%	10%
For fresh sashimi						0%	0%	0%	0%				0%	0%	0%	0%				0%	30%	0%	50%				0%	25%	0%	50%				0%	50%		0%				0%	0%	0%	0%				0%	0%
For frozen sashimi						0%	0%	0%	0%				0%	0%	0%	0%				0%	70%	0%	50%				0%	5%	0%	50%				0%	50%		0%				0%	0%	0%	0%				0%	0%
EAO	**100%**	**100%**	**100%**			**100%**	**100%**						**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**	**100%**		**100%**			**100%**		**100%**	**100%**	**100%**			**100%**	**100%**	**100%**						
For loining/canning	100%	100%	0%			100%	100%						100%	0%	0%	0%	0%			100%	0%	100%	0%	0%			100%	0%	0%		0%			100%		100%	100%	0%			100%	100%	50%						
For domestic (fresh or processing)	0%	0%	0%			0%	0%						0%	100%	100%	100%	0%			0%	100%	0%	0%	10%			0%	0%	100%		0%			0%		0%	0%	0%			0%	0%	50%						
For fresh sashimi	0%	0%	75%			0%	0%						0%	0%	0%	0%	75%			0%	0%	0%	0%	30%			0%	0%	0%		0%			0%		0%	0%	0%			0%	0%	0%						
For frozen sashimi	0%	0%	25%			0%	0%						0%	0%	0%	0%	25%			0%	0%	0%	100%	60%			0%	100%	0%		100%			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%	100%			0%	0%	0%						
WAO	**100%**	**100%**				**100%**	**100%**						**100%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**	**100%**	**100%**	**100%**			**0%**	**100%**	**100%**	**100%**	**100%**			**100%**	**100%**	**100%**	**100%**	**0%**			**100%**	**100%**						**100%**	**100%**
For loining/canning	95%	95%				95%	95%						0%	0%	0%	0%	0%			0%	0%	100%	0%	0%				0%	0%	0%	0%			0%	0%	100%	100%	0%			100%	100%						0%	0%
For domestic (fresh or processing)	5%	5%				5%	5%						100%	100%	100%	100%	0%			100%	0%	0%	0%	10%				0%	100%	100%	0%			100%	100%	0%	0%	0%			0%	0%						100%	0%
For fresh sashimi	0%	0%				0%	0%						0%	0%	0%	0%	100%			0%	100%	0%	0%	30%				0%	0%	0%	100%			0%	0%	0%	0%	0%			0%	0%						0%	100%
For frozen sashimi	0%	0%				0%	0%						0%	0%	0%	0%	0%			0%	0%	0%	100%	60%				100%	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%	100%			0%	0%						0%	0%
Antarctic																										**100%**														**100%**									
For ranching																										0%														100%									
For frozen sashimi																										100%														0%									

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						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**33,783**	**3,932**		**113**		**170,503**	**34,657**
For loining/canning	23,648	2,752		0		119,352	24,260
For domestic (fresh or processing)	10,135	1,180		0		51,151	10,397
For fresh sashimi	0	0		113		0	0
For frozen sashimi	0	0		0		0	0
For ranching	0	0		0		0	0
EPO						**303**	**413**
For loining/canning						303	413
For domestic (fresh or processing)						0	0
For fresh sashimi						0	0
For frozen sashimi						0	0
For ranching							
WIO		**716**				**61,374**	**13,864**
For loining/canning		179				15,344	3,466
For domestic (fresh or processing)		537				46,031	10,398
For fresh sashimi		0				0	0
For frozen sashimi		0				0	0
EIO						**7,350**	**2,728**
For loining/canning						1,103	409
For domestic (fresh or processing)						6,248	2,319
For fresh sashimi						0	0
For frozen sashimi						0	0
EAO	**14,558**	**9,541**	**282**			**45,086**	**6,529**
For loining/canning	14,558	9,541	0			45,086	6,529
For domestic (fresh or processing)	0	0	0			0	0
For fresh sashimi	0	0	212			0	0
For frozen sashimi	0	0	71			0	0
For ranching	0	0	0			0	0
WAO	**969**	**475**				**30,693**	**1,108**
For loining/canning	921	451				29,158	1,053
For domestic (fresh or processing)	48	24				1,535	55
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							

Volumes in tonnes	GN						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**26**	**365**				**21,093**	**1,030**
For loining/canning	23	329				18,984	927
For domestic (fresh or processing)	3	37				2,109	103
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		**1,491**				**30,302**	**48,549**
For loining/canning		1,193				24,242	38,839
For domestic (fresh or processing)		298				6,060	9,710
For fresh sashimi		0				0	0
For frozen sashimi		0				0	0
EIO	**114**	**1,633**				**62,408**	**14,093**
For loining/canning	6	82				3,120	705
For domestic (fresh or processing)	108	1,551				59,288	13,388
For fresh sashimi	0	0				0	0
For frozen sashimi	0	0				0	0
EAO						**4,946**	**604**
For loining/canning						4,946	0
For domestic (fresh or processing)						0	604
For fresh sashimi						0	0
For frozen sashimi						0	0
For ranching						0	0
WAO						**52**	**23**
For loining/canning						0	0
For domestic (fresh or processing)						52	23
For fresh sashimi						0	0
For frozen sashimi						0	0
For ranching						0	0
Antarctic							
For ranching							
For frozen sashimi							

Volumes in tonnes	HL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**378**	**3,037**				**11,051**	**37,499**
For loining/canning	0	0				0	0
For domestic (fresh or processing)	378	0				11,051	0
For fresh sashimi	0	3,037				0	0
For frozen sashimi	0	0				0	37,499
For ranching	0	0				0	0
EPO							
For loining/canning							
For domestic (fresh or processing)							
For fresh sashimi							
For frozen sashimi							
For ranching							
WIO	**221**	**69**				**2,457**	**73,307**
For loining/canning	0	0				0	0
For domestic (fresh or processing)	0	0				0	0
For fresh sashimi	188	59				2,088	62,311
For frozen sashimi	33	10				369	10,996
EIO	**340**	**115**				**4,863**	**8,052**
For loining/canning	0	0				0	0
For domestic (fresh or processing)	340	0				4,863	0
For fresh sashimi	0	0				0	2,416
For frozen sashimi	0	0				0	5,636
EAO	**17**	**267**	**191**			**982**	**1,337**
For loining/canning	0	0	0			982	0
For domestic (fresh or processing)	17	267	0			0	1,337
For fresh sashimi	0	0	143			0	0
For frozen sashimi	0	0	48			0	0
For ranching	0	0	0			0	0
WAO	**222**	**349**	**951**			**313**	**2,366**
For loining/canning	0	0	0			0	0
For domestic (fresh or processing)	0	349	0			313	0
For fresh sashimi	0	0	951			0	2,366
For frozen sashimi	0	0	0			0	0
For ranching	0	0	0			0	0
Antarctic							
For ranching							
For frozen sashimi							

Volumes in tonnes	LL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**100,422**	**79,420**		**210**		**1,973**	**79,632**
For loining/canning	80,338	0		0		1,973	0
For domestic (fresh or processing)	0	0		0		0	0
For fresh sashimi	0	39,710		0		0	39,816
For frozen sashimi	20,084	39,710		210		0	39,816
For ranching	0	0		0		0	0
EPO	**22,525**	**31,722**					**10,119**
For loining/canning	22,525	6,344					2,024
For domestic (fresh or processing)	0	0					0
For fresh sashimi	0	9,517					3,036
For frozen sashimi	0	15,861					5,060
For ranching	0	0					0
WIO	**9,474**	**53,652**				**1,552**	**23,323**
For loining/canning	7,579	0				1,552	0
For domestic (fresh or processing)	0	0				0	0
For fresh sashimi	0	0				0	0
For frozen sashimi	1,895	53,652				0	23,323
EIO	**21,459**	**33,512**				**6,687**	**49,550**
For loining/canning	21,459	0				0	0
For domestic (fresh or processing)	0	0				6,687	29,730
For fresh sashimi	0	16,756				0	17,343
For frozen sashimi	0	16,756				0	2,478
EAO	**2,471**	**16,796**	**1,715**			**347**	**5,395**
For loining/canning	2,471	0	0			347	0
For domestic (fresh or processing)	0	0	172			0	0
For fresh sashimi	0	0	515			0	0
For frozen sashimi	0	16,796	1,029			0	5,395
For ranching	0	0	0			0	0
WAO	**21,045**	**21,556**	**734**			**470**	**12,805**
For loining/canning	21,045	0	0			0	0
For domestic (fresh or processing)	0	0	73			0	0
For fresh sashimi	0	0	220			0	0
For frozen sashimi	0	21,556	440			0	12,805
For ranching	0	0	0			0	0
Antarctic					**5,811**		
For ranching					0		
For frozen sashimi					5,811		

Volumes in tonnes	Other						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**425**	**8,762**		**2,715**		**122,629**	**62,127**
For loining/canning	425	0		0		0	0
For domestic (fresh or processing)	0	0		0		122,629	0
For fresh sashimi	0	8,762		2,715		0	0
For frozen sashimi	0	0		0		0	62,127
For ranching	0	0		0		0	0
EPO	**1,126**			**38**		**1,039**	**528**
For loining/canning	563			0		104	264
For domestic (fresh or processing)	563			0		935	264
For fresh sashimi	0			38		0	0
For frozen sashimi	0			0		0	0
For ranching	0			0		0	0
WIO						**40**	**80**
For loining/canning						40	80
For domestic (fresh or processing)						0	0
For fresh sashimi						0	0
For frozen sashimi						0	0
EIO	**208**	**1,532**				**5,014**	**981**
For loining/canning	104	0				2,507	0
For domestic (fresh or processing)	104	0				2,507	0
For fresh sashimi	0	766				0	491
For frozen sashimi	0	766				0	491
EAO	**3,302**		**2,522**			**146**	
For loining/canning	0		0			146	
For domestic (fresh or processing)	3,302		0			0	
For fresh sashimi	0		0			0	
For frozen sashimi	0		2,522			0	
For ranching	0		0			0	
WAO	**3,564**	**33**	**100**			**7**	**330**
For loining/canning	0	0	0			0	0
For domestic (fresh or processing)	3,564	33	0			7	330
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							

Volumes in tonnes	PS						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO		**71,543**		**3,883**		**1,392,275**	**397,738**
For loining/canning		57,234		0		1,392,275	397,738
For domestic (fresh or processing)		0		0		0	0
For fresh sashimi		0		3,883		0	0
For frozen sashimi		14,309		0		0	0
For ranching		0		0		0	0
EPO		**75,731**		**6,667**		**256,504**	**198,017**
For loining/canning		75,731		0		256,504	198,017
For domestic (fresh or processing)		0		0		0	0
For fresh sashimi		0		0		0	0
For frozen sashimi		0		4,334		0	0
For ranching		0		2,333		0	0
WIO	**1,297**	**17,071**				**82,416**	**130,276**
For loining/canning	1,297	17,071				82,416	130,276
For domestic (fresh or processing)	0	0				0	0
For fresh sashimi	0	0				0	0
For frozen sashimi	0	0				0	0
EIO		**4,978**				**28,877**	**4,492**
For loining/canning		4,978				28,877	4,492
For domestic (fresh or processing)		0				0	0
For fresh sashimi		0				0	0
For frozen sashimi		0				0	0
EAO	**265**	**21,383**	**6,106**			**152,464**	**67,414**
For loining/canning	265	21,383	0			152,464	67,414
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	6,106			0	0
WAO	**333**	**87**	**2**			**5,202**	**3,302**
For loining/canning	333	87	0			5,202	3,302
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	2			0	0
Antarctic					**4,444**		
For ranching					4,444		
For frozen sashimi					0		

Volumes in tonnes	TR						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO	**3,575**	**273**		**570**		**6,235**	**3,935**
For loining/canning	3,575	0		0		4,365	0
For domestic (fresh or processing)	0	0		0		1,871	0
For fresh sashimi	0	137		0		0	1,968
For frozen sashimi	0	137		0		0	1,968
For ranching	0	0		570		0	0
EPO	**16,634**						
For loining/canning	14,971						
For domestic (fresh or processing)	1,663						
For fresh sashimi	0						
For frozen sashimi	0						
For ranching	0						
WIO	**8**	**148**				**10,592**	**8,688**
For loining/canning	0	0				0	0
For domestic (fresh or processing)	8	148				10,592	8,688
For fresh sashimi	0	0				0	0
For frozen sashimi	0	0				0	0
EIO	**541**	**673**				**9,749**	**2,866**
For loining/canning	487	606				8,774	2,579
For domestic (fresh or processing)	54	67				975	287
For fresh sashimi	0	0				0	0
For frozen sashimi	0	0				0	0
EAO	**5,959**						
For loining/canning	2,980						
For domestic (fresh or processing)	2,980						
For fresh sashimi	0						
For frozen sashimi	0						
For ranching	0						
WAO						**136**	**164**
For loining/canning						0	0
For domestic (fresh or processing)						136	0
For fresh sashimi						0	164
For frozen sashimi						0	0
For ranching						0	0
Antarctic							
For ranching							
For frozen sashimi							

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						
	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
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
For fresh sashimi				4,088,782										
For frozen sashimi														
For ranching														
EPO														
For loining/canning						476,913	934,206							
For domestic (fresh or processing)														
For fresh sashimi														
For frozen sashimi														
For ranching														
WIO														
For loining/canning		358,850				24,004,676	6,419,343		2,391,266				37,925,620	71,933,683
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														
For frozen sashimi														
EIO														
For loining/canning						2,021,434	925,610	19,676	163,688				4,881,819	1,305,075
For domestic (fresh or processing)						11,454,791	5,245,126	373,852	3,110,069				92,754,562	24,796,425
For fresh sashimi														
For frozen sashimi														
EAO														
For loining/canning	50,254,216	18,435,597				70,536,372	14,768,598						7,737,943	
For domestic (fresh or processing)														1,118,662
For fresh sashimi			7,652,897											
For frozen sashimi			883,680											
For ranching														
WAO														
For loining/canning	3,177,739	871,928				45,617,802	2,380,981							
For domestic (fresh or processing)	167,249	45,891				2,400,937	125,315						81,353	42,598
For fresh sashimi														
For frozen sashimi														
For ranching														
Antarctic														
For ranching														
For frozen sashimi														

Total ex vessel values in $	HL							LL						
	ALB	BET	BFT	PBF	SBF	SKJ	YFT	ALB	BET	BFT	PBF	SBF	SKJ	YFT
WCPO														
For loining/canning								277,325,395					3,086,729	
For domestic (fresh or processing)	1,304,856					17,289,124								
For fresh sashimi		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								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								26,762,155					2,428,081	
For domestic (fresh or processing)														
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								74,076,468						
For domestic (fresh or processing)	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						1,536,324		8,529,892					542,876	
For domestic (fresh or processing)	58,684	517,446	0				2,476,244			332,367				
For fresh sashimi			5,183,345							18,616,621				
For frozen sashimi			598,521						105,230,362	12,897,969				31,665,155
For ranching														
WAO														
For loining/canning		0	0					72,647,340						
For domestic (fresh or processing)		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)

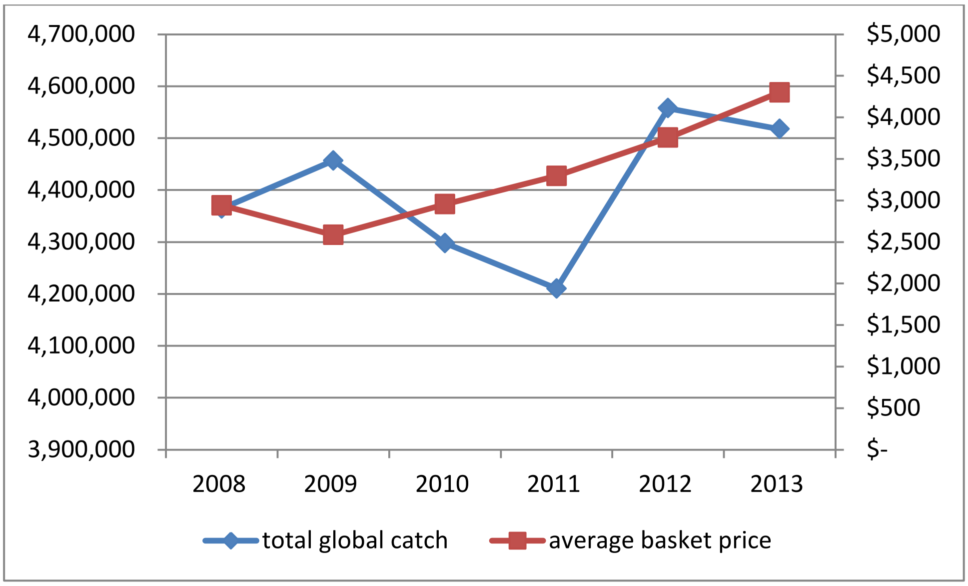
Year	Ecuador canning price froz skipjack	Ecuador canning price froz yellowfin	Ecuador canning froz price bigeye	Thai globefish canning price froz skipjack	Seychelles globefish canning price froz skipjack	Thai import canning price froz skipjack	Thai import canning price froz alabacore	Thai import canning 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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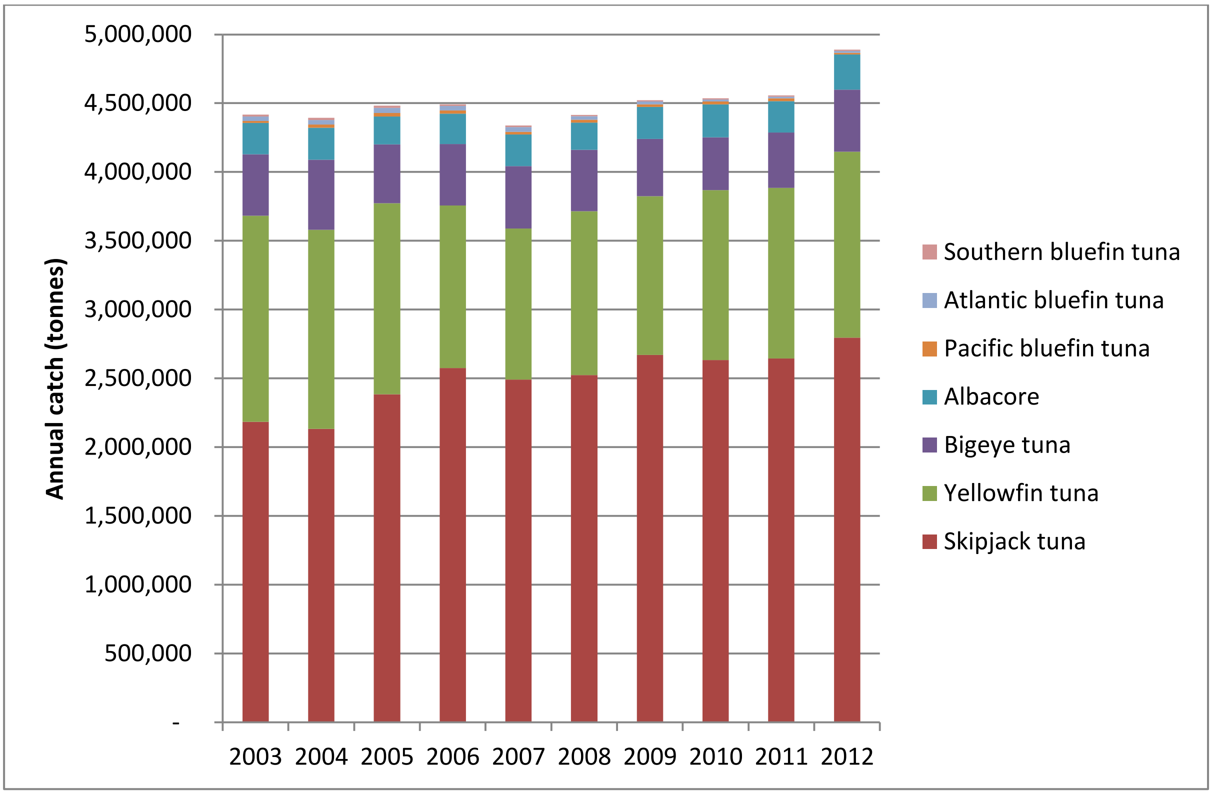
Appendix 1: Indonesian canned tuna exports

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