Electronic Monitoring (EM) Data Analysis Report Pacific Longline tuna (Thai Union) FIP

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1 Glossary

Acronym	Definition
EM	Electronic Monitoring
EPO	Eastern Pacific Ocean
ERA	Ecological risk assessment
ETP	Endangered, threatened and Protected (species)
FIP	Fishery Improvement Programme
IATTC	Inter American Tropical Tuna Commission
PSA	Productivity-susceptibility analysis
WCPO	Western and Central Pacific Ocean
WCPFC	Western and Central Pacific Fisheries Commission
MSC	Marine Stewardship Council

2 Executive Summary

This document presents the analysed catch data, retrieved from the Electronic Monitoring (EM) systems onboard the longline vessels within the Tunago Pacific Ocean fleet in line with the Marine Stewardship Council (MSC) Fisheries Standard for sustainable fishing (version 2.01). Within the Fisheries Standard, a fishery must be able to evidence catch data to pass Principle 2 requirements before reaching full certification. The fishery being assessed is the Pacific Ocean longline tuna fishery (Tunago, Thai Union) which targets albacore tuna (*Thunnus alalunga*). The fleet consists of Vanuatu and Chinese-flagged longline vessels, operating on the high seas of the Pacific Ocean and within the Vanuatu EEZ, and is managed by the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tunas Commission (IATTC).

The aim of this report is to analyse and describe the total catch data recorded from the EM systems onboard Vanuatu flagged longline vessels in the Tunago Pacific Ocean fishery to understand the impact that the fishery is having on both target and non-target species, including endangered, threatened, and protected (ETP) species.

Electronic monitoring systems were installed on four vessels within the Tunago longline fishery and monitored 17 fishing trips between April 2019 and September 2020. Of these 17 trips, 11 trips were extracted and analysed by the Digital Observer Services (DOS), a fisheries consultancy company and EM service provider. In total, Key Traceability received the EM reports from nine of the 11 trips analysed, which accounts for 12% of total fishing trips across the entire Tunago fishing fleet. The 12% coverage was further analysed and extrapolated by Key Traceability and is presented in this report. Species ID was recorded from the video footage by the third-party, however in the absence of specific albatross identification, Key Traceability obtained the footage to attempt this.

The main findings from this report show that:

- Albacore tuna was caught in the highest abundance of individuals, and yellowfin tuna was the target species contributing to the highest percentage of total weight (kg).
- Lancetfish (*Alepisaurus* spp.) contributed to the highest number of species caught from the secondary species catch, representing <5% of the total catch. However, blue shark (*Prionace glauca*), opah (*Lampris guttatus*), and swordfish (*Xiphias gladius*) were the top three contributors to the total catch weight (kg).
- Of the ETP species, seabirds, including albatross, and boobies & gannets, were caught in the highest abundance, but a variety of unspecified sharks and requiem sharks were caught in the highest weight (kg).

There were several weaknesses to the EM systems that limited the extent of the analysis able to be conducted on this catch data:

- The inability to record individual weights meant that contribution to total tuna catch by weight was unable to be analysed and, therefore, assessing whether a species constitutes to being a major or minor species in this fishery was not a possibility.
- Some of the species' identification could not be completed due to the image quality, influenced by poor weather conditions or a dirty lens.

It is a suggestion from Key Traceability that these issues should be repaired to improve the recording capability of the EM systems and, therefore, improve the reliability of the data, which will be beneficial for future assessments.

The optimal percentage coverage of EM catch data to represent true catch estimates is 20% (Linden, 2019), and due to the data in this report representing only 12%, it may be underestimating the impact the fishery is having on bycatch ETP species. To increase the percentage coverage of EM data to meet 20%, five more fishing trips need to be analysed across the vessels installed with EM systems.

3 Introduction

This report presents the results of an analysis conducted on the Electronic Monitoring (EM) data from Thai Union fishing vessels within the Pacific Ocean longline tuna fishery improvement project (FIP). The aim of this analysis is to provide critical information about the impact of the longline fishery on target catch rates of tuna, as well as bycatch rates of endangered, threatened, and protected (ETP) species, and non-target species, which is required to progress with Principle 2 actions of the workplan.

The FIP is the Thai Union Pacific Ocean longline tuna fishery, targeting albacore (*Thunnus alalunga*) and catching bigeye (*Thunnus obesus*) and yellowfin (*Thunnus albacares*). The pelagic longline vessels are flagged to China and Vanuatu and operate on the high seas in the Pacific Ocean. The fishery is regionally managed by the Western and Central Pacific Fisheries Commission (WCPFC) in the Western and Central Pacific Ocean (WCPO), and the Inter American Tropical Tuna Commission (IATTC) in the Eastern Pacific Ocean (EPO). The entire FIP scope can be found in Table 1 of this report.

In 2021, an environmental risk assessment (ERA) was produced and published using a productivity-susceptibility analysis (PSA) to assess the fishing mortality of non-target species encountered within the Pacific Ocean Tunago Fishery (Gilman, Chaloupka , & Sieben, 2021). The study found that the populations most at risk from fishing mortality (highest to lowest) were albatross, cetaceans, mesopelagic sharks, rays, turtles, epipelagic sharks, and teleost. The report highlighted that there was insufficient data available to indicate the condition of the individual upon both capture and release, if relevant, which could therefore alter the conclusions made. However, due to the individual life history traits of the above populations, it is likely that this would be an appropriate estimation of risk (Gilman, Chaloupka , & Sieben, 2021).

Table 1: FIP Scope

Species	Albacore (*Thunnus alalunga*), bigeye (*Thunnus obesus*), and yellowfin (*Thunnus albacares*)
Stocks	Pacific Ocean albacore, bigeye, and yellowfin stocks.
Fishing gear	Longline
Geographical area	Pacific Ocean (Northwest, Northeast, Western Central, Eastern Central, Southwest, Southeast)
Management	Western Central Pacific Fisheries Commission (WCPFC), Inter American Tropical Tuna Commission (IATTC).
Number of vessels used in this report	4
Name of vessels used in this report	Tunago No. 31. Tunago No. 51. Tunago No. 61. and Fortuna No. 12.
% coverage of entire fleet	12%

3.1 Data collection

The EM systems were deployed across four vessels within the Tunago longline fishery and 20% of the sets from the vessels were extracted from the systems by Digital Observer Services (DOS), a

fisheries consultancy company and EM service provider. However, upon review, the analysed data only represented 12% of the total fishing trips across the entire Tunago fishing fleet and increasing this coverage to 20% should be considered for future catch data.

A 2019 study researched the optimum percentage coverage of EM that a fleet could use to represent the most-accurate total catch data, whichs was 20% (Linden, 2019). To gain a catch estimate across the entire fishing fleet, we extrapolated the data to fulfil 100% of the vessels. It must be said that an extrapolation of this magnitude may not be totally accurate or provide entirely reliable data because of differences in fishing activity across the fleet. Seasonal fishing is prevalent in this fishery and different seasons can lead to interactions with varying numbers of species. As such, there is ambiguity in the scaled-up catch dataset.

The EM data represented target catch and bycatch data, portraying more than 16,000 data points between April 2019 and September 2020. The video footage was received and initially processed by Digital Observer Services (DOS), a consulting company composed of scientific observers with specific knowledge on marine biology and species ID. A review of the videos was performed, and the species were identified, the records were supplemented with environmental data, including geographic location, start/end hauling date and time, and set number. The fate and condition of the individuals were recorded by the observer and included reference to whether the animal was caught dead or alive; whether it was retained or discarded; and if it was dead or alive upon discard. To the best of the ability of the observer, the length of the individual was also recorded, which can be helpful in determining the age of the animal and whether it is an adult or juvenile. The data was provided to Key Traceability in the form of separate spreadsheets per vessel, per fishing trip, and data analysis to determine the contribution to total catch was completed.

4 Data Analysis

4.1 MSC Principle 2 definition summary

This section provides a short summary of how the MSC Fisheries Standard designates components for Principle 2 to provide context of the following species' category allocations and analysis.

The fishery's impact of non-target species is analysed differently if the species is from a "managed" stock or not considered ETP. These are defined as follows:

Primary species (MSC Component 2.1):

- Species in the catch that are not covered under P1.
- Species that are within scope of the MSC programme, i.e., no amphibians, reptiles, birds, or mammals.
- Species where management tools and measures are in place, intended to achieve stock management objectives reflected in either limit (LRP) or target reference points (TRP). Primary species can therefore also be referred to as 'managed species.

Non-target species (MSC Component 2.2):

- Species in the catch that are not covered under P1.
- Species that are not managed in accordance with limit or target reference points, i.e., do not meet the primary species criteria.
- Species that are out of scope of the programme, but where the definition of ETP species is not applicable (see below).

ETP (Endangered, Threatened or Protected) species (MSC Component 2.3) are assigned as follows:

- Species that are recognised by national ETP legislation.
- Species listed in binding international agreements (e.g., CITES, Convention on Migratory Species (CMS), ACAP, etc.).
- Species classified as 'out of scope' (amphibians, reptiles, birds, and mammals) that are listed in the IUCN Red List as vulnerable (VU), endangered (EN) or critically endangered (CE).

Both **primary** and **non-target** species are defined as 'main' if they meet the following criteria:

- The catch comprises 5% or more by weight of the total catch of all species by the UoC.
- The species is classified as 'less resilient' and comprises 2% or more by weight of the total catch of all species by the UoC. Less resilient is defined here as having low to medium productivity, or species for which resilience has been lowered due to anthropogenic or natural changes to its life-history.
- The species is out of scope but is not considered an ETP species (non-target species only).
- Exceptions to the rule may apply in the case of exceptionally large catches of bycatch species.

4.2 Data Review

The data presented in this report was retrieved from EM systems on four Tunago fishing vessels between 2019 and 2020 and represents 12% of the total catch from four vessels from the Pacific Ocean longline FIP (Figure 1). To understand the composition of the total catch, the EM data was scaled-up to estimate 100% coverage.

Table 2: Total number of target, non-target, ETP, and unknown individuals caught according to EM systems, and scaled up to represent total catch rates

Designation	Total number of individuals (EM)	Total number of individuals (scaled to 100%)
Target	10,349	86,242
Primary	805	6,708
Secondary	4,560	38,000
ETP	489	4,075
Unknown	305	2,542
Total	**16,508**	**137,567**

The EM data was unable to record the weights of the individuals caught by the four vessels. Key Traceability used online sources, including scientific research papers, to determine the average weights of each species that was caught, and then used this data across the entire species catch. There were 305 individual species that could not be identified and are reported as 'unknown', which could be due to a range of potential problems with the EM systems including, a dirty lens, bad weather conditions, or human misidentification. As a result, these species' weights could not be identified (Figure 2).

Table 3: The total weight (kg) of target, primary, secondary, and ETP species caught according to EM systems, and scaled up to represent the total catch.

Designation	Total weight (kg) (EM)	Total weight (kg) (scaled to 100%)
Target	374,657	3,122,142
Primary	27,627	230,225
Secondary	111,804	931,700
ETP	44,879	373,992

The two designation tables below (Table 4 and Table 5) Table *1*demonstrate the percentage composition of each species to the total catch and the designation of each to either Target, Primary, Secondary, or ETP categories. Table 4 shows how the species would be designated based on their total catch numbers, whereas Table 5 shows how the species would be designated based on their total weight (kg). Both tables are useful tools to identify the discrepancies with each other. For instance, sharks (Carcharhinidae) represented only 0.7% of the total catch by number (Table 4), but 2.46% of the total catch by weight (Table 5). Being an ETP species, this difference in composition is critical when considering the implications that the fishery may be having on the total population. This is a primary reason why weight data needs to be a priority for the EM systems reporting capacity.

Table 4: Total number of individuals from each species caught from EM data and scaled-up to represent the entire catch.

Species	Common name	Designation	Category	Justification	No. of individuals (EM)	No. of individuals (estimated total catch)	% EM catch
Thunnus alalunga	Albacore tuna	Target	Main	>5% total catch	7,307	60,891	44.26
Thunnus albacares	Yellowfin tuna	Target	Main	>5% total catch	1,621	13,508	9.82
Thunnus obesus	Bigeye tuna	Target	Main	>5% total catch	1,421	11,842	8.61
Thunnus spp.	Tunas	Primary	Minor	<5% total catch	486	4,050	2.94
Katsuwonus pelamis	Skipjack tuna	Primary	Minor	<5% total catch	319	2,658	1.93
Prionace glauca	Blue shark	Secondary	Minor	<5% total catch	599	4,992	3.63
Brama brama	Atlantic pomfret	Secondary	Minor	<5% total catch	506	4,217	3.07
Sphyraenidae	Barracuda	Secondary	Minor	<5% total catch	15	125	0.09
Makaira indica	Black marlin	Secondary	Minor	<5% total catch	5	42	0.03
Makaira nigricans	Blue marlin	Secondary	Minor	<5% total catch	1	8	0.01
Gasterochisma melampus	Butterfly kingfish	Secondary	Minor	<5% total catch	104	867	0.63
Lophotus lacepede	Crested oarfish	Secondary	Minor	<5% total catch	1	8	0.01
Squaliformes	Dogfish	Secondary	Minor	<5% total catch	2	17	0.01

Lepidocybium flavobrunneum	Escolar	Secondary	Minor	<5% total catch	315	2,625	1.91
Sphyraena barracuda	Great barracuda	Secondary	Minor	<5% total catch	84	700	0.51
Trichiurus spp.	Hair tails	Secondary	Minor	<5% total catch	1	8	0.01
Istiophorus platypterus	Indo-Pacific sailfish	Secondary	Minor	<5% total catch	32	267	0.19
Alepisaurus spp.	Lancetfish	Secondary	Minor	<5% total catch	767	6,392	4.65
Alepisaurus ferox	Long snouted lancetfish	Secondary	Minor	<5% total catch	8	67	0.05
Coryphaena hippurus	Mahi-mahi	Secondary	Minor	<5% total catch	79	658	0.48
Istiophoridae	Marlin/sailfish	Secondary	Minor	<5% total catch	21	175	0.13
Regalecidae	Oarfish spp.	Secondary	Minor	<5% total catch	1	8	0.01
Lagocephalus lagocephalus	Oceanic puffer	Secondary	Minor	<5% total catch	4	33	0.02
Ruvettus pretiosus	Oilfish	Secondary	Minor	<5% total catch	29	242	0.18
Lampris guttatus	Opah	Secondary	Minor	<5% total catch	487	4,058	2.95
Dasyatis violacea	Pelagic stingray	Secondary	Minor	<5% total catch	604	5,033	3.66
Bramidae	Pomfrets	Secondary	Minor	<5% total catch	70	583	0.42
Elagatis bipinnulata	Rainbow runner	Secondary	Minor	<5% total catch	6	50	0.04

Assurger anzac	Razorback scabbardfish	Secondary	Minor	<5% total catch	14	17	0.08
Carangidae	Ray-finned fish	Secondary	Minor	<5% total catch	2	117	0.01
Trachipteridae	Ribbonfishes	Secondary	Minor	<5% total catch	1	8	0.01
Scombridae	Scomber mackerel spp.	Secondary	Minor	<5% total catch	1	8	0.01
Tetrapturus angustirostris	Shortbill spearfish	Secondary	Minor	<5% total catch	61	508	0.37
Alepisaurus brevirostris	Short-snouted lancetfish	Secondary	Minor	<5% total catch	29	242	0.18
Tetrapturus angustirostris	Sickle pomfret	Secondary	Minor	<5% total catch	204	1,700	1.24
Gempylus serpens	Snake mackerel	Secondary	Minor	<5% total catch	140	1,167	0.85
Thyrsites atun	Snoek	Secondary	Minor	<5% total catch	3	25	0.02
Tetrapturus audax	Striped marlin	Secondary	Minor	<5% total catch	97	808	0.59
Loliginidae	Various squids nei	Secondary	Minor	<5% total catch	1	8	0.01
Mola mola	Sunfish	Secondary	Minor	<5% total catch	7	58	0.04
Xiphias gladius	Swordfish	Secondary	Minor	<5% total catch	124	1,033	0.75
Lophotus capellei	Unicornfish	Secondary	Minor	<5% total catch	6	50	0.04
Scymnodon squamulosus	Velvet dogfish	Secondary	Minor	<5% total catch	9	45	0.05

Acanthocybium solandri	Wahoo	Secondary	Minor	<5% total catch	120	1,000	0.73
Unknown	Unknown	Secondary	Minor	<5% total catch	305	2,542	1.85
Carcharhinidae	Requiem sharks	ETP	N/a	CMS Appendix I; CITES Appendix II; IUCN Red List as Vulnerable and Critical; Kiribati shark sanctuary	128	1,067	0.78
Sulidae	Boobies and Gannets	ETP	N/a	CITES Appendix I; IUCN Red List as Least Concern and Endangered	100	833	0.61
Selachimorpha	Sharks	ETP	N/a	CMS Appendix I; CITES Appendix II; IUCN Red List as Vulnerable and Critical	100	833	0.61
Isurus oxyrhinchus	Shortfin Mako	ETP	N/a	CMS Appendix II; Endangered on IUCN Red List	57	475	0.35
Carcharhinus falciformes	Silky shark	ETP	N/a	CMM 2013-08; CMS Appendix II; CITES Appendix II; Vulnerable on IUCN Red List	29	242	0.18
Diomedeidae	Albatross	ETP	N/a	CMS Appendix II	21	175	0.13
Isurus spp.	Mako	ETP	N/a	CMS Appendix II; Endangered on the IUCN Red List	18	150	0.11

Laridae	Gulls	ETP	N/a	CITES Appendix I; IUCN Red List as Least Concern to Vulnerable	13	108	0.08
Carcharhinus longimanus	Oceanic whitetip	ETP	N/a	CMM 2011-03; CITES Appendix II; Critical on IUCN Red List	4	33	0.02
Pseudocarcharias kamoharai	Crocodile shark	Secondary but ETP in Kiribati	N/a	Kiribati shark sanctuary	3	25	0.02
Alopias vulpinus	Thresher shark	ETP	N/a	CITES Appendix II; CMS Appendix II; Vulnerable on IUCN Red List	3	25	0.02
Isurus paucus	Longfin mako shark	ETP	N/a	CMS Appendix II; Endangered on the IUCN Red List	2	17	0.01
Testudinata	Marine turtles	ETP	N/a	CMS Appendix I; CITES Appendix I and II; IUCN Red List as Vulnerable and Critical	2	17	0.01
Lepidochelys olivacea	Olive Ridley turtle	ETP	N/a	CMM 2008-03; CMS Appendix I; CITES Appendix I; Vulnerable on IUCN Red List	2	17	0.01
Phoebastria immutabilis	Laysan albatross	ETP	N/a	CMS Appendix II; Near Threatened on IUCN Red List	2	17	0.01
Alopias superciliosus	Bigeye thresher	ETP	N/a	CMS Appendix II; CITES Appendix II; Vulnerable on IUCN Red List	1	8	0.01

Dalatias licha	Kitefin shark	Secondary but ETP in Kiribati	N/a	Kiribati shark sanctuary; Vulnerable on IUCN Red List	1	8	0.01
Mobula spp.	Mobula	ETP	N/a	CMS Appendix II; CITES Appendix II; Vulnerable on IUCN Red List	1	8	0.01
Sphyrna zygaena	Smooth hammerhead	ETP	N/a	CMS Appendix II; CITES Appendix II; Vulnerable on IUCN Red List	1	8	0.01

Table 5: Individual species' weight composition for recorded EM catch and scaled-up total catch

Species	Common name	Designation	Category	Justification	EM total weight (kg)	Scaled weight (kg)	% EM composition (by weight)
Thunnus albacares	Yellowfin tuna	Target	Main	>5% total catch	256,928.5	2,141,069.98	46.07%
Thunnus alalunga	Albacore tuna	Target	Main	>5% total catch	82,203.75	685,030.976	14.74%
Thunnus obesus	Bigeye tuna	Target	Main	>5% total catch	35,525	296,041.548	6.37%
Thunnus spp.	Tunas	Primary	Minor	<5% total catch	24,756.84	206,306.917	4.44%
Katsuwonus pelamis	Skipjack tuna	Primary	Minor	<5% total catch	2,871	23,924.9904	0.51%
Prionace glauca	Blue shark	Secondary	Minor	<5% total catch	24,559	204,658	4.40%
Lampris guttatus	Opah	Secondary	Minor	<5% total catch	22,109.8	184,248	3.96%

Xiphias gladius	Swordfish	Secondary	Minor	<5% total catch	17,050	142,083	3.06%
Tetrapturus audax	Striped marlin	Secondary	Minor	<5% total catch	8,138.3	67,819	1.46%
Lepidocybium flavobrunneum	Escolar	Secondary	Minor	<5% total catch	7,875	65,625	1.41%
Mola mola	Sunfish	Secondary	Minor	<5% total catch	7,864.5	65,537	1.41%
Dasyatis violacea	Pelagic stingray	Secondary	Minor	<5% total catch	7,248	60,400	1.30%
Istiophorus platypterus	Indo-Pacific sailfish	Secondary	Minor	<5% total catch	2,470.4	20,587	0.44%
Istiophoridae	Marlin/sailfish	Secondary	Minor	<5% total catch	2,142	17,850	0.38%
Brama brama	Atlantic pomfret	Secondary	Minor	<5% total catch	1,771	14758	0.32%
Alepisaurus spp.	Lancetfish	Secondary	Minor	<5% total catch	1,725.75	14,381	0.31%
Acanthocybium solandri	Wahoo	Secondary	Minor	<5% total catch	1,360.8	11,340	0.24%
Tetrapturus angustirostris	Sickle pomfret	Secondary	Minor	<5% total catch	1,122	9,350	0.20%
Gasterochisma melampus	Butterfly kingfish	Secondary	Minor	<5% total catch	1,081.6	9,013	0.1935%
Ruvettus pretiosus	Oilfish	Secondary	Minor	<5% total catch	870	7,250	0.16%
Tetrapturus angustirostris	Shortbill spearfish	Secondary	Minor	<5% total catch	830.21	6,918	0.15%
Coryphaena hippurus	Mahi-mahi	Secondary	Minor	<5% total catch	790	6,583	0.14%

Sphyraena barracuda	Great barracuda	Secondary	Minor	<5% total catch	499.8	4,165	0.09%
Gempylus serpens	Snake mackerel	Secondary	Minor	<5% total catch	420	3,500	0.08%
Makaira indica	Black marlin	Secondary	Minor	<5% total catch	340	2,833	0.06%
Alepisaurus brevirostris	Short-snouted lancetfish	Secondary	Minor	<5% total catch	261	2,175	0.05%
Bramidae	Pomfrets	Secondary	Minor	<5% total catch	245	2,042	0.04%
Lophotus lacepede	Crested oarfish	Secondary	Minor	<5% total catch	240	2,000	0.04%
Regalecidae	Oarfish spp.	Secondary	Minor	<5% total catch	240	2,000	0.04%
Assurger anzac	Razorback scabbardfish	Secondary	Minor	<5% total catch	145.6	1,213	0.026%
Makaira nigricans	Blue marlin	Secondary	Minor	<5% total catch	136	1,133	0.02%
Sphyraenidae	Barracuda	Secondary	Minor	<5% total catch	89.25	744	0.02%
Lophotus capellei	Unicornfish	Secondary	Minor	<5% total catch	51.54	429	0.009%
Elagatis bipinnulata	Rainbow runner	Secondary	Minor	<5% total catch	47.4	395	0.008%
Alepisaurus ferox	Long snouted lancetfish	Secondary	Minor	<5% total catch	18	150	0.003%
Thyrsites atun	Snoek	Secondary	Minor	<5% total catch	18	150	0.003%
Carangidae	Ray-finned fish	Secondary	Minor	<5% total catch	15.8	132	0.003%

Lagocephalus lagocephalus	Oceanic puffer	Secondary	Minor	<5% total catch	12.8	107	0.002%
Scymnodon squamulosus	Velvet dogfish	Secondary	Minor	<5% total catch	11.7	97	0.002%
Squaliformes	Dogfish	Secondary	Minor	<5% total catch	1.36	11	0.0002%
Trichiurus spp.	Hair tails	Secondary	Minor	<5% total catch	1	8	0.0002%
Trachipteridae	Ribbonfishes	Secondary	Minor	<5% total catch	1	8	0.0002%
Scombridae	Scomber mackerel spp.	Secondary	Minor	<5% total catch	0.55	5	0.0001%
Loliginidae	Various squids nei	Secondary	Minor	<5% total catch	0.096	1	0.00002%
Selachimorpha	Sharks	ETP	Main	>2% total catch	13,730	114,417	2.46%
Carcharhinidae	Requiem sharks	ETP	Main	>2% total catch	13,696	114,133	2.46%
Isurus oxyrhinchus	Shortfin Mako	ETP	Minor	<2% total catch	7,239	60,325	1.30%
Carcharhinus falciformes	Silky shark	ETP	Minor	<2% total catch	55,24.79	46,040	0.99%
Mobula spp.	Mobula	ETP	Minor	<2% total catch	1315	10,958	0.24%
Isurus spp.	Mako	ETP	Minor	<2% total catch	1260	10,500	0.23%
Alopias vulpinus	Thresher shark	ETP	Minor	<2% total catch	690	5,750	0.12%
Carcharhinus longimanus	Oceanic whitetip	ETP	Minor	<2% total catch	360	3,000	0.06%

Sphyrna zygaena	Smooth hammerhead	ETP	Minor	<2% total catch	340.2	2,835	0.06%
Alopias superciliosus	Bigeye thresher	ETP	Minor	<2% total catch	160	1,333	0.03%
Isurus paucus	Longfin mako shark	ETP	Minor	<2% total catch	140	1,167	0.025%
Sulidae	Boobies and Gannets	ETP	Minor	<2% total catch	135	1,125	0.02%
Testudinata	Marine turtles	ETP	Minor	<2% total catch	68.46	570	0.01%
Lepidochelys olivacea	Olive Ridley turtle	ETP	Minor	<2% total catch	68.46	570	0.01%
Diomedeidae	Albatross	ETP	Minor	<2% total catch	57.75	481	0.01%
Sphyrna lewini	Scalloped hammerhead	ETP	Minor	<2% total catch	54.5	454	0.01%
Pseudocarcharias kamoharai	Crocodile shark	ETP	Minor	<2% total catch	15	125	0.003%
Laridae	Gulls	ETP	Minor	<2% total catch	11.7	97	0.002%
Dalatias licha	Kitefin shark	ETP	Minor	<2% total catch	8	67	0.001%
Phoebastria immutabilis	Laysan albatross	ETP	Minor	<2% total catch	5.5	46	0.001%
Unknown	Unknown	Secondary	Minor	<5% total catch	0	0	0.000%

5 Catch data

5.1 Catch composition

Total data was initially separated by target and bycatch species. From this, the total numbers of each target species; albacore, bigeye, and yellowfin tuna, were determined. Likewise, the bycatch data was split into target, primary, secondary and ETP species as per MSC classifications. Primary species include the commercial species that are caught and sold, but not the target for this fishery. In this report, the primary species accounts for skipjack and unidentified tunas, and contributes 4.9% of the total catch (Figure 1).

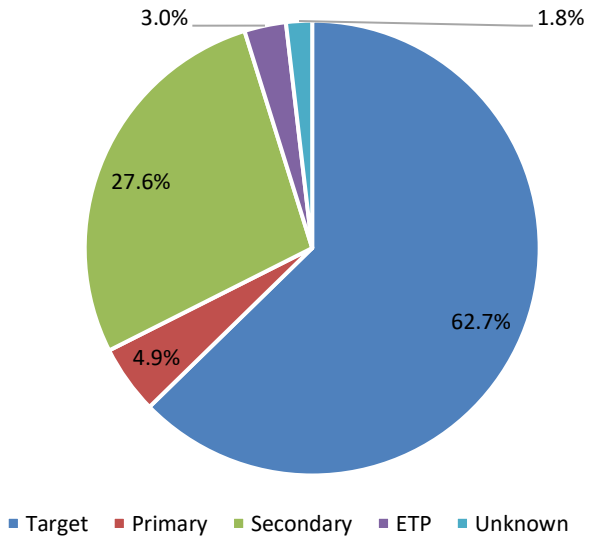

Figure 1: Percentage composition of target, primary, secondary, ETP, and unknown individuals caught according to EM systems

The number of target species individuals contributed the largest majority to the total catch data (62.7%), with secondary species individuals contributing 27.6%, and ETP species, 3%. The species that could not be identified from the EM recordings, are referred to, collectively as 'unknown' and represents the smallest proportion of the total catch (1.8%). This failure to identify the species could be for a range of issues such as bad weather, a dirty camera lens, or human error. The DOS report noted next to some of the unknown or unspecified species individuals that a dirty lens was the reason for the ambiguity of data. Most unknown or unspecific species did not have an explanation as to why the specific species was not identified and therefore it is likely that this was a human error made by the observers who couldn't identify to specifics.

Using the average weight data from the online searches, a similar percentage composition can be seen for each of the designations (Figure 2). The largest percentage derives from the target species, followed by the secondary species. Unlike the total catch number data, ETP species contributed a higher percentage to the total catch weight than primary species (8% and 4.9%, respectively).

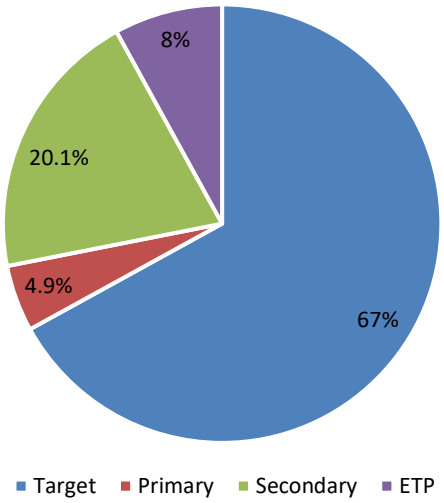

Figure 2: Percentage composition of the total weights of target, primary, secondary, and ETP species to the total catch weight (kg)

5.1.1 Target species catch

The albacore, bigeye, and yellowfin tuna catch contributed the largest proportion to the entire fishery catch by both number and weight (>60% in both).

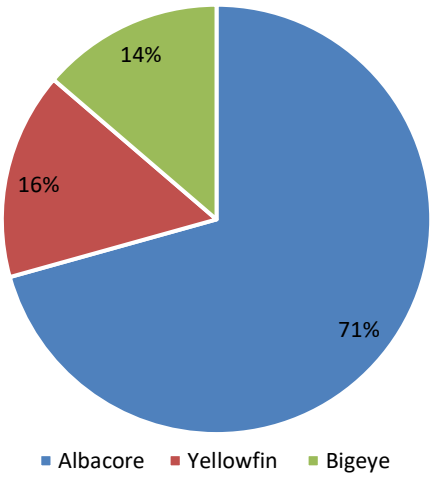

Figure 3: Percentage composition of species to the total number of target catch individuals.

The highest number of target tunas caught were albacore (70%) (Figure 3). However, due to their larger size, the yellowfin tuna contribution to total weight was the highest across the target species (69%), with albacore and bigeye tuna contributing 22% and 9%, respectively (Figure 4).

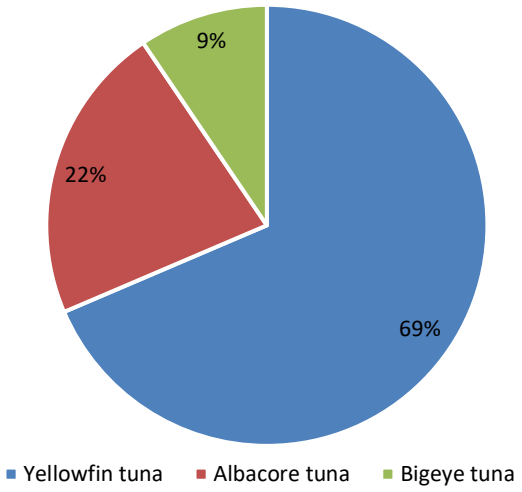

Figure 4: Percentage composition of target species (yellowfin, albacore, and bigeye tuna) to the total catch by weight (kg)

5.1.2 Secondary species catch

The secondary species reported contribute to 20% of the total catch.

The largest contributors within the secondary species group derives from the blue shark (*Prionace glauca*) (22%), opah (*Lampris guttatus*) (20%), and swordfish (*Xiphias* gladius) (15%). The remaining 43% of the total non-target species catch consists of 38 different species (Figure 5).

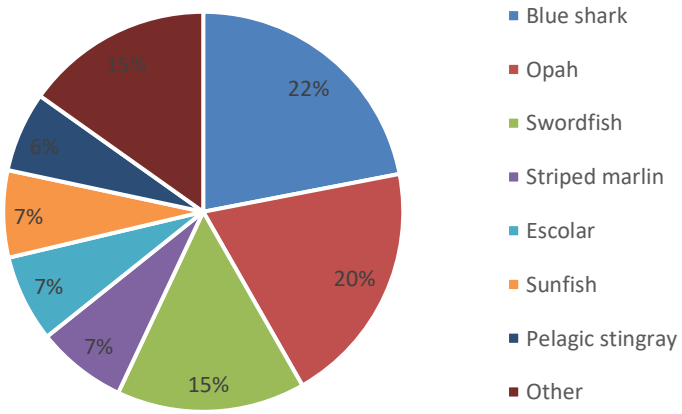

Figure 5: Percentage composition of species to the total secondary species catch by weight (kg)

5.1.3 ETP species catch

The percentage composition of ETP species to the total catch weight from this dataset represent 8%. Specific reference to the species contributing to the ETP species catch data, as well as the importance of these species and next steps in mitigation, can be found in the ETP species report.

5.1.4 Primary species catch

There were two other tunas recorded in this dataset, skipjack, and unidentified tuna, which, collectively, represent 4.9% of the entire species catch weight (kg). Due to their smaller catch rates of both species, these two species records are designated as minor primary species.

5.1.5 Unknown species catch

There were several species recorded by the EM systems that could not be identified, mostly due to either the weather conditions, or a dirty lens. However, it is also noteworthy that reasons for an unidentified species were only sporadic, meaning that there is ambiguity over whether it was solely due to weather conditions/dirty lens, or human error. Either way, improvements need to be made to improve the number of unknown species records.

The inability to identify the species also means that their weights could not be included in the weight data. With 305 individuals, this contributes to 1.85% of the entire catch, by number so is still significant to the data. Likewise, if these species were ETP, then their unreported catch could have severe consequences to their populations on a large scale.

5.2 Species Fates

Using the data from the composition analysis, the percentage composition of species' fates; retained or discarded, were determined (Figure 6). A majority percentage of individuals that were retained, occupied 86% of the total catch, by weight (kg). Of the remaining 14% that were discarded, 50% were discarded dead, 48% were discarded alive (Figure 7).

Where an individual was discarded and its condition could not be/was not monitored, it is hereafter referred to as 'discarded unknown' and contributes to 2% of the total discarded catch.

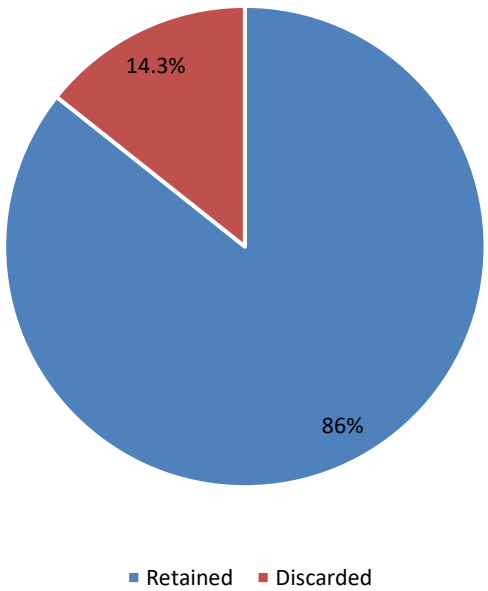

Figure 6: Percentage composition of retained or discarded species from the total EM catch data, by weight (kg)

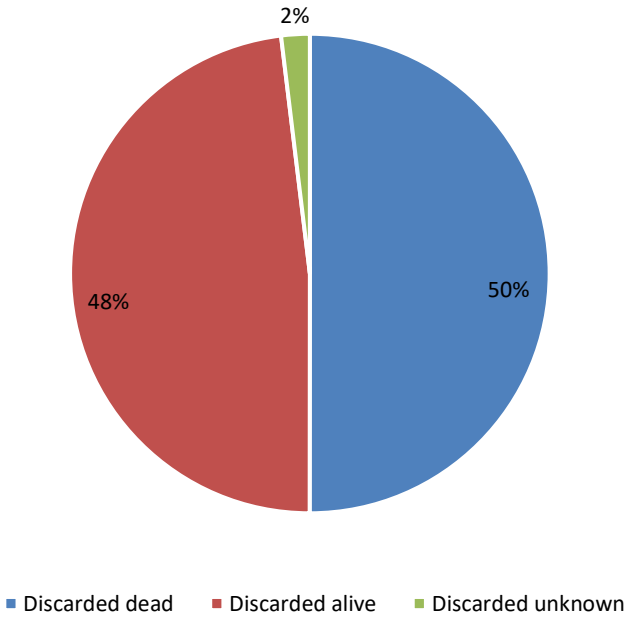

Figure 7: Percentage composition of species' fates when discarded: dead, alive, or unknown, by weight (kg).

After removing the target species from the total catch composition data, to identify whether the retained tuna species were impacting the fate results, it was found that the retained species were still contributing the majority percentage of the total catch in both number and weight.

There was no reference to poor crew handling on board the vessel as a reason for the number of dead discards mentioned in the fishing report. However, 14,167 kg of animals were alive when they were hauled on board the vessel but dead upon discard, which infers a possibility that these animals may have been mis-handled between capture and discard. Of this weight of discarded animals, 55% of them were ETP species, consisting of eight silky sharks, six mako sharks, one crocodile shark, and 48 unidentified sharks.

6 Conclusion

The information presented in this report represents the catch data from the Tunago Pacific Ocean longline tuna fishery. The original data received represented 12% of the total fishing trips from Electronic Monitoring (EM) systems on board the vessels. This EM data was scaled-up accordingly, to estimate the total number of species that were caught during the fishing trip, including target, non-target and ETP species. Average weights of species were researched using online sources and scientific research papers and applied to each individual catch. This report represents a combination of the total number and weight data from the Tunago catch reports. Weights could not be determined or applied to the species that were listed as 'unknown' in the initial data analysis received from DOS and are collectively referred to as 'unknown' throughout this report.

Most of the catch, both by number and weight, is derived from the target species. Discrepancies between the number and weight data compositions derived from albacore and yellowfin tuna, where albacore contributed the greatest percentage in the total number of individuals, but yellowfin contributed the greatest percentage by weight (kg).

The remaining catch was comprised of primary species, secondary species, ETP species, and 'unknown' species. To reduce the number of 'unknown' species from the data, vessels need to ensure that the EM systems are properly maintained and cleaned. Dirty cameras reduce the accuracy of species' identification and should be checked regularly to make sure the quality of the video is upheld, as keeping the lens clean. Similarly, comprehensive training for the observers that conduct the initial data analysis at DOS is also beneficial for determining specific species within a group of animals. For example, there were a few instances where an individual could not be identified and was therefore listed as just 'shark'. Since sharks are predominantly ETP species, it is important that these specific identities are recorded so to understand more about the effect the fishery could be having on their populations.

Improvements need to be made on the EM systems and analysis, including in increasing the number of trips that are analysed by five in order to represent 20% of the entire number of trips across the Tunago fishing fleet. The EM systems should also start recording the weights of the individuals, which will be hugely beneficial for the reliability and accuracy of the reports. Average weights are appropriate in this report to estimate the impacts to the stocks and populations, but it is also important that fisheries regulate the sizes of the individuals they catch, so appropriate weight data is important for this. For ETP species, which have life-history traits that make them vulnerable to overfishing, capturing, and potentially killing individuals may have devastating impacts on their populations.

A comprehensive discussion about the best next steps for the Tunago fishery regarding mitigation advancements and EM improvements can be found in the ETP report.