Ecological Risk Assessment of Small-scale Yellowfin Tuna Handline Fishery in Mindoro Strait, Philippines.

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ABSTRACT

This report sets out the result of the assessment done under the Partnership Program Towards Sustainable Tuna (PPTST), a Fishery Improvement Project on Yellowfin Tuna handline fisheries for Mindoro Strait in the Philippines against the Marine Stewardship Council (MSC) Principle 2. The assessment used the Risk Based Framework to assess and manage the impacts of fishery on the ecosystem.

The Small-scale yellowfin tuna handline fishery is currently concentrated on the west side of island of Mindoro facing northern Palawan within 12°30′ – 13°025′ N and 119°15′ – 120°40′ E and is operating within a depth range of 800m to 2900m. Using 1,318 Tuna Fishing Vessels with approximately three trips per month, yields approx. 54,476 kg of yellowfin tuna per year based on the PPTST fish catch data June 2014 – June 2015.

The PSA for the interacted species in tuna handline fisheries were at low risk showing that the gear do not pose irreversible harm to the associated species of yellowfin tuna being the target species. However, tuna handline fishers required bait for them to be able to catch fish. The score exhibit to be in a low risk category for all bait species which means that the fishery does not pose a risk of serious or irreversible harm to the bait species and does not hinder recovery of the bait species.

Two ecological components were eliminated at SICA (retained species and habitats); Although the spatial and temporal scale of fishing activity is high, which results also ta a high intensity in fishing activity, the small-scale handline tuna fisheries has no direct impact to any habitat type, as they operate in a deeper area of the strait. For the consequence score 5 was given because handline fisheries is the most selective fishing gear and is not exploitative compare to other forms and methods of fishing. The fishery removal in this area does not affect the reproduction of this species because majority of the catch were already at maturity stage. Likely, there is no detectable changes in functional group composition against the natural variation using this gear.

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1. INTRODUCTION

1.1 *The Fishery Proposed for Certification*

The Unit of Certification is the unit that will be assessed by certifiers against the MSC environmental standard. It is defined as the fishery or fish stock (a biological distinct unit) combined with the fishing method, gear and practice (the vessel/s) pursuing that stock. The Mindoro Strait Small-scale handline yellowfin tuna in the Philippines proposed for certification is defined as follows:

Species:	Yellowfin Tuna (*Thunnus albacares*)
Geographical Area:	Mindoro Strait, Occidental Mindoro
Method of Capture:	Handline
Stock:	Western and Central Pacific Ocean
Management System:	National: Department of Agriculture Bureau of Fisheries and Aquatic Resources (DA-BFAR) Regional: Western and Central Pacific Fisheries Commission (WCPFC)
Client Group	Tuna Fishers Association

1.2 Ecosystem Background

Occidental Mindoro is located at the western part of the entire island of Mindoro, Philippines. It is strategically located at the south of the Verde Island Passage and is facing Mindoro Strait. The province of Occidental Mindoro is considered the 17th largest in the country with 11 municipalities and among these; six of the coastal municipalities (i.e. Mamburao, Paluan,

Sablayan, Sta. Cruz, Calintaan, and Rizal) are part of the Partnership Program Towards Sustainable Tuna (PPTST) of WWF-Philippines and WWF-Germany. The PPTST project is working to promote sustainable tuna fishing and to achieve Marine Stewardship Council (MSC) certification for the yellowfin tuna handline fishery.

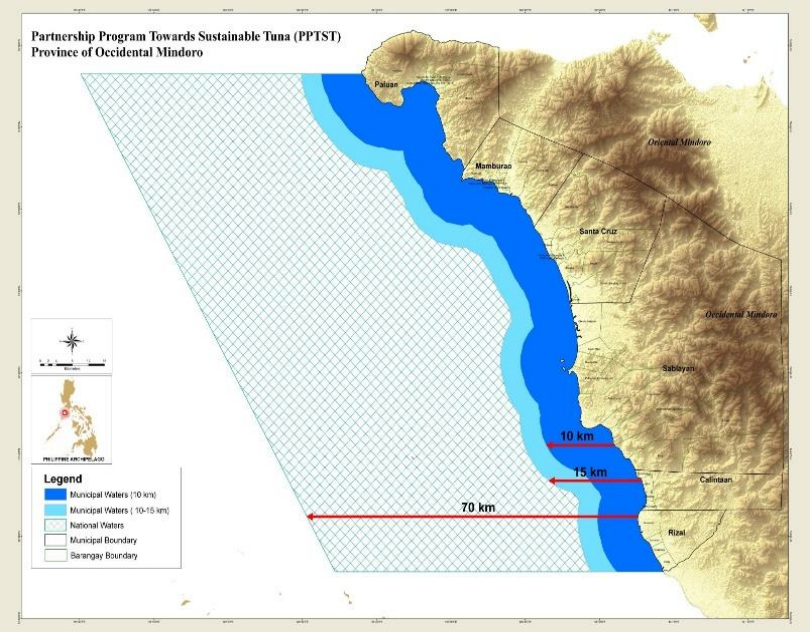

Figure 1. Mindoro Strait showing the management area for municipal and commercial waters.

According to the Assistant Regional Director of the Bureau of Fisheries and Aquatic Resources (BFAR) MIMAROPA, they are seeing a great potential for Occidental Mindoro as a source of export quality yellowfin tuna because they are looking into Mindoro Strait and nearby waters as a probable tuna highway. This is supported by observation that there are plenty of yellow fin tuna, weighing about 40 up to 100 kilos each, are caught in the area by local fishermen using tuna handline. According to an interview with the fishers in Occidental Mindoro by a local newspaper, tuna handline fishermen have an average catch of 200 to 300 kilos of yellowfin tuna daily, but as of the moment there is no official data that can describe the yellowfin tuna production from Mindoro Strait. It has been known that there are exporters sourcing yellowfin tuna from occidental Mindoro for export in the countries of Europe, US and Japan for four (4) decades now.

An initial assessment of the tuna handline fisheries in Mindoro strait was conducted by Dr. Babaran of University of the Philippines in the Visayas in 2010. The study aimed to characterize

the tuna fisheries in Mindoro strait and to estimates the tuna annual production. The assessment covered the fishing operations of the tuna handline fishermen in Mindoro Strait as a preparatory study to monitor the tuna handline fisheries that can be used in formulating a sustainable harvesting strategies for yellowfin tuna. This rapid assessment was done because there was no available information regarding the tuna fisheries in the area during that time. Through this rapid assessment, the estimated annual tuna production of Mindoro Strait is slightly over 7,000 tonnes. This estimate is probably a conservative estimate because the monitoring period coincides with the lean months of the year.

The study described the tuna fishing operations and the estimates of the annual tuna production in Mindoro strait, but it does not describe the bycatch (retained species) and bait species associated with tuna handline fisheries. The National Stock Assessment Program (NSAP) of the Bureau of Fisheries and Aquatic Resources (BFAR) just started gathering fisheries data in 2012 and according to them, they will release results after they completed at least 5 years of data. Due to the deficiency of data on tuna fisheries in Mindoro Strait, PPTST uses the MSC Risk-based Framework (RBF) to determine the risk score for habitat and ecosystem outcomes using the Scale, Intensity and Consequence Analysis (SICA). For the retained, bait and bait ETPs species that was accidentally caught as bycatch, the Productivity Susceptibility Analysis (PSA) was used.

1.3 Introduction to Risk-based Framework (RBF)

The Risk-Based Framework (RBF) was developed to make MSC Certification more accessible to all types of fisheries, including traditionally operated small-scale and developing country fisheries (MSC 2016). There are four scoring RBF methodologies of RBF; the Productivity Susceptibility Analysis (PSA), the Scale Intensity Consequence Analysis (SICA), the Consequence

Spatial Analysis (CSA) and the Consequence Analysis (CA). PSA and SICA were used to assess the handline tuna fisheries in Mindoro Strait if it is having a negative impact on each species interacted with the gear including Endangered, Threatened and Protected species (ETPs) and also the impact of the gear to the ecosystem.

1.3.1 What is Productivity Susceptibility Analysis (PSA)?

PSA uses a semi-quantitative approach to determine the productivity of the species and the level of fishing impact a species/stock can sustain. This method is used to determine the capacity of a species to recover from the fishing impact. Uses the PSA excel worksheet to determine the risk scores. The PSA spreadsheet automatically converts PSA scores into MSC scores. The PSA was incorporated into one spreadsheet which calculates the PSA scores automatically together with the MSC final scoring. Each indicators/variables for productivity and susceptibility were scored as indicated in Table 1 & 2 (Productivity and Susceptibility attributes).

The basic biological information of the identified retained and bait species as well as the ETPs in the tuna handline fisheries in Mindoro Strait includes the average age of maturity, average maximum age, fecundity, average maximum size, reproductive strategy, trophic level and density dependence (invertebrate only) were taken from Fishbase (Froese & Pauly 2016)

Table 1. PSA Productivity attributes and scores. page 89 of MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

Productivity Determinant	High Productivity (low risk, score=1)	Medium Productivity (medium risk, score=2)	Low Productivity (high risk, score=3)
Average age at maturity	<5 years	5 – 15 years	>15 years
Average maximum age	<10 years	10 – 25 years	>25 years
Fecundity	>20,000 eggs per year	100 – 20,000 eggs per year	<100 eggs per year

Average maximum size (not to be used when scoring invertebrate species)	<100 cm	100 – 300 cm	>300 cm
Average size at maturity (not to be used when scoring invertebrate species)	<40 cm	40 – 200 cm	>200 cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
Trophic level	<2.75	2.75 – 3.25	>3.25
Average size at maturity (to be used when scoring invertebrate species only)	Compensatory dynamics at low population size demonstrated or likely	No dispensatory or compensatory dynamics demonstrated or likely	Dispensatory dynamics at low population sizes (Allee effect) demonstrated or likely

Table 2. PSA Susceptibility attributes and scores. page 91 of MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

Susceptibility Determinant	**Low Susceptibility (low risk, score=1)**	**Medium Susceptibility (medium risk, score=2)**	**High Susceptibility (high risk, score=3)**
Areal overlap (availability) Overlap of the fishing effort with a species concentration of the stock	<10 overlap	10-30% overlap	>30 overlap
Encounterability The position of the stock/species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Low overlap with fishing gear (low encounterability)	Medium overlap with fishing gear	High overlap with fishing gear (high encounterability) Default score for target species (P1 – P2)
Selectivity of gear type Potential of the gear to retain the species	Individuals < size of maturity are rarely caught Individuals < size of maturity can escape or avoid gear	Individuals < size of maturity are regularly caught Individuals < half the size of maturity can escape or avoid gear	Individuals < size of maturity are frequently caught Individuals < half the size of maturity are retained by gear

Post-capture mortality (PCM) The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Evidence of majority released post-capture and survival	Evidence of some released post-capture and survival	Retained species majority dead when released Default score for retained species (P1-P2)

1.3.2 What is Scale, Intensity, Consequence Analysis (SICA)?

SICA uses qualitative analysis to identify broad ecosystem impacts of a fishery. It is used if information is not available to support an analysis of the impact of the fishery on the ecosystem. To evaluate the risk, it uses the spatial and temporal scale and intensity of fishery activities. It also evaluates the consequence of activity for most vulnerable ecosystems. Stakeholder consultation with a suitable broad stakeholder group with a good balance of knowledge about the fishery is critical during a qualitative assessment.

Table 3. SICA scoring template for ecosystem, page 109 of MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

Performance Indicator PI 2.5.1 Ecosystem outcome	Spatial scale of fishing activity	Temporal scale of fishing activity	Intensity of fishing activity	Relevant subcomponents	Consequence score
Fishery name:				Species composition	
				Functional group composition	
				Distribution of the community	
				Trophic size/structure	
Rationale for spatial scale of fishing activity					
Rationale for temporal scale of fishing activity					
Rationale for intensity of fishing activity					
Rationale for Consequence score					

Table 4. SICA spatial scale score table. For Principle 1. MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

<1%:	1-15%:	16-30%:	31-45%:	46-60:	>60%:
1	2	3	4	5	6

The percentage pertains to the percent of the total range of the stock that overlaps with all the fishing activity affecting the stock. For Principle 2, only overlap of the stock, habitat, or ecosystem with the fishing activity of the Unit of Certification shall be considered.

Table 5. SICA temporal scale score table. MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

Decadal (1 day every 10 years or so)	Every several years (1 day every several years)	Annual (1-100 days per year)	Quarterly (100-200 days per year)	Weekly (200-300 days per year)	Daily (300-365 days per year)
1	2	3	4	5	6

Table 6. SICA intensity score table. MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

Level	Score	Description
Negligible	1	remote likelihood of detection of activity at any spatial or temporal scale
Minor	2	activity occurs rarely or in few restricted locations and evidence of activity even at these scales is rare
Moderate	3	moderate detection of activity at broader spatial scale, or obvious but local detection
Major	4	detectable evidence of activity occurs reasonably often at broad spatial scale
Severe	5	easily detectable localized evidence of activity or widespread and frequent evidence of activity
Catastrophic	6	local to regional evidence of activity or continual and widespread evidence

Table 7. SICA Consequence Table for Principle 1: Target Species and Principle 2: Retained and Bycatch Species. MSC Fisheries Certification Requirements and Guidance, Version 2, 1st October 2014.

Subcomponent	Consequence Category (MSC Score)		
	1 (100)	2 (80)	3 (60)
Population size	Insignificant change to population size/growth rate (r). Unlikely to be detectable against background variability for this population.	Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	Full exploitation rate but long-term recruitment dynamics not adversely damaged
Reproductive capacity	No detectable change in reproductive capacity. Unlikely to be detectable against background variability for this population.	Possible detectable change in reproductive capacity but minimal impact on population dynamics.	Detectable change in reproductive capacity, impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged.
Age/size/sex structure	No detectable change in age/size/sex structure. Unlikely to be detectable against background variability for this population.	Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	Detectable change in age/size/sex structure. Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely damaged.
Geographic range	No detectable change in geographic range. Unlikely to be detectable against background variability for this population.	Possible detectable change in geographic range but minimal impact on population range and none on dynamics.	Clear change in geographic range due to fishing activities

In here, the assessor will choose and justify one subcomponent that, when impacted by fishing activities, results in the worst plausible case. Note that "changes" to subcomponents in this context means changes due to fishing activities only. This is particularly important to remember with respect to the "geographic range" subcomponent, which might be affected by other considerations, e.g. natural or anthropogenic climate change of other anthropogenic factors.

2. METHODS

2.1 Occidental Mindoro small-scale tuna handline fishing method/s

Tuna handline fishing gear highly selective therefore more sustainable as compared with the other fishing gears operating in Mindoro Strait. From the result of Babaran's assessment on handline tuna fisheries in 2010, a typical practice on fishing for yellowfin tuna was done by detaching the FAD from the fishing vessel and allow it to drift with the current. The FAD may also stay attached to the fishing vessel but this depends on the weather condition, sea state and current speed. The fishing operations approximately starts at around 1200H to 0200H and lasts

until about 0600H. Each fisherman would normally handle two (2) fishing lines throughout the fishing period, one line is set for surface operation. This has no sinker and is attached on the line. Live squid was set to be the bait for this handline gear. The other line is set deeper at around 150 meters to 250 meters depth using the drop-stone fishing technique. For this gear, dead fish or squid are used as the main bait together with a pre-pricked pouch of cuttlefish ink; chopped pieces of fish/squid flesh were also tied for release with the stone. These information were also validated during the conduct of focus group discussion among tuna fishers.

2.1.1 Fish Aggregating Devices (FADs)

Information on the Fish Aggregating Device (FADs) used by small scale tuna handline fisheries in Mindoro Strait were gathered through a Focused Group Discussion (FGD). The FADs used in Occidental Mindoro are of variety of polystyrene foam (Styrofoam) and used nets, plastic drums, bamboo rafts and steel/metal payao. These payaos are deployed at different distances from the coasts depending on the type of payao and the owner. Most steel/metal payaos, are installed 10.1Km to 15Km offshore municipal waters and up to 70 nautical miles off of West Philippine Sea because of its durability that lasts up to five (5) years. The steel/metal type of payaos are usually are usually given by the Bureau of Fisheries and Aquatic Resources (BFAR) to help fishers who can't afford to provide FADs to assist them in catching fish. Styrofoam and bamboo payao are usually installed within the municipal waters and are owned by municipal fishers. These usually last for about one to two years. Deployment of payaos is usually done by 4-10 people and are deployed on the deeper parts of the strait where there are no known coral reef habitats.

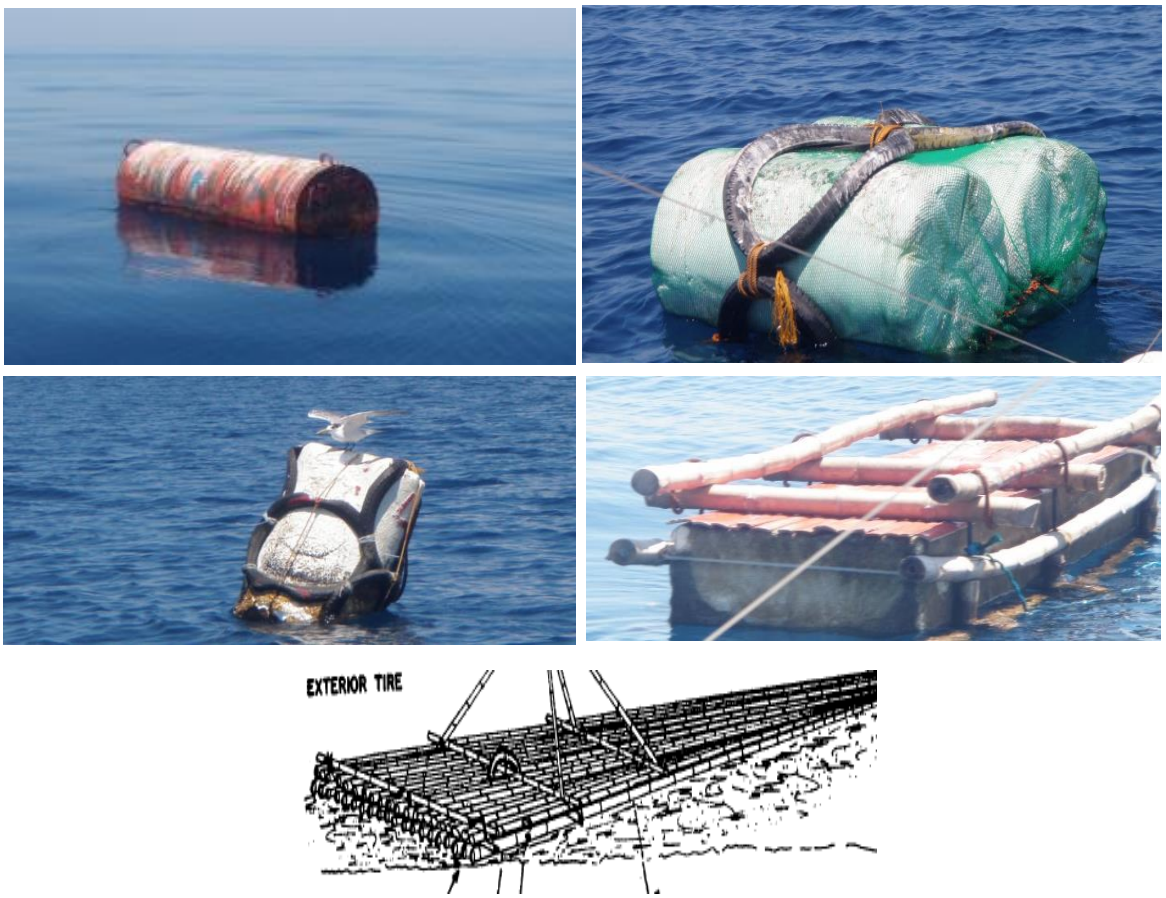

Figure 2. Types of Payao used in Mindoro Strait.

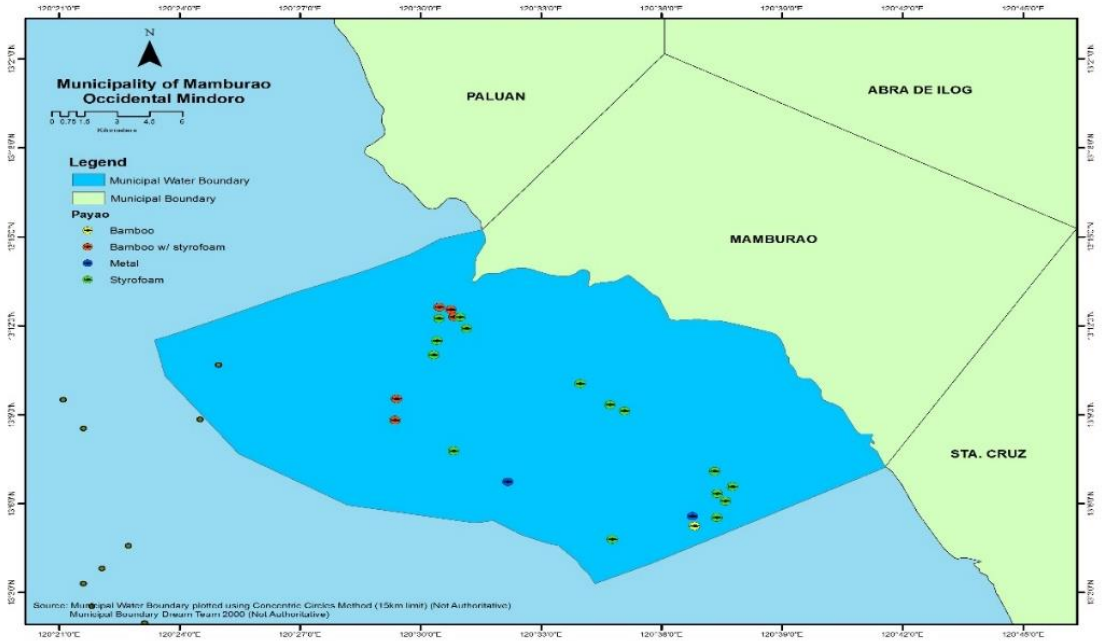

Figure 3. Location of some of the FADs in Mindoro Strait.

2.2 Data collection

The WWF Partnership Program Toward Sustainable Tuna (PPTST) team conducted a "Trainers Training on Fisheries Data Collection" to selected tuna fishers' leaders from 6 municipal Federated Tuna Fishers Association in Occidental Mindoro with an aim to capacitate the tuna fishers in collecting fisheries data.

Figure 4. Training on Fisheries Data Collection.

The fish catch data collection was focused in the two major landing areas of Mindoro Strait tuna handline fisheries which is in Sablayan and Mamburao, conducted in 6 municipalities of Occidental Mindoro including the CASA casas. covering 10% of the total tuna fishing vessels on a daily fishing from June 2014 to June 2015. The data gathering was done on a daily basis from June 2014 to June 2015 by the PPTST staffs in cooperation with the tuna fishers particularly those who received the formal training on fish catch data collection based on the method of BFAR's National Stock Assessment Program (NSAP).

The trained tuna fishers are encouraged to measure the length and weight of their yellowfin tuna catch including all bycatch. All species caught by tuna handline fishing gear other than yellowfin

tuna are considered as bycatch. Data on bait used in tuna handline fisheries were gathered also by measuring samples, weight and also the type of gears used in catching them. All the fish catch reports were collected by the PPTST staffs from the fishers and from the participating Casas.

2.3 Risk-based Framework

The available data and information used for the RBF assessment are catch and effort data collected by the Tuna Fishers Association through the help of the Partnership Program Towards Sustainable Tuna (PPTST) field staffs from June 2014 to June 2015.

3. RESULTS AND DISCUSSION

3.1 Tuna Handline Fisheries

Based on the information voluntarily provided by the fishers during one year fish catch monitoring, a total of 11 species of fish and sharks, including the target species, were interacted with the gear. Almost all catches of the tuna handline were yellowfin tuna that comprises 95% of the total catch and then followed by swordfish and mahi-mahi with 1.86% and 1.77% respectively and a very minimal interaction with other species (Table 8).

Table 8. Percentage contribution of the total landed catch of handline tuna fisheries (primary and secondary species).

			Contribution (%)
Scientific Name	**English Name**	**Total (kg.)**	
Acanthocybium solandri	Wahoo	261.00	0.48
Auxis thazard	Frigate Tuna	66.00	0.12
Coryphaena hippurus	Common Dolphinfish	962.75	1.77
Katsuwonus pelamis	Skipjack Tuna	156.81	0.29
Lampris guttatus	Opah	29.00	0.05

Makaira mazara	Blue Marlin	273.00	0.50
Scomberomorus commerson	Narrow-barred Spanish Mackerel	54.00	0.10
Alopias sp.	Thresher Shark	75.00	0.14
Thunnus alalunga	Albacore	9.00	0.02
Thunnus albacares	Yellowfin Tuna	51,578.50	94.68
Xiphias gladius	Swordfish	1,011.00	1.86
Grand Total		**54,476.06**	100.00

Handline tuna fishers in Mindoro Strait are categorized into municipal which normally manned by 4 fishermen and a much bigger boat (commercial) manned by around 7 crew. The one year fish catch data collection shows that majority of the tuna catches from Mindoro Strait are from municipal fisher that comprises 83 % (35,217 kg) and a small portion at around 17 % (8,175 kg) is from commercial handline tuna fishers (Figure 3).

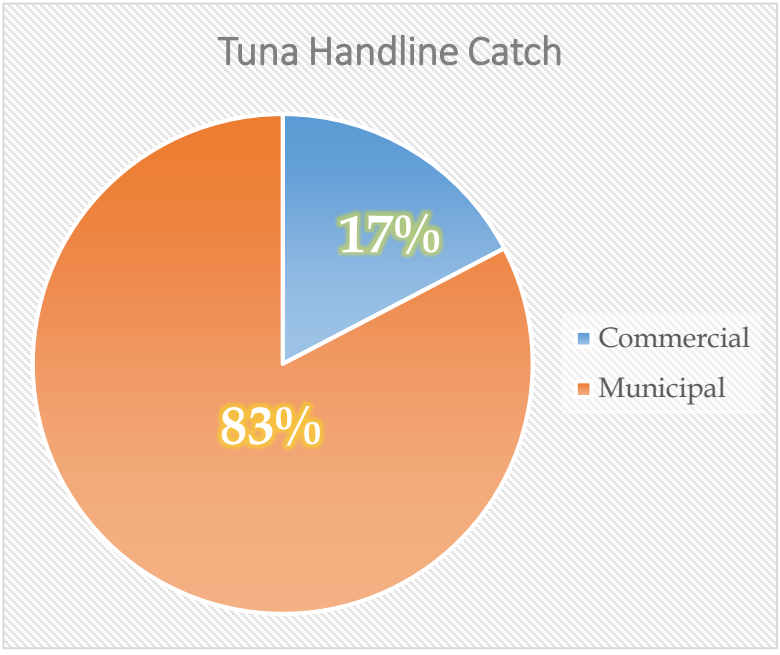

Figure 5. Percent catch contribution.

On the one year data collection, it shows that in October, February and April peaks the tuna catch in Mindoro Strait (Figure 4).

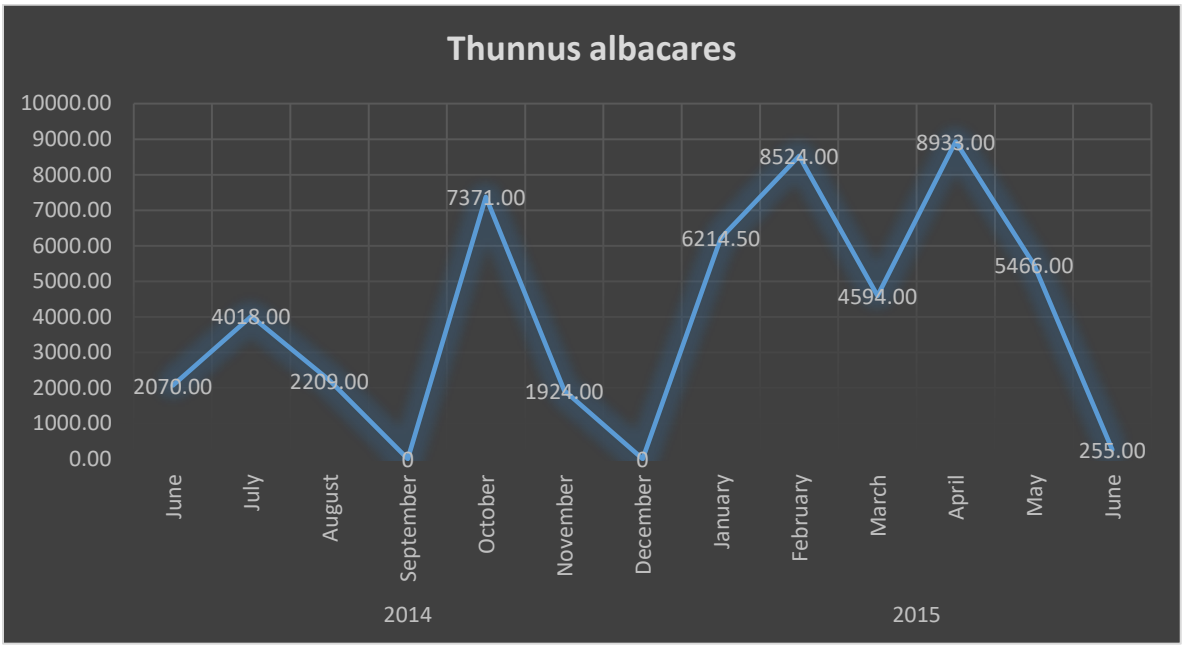

Figure 6. Year-round data of Yellowfin Tuna catch (kgs) in Mindoro, Philippines.

3.2 Risk-based Framework (RBF)

The MSC Risk-Based Framework (RBF) is a set of assessment methods contained in the MSC certification requirements. It is used while carrying out an MSC fishery assessment where there is insufficient data to assess the fishery using the standard assessment tree. The Risk-Based Framework was developed to make MSC certification more accessible to all types of fisheries. Since there were no available studies or researches about the bait species, there is uncertainty on the impact of tuna fisheries to the ecosystem and to other fisheries. Therefore the risk-based framework was used to determine the score in the PSA which shows whether or not the tuna handline fishery negatively impacts other marine species that are by-caught or caught as bait.

3.2.1 Productivity Susceptibility Analysis (PSA)

All associated species in tuna handline fisheries including the bait species were treated to PSA. The basic information of the species required in scoring productivity that's not available was scored with the default score of 3. For the weight of retained and bait species, the one-year data of PPTST was used to consider the effect of individual gears used. Most of the fish catch data used in Risk-based Framework were from Casas and from some of the tuna fishers who volunteer to do the fish catch monitoring. It is difficult to oblige the fishermen to do the fish catch monitoring because they feel that it's an additional burden for them after days of fishing. The project is on the process of working with the Local Governments under PPTST project to implement the reportorial requirements on fish catch to the fishers which is a vital part of traceability.

3.2.1.1 Primary species

The species categorized as primary were those species that are managed according to either target or limit reference points such as the Conservation Management Measures (CMM) set by the WCPFC (Western Central Pacific Fisheries Commission). There were 4 (four) species, namely Makaira mazara (Pacific Blue Marlin), Xiphias gladius (Swordfish), Katsuwonus pelamis (Skipjack tuna) and Thunnus alalunga (Albacore), determined to be the primary spices as falls on the default thresholds to determine the main species having ≥ 5% of the total catch by weight and when less resilient, a catch of ≥ 2%. The PPTST assessed these species to determine the risk posed by the handline fisheries within the UoA (Unit of Assessment). All these species had MSC derived PSA score of 90-95 with an MSC scoring guidepost of ≥ 80 (Table 10). Though the RBF on the case of this primary species is no longer required where management measures of the said species are already established through the WCPFC but the project still tried to explore to determine the status within the UoA.

In WCPFC stock assessment (2015 Overview and Status of the stock), status of the primary species identified in the UoAs:

• *Makaira mazara* (Pacific Blue Marlin) – According to the Stock Assessment for Pacific Blue Marlin in 2013 and 2016, the status was not overfished and was not experiencing overfishing. Pacific Blue Marlin is mainly caught as bycatch, direct control of the annual catch amount through the setting of a total allowable catch may be difficult. Since the stock is nearly fully exploited, the ISC recommends that fishing mortality remain at or below current levels (2012 – 2014).

• *Xiphias gladius* (swordfish) – In the WCPFC stock assessment 2014, the WCNPO swordfish stock is not currently overfished and is not experiencing overfishing. The WCPO stock is not fully exploited.

• *Katsuwonus pelamis* (skipjack tuna) – The WCPFC 2016 assessment estimated that the stock is not experiencing overfishing and the estimate of spawning biomass is well above the level that will support MSY (SBlatest/SBMSY = 2.56).

• *Thunnus alalunga* (Albacore) – The stock assessment of WCPFC 2014 on the North Pacific albacore assessed that the stock is not experiencing overfishing and is probably not in an overfished condition.

Table 9. Productivity-Susceptibility Analysis of the primary species in handline fisheries (June 2014 to June 2015).

					Productivity Scores [1-3]									Susceptibility Scores [1-3]						Cumulative only						
Family name	Scientific name	Common name	Species type	Fishery descriptor	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	Weighted Total	Weighted PSA Score	MSC PSA-derived score	Risk Category Name	MSC scoring guidepost
Istiophoridae	Makaira mazara	Blue Marlin	Non-invertebrate	Tuna Handline	1	2	1	3	3	1	3		2.00	1	1	1	3	1.05	2.26	0.301	1.00	2.26	2.26	90	Low	≥80
Xiphiidae	Xiphias gladius	Swordfish	Non-invertebrate	Tuna Handline	2	2	1	2	2	1	3		1.86	1	1	1	3	1.05	2.13	1.114	1.00	2.13	2.13	93	Low	≥80
Scombridae	Katsuwunus pelamis	Skipjack tuna	Non-invertebrate	Tuna Handline	1	2	1	2	2	1	3		1.71	1	1	1	3	1.05	2.01	0.172	1.00	2.01	2.01	95	Low	≥80
Scombridae	Thunnus alalunga	Albacore	Non-invertebrate	Tuna Handline	1	2	1	2	1	1	3		1.57	1	3	1	3	1.20	1.98	0.009	1.00	1.98	1.98	95	Low	≥80
																							MSC Score		95	
																							Status		Unconditional Pass	

3.2.1.2 *Secondary species*

According to MSC methodology, secondary species are defined as all species that do not fall under one of the categories primary species (see above). A total of 7 species that are being encountered in the tuna handline fisheries in Mindoro Strait were categorized as secondary species. These species were retained by the fishermen for their own consumption or being sold to the local market. All the recorded tuna handline fisheries retained species were scored for the productivity and susceptibility analysis which exhibit low risk (Table 11) and shows a very low percentage in the tuna handline production of Mindoro Strait as shown in Table 8.

3.2.1.3 *Endangered, Threatened and Protected Species*

ETP species are those recognized by national ETP legislation and listing in the binding international agreements including CITES and Agreements concluded under the Convention of Migratory Species (CMS). In addition, out of scope species (e.g. amphibians, reptiles, birds and mammals) categorized as vulnerable, endangered or critically endangered of the IUCN redlist shall be considered ETP (MSC 2014).

A certain species of thresher shark was treated in PSA (PI 2.3.1) and it falls under the category of medium risk. Thresher sharks were just recently (October 4, 2016) included under CITES by 182 countries including the European Union (EU). They have decided to put thresher sharks along with 500+ new species of wild animals and plants, under the global treaty's trade regulation regime. Also, under IUCN red list of threatened species, all species of thresher sharks are categorized as vulnerable species. Inclusion of species of thresher sharks in the CITES and IUCN as threatened species automatically makes it protected under Section 102 of the Republic Act 8550 as amended by Republic Act 10654 also known as The Philippines Fisheries Code. This also applies to the parts and derivatives of the species as stated in Rule 102.1.

Thresher shark bycatch by tuna handline fisheries in Mindoro Strait is very minimal, only 2 individuals was recorded during the one year sampling period. There was no known fisheries targeting sharks operating in the strait and no shark finning was reported or observed during the data gathering.

Table 10. Productivity-Susceptibility Analysis of the ETPs in handline fisheries (June 2014 to June 2015).

					Productivity Scores [1-3]								Susceptibility Scores [1-3]								
Scoring element	Family name	Scientific name	Common name	Species type	Average age at maturity	Average max age	Fecundity	Average max size	Average size at maturity	Reproductive strategy	Trophic level	Density dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	MSC PSA-derived score	Risk Category Name	MSC scoring guidepost
1	Alopidae	Alopias sp.	Thresher	Non-invertebrate	2	2	3	3	3	3	3		2.71	1	1	1	3	1.05	2.91	71	Med	60-79
																			MSC score		71	
																			Status		Pass with condition	

3.2.1.4 *Fish Aggregating Device (FADs)*

According to the respondents of the FGD conducted , there have no by-catch of any threatened or endangered species (i.e. turtles, sharks, dolphins nor whales) and does not witness any entanglement of ETPs in the FAD. Very seldom that they caught big eye tuna. Since under these *payaos* are only coconut fronds, they do not pose any threat to the ecosystem. Interestingly, fishers also see these *payaos* as "life-savers" especially in times of strong typhoon wherein they anchor their boats into these *payaos* and wait for the typhoon to subside. In general, fishers in Mindoro believe that these FADs present no detrimental effects both to non-targeted species as well as to the ecosystem.

3.2.1.5 *Bait Species*

Fishing operation in Mindoro usually begins late afternoon at around 4 PM. Fisherman usually use a multi-hooked and line around a FAD to capture associated juvenile skipjack tuna, frigate tuna, bullet tuna and sometimes juvenile yellowfin tuna used as bait. Main bait used for catching tuna is squid which is caught by a scoop net and squid jig. The fishermen attached their boat to a FAD or just drifting, and light up their lamp powered by an electric generator. Fishermen would spend one to two hours fishing for squid using only a scoop net and a shiny object tied at the end of a stick (tiw-tiw) to lure the squids. Occasionally, flying fish and lantern fishes are being caught also in the scoop net which the fishermen chop it in smaller fishes used to lure tuna. The captured squids were then pierced with a monofilament line by their rear end and submerged it to the seawater hanging on the side of the boat to keep them alive.

Sometimes fishermen use tuna handline non-target species as well as bait such as the snake mackerel and common dolphin fish. Snake mackerel and common dolphin fish were chopped into smaller pieces and use it as bait.

During the one year catch monitoring in the tuna handline fishery, results shows a total of 6 bait species were used in the tuna handline fishery. The score exhibit to be in a low risk category having a PSA derived score of 86 - 100 for all bait species, which means that the fishery does not pose a risk of serious or irreversible harm to the bait species and does not hinder recovery of the bait species.

3.2.2 Scale, Intensity, Consequence Analysis (SICA)

The PPTST conducted a Focus Group Discussion to the two major yellowfin tuna handline fishing community in Occidental Mindoro to gather information on the impact of small-scale handline yellowfin tuna fisheries to the ecosystem.

Fishery Description

Gear: Small-scale yellowfin tuna handline fishery

Area: Currently concentrated on the west side of island of Mindoro facing northern Palawan within 12O30′ – 13O25′ N and 119O15′ – 120O40′ E

Depth range: 800m to 2900m

Fishing Vessel: 1,318 Tuna Fishing Vessel

Effort: Approximately three trips per month

Landings: ~54,476 kg (PPTST data June 2014 – June 2015)

Main target species: Yellowfin tuna

Management: Fishery Improvement Project

Ecological Units Assessed

Target species: Yellowfin tuna and 6 bait species used in capture

Retained species: 10 species

ETP species: Rare interactions with Devil Rays but are not caught; sea turtles are released if caught

Habitats: Pelagic within fishery jurisdiction

The PPTST conducted focused group discussion to the major tuna fishing villages (Sablayan and Mamburao) in Occidental Mindoro where most of the tuna fishers operating in Mindoro Strait are located to gather information on the impact of the handline fishing in the ecosystem.

The tuna fishing was taken place at 800 up to 2900 meters water deep in Mindoro Strait. The fishers use single handline, using 3-10 reels with 250 to 300 meters in length of number 160 or 150 nylon. They uses drop stones attached to the hook with bait and released when reached the desired depth. They believe that their fishing activity does not affect physically the seafloor, corals and other habitat during their operations since the fishing done at the deep waters.

Consequence of the fishing activity on the most vulnerable component was determined by the stakeholder input during the focused group discussion. The SICA result of the handline fishery showed in Table 11.

Table 11. Ecosystem impact assessment of handline fisheries in Mindoro Strait Lagonoy Gulf using the Scale Intensity Consequence Analysis (SICA).

Performance indicator PI 2.5.1 Ecosystem Outcome	Spatial scale of fishing activity	Temporal scale of fishing activity	Intensity of fishing activity	Relevant subcomponents	Consequence score
Fishery Name: Small scale tuna handline fisheries.	4	5	4	Species composition	
				Functional group composition	100
				Distribution of the community	
				Trophic size/structure	

Rationale for Spatial scale of fishing activity	Spatial scale of fishing activity score of 4 was given because the handline tuna fisheries operation extends to about 41% of the total area of Mindoro Strait. During the Focus Group Discussion with the tuna fishers in Mindoro, the fishermen was asked to show where they are fishing using a nautical chart of Mindoro Strait from the National Mapping and Resource Information Authority (NAMRIA). Result shows that tuna handline fisheries operation covers about 41% of Mindoro Strait and majority of them are operating in the middle and northern part of the strait. This is supported by the pilot testing of 13 multiple tracking devices for use on a small-scale fishing vessel to improved transparency and monitoring for fishery enforcement for 97 to 99 days depending on the day the device was installed. The real time data streaming was monitored through the seeOcean.
Rationale for Temporal scale of fishing activity	A score of 5 which is equivalent to 201 – 300 days per year was given in terms of temporal scale of activity because as per our consultation with our stakeholders, handline tuna fishing in Mindoro Strait is considered whole year round, they only stop fishing during bad weather and during the six day period of full moon in the belief that it is hard to catch tuna during this period, but there are municipality who do not conform on this belief and stiff fish during full moon.
Rationale for Intensity of fishing activity	A major level of fishing activity is detectable with a numerical score of 4 was given because of the detectable evidence of fishing activity which occurs which ranges about 41% of the whole fishing ground.
Rationale for Consequence score	It has been identified that the most vulnerable subcomponent that can be affected by the tuna handline fisheries would be the functional group composition since the yellowfin tuna is one of the largest open ocean predators. Tunas are highly migratory species and its place in the food chain, as both predator and prey, demonstrates the important principle of interdependence: each individual tuna pursues its individual purpose of survival, maintenance, and reproduction, while it also fulfills a greater role in the ecosystem. The stock status of yellowfin tuna in WCPO is least fully exploited with no potential for a substantial increase in catches to be sustainable. Being the target species of handline tuna fisheries, over extracting them might have drastic effect on the internal dynamics of the community. Since handline fisheries is the most selective fishing gear, it is not exploitative compare to other forms and methods of fishing. The fishery removal in this area does not affect the reproduction of this species because majority of the catch were already at maturity stage. Likely, there is no detectable changes in functional group composition against the natural variation using this

	gear. As a result, a consequence scores 100 was given for the functional group composition subcomponent.

Impacts from fishing on target and retained species components were assessed in more detail at PSA. Pelagic community impacts should further be examined in future iterations.

4. CONCLUSION

Due to insufficiency of data on tuna fisheries in Mindoro Strait, this assessment was carried out to determine the impact of the handline tuna fisheries on the target species and bait species interacted with the gear including Endangered, Threatened and Protected species (ETPs) and also the impact of the gear to the ecosystem.

A total of 7 species that are being encountered in the tuna handline fisheries in Mindoro Strait were categorized as secondary species. These species were retained by the fishermen for their own consumption or being sold to the local market. All the recorded tuna handline fisheries retained species were scored for the productivity and susceptibility analysis which exhibit low risk and shows a very low percentage in the tuna handline production of Mindoro Strait. A certain species of thresher shark was treated in PSA (PI 2.3.1) and it falls under the category of medium risk. Thresher sharks were just recently (October 4, 2016) included under CITES by 182 countries including the European Union (EU). Inclusion of species of thresher sharks in the CITES and IUCN as threatened species automatically makes it protected under Section 102 of the Republic Act 8550 as amended by Republic Act 10654 also known as The Philippines Fisheries Code. This

also applies to the parts and derivatives of the species as stated in Rule 102.1. Thresher shark bycatch by tuna handline fisheries in Mindoro Strait is very minimal, only 2 individuals was recorded during the one year sampling period. There was no known fisheries targeting sharks operating in the strait and no shark finning was reported or observed during the data gathering. During the one year catch monitoring in the tuna handline fishery, results shows a total of 6 bait species were used in the tuna handline fishery. The score exhibit to be in a low risk category having a PSA derived score of 86 - 100 for all bait species, which means that the fishery does not pose a risk of serious or irreversible harm to the bait species and does not hinder recovery of the bait species.

Fish aggregating device used in tuna handline fisheries were assessed using FGD. Results shows that there were no by-catch of any threatened or endangered species (i.e. turtles, sharks, dolphins nor whales) and does not witness any entanglement of ETPs in the FAD. *Payaos* are only using coconut fronds underneath which does not pose any threat to the ecosystem. FADs used bytuna handline fishers in Mindoro Strait presents no detrimental effects both to non-targeted species as well as to the ecosystem.

The consequence score for handline tuna fisheries is 100. The stock status of yellowfin tuna in WCPO is least fully exploited with no potential for a substantial increase in catches to be sustainable. Being the target species of handline tuna fisheries, over extracting them might have drastic effect on the internal dynamics of the community. Since handline fisheries is the most selective fishing gear, it is not exploitative compare to other forms and methods of fishing. The fishery removal in this area does not affect the reproduction of this species because majority of

the catch were already at maturity stage. Likely, there is no detectable changes in functional group composition against the natural variation using this gear.

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