Tuna Handline Fisheries in Lagonoy Gulf, Philippines

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Summary

In this paper provides information of all other fishery removals from the handline fisheries and the impact of the fishery to the non-target species, ETP (Endangered, Threatened and Protected) and habitat through the Productivity and Susceptibility Analysis (PSA). A one year (August 2014—July 2015) fish catch data collection on the tuna handline fisheries covering 24% (214 out of 1721 municipal tuna fishing vessels) and 41% (15 out of 37 commercial tuna fishing vessels) of the total tuna fishing vessels respectively in the Lagonoy Gulf was used to assess the risk of non-target species in tuna handline fisheries including the bait species used. For the tuna handline fisheries, except for the *Thunnus albacares*, 29 species were noted to be the non-target species but none of these species belong to Endangered, Threatened and Protected (ETP). For the baits, mostly small pelagic species like scads and mackerels, and some species of invertebrates such as the squids and cuttlefish were used.

The results of the tuna handline fisheries of the Productivity Susceptibility Analysis clearly demonstrated a low risk score for both the non-target and bait species. Species caught from ringnet, gillnet and purse seine fisheries were used for domestic consumption in which only 2-5% of the total catch of one vessel was used as bait which is considered as a small proportion of the total catch and therefore there is no significant negative impact is assumed from the proportion that is used as bait.

Introduction

Lagonoy gulf is a major fishing ground in the Bicol Region, Luzon Island in the Philippines. This fishing ground covers 3 provinces namely Albay, Camarines Sur and Catanduanes with 14 municipalities and 1 city comprising 164 total coastal barangays where 112 tuna fishing villages (Figure 1.). It has an area of 3,071 square kilometres where 3000.98 square kilometres is Municipal and 70.02 is Commercial Fisheries (Olañ0 et al, 2009). About 80% of the area are deep ranging from 800-1200m (*Victor S. Soliman et al., 2008).*

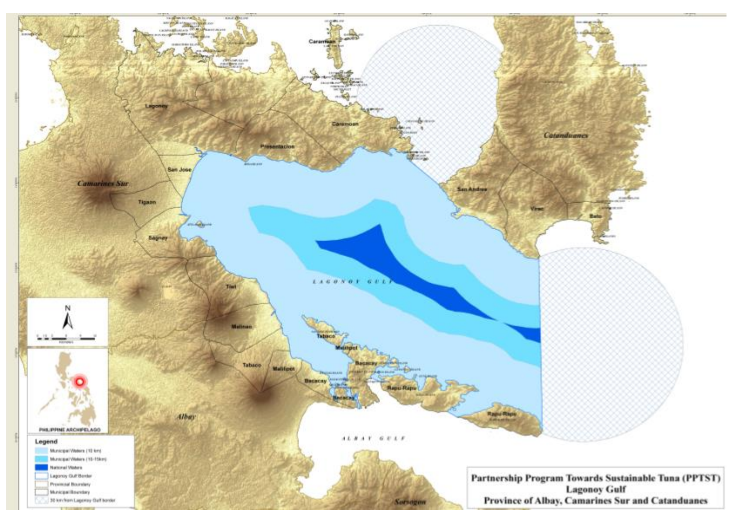

Figure 1. Lagonoy Gulf showing the management area for municipal and commercial waters

A preliminary assessment on the handline fishery in Bicol Region, Philippines was conducted by Prof. Ron West et al of Australian National Centre for Ocean Resources and Security (ANCORS), Dr Mary Ann Palma (ANCORS, University of Wolongong) and Barut et. al of National Fisheries Resources and Development Institute in 2011. This Project was then developed to provide new information concerning the Philippine handline fishery which will assist in applying long-term improvements in its policy and management frameworks. It also aims to fill some of the gaps in data collection to support the BFAR National Stock Assessment Program. The *Assessment of the Fisheries of Lagonoy Gulf by National Stock Assessment Program* from 1998 to 2015 still on the process of analysis and will release after it is evaluated in the national level. Due to the data deficient in the tuna handline fisheries, the PPTST uses the MSC Risk-Based Framework Assessment to assess the risk that a fishery is having an impact on species, habitats and the surrounding ecosystems using the Productivity and Susceptibility Analysis (PSA). It is used when 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, including traditionally operated small-scale and developing country fisheries (MSC 2016). The productivity refers to the capacity of the stock to rapidly recover when depleted, whereas susceptibility is the potential for the stock to be negatively impacted by the fishery (Patrick et al 2010). In summary, a PSA assesses how likely a stock is to recover when depleted, as well as how likely a species is to interact with fishing gear (MSC 2016).

This paper also aimed to make available information from the tuna handline fisheries on the fishery removals and determine the risks that may the fishery impacted the interacted species and habitats as well that this will serve as reference for managing main retained species and ETPs, that is expected to maintain these species at levels which are highly likely to be within biologically based limits or to ensure that the fishery does not hinder their recovery and for creating management system that is consistent with local, national or international laws or standards that are aimed at achieving sustainable fisheries in accordance with MSC Principles 1 and 2.

Materials and Methods:

Data Collection: The fish catch data collection was conducted in 12 municipalities of Albay and Camarines Sur within Lagonoy Gulf covering 24% of the total municipal tuna fishing vessels (or 214 out of 1721 vessels) and 41% (or 15 out of 37 vessels) of the total commercial tuna fishing vessels on a daily fishing from August 2014 to July 2015 (table__).

Figure 2. ***Trainors' Training on Fisheries Data Collection***

The PPTST team received training on the proper data collection and started to monitor the fish catch data in tuna handline fisheries including the bait species in early part of 2014 together with the tuna fishers leader. In February 2015, WWF Partnership Program Toward Sustainable Tuna (PPTST) team conducted a "Trainers Training on Fisheries Data Collection" to a selected tuna fishers' leaders from 15 municipal wide Tuna Fishers Association in Lagonoy Gulf with an aim to capacitate the tuna fishers in collecting fisheries data.

The data gathering was done by the PPTST staff in cooperation with the tuna fishers particularly the tuna leaders who received the formal training.

Figure 3. *Tuna fishers leaders conducting actual fish catch monitoring on their respective communities on voluntarily basis.*

Other information on Fish Aggregating Devices was conducted through the Focused Group Discussion (FGD) and fishing gear information through survey. The profiling of the number of tuna fishers and fishing vessels was conducted bi-annually through census.

Data analysis: The data analysis on the species composition catch contribution, percentage share and count of number of individual of the species caught, seasonality, CPUE (Catch per Unit Effort) was used the Microsoft excel worksheet. The estimated production of the tuna handline gear for large species was computed using the formula:

Estimated production = CPUE x frequency of operation X no. of fishing vessels

In Risk Based Framework Template, the Productivity Susceptibility Analysis (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.

For the weight of the tuna bait species caught with ringnet and gillnet indicated in the PSA template, we make reference to the available data as published by NSAP on the Assessment of the Fisheries in Lagonoy Gulf from July 1997—June 2002.

The basic biological information of the identified retained and bait species of the tuna handline fisheries in Lagonoy Gulf includes the average age of maturity, average maximum age, fecundity, average maximum size, average size at maturity, reproductive strategy and trophic level taken from Froese & Pauly 2016.

Table 1. Productivity attributes:

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. Susceptibility Attributes:

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)

Results and Discussions

Tuna Fishing

In Lagonoy Gulf, tuna handline is one of the most diversified fishing gear that is being used in 112 tuna fishing villages out of 164 coastal barangays. A total of 1,759 fishers using this gear with a total of 1,721 fishing vessels of an average of 2 fishers per fishing vessels are employed both in municipal and commercial fishing (Table 3). Municipal fishing done in municipal waters that is 15 kilometers from the shore with the use of fishing boat with 3 gross tons or less while the commercial fishing done beyond 15 kilometers with the use of fishing vessels 3.1 gross tons above. The vessels being used in tuna handline fishing are non-motorized and motorized. The non-motorized fishing vessels (Fig. 4) are operating within the distance of 2 kilometers and less from the shore while those motorized (Fig.5) is far from the shore wherever there are opportunities of tuna occurrence within the municipal water and 15 kilometers beyond (Fig.6). However, all fishers with fishing vessels needs to secure first a licensed before they can operate. Registration both for fishers, gears and vessels are pre-requisite before they can secure licensed. In the table below, 65% of the fishing vessels are registered and only 16% has a licensed. It clearly demonstrate that the fishery resources was taken out by the illegal fishers.

***Figure 4.* Non-motorized boats using in tuna handline fishing.**

***Figure 5.* Motorized boat used by tuna hand-liners in municipal waters.**

***Figure 6.* Small-scale commercial fishing vessels used for tuna handline fishing.**

Tuna fishers uses 5—13 reels of tuna handline fishing gears that has different length of lines from 100—1000 meters and nylon numbers from 70—150 with different hook sizes per reel (Fig. 7) for their daily fishing activity either night or day. The frequency of fishing operation was shown in Appendix 1 for both commercial and municipal fishing.

Table 3. Profile for the tuna fishers and fishing vessels in tuna handline fisheries in Lagonoy gulf

Municipalities per province	No. of Tuna Fishers	No. of Vessels	Ave. No. of fishers per vessels	Vessels Information					
				Motorized (with engine)	Non-motorized (without engine)	Registered	Unregistered	Licensed	Unlicensed
Municipal Fisheries									
Albay	**1379**	**818**	**2**	**810**	**8**	**503**	**315**	42	**776**
Tabaco	555	295	2	295	0	212	83	41	254
Malilipot	82	38	2	38	0	26	12	0	38
Tiwi	326	234	1	234	0	209	25	0	234
Malinao	33	11	3	11	0	7	4	1	10
Bacacay	236	148	2	140	8	48	100	0	148
Rapu-Rapu	147	92	2	92	0	1	91	0	92
Camarines Sur	**947**	**752**	**1**	**548**	**204**	**624**	**128**	229	**523**
Caramoan	181	144	1	104	40	68	76	0	144
Lagonoy	66	54	1	47	7	39	15	0	54
Presentacion	317	256	1	191	65	222	34	82	174
Sagnay	249	175	1	52	27	172	3	99	76
San Jose	120	115	1	70	45	115	0	48	67
Tigaon	14	8	2	7	1	8	0	0	1
Catanduanes	**433**	**151**	**3**	**143**	**8**	**0**	**151**	0	**151**
Bato	90	42	2	42	0	0	42	0	42
San Andres	183	45	4	45	0	0	45	0	45
Virac	160	64	3	56	8	0	64	0	64
Grand Total	**2759**	**1721**	**2**	**1501**	**220**	**1127**	**594**	**271**	**1450**
Commercial Fisheries									
Albay		**37**		**37**		**0**	**37**	**0**	**37**
Tabaco		37		37		0	37	0	37

***Figure 7.** Tuna handline fishing gear with different length of nylon and hook sizes.*

Fishing activity done either with the use of Fish Aggregating Device (FAD) or none. The FAD being used by the tuna fishers were basically made of straw, coconut leaves drums and sinkers as shown in Figure 8. A total of 80 FADs were mapped out by the GIS team of WWF Philippines as of 2012 (Figure 9). The FADs were installed from 400—1500 meters deep within Lagonoy Gulf from the months of March—August. Based on the results of the focused group discussions (FGD) conducted (Appendix 1), the lifespan of the FAD structure according to the fishers about 1-3 years provided if there will be no occurrence of natural calamities or some intervening manmade destruction. The fishers explained that they change the coconut leaves for at least 3 times a month. The FADs are being utilized by ring net, gillnet, hook and line and multiple hook and line. There were several species both small and large pelagic fish species, sharks and rays interacted with the FADs but there were no ETPs recorded to interact with tuna handline fishing gears. Tuna fishers believed that the presence of FADs is beneficial for their tuna fishing operation, mainly because the foods of yellowfin tuna stays within the FAD if not disturbed and as long there is food for them to consume. There is no documented irreversible harmful effect of FADs on marine habitat. However, the small pelagics were vulnerable with regard to the ring net and gill net fisheries operating within the FADs where juveniles are caught.

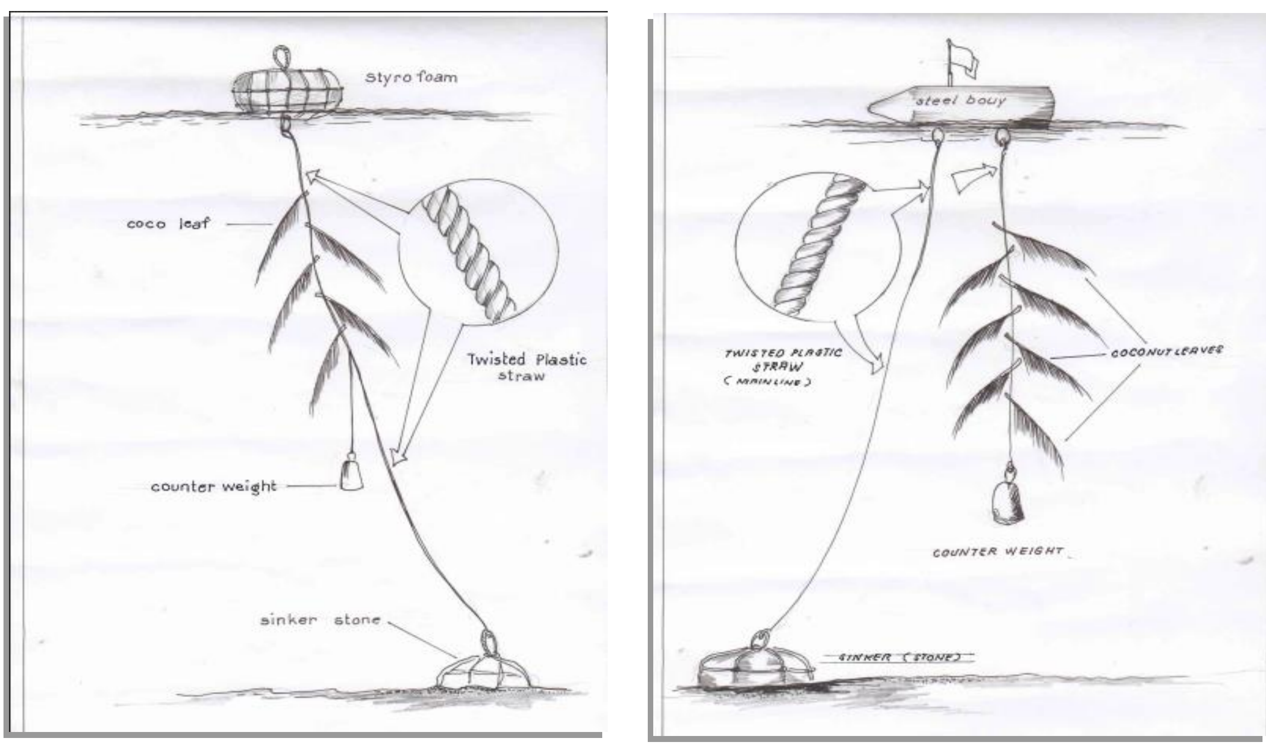

Figure 8. FADs structure in Lagonoy Gulf. (Credits to Mr. Romualdo Rangasa of BFAR 5 – Capture Division)

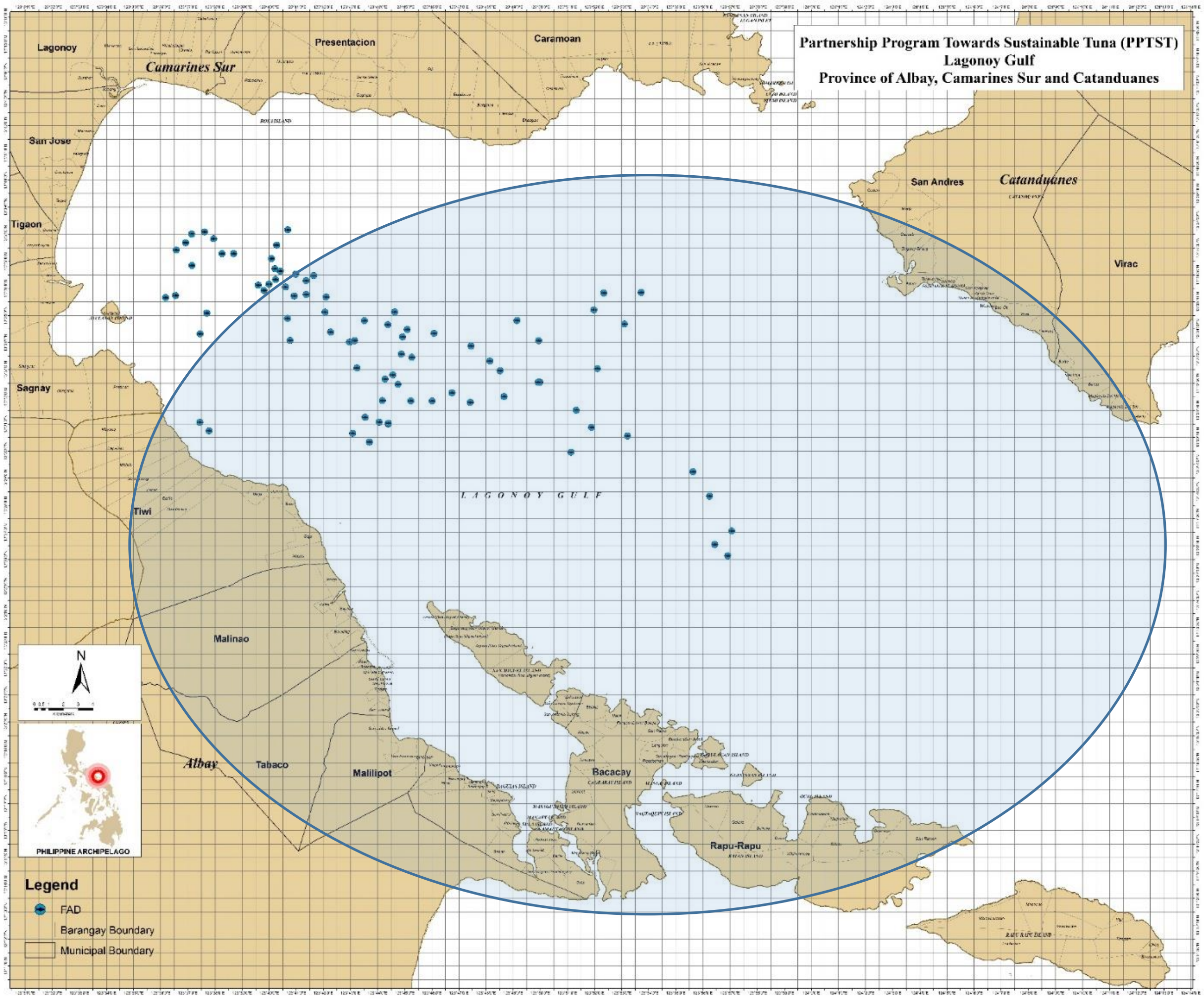

Figure 9. FADs mapping in Lagonoy Gulf by WWF Philippines in 2012

In one year daily monitoring (August 2014-July 2015), the average frequency of fishing and CPUE in kgs/boat taken from 24% for municipal and 41% for commercial are as follows:

Fisheries	Average Frequency of operation	Average CPUE (kg/boat)
Municipal	• *0.6 day per trip* • *3 trips per month* • *3 months per year*	24.44 kg/boat
Commercial	• *2 days per trip* • *2 trips per month* • *4 months per year*	69.68 kg/boat

With the information available, the estimated production of the tuna handline gear for large only are 227.13 metric tons and 41.25 metric tons for municipal and commercial respectively.

Species Composition

In one year monitoring that is from August 2014 to July 2015, the municipal fishing has 30 species caught in which 23 of it are finfishes, 4 elasmobranch species and 2 invertebrates species while in commercial fishing 10 species interacted with the gear which 9 species of finfishes and 1 elasmobranch species. About 92% of the total catch landed monitored contributed by the municipal fisheries sector that is tuna handline fishers who uses boats of 3 gross tons and 8% from the commercial fisheries sector the tuna handline fishers who uses a much bigger boat which is beyond 3 gross tons.

Table 4. Species caught and its contribution from municipal and commercial fishing boats.

Scientific Name	Vernacular name	August 2014-July 2015		
		Catch Contribution	Percentage share	
			Municipal Total	Total Catch
Municipal				
1. Thunnus albacares	Bangkulis-kiyawon	52829.22	70	64
2. Thunnus alalunga	Bangkulis –iliwon	6324.80	8	8
3. Katsuwonus pelamis	Pundahan/rayado	4467.75	6	5
4. Coryphaena hippurus	Lamadang	3221.35	4	4
5. Acanthocybium solandri	Tnaguigi-batang	1825.60	2	2
6. Thunnus obesus	Bangkulis-Paranganon	1287.70	2	2
7. Istiophorus platypterus	Malasugi	1258.45	2	2
8. Makaira mazara	Marlin (olob)	1069.60	1	1
9. Lampris guttatus	Golden fish	1057.50	1	1
10. Xiphias gladius	Malasugi	460.80	1	1
11. Carcharhinus sp.	Pating	457.20	1	1
12. Promethichthys premetheus	Langkoy sa lawod	421.05	1	1
13. Elagatis bipinnulata	Bulangawan	242.00	0	0
14. Sphyraena barracuda	Manabang, barracuda	185.85	0	0
15. Ruvettus pretiosus	Pandawan	172.75	0	0
16. Carcharhinus melanopterus	Pating	133.00	0	0
17. Scomberomorus commerson	Tnaguigi-natural	108.75	0	0
18. Carcharhinus sorrah	Pating	94.00	0	0
19. Lobotes surinamensis	Puyo, tilapia sa lawod	89.25	0	0
20. Rexea sp.	Salmingan	82.25	0	0
21. Thysanoteuthis rhombus	Giant squid	69.10	0	0
22. Auxis thazard	Turingan-lapad	38.75	0	0
23. Makaira indica	Marlin-bigho	29.00	0	0
24. Euthynnus affinis	Burirawan	20.50	0	0
25. Carcharhinus leucas	Pating	12.40	0	0
26. Sphyraena jello	Titso	11.50	0	0
27. Dasyatis sp.	Pagi	10.70	0	0
28. Grammatorcynus bilineatus	Tangirion	5.00	0	0
29. Thunnus tonggol	Bangkulis-small jo	4.00	0	0
30. Caranx sp.	Talakitok	3.50	0	0
Municipal Total		75993.32	100.00	92

.Scientific Name	Vernacular name	August 2014-July 2015		
		Catch Contribution	Percentage share	
			Commercial Catch	Total Catch
Commercial				
1. Thunnus albacares	Bangkulis-Kiyawon	6029.90	91	7
2. Katsuwonus pelamis	Pundahan (Rayado)	226.50	3	0
3. Thunnus alalunga	Bangkulis – iliwon	141.50	2	0
4. Scomberomorus commerson	Tanguigi – natural	66.50	1	0
5. Carcharhinus melanopterus	Pating	46.00	1	0
6. Coryphaena hippurus	Lamadang, mahi-mahi	40.00	1	0
7. Lampris guttatus	Golden fish	31.00	0	0
8. Thunnus obesus	Bangkulis – Paranganon	19.00	0	0
9. Makaira mazara	Marlin	16.50	0	0
10. Acanthocybium solandri	Tanguigi - batang	2.50	0	0
Commercial Total		6619.40	100	8

For the totality, the *Thunnus albacares* dominated the catch as this is the target species of the gear. However, these resources as reflected in Table 5 was taken out through legal and illegal fishers (Figure 10). Those legal fishers were secured licensed for their fishing vessel and illegal without licensed issued by respective government units.

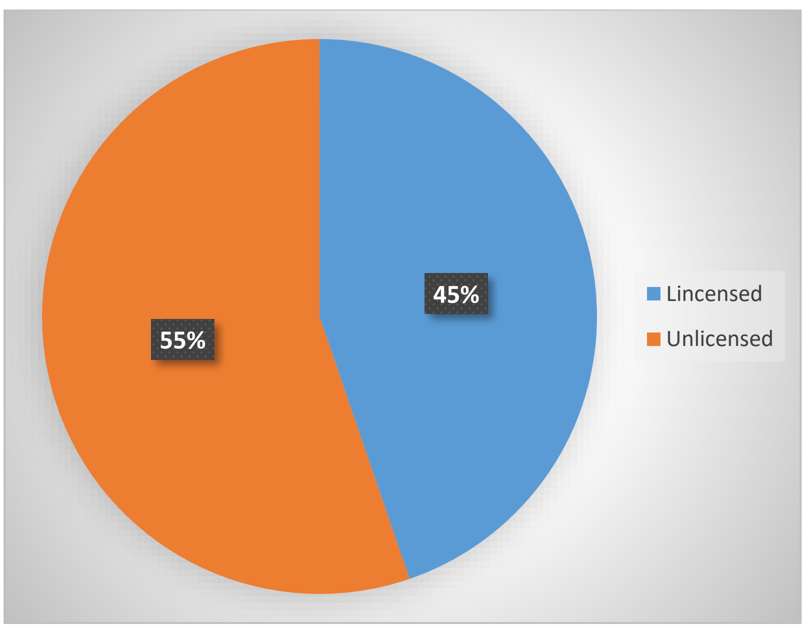

***Figure 10.* Contribution of licensed and unlicensed fishing operation of tuna handline in Lagonoy gulf**

Table 5. Species interacted in tuna handline fisheries both municipal and commercial in Lagonoy Gulf (August 2014 – July 2015).

Species Composition	Catch (kg)												TOTAL	Percentage	Number of pieces	Average weight	Size range (kilo)
	2014					2015											
Scientific Name	August	September	October	November	December	January	February	March	April	May	June	July					
Thunnus albacares	7,594.82	8,479.05	14,955.60	9,490.20	1,545.70	396.20	2,043.10	2,666.35	2,369.20	2,826.30	3,356.50	3,136.10	58,859.12	71.25	3625	16.24	1-154
Thunnus alalunga	1,823.00	1,049.60	576.90	2,508.80	127.00			135.50				245.50	6,466.30	7.83	955	6.77	5-20
Katsuwonus pelamis	445.80	224.70	871.00	759.70	272.50	219.90	40.35	230.60	52.00	722.00	109.60	746.10	4,694.25	5.68	3578	1.31	1-6
Coryphaena hippurus	75.70	142.20	176.10	327.30	62.50	277.25	275.90	432.65	405.10	342.40	542.55	201.70	3,261.35	3.95	901	3.62	3-12.5
Acanthocybium solandri	118.00	234.40	87.00	137.65	11.20	141.10	328.00	137.25	130.70	235.70	221.40	45.70	1,828.10	2.21	380	4.81	1.5 -17
Thunnus obesus	73.60	117.50	140.00	784.10	103.50				60.00			28.00	1,306.70	1.58	180	7.26	7-29
Istiophorus platypterus	31.00	133.70	79.30	182.95		199.40	181.10	15.00	114.00	115.70	206.30		1,258.45	1.52	123	10.23	3-53
Lampris guttatus	336.00	134.00	291.50	45.00	32.00			33.00		65.00	50.00	102.00	1,088.50	1.32	48	22.68	20-80
Makaira mazara			53.00			18.50		27.00	510.20	231.60	66.40	179.40	1,086.10	1.31	54	20.11	5-123
Xiphias gladius	26.50	8.00	23.00	20.00				189.30	148.00	46.00			460.80	0.56	44	10.47	3.5-35
Carcharhinus sp.	165.20		-				155.00	36.00		29.00	19.00	53.00	457.20	0.55	25	18.29	3.2-40
Promethichthys premetheus	29.50	37.50	16.00	4.00	22.30	45.00	57.50	64.00	6.00	20.75	57.75	60.75	421.05	0.51	817	0.52	0.5-6.5
Elagatis bipinnulata			127.70			35.40	32.50		32.50	7.20	6.70		242.00	0.29	138	1.75	2.2-3
Sphyraena barracuda		6.00	6.40	2.80		17.50	14.30	56.10	6.75	23.75	42.50	9.75	185.85	0.22	79	2.35	1.2-9
Carcharhinus melanopterus		35.00	11.00	81.00				52.00					179.00	0.22	9	19.89	11-102
Scomberomorus commerson	66.50	50.50					5.50		9.50	36.25	5.00	2.00	175.25	0.21	32	5.48	2-43
Ruvettus pretiosus		26.00		39.00			42.00	22.00	6.00	2.50	10.75	24.50	172.75	0.21	15	11.52	3-39
Carcharhinus sorrah				30.00						40.00	24.00		94.00	0.11	6	15.67	12-30
Lobotes surinamensis	2.00	7.00					4.50	21.50	18.75	13.00	18.50	4.00	89.25	0.11	68	1.31	0.5-6.25

Table. ___ (continued). Species composition caught by tuna handline in Lagonoy Gulf

Species Composition	Catch (kg)												TOTAL	Percentage	Number of pieces	Average weight	Size range (kilo)
	2014					2015											
Scientific Name	August	September	October	November	December	January	February	March	April	May	June	July					
Rexea sp.	27.50							15.85	1.40	8.00	19.50	10.00	82.25	0.10	16	5.14	1.4-11.75
Thysanoteuthis rhombus							15.00		11.50	9.10		33.50	69.10	0.08	9	7.68	9-18
Auxis thazard											3.25	35.50	38.75	0.05	22	1.76	1-2.5
Makaira indica	7.50	9.50				12.00							29.00	0.04	9	3.22	4.5-12
Euthynnus affinis								2.50				18.00	20.50	0.02	66	0.31	0.44-2.5
Carcharhinus leucas					10.70	1.70							12.40	0.02	9	1.38	1.7-6
Sphyraena jello		4.00								1.00	2.50	4.00	11.50	0.01	15	0.77	1-2.5
Dasyatis sp.	7.00	3.70											10.70	0.01	4	2.68	3.7-7
Grammatorcynus bilineatus							5.00						5.00	0.01	5	1.00	1
Thunnus tonggol			4.00										4.00	0.00	4	1.00	1
Caranx sp.		3.50											3.50	0.00	2	1.75	3.5
Grand Total	10,829.62	10,705.85	17,418.50	14,412.50	2,187.40	1,363.95	3,199.75	4,136.60	3,881.60	4,775.25	4,762.20	4,939.50	82,612.72	100.00			

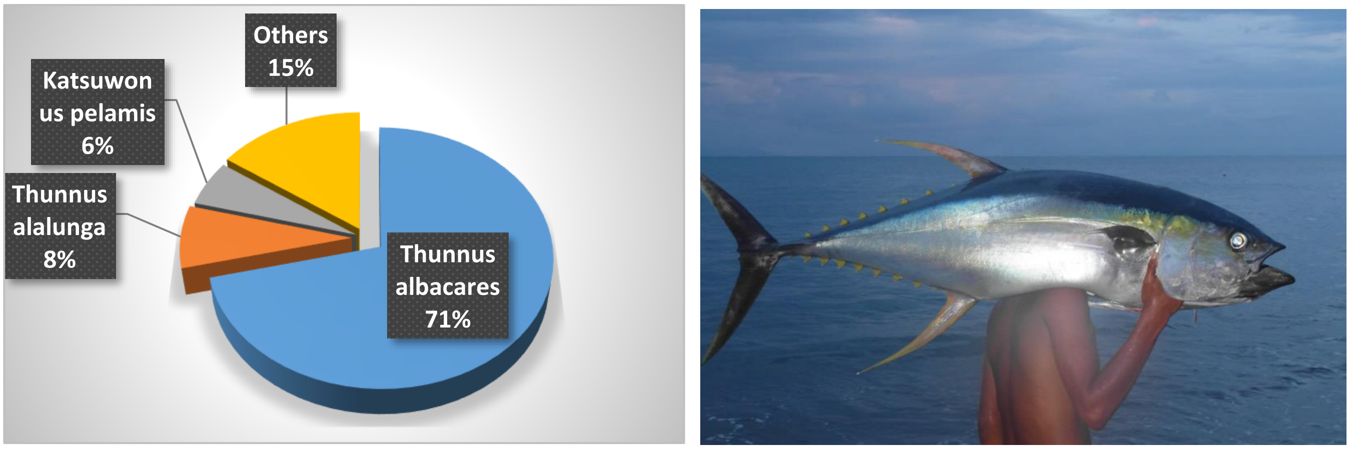

Figure 10. Top species of tuna handline gear (August 2014 – July 2015)

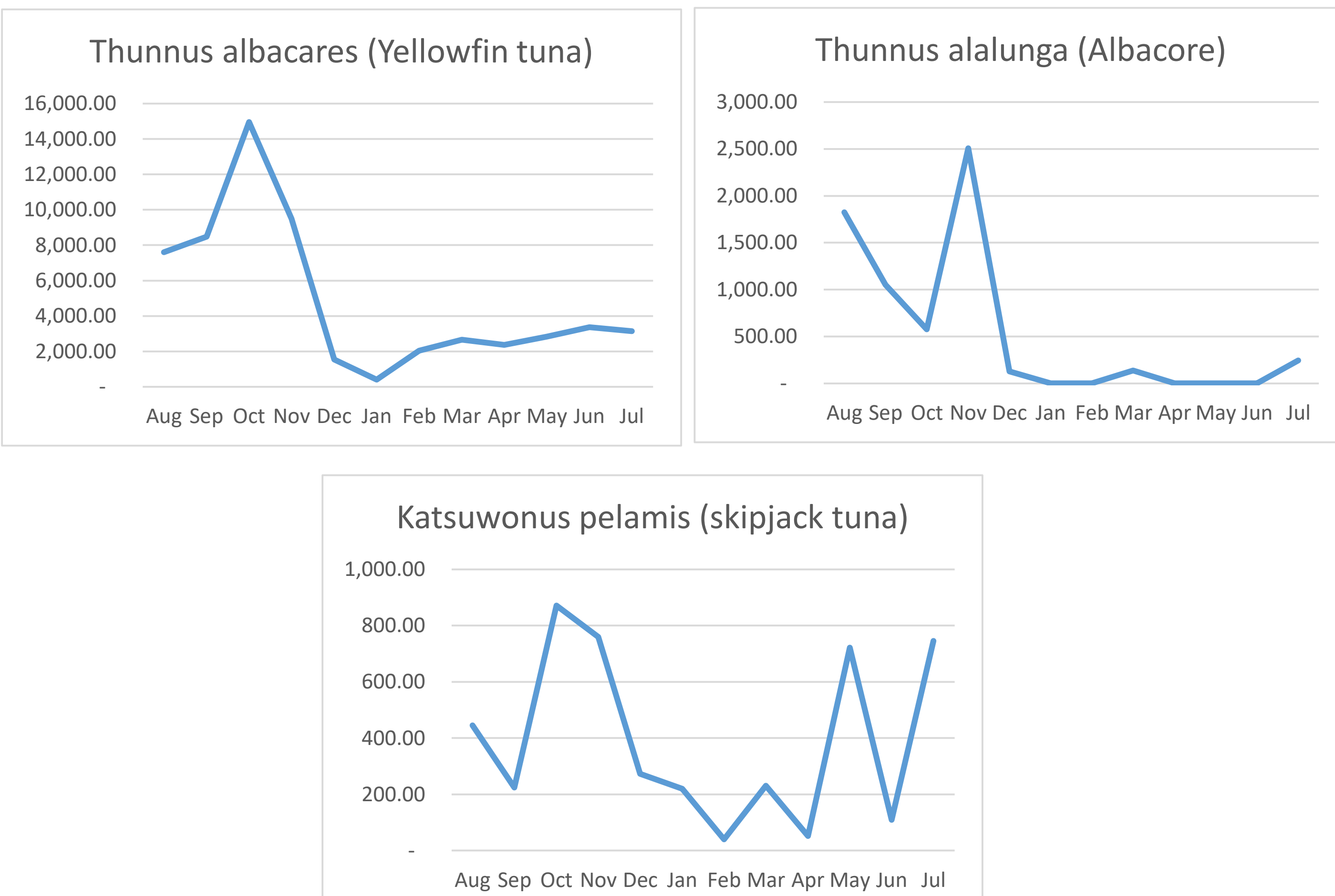

Figure 11. Seasonality of top species of tuna handline in Lagonoy Gulf (August 2014 – July 2015)

Thunnus albacres (yellowfin tuna) dominated the catch followed by *Thunnus alalunga* (albacore) and *Katsuwonus pelamis* (skipjack tuna) (Figure 10). Also the number of pieces per species, computed average weight and the size ranges in kilo was reflected in Table 1. It has been observed that the yellowfin tuna and albacore abundant starting from August to December while the skipjack tuna observed to be peak on October, May and July (Figure 11). Peak catches of the yellowfin tuna and albacore observed during the abundance also of the small pelagics such roundscad, mackerel, bigeye scad, etc. (Olaṇ̃o et al, 2009) where these species served as their food.

Bait species

Tuna fishing was undertaken during daytime and night time with or without the use of Fish Aggregating Device (FAD). For the survey on bait fisheries, small pelagic species of fish, squid and ink of squid were being used as baits. The graduating students of Bicol University took "Assessment on YFT Baits" and documented the top 3 used baits both natural and artificial (Table 6). A list of bait species that were caught by hook and line, multiple hook and line, gill net, bagnet, ring net and purse seine during the investigation period August 2014 – July 215 are shown in Table 7.

A total of 20 bait species was used, of these 17 fish species and 3 cuttlefish and squid species. Most of the handline tuna fishers were catching their own baits using multiple hooks and line in addition to their baits bought from commercial fishers; they do this to lessen operational expenses. The bait species from the ring nets, bagnets, gillnets, etc., according to the fishers comprised 2-5% of the total catch of the respective gears catch. Most of the species caught from the nets (gill net, ring net, bagnet, purse seine) in and outside Lagonoy Gulf were sold to the local markets.

Table 6. Top 3 natural and artificial baits used in tuna handline in yellowfin tuna fishing.

CPUE OF THE TOP 3 NATURAL BAITS USED IN ACTUAL HAND LINE FISHING

Rank	Natural baits	Total catch volume of species (kg)	No. of Hours In fishing operation	Catch per Unit Effort (CPUE)
1st	Shortfin Scad	258	72	3.6 kg/hr
2nd	Squid	170	72	2.4 kg/hr
3rd	Fringescale Sardinella	45	36	1.3 kg/hr
TOTAL		473	180	2.6 kg/hr

CPUE OF THE TOP 3 ARTIFICIAL BAITS USED IN ACTUAL HAND LINE FISHING

Rank	Artificial baits	Total catch volume of species (kg)	No. of Hours In fishing operation	Catch per Unit Effort (CPUE)
1st	Beach ball squid	11	36	0.3 g/hr
2nd	Bantex	50	36	1.4 kg/hr
3rd	Stainless fish	5	36	0.1 g/hr
TOTAL		66	108	0.7 g/hr

Table 7. Bait Species used for tuna handline fisheries

Scientific name	Common name	Species type	Fishery descriptor
Decapterus kurroides	Redtail scad	Non-invertebrate	Multiple handline, Ring net, Bagnet
Decapterus russelli	Indian scad	Non-invertebrate	Multiple handline, Ring net, Bagnet
Selar boops	Oxeye scad	Non-invertebrate	Multiple handline, Ring net, Bagnet
Selar crumenophthalmus	Bigeye scad	Non-invertebrate	Multiple handline, Hook and line, Ring net, Gill net
Atule mate	Yellowtail scad	Non-invertebrate	Multiple handline, Purse Seine, Ring net, Gill net
Chirocentrus dorab	Dorab wolf-herring	Non-invertebrate	Hook and line
Stoleporus spp.	Anchovies	Non-invertebrate	Beach seine, Bagnet, Ring net
Prometichthys prometheus	Roudi escolar	Non-invertebrate	Hook and line, Multiple hook and line, Scoopnet, troll line
Ruvettus pretiosus	Oilfish	Non-invertebrate	Hook and line
Mene maculata	moonfish	Non-invertebrate	Multiple handline
Auxis thazard	Frigate tuna	Non-invertebrate	Hook and line, Multiple hook and line
Grammatorcynus bilineatus	Double-lined mackerel	Non-invertebrate	Troll line
Katsuwonus pelamis	Skipjack tuna	Non-invertebrate	Ring net, Hook and line, Troll line
Rastrelliger faughni	Island mackerel	Non-invertebrate	Ring net, Hook and line, Multiple hook and line
Rastrelliger kanagurta	Indian mackerel	Non-invertebrate	Ring net, Hook and line, Multiple hook and line
Sphyraena jello	Pick-handle barracuda	Non-invertebrate	Hook and line
Sardinella longiceps	Indian oil sardine	Non-invertebrate	Gill net, Ring net, Purse seine
Loligo spp.	squid	Invertebrate	Jigger, Scoopnet, Squid pot
Sepioteuthis lessoniana	Bigfin Squid	Invertebrate	Jigger, Scoopnet
Sepia pharaonis	Cuttlefish	Invertebrate	Jigger. Scoopnet

Productivity and Susceptibility Analysis (PSA)

All interacted species in tuna handline fisheries including the bait species were treated to PSA. Tables 1 and 2 shows the values of productivity and susceptibility variables to be used for scoring the PSA. The basic information of the species required in scoring productivity that's not available was scored with default score of 3. For the weight of bait species, we used the NSAP and PPTST data to consider the effect of individual gears used.

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 species, namely *Thunnus alalunga* (Albacore), *Katsuwonus pelamis* (Skipjack tuna), *Thunnus obesus* (Bigeye tuna) and *Xiphias gladius* (Swordfish) determined to be the primary species 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%. These species from the tuna handline fisheries were score under the primary species on PSA template (Table__). In the case of *Thunnus obesus*, the fishing mortality for this species should be reduced to a level no greater than the Fmsy while for *Katsuwonus pelamis* the Fishing Mortality Rate (F) should be maintained at a level no greater than Fmsy (CMM 2015-01). This measure applies to all Cooperating Commission Members (CCMs) of WCPFC. The same applies to Xiphias gladius under paragraph 2 of CMM 2009-03 where CCMs shall exercise restraint through limiting the number of fishing vessels for swordfish in the Convention Area. For *Thunnus alalunga* (CMM 2015-02), Commission Members, Cooperating Non-Members and participating Territories (CMMs) shall not increase the number of their fishing vessels actively fishing for South Pacific Albacore in the Convention Area South of 20ºS above 2005 levels or recent historical (2000-2004) levels. The numbers of the *Thunnus obesus* and *Xiphias gladius* categorized as primary species in Lagonoy gulf will not cause a significant negative impact on the species caught, where only 1.58% of the total catch were recorded in the one year data gathering comprising 180 individuals only. While the Swordfish with 44 individuals contributes only 0.56% of the total catch of tuna hanline fisheries in Lagonoy Gulf (Table__). All the four species scored were all at low risk having the MSC-PSA derived scores of 93-96 with an MSC scoring guidepost of ≥80.

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), ETP species, or out of scope species (amphibians, reptiles, birds and mammals) (MSC 2014). A total of 21 species from the tuna handline fisheries and 20 bait species from the different fisheries were scored for the PSA. Other 4 species namely *Carcharhinus sp., Dasyatis sp., Rexea sp. and Caranx sp.* no longer treated because it needs further identification what specific species of the respective genus. From the tuna handline fisheries, 1 out of 21 species were treated at medium risk and the rest were at low risk (Table__). Due the older age of *Carcharhinus leucas* (species at medium risk) before it can reach average age at maturity which is 13 years old compared to the other 2 sharks species ranging 1.8-5.8 years of age, the chance of releasing the captured species by the tuna handline that with ability to survive the species would take this species to low risk. The contribution of 20 secondary species to the tuna handline gears ranging from 0.01-3.95% of the total catch indicating that the gear does not harm non-target species.

The bait species composed of small pelagic species (17 species) of fish and squids (3 species) as enumerated in Table __. Of the 17 species of finfishes, the six (6) species such as Decapturs kurroides, Decapterus russelli, Atue mate, Selar boops, Selar crumenophthalmus and Rastrelliger faughni showed medium risk and the remaining 11 species were at low risk. The medium risk for six species, were mainly related to their high susceptibility to high catch rates in ringnet and purse seine fisheries despite of their high productivity. Species caught from ringnet, gillnet and purse seine fisheries were used for domestic consumption in which only 2-5% of the total catch of one vessel was used as bait which is considered as a small proportion of the total catch and therefore there is no significant negative impact is assumed from the proportion that is used as bait. For the invertebrates, squids were the source of ink used by the tuna fishers as bait aside from the raw squid they had been used. The analysis showed a low risk for all these species.

Endangered, Threatened and Protected (ETP) species

There were no ETP species documented for one year fish catch monitoring.

Conclusion

The PSA for the additional species in tuna handline fisheries were at low risk showing that the gear does not pose negative impact to the non-target species. However, tuna handline fishers require bait for them to be able to catch their target fish. Productivity Susceptibility Analysis results for the bait species used in the handline fishery showed that 6 out of 17 species were on medium risk due to high susceptibility in the ring net, gill net and purse seine. These results confirm that the small pelagic species are particularly negatively impacted by the FAD fisheries using ringnets and gillnets, as shown by the results of biological studies of NSAP by Olano et.al who found that the said species have high values of exploitation rate.

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