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Assessment on the Effect Ringnet and Purse Seine Net Depth Reduction on the Catch of Bigeye Tuna (Thunnus obesus)

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Assessment on the Effect Ringnet and Purse Seine Net Depth Reduction on the Catch of Bigeye Tuna (*Thunnus obesus*)

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Abstract

Analysis on the catch of bigeye tuna (*Thunnus obesus*) from purse seine and ring nets of various net depths was conducted to assess the effect of reducing net depth as a compatible measure that the Philippines has implemented to reduce the catch of bigeye in its internal waters and the EEZ.

The analysis was based on Observer reports from from ringnet and purse seine fishing vessels operations in internal waters and EEZ in 2010-2016 as well as from group seine operations in the high seas pocket 1 in 2012-2016. The catch of bigeye by depth of nets and fishing ground were examined which indicated that the catch of bigeye is correlated with the depth of net, with higher catch of bigeye in deeper nets.

The result of the study is consistent with other studies elsewhere, and in consonance with the implementation of Fisheries Administrative Order 236 limiting the depth to 115 fathoms for ring net and purse seine operating in Philippine internal waters and the EEZ as compatible measure to reduce the catch of bigeye.

INTRODUCTION

Tuna fishing significantly contributes to the country's fish production, contributing about a quarter of the total marine fish production annually. There are eleven tuna species reportedly caught in the country that include skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), albacore (*Thunnus alalunga*), longtail tuna (*Thunnus tonggol*), striped bonito (*Sarda sarda*), Pacific bluefin (*Thunnus orientalis*), frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*) and eastern little tuna/kawa-kawa (*Euthynnus affinis*). In 2014, skipjack formed the bulk of the oceanic tunas, with about with about 64%, 34% yellowfin and 2% bigeye.

The sustainability of bigeye tuna in the WCPO is however under threat with stocks indicating spawning stock biomass below the limit reference point. The Western Central Pacific Commission (WCPFC) has introduced measures to rebuild the stock of bigeye, among which is the FADs closure, which prohibits purse seining with FADs in the high seas and EEZ.

The Philippines has implemented Fisheries Administrative Order 236 that requires all purse seines and ringnets operating in internal waters and the EEZ to reduce the depth of nets not to exceed 115 fathoms as a compatible measure to reduce the catch bigeye tuna. The result of the monitoring of this measure had been annually reported to the SC.

This paper consolidates data from Observers from 2010-2016 to further validate catch of bigeye tuna with various net depths and to evaluate current measure.

METHODOLOGY

Net Depth Inspection/Validation

Net depths were determined based on the annual fishing gear inspection conducted by the Fisheries Regulatory and Licensing Division (FRLD) of the Bureau of Fisheries and Aquatic Resources (BFAR). Inspections were either conducted at Company yard or compound or when the vessel is docked in port or as verified by Fisheries Observers.

Catch Estimation

Catch estimate was based on the degree of fullness of fish hold and its capacity estimated by the Captain of the carrier vessel or the Fisheries Observers using a standard estimate on brail capacity, brail fullness and number of brails.

In the brailing capacity, estimation was based on the following formula:

Volume = $\pi r^2 h$

Brail Capacity = Volume x 80%
Where
$\pi = 3.1416$
r = brail radius
h = brail height with load

Brail capacity was approximately 80% of the fish catch when displaced while the 20% were accounted for air and water space. Based on the formula, it was observed that a margin of +/- 2% difference with the actual catch landing in port (dela Cruz, 2010).

Data Collection

Data were taken from the reports of Fisheries Observers deployed onboard Philippine flagged vessels operating in the country's internal waters and the EEZ, as well as from the group seine operations in the high seas pocket 1. Compilation of data were done by the Technical staff from Fisheries Observer Program Management Office (FOPMO).

Catch Sampling and Species Identification

Samples were taken randomly from the catch either by scooping from the brail or from the fish hold. Spill sampling method was used starting 2014.

Samples were sorted according to species, weighed to the nearest0.1 kg and measured their fork length to the nearest cm.

Morphological evaluation on the unique external characteristics of yellowfin and bigeye tuna was considered to differentiate the two species. Species identification manual was also provided to Observers as reference.

Data and Statistical Analysis

Depths of net were stratified at 20 fathoms class interval. Comparison on the average nominal catch (t/set) of bigeye tuna was done by net depth class/interval across fishing grounds (i.e. internal waters/EEZ and HSP1). Analysis of Variance (ANOVA) and Covariance (ANCOVA) using Statistical Package for the Social Sciences (SPSS) version 15 was used to compare nominal bigeye catch by net depth class/interval and by fishing ground.

Linear regression analysis on the catch by net depth class/interval and the correlation was used to estimate the relative reduction of bigeye across net depth class and the predicted reduction of bigeye as a result of the current regulation reducing the maximum net depth to 115 fathoms.

RESULTS

Internal waters and EEZ

Between 2010-2016, Observer data covered 2,634 sets from four (4) fishing grounds that include the Mindanao/Celebes Sea (CEL), Pacific Seaboard (PAC), Sulu Sea (SS) and West Philippine Sea (WPS). The distribution of observations by net depth class and fishing grounds is presented in Table 1.

Table 1. Distribution of observed sets by net class/interval and fishing ground

Neth depth	**CEL**	**PAC**	**SS**	**WPS**	**Total**
101-120	835	661	86	86	**1,668**
81-100	628	110	34	156	**928**
61-80	38				**38**
Total	**1,501**	**771**	**120**	**242**	**2,634**

Catch Variation by Net Depth

Analysis on the catch of bigeye tuna across net depth class/interval indicated direct correlation of bigeye catch with the depth of net, with the highest average catch in deeper nets (101-120 fathoms). With this, the bigeye catch under current net depth regulation of 115 fathoms maximum (100-120 depth class) indicated a decrease by 28.3% when compared to the predicted catch (by linear regression) for next higher net depth class (121-140 fathoms) as shown in Table 2 and Fig 2.

Table 2. Average bigeye catch by net depth class and % reduction

Net Depth (fathom)	Midpoint	BET_catch	% Reduction
121-140	130	0.283*	
101-120	110	0.203^{c}	28.3
81-100	90	0.114^{b}	43.8
61-80	70	0.039^{a}	66.1

*predicted by linear regression

Different superscript are significant at $p < 0.05$

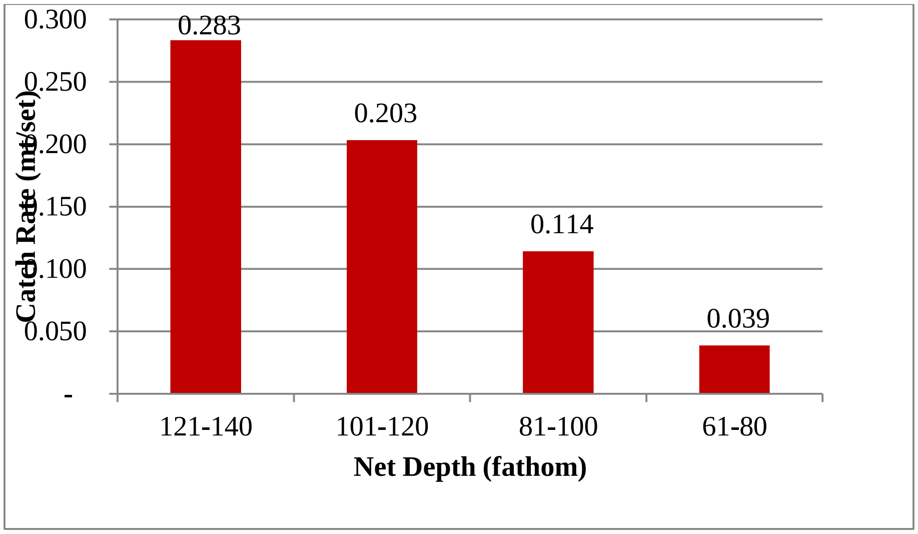

Figure 1. Average bigeye catch by net depth class (121-140 was predicted by linear regression)

Analysis of Variance (ANOVA) also suggests significant difference on the average catch of bigeye by depth of net across all fishing grounds, which signifies significantly lower bigeye catch in shallower nets (Table 3).

Table 3. Analysis of variance on the average bigeye catch by net depth class and fishing ground.

Depth (fathor	Celebes Sea	Sulu Sea	West Phil. Sea	Phil Pacific Seaboard	Across all fishing grounds
61 – 80	0.039 a	-	-	-	0.039 [a]
81- 100	0.119 b	0.118	0.011	0.233	0.114 [b]
101 - 120	0.241 c	0.08	0.074	0.187	0.203 [c]
Significance	$p < .01$ highly sig	$p > .05$ not sig	$p < .01$ highly sig	$p > .05$ not sig	$p < .01$ highly sig

Similar results were observed based on annual assessment/monitoring done in previous years (Ramiscal et al, 2011-2014) which initially formed the basis for the of the implementation of FAO 236.

High Seas Pocket 1 (HSP1)

In the High Seas Pocket 1 where no regulation for net depth is being implemented, variation of bigeye tuna catch by net depth class was also analysed. A total of 9,309 sets from 46 purse seine and ringnet vessels in 2012- 2016 were examined (Table 4).

Table 4. Distribution of observed sets of group seine operation in the high seas pocket 1 by depth of net

Net Depth	2012	2013	2014	2015	2016	Total
>140	38	94	138	144	387	801
121-140	50	361	795	971	1,225	3,402
101-120	98	782	1,482	1302	982	4,646
81-100	25	115	253	18	49	460
Total	211	1,352	2,668	2435	2,643	9,309

Catch Variation by Net Depth

Using the same net depth class applied above, analysis showed a lower catch of bigeye by 43.5% in shallower nets (121-140 fathoms) compared to deeper nets (>140 fathoms). Further reductions by 6.2% and 19.2% were observed in 100-120 fathoms and 81-100 fathoms nets respectively (Table 5, Figrue 2). The Analysis of Variance also showed significantly higher bigeye catch was observed in deeper nets (>140 fathoms) when compared with shallower nets (Table 5, Figure 2).

Table 5. Analysis of variance on the average bigeye catch by depth of net and % reduction

Net Depth (fathom)	n	BET catch (mt/set)	% Reduction
>141	801	0.540^{b}	
121-140	3,402	0.305^{a}	43.5
101-120	4,646	0.286^{a}	6.2
81-100	460	0.230^{a}	19.6

Different superscript are significant at $p < 0.05$

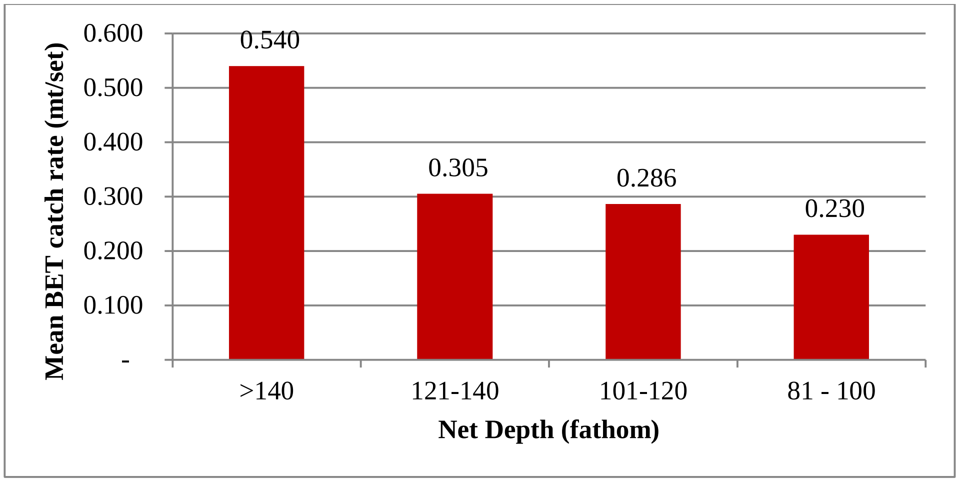

Figure 2. Average catch of bigeye by net depth, HSP1

SUMMARY AND CONCLUSION

1) Based on the foregoing, the reduction and limiting the depth of net for purse seine and ring nets operating in Philippine internal waters and EEZ is consistent with the objective of reducing the catch of bigeye and can be considered as a compatible measure with the current CMMs to reduce the catch of bigeye.

2) Adjusting the depth of net has also been suggested elsewhere to reduce the catch of yellowfin and bigeye. In the behavioral study of small bigeye, yellowfin and skipjack tunas associated with drifting FAD using ultrasonic coded transmitter in the central Pacific Ocean results suggested that it is possible to reduce the catch of yellowfin and bigeye tunas to some extent by adjusting the depth of the net (Matsumoto, et al, 2006). Similarly, Lennert-Cody et al. (2016) also suggested that net depth and floating-object depth were the most important for predicting the presence of bigeye catches.

3) It is recommended that FAO 236 as a compatible measure should be maintained with considerations of the following:

   a) Strengthen fishery law enforcement. Enhanced patrolling and visibility of enforcement units in major fishing grounds to non-compliant vessels conducting Illegal, Unreported and Unregulated Fishing (IUUF).

   b) Continue assessment of the current regulation through the Observer program and the National Stock Assessment Program (NSAP) and adapt/adjust the measure to reduce bigeye as maybe be necessary.

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