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**HARVEST STRATEGIES FOR TROPICAL TUNA IN ARCHIPELAGIC WATERS OF
INDONESIA: UPDATE**

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Harvest Strategies for Tropical Tuna in Archipelagic Waters of Indonesia: Update

Introduction

The Western and Central Pacific Fisheries Commission (WCPFC) has adopted the Conservation and Management Measure on establishing a harvest strategy for key fisheries and stocks in the Western and Pacific Ocean (CMM 2014-06) to ensure the long-term conservation and sustainable use of the highly migratory fish stocks of the WCPO in 2014. In the following year, a work plan for the adoption of harvest strategies (HS) has been agreed. The development and implementation harvest strategies for major tuna species is also consistent with Indonesia's rights and obligations as a member of the international governance bodies for these highly migratory stocks: Regional Fisheries Management Organizations (RFMOs). Indonesia intends to develop Harvest Strategies within its Archipelagic Waters which are compatible with measures mandated by the RFMOs. In addition, implementation of the monitoring, assessment and management measures, which form the essential elements of a harvest strategy, are central to achieve certification of fisheries to international standards for sustainability, an important milestone for the private sector in Indonesia, and to safeguard against local depletions of tuna stocks.

Indonesia intends to develop scientifically-tested harvest strategies for tropical tuna in the Indonesia's Archipelagic Waters (IAW). This development has been initiated since November 2014. The aim of developing the HS is to enable Indonesia to manage its tropical tuna fishery within its IAW in an adaptive way which can be measurable and predictable in achieving its management objective. This work is a participatory and consultative process which involves a spectrum of relevant stakeholders, including central and local Government, fishery managers, fishing associations, industry stakeholders, private sector companies, international and local Non-Government Organizations (NGOs), fishery scientists and experts.

Indonesia's Archipelagic Waters (IAW) encompass Fisheries Management Areas (FMAs) 713, 714 and 715, and are identified as the priority areas for this initiative due to the significant role it plays for Indonesian tuna fisheries. In recent years, the proportion of tuna catches from those areas has increased relative to the national tuna catches. A strong residential behavior has been reported by Rice *et al.* (2014) for skipjack, and highlighted during the WPEA, *Three Country*

Stock Assessment Workshop, held in Vietnam in 2015, for skipjack and yellowfin tuna. Therefore, the development and implementation of harvest strategies for tuna fisheries in Indonesian archipelagic waters demonstrates Indonesia's commitment to long-term sustainability of these nationally and regionally important resources. It is the intention that this process will initially focus on these three FMAs but will, at a later date, be expanded to include all national waters.

This is the first attempt to develop harvest strategies for Indonesia's tuna fisheries, a specific harvest strategy framework has been developed through a collaborative work between the Center for Fisheries Research (CFR), Ministry of Marine Affairs and Fisheries (MMAF), Indonesia and the WCPFC under the West Pacific East Asia – Sustainable Management (WPEA-SM) with the involvement of the Commonwealth Scientific and Industrial Research Organization (CSIRO) experts. WPEA-SM has supported the development of Indonesia's National Tuna Management Plan (NTMP) and the interim harvest strategy framework for tropical tuna fishery in Indonesia's archipelagic waters (FMAs 713, 714 and 715) as well as the port-based sampling program for at least 10 years. This paper provides an update of the process of the HS development for the tropical tuna in the Indonesia's archipelagic waters (FMAs 713, 714 and 715) up to mid of 2021.

Harvest Strategy Development Process

The process of development to current status of the harvest strategy has been conducted in a consultative, collaborative and multi-stakeholder approach. Lead government institutions have been the Directorate of Fish Resources Management, Directorate General of Capture Fisheries (DGCF) and CFR, both under MMAF. Under the direction of the Directorate of Fish Resources Management and by instruction from the Director General for Capture Fisheries a steering committee was established comprised of officials from DGCF, Centre for Fisheries Research and some external expert advisors (from CSIRO and the Pacific Community (SPC)). During the initial process, the consultation has involved experts from three RFMOs (WCPFC, Commission for the Conservation of Southern Bluefin Tuna (CCSBT) and Indian Ocean Tuna Commission (IOTC)) which Indonesia is a member.

Additionally, a technical group was established and led by the Centre for Fisheries Research which included technical guidance and input from CSIRO, whom have extensive experience

in the harvest strategies and MSE (Management Strategy Evaluation), and also with support from various stakeholders that include NGOs and academia.

Multi-stakeholder consultations and technical workshops have taken place over the past couple of years, fostering a transparent and participative environment for harvest strategy development. A summary table that shows a time-line of progress to develop Indonesia's harvest strategies of tropical tuna in its Archipelagic Waters can be found in Figure 1. The interim harvest strategy for tropical tuna in Indonesia's Archipelagic Waters had been launched at the Third *Bali Tuna Conference* in 2018 (WCPFC14-2017-DP26 and WCPFC15-2018-DP28). A management objective and limit reference point have been agreed, while five candidates of management measures were agreed, with target reference points still in discussion.

Technical Workshops – Scientific Related Process

In 2016, thirteen data-sets were submitted as the first submission for harvest strategy work. These datasets were collected from 2010 – 2015, and three data-sets were selected for further harvest strategy development (WCPFC-SC14-2018/MI-IP-06, Satria and Sadiyah, 2018). The second data submission was in March 2019 for data collected from 2016 – 2018. In the third data submission in March 2020, the number of data-sets used increases to 11 data-sets from 8 data providers. The number of data-sets in the fourth data submission remains the same as the previous year, the summary is provided in Table 1. Number of trips of pole-and-line, handline, longline and purse seine fisheries recorded from 2010 – 2020) are provided in Tables 2, 3, 4 and 5, respectively.

The 6th Technical Harvest Strategy Workshop was conducted in February 2021. The updated analyses on the CPUE standardization and selectivity estimation were presented and discussed during the 6th technical workshop. The following activities were updated with data inputs from 2016-2019.

1. Estimation of the relative abundance index of skipjack (SKJ) based on the standardization of pole and line catch and effort data was updated during that workshop. The increase in the quality and number of years of data now included in this data series has substantially improved the quality of the standardization so that it can be included in the Operating Models for evaluating specific harvest strategies for IAW.

2. Updated the estimation of the relative abundance index of skipjack (SKJ) based on the standardization of pole and line catch and effort data. The increase in the quality and number of years of data now included in this data series has substantially improved the quality of the standardization so that it can be included in the Operating Models for evaluating specific harvest strategies for IAW.
3. Improved the estimation of the selectivity by length analysis shows the relative vulnerability of specific age and length classes of skipjack and yellowfin tuna to the Indonesian fisheries, including for longline, pole and line, handline and purse seine fishing gears in FMA 713, 714 and 715.
4. Updated and expanded the forms of uncertainty included in the Operating Model for skipjack tuna based on the most recent WCPFC stock assessment. The models now allow for alternative assumptions about recruitment and connectivity between IAW and the wider WCPO. The improvements in the quality of the CPUE standardization and selectivity estimation (noted above) will allow these to be included in the next iteration of developments of the operating models. This will mean the models will reflect the current Indonesian fisheries more closely than previously possible.

Prototype Operating Models (OMs) have been developed for skipjack and yellowfin tuna, based on the relevant WCPFC regional stock assessments. These models provide the basis for testing the performance of specific alternative harvest strategies and providing government and stakeholders with results to select the most appropriate harvest strategy for each species for implementation. Summary of specification and process of developing prototype OMs and preliminary examples of harvest strategy framework for skipjack tuna and yellowfin tuna in Indonesian archipelagic waters is provided by Hoshino *et al.* (2018). These models are conditioned using the WCPO stock assessment outputs as well as Indonesian port-sampling data. Progress of the harvest strategy development has been reported in the Scientific Committee meeting of the WCPFC - SC14 (WCPFC-SC14-2018/MI-IP-06) and WCPFC – SC15 (WCPFC-SC15-2019/MI-IP-11), SC16 (WCPFC-SC16-2020/MI-IP-24) and Regular Session of the Commission – WCPFC 14 (WCPFC14-2017-DP26) and 15 (WCPFC15-2018-DP28).

The 6th Technical Harvest Strategy Workshop concluded that the prototype of Operating Models from 2018 for yellowfin still need updating, following the major changes in the most

recent stock assessment conducted by SPC in 2020 (Vincent *et al.* 2020). This work, and the incorporation of the updated CPUE standardization and selectivity estimates for skipjack, is planned for 2021. The completion of these updates and refinements will provide a set of operating models for skipjack and yellowfin tuna that can be used to explore the relative performance and implications of specific harvest strategies developed with government and stakeholders.

Stakeholder Workshop – Management Related Process

During the Stakeholder workshop in 2017, five priority selected management measures were selected (WCPFC15-2018-DP28):

- a. Limit on use of Fish Aggregating Devices.
- b. Spatial closures (of important spawning or nursery grounds) and temporal closures (during important events such as spawning).
- c. Number of fishing days (per gear, for semi industrial and industrial vessels).
- d. Number of vessels – limited entry (per gear; for semi industrial and industrial vessels through licensing, permits, taxing, royalties).
- e. Total Allowable Catch (TAC) limits per Fisheries Management Area.

The 1st Harvest Strategy Implementation Workshop in November 2018 has involved various relevant stakeholders and international experts including Harvest strategy expert from SPC. The workshop recommended that there are no additional fishing permits for industrial fishing vessels (>30 GT) catching yellowfin and skipjack tuna until the NTMP completes its review.

The 2nd Harvest Strategy Implementation Workshop was held from 30 – 31 October 2019. During this workshop, the five priority selected management measures were discussed. All stakeholders attended the workshop, including relevant central and local Governments, fishing associations, industry and private sector stakeholders, international and local Non-Government Organizations, Scientists and Academics, agreed to implement these management measures, until the harvest strategies fully developed for the tropical tuna in the IAW. Review of the NTMP has been conducted since 2019 and completed in December 2020, followed by public consultations in early 2021.

The 3rd Harvest Strategy Implementation Workshop in 2 – 3 March 2021 agreed that the continuation and improvement of data collection for tuna longline fishery is needed which can be fulfilled from stakeholders associated with the longline fisheries in FMA 713, 714 and 715. The workshop has underlined the importance to pay attention to the aspects of protection and welfare of small fishers, given the significant contribution of the small-scale fisheries. The workshop recommends that the 5 management measures can continue to be considered for implementation taking into account the characteristics of fisheries and the needs of stakeholders in each region. In addition, it also recommends that a socio-economic study be conducted so that the results can be used, among others in refining the design and the selection criteria for candidate harvest strategies.

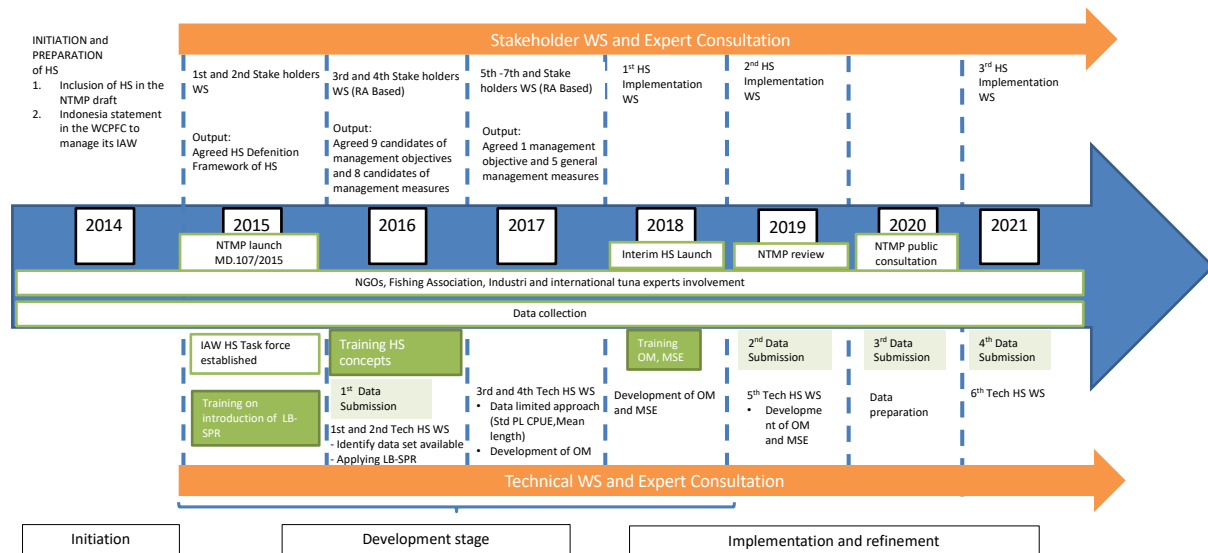


Figure 1. Summary of Harvest Strategy Development Process for Tropical Tuna in the Indonesia's Archipelagic Waters (modified from Satria and Sadiyah (2018))

Table 1. Summary of datasets submitted to the Fourth data submission in March 2021 (combined with the previous submissions).

Data series name/source	Sampling period	Sampling freq.	FMA coverage	% landing/gear coverage	Source of effort/catch data	Rel. abundance?	Size indices?	On-going?
CFR – WPEA (Port Sampling)	2010 - 2020	Daily	713 - 715	30% of # vessels landed. PL,PS,SHL,TLH,TR, LHL,LL	Effort (fishing days, hooks), total catch volume per port-sampled vessel	√ SKJ, YFT, BET, ALB (Bitung)	√	√
CFR – ACIAR (CSIRO) (Port Sampling)	Oct 2013 - Dec 2015	Daily	714, 715	20% of # vessels landed. Mainly HL and TL, but also PL, PS at 4 ports	Number of fishing days, catch per trip recorded by enumerator	√ SKJ, YFT, BET	√	-
MDPI (Port Sampling)	2016 - 2020	Daily	713 - 715	HL, PL, PS, TL	Effort (fishing days), Catch (per landing by species)	√ SKJ, YFT, BET	√	√
MDPI (Observer)	2019 - 2020	Setting	713 - 715	HL	Effort (fishing days), Catch (per setting by species)	SKJ, YFT, BET	√	√
SFP (Port Sampling)	2016 - 2020	Daily	713 - 715	HL	Effort (fishing days), Catch (per landing by species)	√ SKJ, YFT, BET	√	√
DGCF (Logbook)	2016 - 2020	Setting	713 - 715	PL, PS, HL, LL	Effort (fishing days, hooks), Catch (per landing by species)	√ SKJ, YFT, BET	N/A	√
DGCF (Observer)	2016 - 2020	Setting	713 - 715	PL, HL, LL, PS	Effort (fishing days, setting, hooks), Catch (per vessel by species)	√ SKJ, YFT, BET	Length - Weight	√

Data series name/source	Sampling period	Sampling freq.	FMA coverage	% landing/gear coverage	Source of effort/catch data	Rel. abundance?	Size indices?	On-going?
AP2HI (Port Sampling)	Jan - Dec 2019	Daily	713 - 715	PL, HL	Effort (fishing days), Catch (per trip by species)	SKJ, YFT, BET, ALB	√	√
AP2HI (Observer)	2017 - 2020	Setting	713 - 715	PL	Effort (fishing days, setting), Catch (per setting by species)	√ SKJ, YFT, BET	√	√
RIMF (Port Sampling)	Feb 2018 - Dec 2019	Daily	713 - 715	HL, LL, PL, PS, TL	Effort (fishing days, no. of hooks, no. of setting), Catch (per trip by species)	SKJ, YFT, BET	√	√
YKAN (Port Sampling)	2019 - 2020	Daily	713 – 715	PL, HL, TL, PS, GL, LL	Effort (fishing days, no. of seting), Catch (per trip by species)	SKJ, YFT, BET	√	√

Notes: CFR – Center for Fisheries Research; DGCF – Directorate General for Capture Fisheries; MDPI – Masyarakat dan Perikanan Indonesia; AP2HI – Asosiasi Perikanan Pole and Line dan Handline Indonesia (collaborates with Yayasan IPNLF Indonesia); SFP – Sustainable Fisheries Partnership; WPEA-SM – West Pacific East Asia-Sustainable Management, ACIAR – Australian Centre for International Agricultural Research; RIMF – Research Institute for Marine Fisheries; YKAN – Yayasan Konservasi Alam Nusantara.

AP2HI ^[O]	-	-	-	-	-	-	-	-	-	-	-
RIMF ^[P]	-	-	-	-	-	-	-	-	1	-	-
YKAN ^[P]	-	-	-	-	-	-	-	-	-	2	9

[P] = Port Sampling, [O] = Observer, [L] = Logbook

Table 5. Number of purse seine trips collected (the first and second data submissions combined). The first submission is data from 2010 – 2015, the second submission is data from 2016 – 2018, the third submission is for 2019 and the fourth submission is for 2020 data only.

Data series name	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CFR-WPEA ^[P]	693	70	52	77	81	539	947	892	587	635	599
MDPI ^[P]	-	-	-	-	-	-	-	-	-	-	-
MDPI ^[O]	-	-	-	-	-	-	-	-	-	-	-
CFR-ACIAR ^[P]	-	-	-	-	-	-	-	-	-	-	-
SFP ^[P]	-	-	-	-	-	-	-	-	-	-	-
DGCF ^[L]	-	-	-	-	-	-	825	1686	1836	5876	1690
DGCF ^[O]	-	-	-	-	-	-	1	-	1	79	44
AP2HI ^[P]	-	-	-	-	-	-	-	-	-	-	-
AP2HI ^[O]	-	-	-	-	-	-	-	-	-	-	-
RIMF ^[P]	-	-	-	-	-	-	-	-	4959	9511	-
YKAN ^[P]	-	-	-	-	-	-	-	-	-	25	189

[P] = Port Sampling, [O] = Observer, [L] = Logbook

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