Catch composition and size distribution of neritic tuna caught in the Indonesian waters FMA 572 and 573

Ririk K Sulistyaningsih[1)], Lilis Sadiyah[1)], Fayakun Satria[1)], Bram Setyadji[2)]

[1]Research Center for Fishery, National Research and Innovation Agency, Indonesia
[2] Department of Earth, Ocean, and Environmental Sciences, University of Liverpool, United Kingdom

Abstract

Neritic tuna commodity has a high economic value and generate state income especially for the coastal states. In Indonesia, the main catch of neritic tuna commodity consists of *Auxis rochei* (bullet tuna), *Auxis tazard* (frigate tuna), and *Euthynnus affinis* (kawakawa). This study aims to describes the catch composition and size frequency distribution of those three species neritic tuna caught in the Indonesian waters FMA 572 and 573. The data were collected daily by enumerators from 16 landing sites in FMA 572 and 573 during 2017 - 2021. A total of 50,407, consist of bullet tuna, frigate tuna, and kawakawa were measured its fork length to the nearest 0.5 cm FL using the measurement tools. The neritic tuna catch composition showed its variation between the two fishing gears, dominated by bullet tuna for gill net and frigate tuna for purse seine. The results showed that bullet tuna be placed in the highest catch from both gillnet and purse seine among the three species while kawakawa showed the lowest catch. The mean length of bullet tuna, frigate tuna, and kawakawa caught by gillnet were 27.6 cm FL, 37.1 cm FL, and 50.6 cm FL, respectively. Whereas the analysis from purse seine catch showed the lowest values of mean length for bullet tuna and frigate tuna but remain the same for kawakawa. Finally, the catch proportion of neritic tuna in Indonesian waters FMA 572 and 573 using gill net was mostly above the length of first maturity which showed high selectivity of the gill net.

Keywords: Catch; Indonesia; neritic tuna; size distribution

Introduction

Indonesia’s categorised as coastal fisheries with minimal complicated technology input and low capital expenditures characterize [1]. The annual rising in Indonesia's national population and socioeconomic structure show that the fishery has altered [1, 2]. Small-scale coastal fisheries is typically a last resort when other sources of income are not accessible [1]. Small- to medium-sized coastal fisheries with minimal complicated technology input and low capital expenditures characterize [1]. Neritic tuna commodity has a high economic value and generate state income especially for the coastal states. The majority catch of neritic tuna commodity in Indonesia consists of *Auxis rochei* (bullet tuna), *Auxis tazard* (frigate tuna), and *Euthynnus affinis* (kawakawa) [3].

Fish abundance in the water can be estimated using nominal catch per unit of fishing effort (CPUE), and utilization can be computed using the distribution of total catch and fishing effort [4]. All Regional Fisheries Management Organizations (RFMOs) have made great improvements in implementing stock assessment, not only because to the high economic worth of targeted species but also for non-targeted species (such as neritic tuna) [5]. A suggestion has been made to increase data collection, including catch, effort, and life cycle data, to improve the data-limited stock [5]. Furthermore, fish length distribution is one of the essential characteristics reflecting the pattern of fish growth status factors, known as the fill index, particularly when comparing the health and relative health of fish populations [4]. This study aims to describes the catch composition and size frequency distribution of those three species neritic tuna caught in the Indonesian waters FMA 572 and 573.

Methods

The data were collected daily by enumerators from 16 landing sites in FMA 572 and 573 (Fig. 1, Fig. 2) during 2017 - 2021. Catch per unit effort (CPUE) calculation based on the formula: CPUE = C/E, where C = catch (Kg) and E = effort (days at sea) [6]. A total of 50,407, consist of bullet tuna, frigate tuna, and kawakawa were measured its fork length to the nearest 0.5 cm FL using the measurement tools. The data gathered from gill net and purse seine. The parameters were recorded including, catch, days of fishing, fishing gear, and length from the daily monitoring activities. The enumerators also conduct the interview to the fishers, vessel owner, fishers' cooperation staff, and fishing port officers.

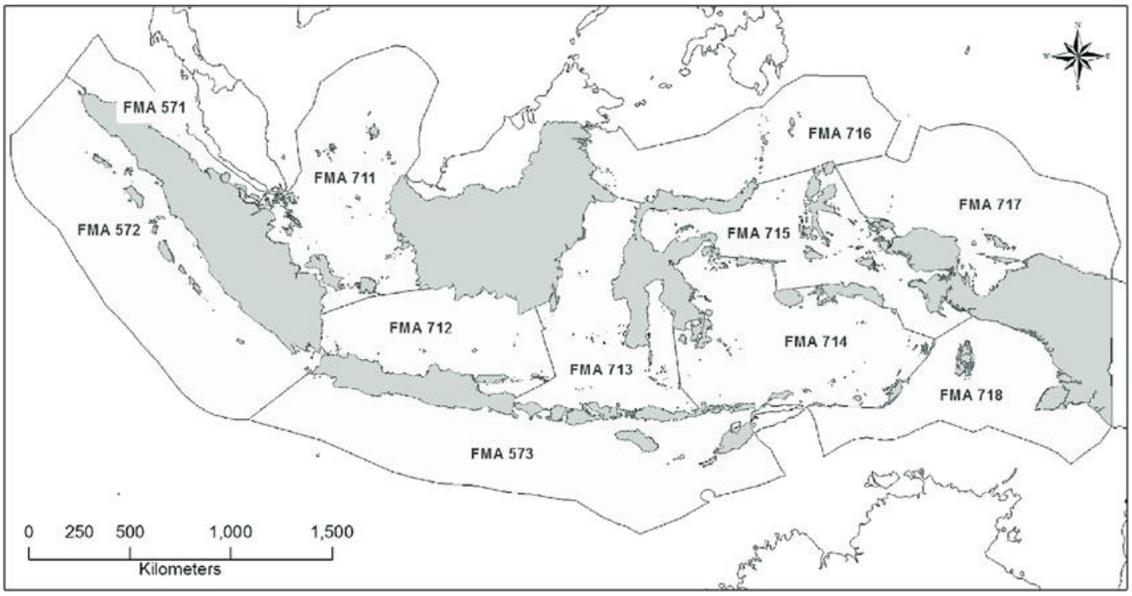

Fig. 1 Fisheries Management Areas (FMA) in Indonesia [7].

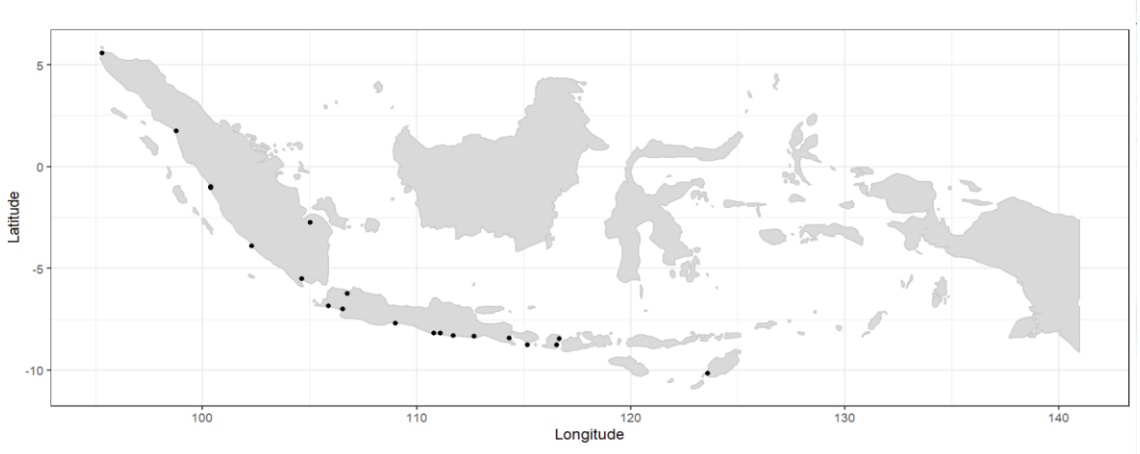

Fig. 2 Sampling locations (FMA 572 and 573).

Results

1. Catch composition

The neritic tuna annual catch composition showed its variation between gill net and purse seine (Fig. 3). The bullet tuna catch data by gill net recorded from 2017 to 2021, while frigate tuna and kawakawa started from 2019 to 2021. The results described bullet tuna caught every year by gill net and had become the only catch in 2017 and 2018. It will then reach 75.65% in 2019 and slightly increased in 2020 to 98.27%. In the last observation year, the bullet tuna catch went down dramatically with only 0.003%. Conversely, frigate tuna was dominated with 91.55%.

The purse seine catch composition showed different results from gill net. Kawakawa was the only catch in 2017 with 100% on the percentage. In 2018, two species caught by purse which were bullet tuna and kawakawa, accounting for 98.61% and 1.39%. Whereas from 2019 to 2021, frigate tuna sits in the highest catch with the decrease in percentage year by year. Bullet tuna was the second highest catch in both 2020 and 2021 (Fig. 3).

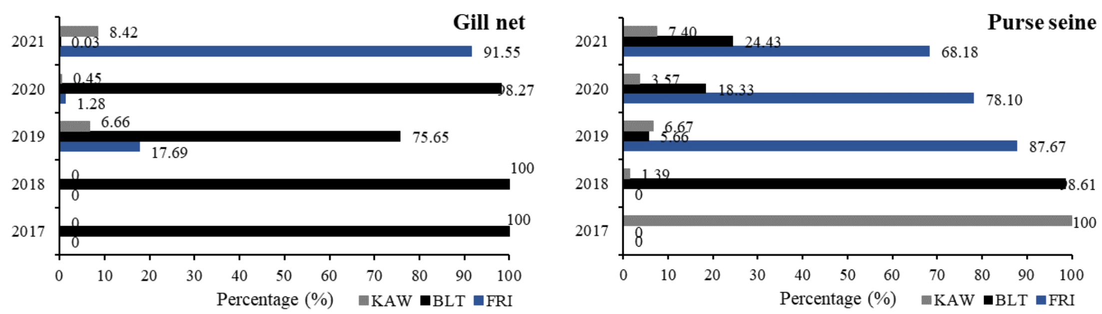

Fig. 3 Annual catch composition of neritic tuna caught by gill net and purse seine during 2017 – 2021.

2. Catch per Unit Effort (CPUE)

The results showed that the highest catch of bullet tuna from gillnet occurred in 2019 with 584.54 ton, while the lowest happened in 2021 with 0.025 ton (Fig. 4). This data is aligned with the nominal CPUE of bullet tuna. While the bullet tuna nominal catches by purse seine in 2018 showed the highest with 7918.79 ton. The second place of gill net catch was frigate tuna with the highest in 2019, accounting for 136.67 ton. On the other hand, the catch of kawakawa appeared to be the smallest among those three species with only 51.46 as the biggest values. In general, the catch frigate tuna, bullet tuna, and kawakawa from both gears, gill net and purse seine were varied during the observation period.

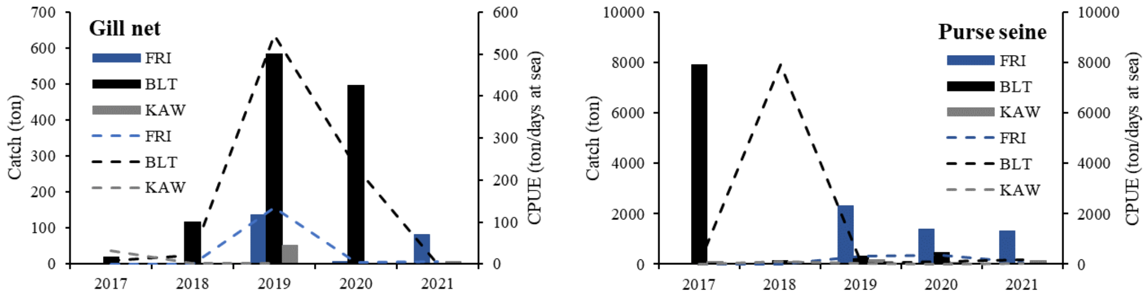

Fig. 4 Nominal CPUE of neritic tuna caught by gill net and purse seine during 2017 – 2021.

3. Size distribution

An important life history parameter is the size at which a specific proportion of the fish population reaches sexual maturity [8]. This information is important for stock assessment, demographic analysis, and establishing minimum legal length and closed fishing seasons, among other fishery control measures [9, 10]. By conducting such investigations, one can arrive at biological reference points, which are measures for stock statuses including biomass levels and fishing mortality rates [11, 12].

The fork length was measured from 1,179 bullet tuna caught by gill net and 31,120 from purse seine. The mean length of bullet tuna from gill net was slightly higher than purse seine with 27.6 cm FL and 21.9 cm FL, respectively (Fig. 5). Furthermore, in the case of frigate tuna, the average length from 293 sample caught by gill net was significantly higher than 14,234 fish caught by purse seine with 37.1 cm FL and 28.2 cm FL, respectively. Moreover, a total 3,581 kawakawa mean length was remain the same between gill net and purse seine with 50.6 cm FL.

Finally, the catch proportion of neritic tuna in Indonesian waters caught by gillnet was mostly above the length of maturity. Its shows the high selectivity of the gillnet [13, 14].

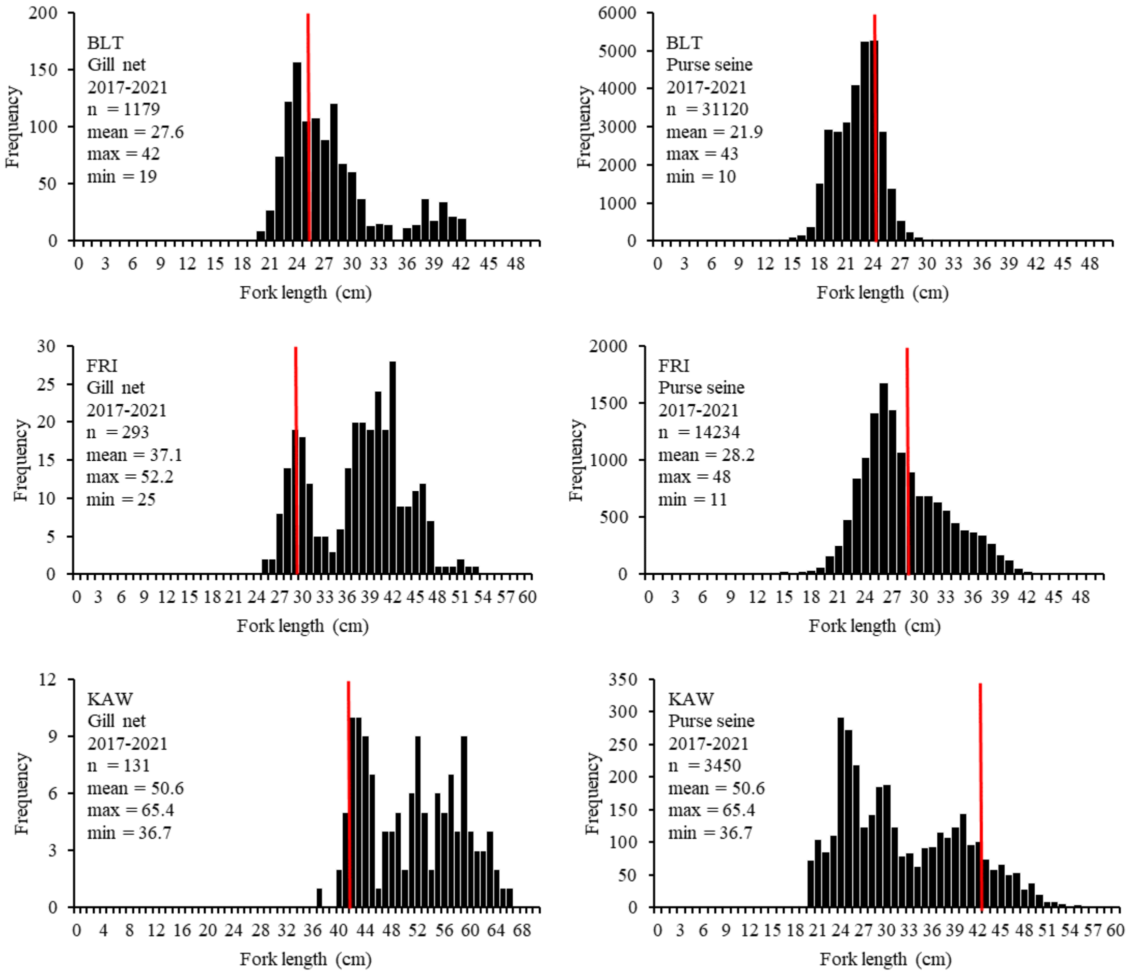

Fig. 5 Length frequency distribution of bullet tuna, frigate tuna, and kawakawa caught by gill net and purse seine during 2017 – 2021. The red line on each graph describes the length at first maturity of each species.

References

1. Pet-Soede, C., et al., *Trends in an Indonesian coastal fishery based on catch and effort statistics and implications for the perception of the state of the stocks by fisheries officials.* Fisheries Research, 1999. **42**(1-2): p. 41-56.
2. Betke, F., *Die" Blaue Revolution": Eine erneute Entwicklungstragödie? Indonesiens Seefischerei heute.* Internationales Asienforum, 1985. **16**(3-4): p. 303-322.
3. Lelono, T.D. and G. Bintoro. *Population dynamics and feeding habits of Euthynnus affinis, Auxis thazard, and Auxis rochei in South Coast of East Java waters*. in *IOP Conference Series: Earth and Environmental Science*. 2019. IOP Publishing.
4. Everhart, W. and W. Youngs, *Principles of fishery Science. Comstock Publishing Associates, a division of Cornell University Press.* Ithaca and London, 1981: p. 349.
5. Heidrich, K.N., et al., *Assessing progress in data reporting by tuna Regional Fisheries Management Organizations.* Fish and Fisheries, 2022. **23**(6): p. 1264-1281.
6. Sparre, P. and S.C. Venema, *Introduction to the assessment of tropical fish stocks - Part 1: Manual*. FAO Fisheries Technical Paper. 1998, Rome, Italy: FAO.
7. Muawanah, U., et al., *Review of national laws and regulation in Indonesia in relation to an ecosystem approach to fisheries management.* Marine Policy, 2018. **91**: p. 150-160.

8. Chen, Y. and J. Paloheimo, *Estimating fish length and age at 50% maturity using a logistic type model.* Aquatic Sciences, 1994. **56**: p. 206-219.
9. Cerdenares-Ladrón de Guevara, G., E. Morales-Bojórquez, and R. Rodríguez-Sánchez, *Age and growth of the sailfish Istiophorus platypterus (Istiophoridae) in the Gulf of Tehuantepec, Mexico.* Marine Biology Research, 2011. **7**(5): p. 488-499.
10. Jacob-Cervantes, M.L. and H. Aguirre-Villaseñor, *Inferencia multimodelo y selección de modelos aplicados a la determinación de L50 para la sardina crinuda Opisthonema libertate del sur del Golfo de California.* Ciencia Pesquera, 2014. **22**(1): p. 61-68.
11. Midway, S.R. and F.S. Scharf, *Histological analysis reveals larger size at maturity for southern flounder with implications for biological reference points.* Marine and Coastal Fisheries, 2012. **4**(1): p. 628-638.
12. Sadeghi, H.R., et al., *Growth parameters and phenotypic variation of Kawakawa Euthynnus affinis (Cantor, 1849) in the Persian Gulf (Hormozgan waters).* Journal of Applied Ichthyological Research, 2017. **4**(4): p. 25-39.
13. Hamley, J.M., *Review of gillnet selectivity.* Journal of the Fisheries Board of Canada, 1975. **32**(11): p. 1943-1969.
14. Holst, R., et al., *Manual for gillnet selectivity.* European Commission, 1998. **43**.