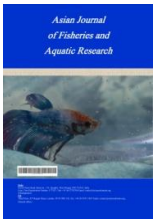

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The Biological Aspects of the Main Targets of Troll Line at Palabuhanratu Fishing Port, Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The biological aspect is a piece of basic information that is commonly presented in assessing the level of environmental friendliness of fishing gear or fishing vessel. This study was conducted to analyze the biological aspects of the main catch of the troll line at the Palabuhanratu Fishing Port, Sukabumi, Indonesia. The biological aspects analyzed consisted of length frequency distribution, length-weight relationship, to the average feasibility status of the caught target fish. There were three main target commodities for fishing from the troll line that was identified during the research activity, namely yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), and frigate tuna (*Auxis thazard*). A total of 14 troll line fleets were obtained as a source of research data based on the accidental sampling method. The total number of 1404 fish consisting of 480 yellowfin tuna, 475 skipjack tuna, and 449 frigate tuna were obtained as research data objects. The stratified random sampling method was used in determining the observed sample fish data. Yellowfin tuna were distributed at size 29 – 148 cm, skipjack tuna at size 29 – 88 cm, and frigate tuna at size 23 – 82 cm. Analysis of the length-weight relationship showed a negative allometric

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growth pattern in the three main fishing target commodities. The analysis of the feasibility of the average fish caught based on compared of $L_{50\%}$ to ½ L^{∞} shows that the average size of tuna and frigate tuna caught is undersize for catching, while the average skipjack caught has reached a legal size. The results of this study indicate that there is a need for a review of the use of fishing hooks in the fishing activity of the troll line fishing fleet. Increasing the hook size can be used to avoid catching fish that are at a size that is not suitable for catching.

Keywords: Biological aspects; length frequency distribution; length-weight relationship; suitable size to catch; troll line.

1. INTRODUCTION

The management of fishery resources has now reached the level of the controlling and assessment approach of fishing resource utilization activities [1]. Biological aspects in the form of the structure of length to the feasibility status of the catch are often used as the main points in assessing the direction of management and regulation of each fishing fleet [2]. Assessment of the level of environmental friendliness of fishing gear or fishing vessels will also be determined by the biological aspect of the catch obtained [3].

Troll line is one of the most common types of fishing fleets found in Palabuhanratu Fishing Port, Sukabumi, Indonesia. There are various fishery commodities of important to high economic value that are caught by the troll line fleet. The catch catches of the troll line fleet that also have high economic value include tuna, skipjack, and frigate tuna [4]. The biological aspects of the three main target commodities from the tug line catch are not known with certainty.

The lack of information regarding the biological aspects of captured commodities can be a major obstacle in monitoring the sustainability of species-based fisheries [5]. The biological aspects of the catch need to be known as a basis for information that can further determine the feasibility status of the catch of a fishing fleet for various existing fishery commodities [6]. This information will be very useful in determining the direction of existing fisheries management to achieve the main fisheries management objectives, namely the sustainability of the capture fisheries business and the sustainability of the fishery commodity population [7].

The lack of information regarding the biological aspects of the target catch commodity from the troll line fleet is the main reason behind this research. This study aims to analyze the biological aspects of the catch of tuna, skipjack, and frigate tuna commodities on the troll line fleet at Palabuhanratu Fishing Port, Sukabumi, Indonesia. The intended biological aspect is limited to the length frequency of the fish caught, the relationship between length and weight, to the analysis of the feasibility status of the catch based on the data on the average length of the fish caught. The results of this study are expected to be considered in determining the regulation of troll line fishing activities in Palabuhanratu Fishing Port.

2. METHODOLOGY

The research was conducted at Palabuhanratu Fishing Port, Sukabumi, Indonesia. Sampling was carried out in August 2020. The timing of this sampling was based on the peak fishing season for troll line fishing fleets. The laboratory identification analysis was carried out until September 2020 at the Macrobiology Laboratory, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, IPB University.

Fish data collection is carried out shortly after loading and unloading activities from the troll line fleet are carried out. An accidental sampling method was used where all troll line ships that carried out loading and unloading activities during the research period were set as research targets. The catches of the troll line fishing fleet are separated by fishermen based on their type. Sampling of fish was carried out using a layered random design method, where layers were assigned to groups of fish lengths at the time of loading and unloading. Samples of fish collected were target fish such as tuna, skipjack, and frigate tuna.

The catch that is included in the fishing target is measured for length and weight. Fish weight was measured using a digital scale (0.01 g accuracy) and fish body length was measured using a ruler (0.05 cm accuracy). Several fish in each species

were preserved with 10% formalin for further identification at the Macrobiology Laboratory, FPIK, IPB University. The identification process is carried out to the lowest taxon to determine the type of species. The identification process is carried out using the main reference [8].

2.1 Length Frequency Distribution

The length-frequency distribution is used to determine the length structure of the main catch of the troll line fishing fleet. The length size distribution begins with the calculation of the number and class intervals that are used as the basis for grouping length classes. Calculation of the number and interval of class length is calculated by the following formula [9]:

$$K = 1 + 3.32 \log(n)$$

$$C = W/K$$

Where :

K : number of classes
n : amount of data
C : class interval
W : area (the maximum data - the minimum data)

2.2 Length-Weight Relationship

The relationship between length and weight is a study used in the study of fish biology, stock estimation, and other aspects of fish resource management [10]. The equation of the relationship between length and weight has helped many researchers in estimating fish weight based on length data [11]. The relationship between length and weight is calculated by the following relationship equation [12]:

$$W = a L^b$$

Dimana:

W : fish weight (kg)
L : fish length (cm)
a dan b : constant

The t-test as a comparative test statistic at the constant value of b was used to determine the growth pattern of the target fish catch. The value of b = 3 indicates an isometric growth pattern, while the value of b 3 indicates an allometric growth pattern [12]. Statistical t-test was carried out with a tolerable alpha value of 0.05.

2.3 Catch Feasibility Status

The feasibility status of the catch can be analyzed in various ways. One of the commonly used analyzes is the ratio of the average length of fish caught (L50%) to ½ L∞. A fishing fleet can be said to have obtained a suitable catch when the average length of fish caught is not less than half its infinity length [13]. Some researchers suggest that the half-length infinity is the maximum estimated value of the average length of fish when the gonads first mature. Fish in the tropics in particular, generally reach gonad maturity in a size range no less than half their infinity length [14-16].

3. RESULTS AND DISCUSSION

3.1 Length Frequency Distribution

A total of 14 troll line fishing vessels carrying out loading and unloading activities were designated as research targets. The identification results from the target catch of the troll line fishing fleet at the Palabuhanratu Fishing Port showed that there were three types of target species caught, namely yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), and frigate tuna (*Auxis thazard*). A total of 1404 sample fish were designated as research data consisting of 480 yellowfin tuna, 475 skipjack tuna, and 449 frigate tuna.

The length-frequency distribution for each target fish shows variations in the structure of the length of the catch. Yellowfin tuna caught were distributed in sizes 29-142 cm with a normal distribution pattern that was more skewed to the left (negatively skewed). The skipjack caught was normally distributed at size 29-88 cm. Meanwhile, frigate tuna fish were distributed in the size of 23 – 88 cm (Fig 1).

3.2 Length-Weight Relationship

The equation model of the relationship between length (L) and weight (W) of the three target commodities for troll line catching, namely yellowfin tuna (W = 9E-05, L 2.67, R2 = 0.90) ; skipjack (W = 0.0002 L 2.36, R2 = 0.93) ; and tuna frigates (W = 0.0002 L 2.52, R2 = 0.83) (Fig. 2). The results of the t test on the constant b showed a significant difference with the value of 3 or b 3 (P value < 0.05). The value of b < 3 indicates a growth pattern that tends to be negative allometric.

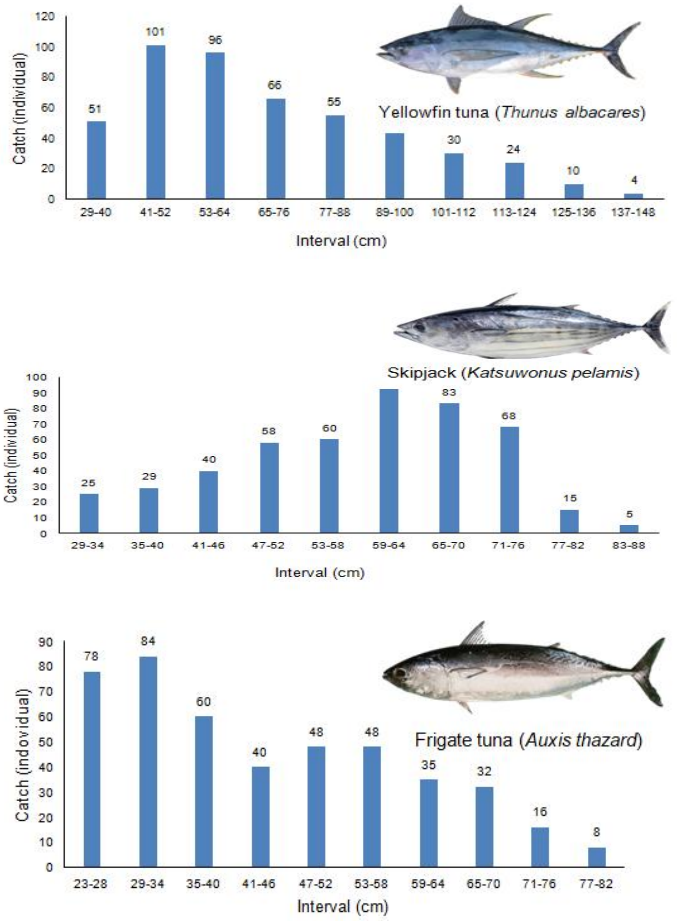

Fig. 1. The length-frequency distribution of yellowfin tuna, skipjack tuna, and frigate tuna

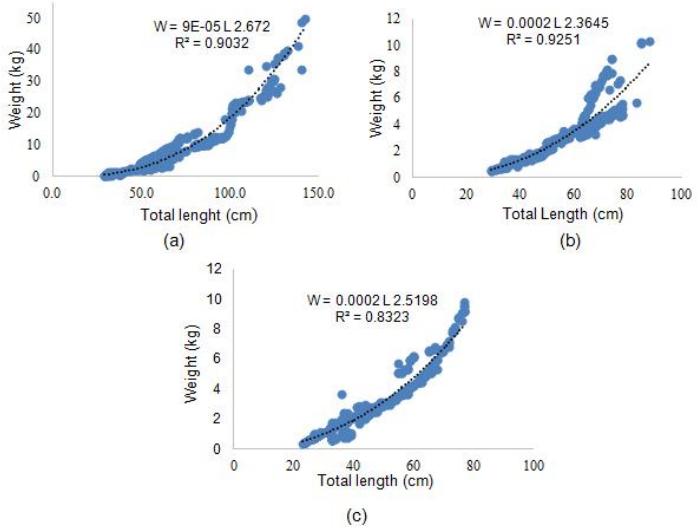

Fig. 2. Graph of scatter diagram of long-weight relationship for yellowfin tuna (a), skipjack tuna (b), and frigate tuna (c).

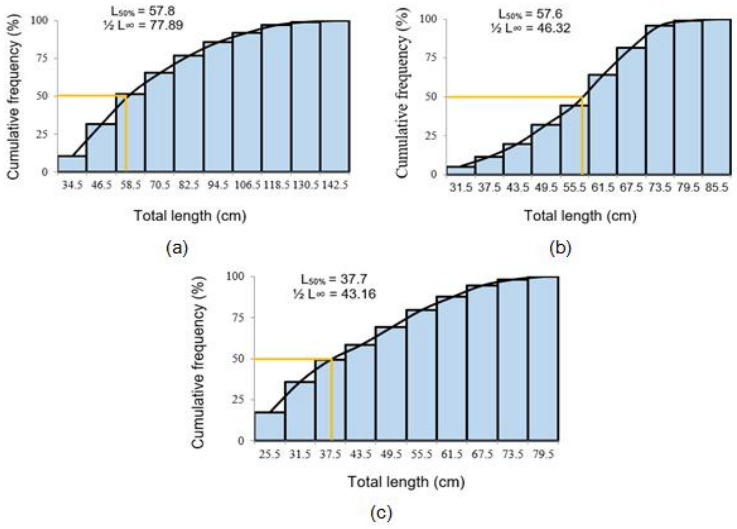

Fig. 3. Cumulative frequency distribution of fish length caught (L50%) by troll line on yellowfin tuna (a), skipjack (b), and frigate tuna (c)

Negative allometric growth patterns are commonly found in fast swimming fish with streamlined body shapes such as yellowfin tuna, skipjack tuna, and frigate tuna. This type of fish has a pattern of growth in length that is more dominant than the growth in weight (negative allometric). Fast swimming fish, especially those that are also classified as high migratory species, take advantage of long growth to maximize swimming strength [17-19].

3.3 Catch Feasibility Status

Analysis of the feasibility of the catch of the three target commodities for troll line catching was carried out using a comparison of the value of L50% to the value of ½ L∞. The L∞ value is obtained based on an alpha value of 0.05 following the equation L∞ = Lmax / 0.95, where Lmax is the maximum length of fish caught [20]. The calculated value of the catch feasibility status parameters for the three target commodities of the troll line fleet, namely yellowfin tuna ($L_{50\%}$ = 57.8 cm, L∞ = 155.79, ½ L∞ = 77.89); skipjack ($L_{50\%}$ = 57.6 cm, L∞ = 92.63, ½ L∞ = 46.32), dan frigate tuna ($L_{50\%}$ = 37.7 cm, L∞ =86.32, ½ L∞ = 43.16) (Fig. 3).

Based on the comparison of the average value of fish caught (L50%) to the value of half the infinity length (½ L∞) shows L50% < ½ L∞ for yellowfin tuna and frigate tuna. These results indicate that the average yellowfin tuna and frigate tuna caught by the troll line at Palabuhanratu Fishing Port are undersized. As for skipjack tuna, the value of L50% < ½ L∞, which indicates that the average skipjack caught by the troll line is legal size.

The catch of undersized fish in hook and line fishing shows the need for a review of the use of hooks [21]. Increasing hook size can be used as a good alternative in preventing undersized fish from being caught [22,23]. This is because the increase in body length is directly proportional to the increase in fish mouth opening [24].

4. CONCLUSION

There were three main target commodities for fishing from the troll line that was identified during the research activity, namely yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), and frigate tuna (*Auxis thazard*). The length-frequency distribution of yellowfin tuna at size 29 – 148 cm, skipjack tuna at size 29 – 88 cm, and frigate tuna at size 23 – 82 cm. Analysis of the length-weight relationship showed a negative allometric growth pattern in the three main fishing target commodities. The analysis of the feasibility of the average fish caught based on compared of L50% to ½ L∞ shows that the average size of tuna and frigate tuna caught is undersized for catching, while the average skipjack caught has reached legal size. The results of this study indicate that there is a

need for a review of the use of fishing hooks in the fishing activity of the troll line fishing fleet. Increasing the hook size can be used to avoid catching fish that are at a size that is not suitable for catching.

5. SUGGESTION

It is necessary to review the hook sizes used by troll lines at Palabuhanratu Fishing Port, Sukabumi, Indonesia. Efforts to increase the size of the hook are an alternative solution in minimizing the capture of undersized fish.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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