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Length-Weight Relationship and Catch Size of Bigeye Tuna (*Thunnus obesus*) Landed in Benoa, Bali, Indonesia

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ABSTRACT

The research was conducted at the Tuna Fisheries Research Station, Denpasar, Bali, in July 2018 (3 weeks duration). There were several types of high-value fish incorporated into this research: tuna, skipjack, shrimp, cob, mackerel, snapper, squid, reef fish (grouper, baronang, lobster / barong shrimp) and ornamental fish. Seaweed processing was also assessed. Benoa Fishing Port is one of the tuna landing base bases in Indonesia. It is the main port in Bali Province and ranks beside Muara Baru (Jakarta), Pelabuhan Ratu (West Java) and Cilacap (Central Java). This research aim to identified length-weight relationship, and proportion of proper catch size of bigeye tuna. Herein, bigeye tuna (*Thunnus obesus*) was identified visually and then assessed. The first identifier is the large size of the eye. The growth pattern of big eye tuna (*Thunnus obesus*) landed in Benoa Fishing Portis is isometric, where the length increase is equal to weight gain (isometric positive). The length distribution of big eye tuna was in range of 81-170 cm FL (334 fishes are obtained), and the distribution of weights varied in size from 11-95 kg, with the most common catch size being in the range of 16-20 kg (95 fishes). Of note, 60% of the fish had not reached the proper catch size.

***Keywords*:** Benoa Fishing Port, Bigeye tuna, *Thunnus obesus*, catch size, length-weight, isometric, main catch

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1. INTRODUCTION

Fish resources in Indonesia are considered to have the highest level of biodiversity. These resources cover at least 37% of the world's fish species (Ministery of Environment, 1994). In the territorial of Indonesia ocean had several types of high-value fish including tuna, skipjack, shrimp, cob, mackerel, snapper, squid, reef fish (grouper, lobster /shrimp), ornamental fish including seaweed (Barani, 2004). The utilization of fisheries resources in the Indian Ocean has increased the capacity of fishing efforts which has caused a high intensity of fishing (Nugraha and Hufiadi 2013). The most economically important tuna species are the temperate tunas albacore (*Thunnus alalunga*), Atlantic bluefin tuna (*Thunnus thynnus*) and southern bluefin tuna (*Thunnus maccoyii*) and the tropical tunas yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*) and skipjack tuna (*Katsuwonus pelamis*) (Arrizabalaga et. al. 215). Bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*) are among the most widely used tuna species for canning purposes (Bojolly et. al. 2017). Government Act Number 15 of 1984 concerning Management of Biological Resources in the Indonesian Exclusive Economic Zone (ZEEI) assign that Benoa Fishing Port is one of the ports where reporting and supervision of the operation of foreign vessels fishing on ZEEI. Benoa Fishing Port (Bali) is one of the tuna landing base in Indonesia which the main fishing port besides Muara Baru (Jakarta), Pelabuhan Ratu (West Java) and Cilacap (Central Java).

Bali is one of the areas that has tuna distribution, starting from Indonesian ocean and its distributed horizontally covering the southern and western waters of Sumatra, southern Java, Nusa Tenggara, Banda Sea and Flores (Hartaty and Sulistyaningsih 2014). Tuna is a family of Scrombidae and highly migratory fish which are included in large pelagic fish. Tuna species found around Indonesian waters include bigeye tuna (*Thunnus obesus*), southern bluefin tuna (*Thunnus maccoyii*) and yellowfin tuna (*Thunnus albacares*), southern bluefin tuna (*Thunnus maccoyii*) (Edyanto 2017). Bigeye tuna (*Thunnus obesus*) inhabit tropical to temperate oceanic waters (Schaefer et. al. 2015; William et. al. 2015). Bigeye tuna became a key target species, and attracted other fishing Countrie (Lehodey et. al. 2018; Dipanoto et al. 2019

Photo 1. *Thunnus obesus* (Lowe, 1839)

Bigeye tuna have large, thickened scales on parts of their bodie (Wainwright et al. 2017). Therefore one of the most important parts of the information base of this report is knowledge about the length and weight of big eye tuna. The size of fish generally has more to do with growth, because some ecological factors and physiological factors are more dependent on calculation of size such as fish length and weight compared to age (Ma et. al., 2016). As a frequently used analysis, long relationships and weights have important implications in fisheries assessment, fisheries biology, physiology, and ecology. Analysis of the relationship between length and weight is the basis used to find out information about fish condition factors and determine the nature of fish growth whether isometric or allometric (Ricker 1975 in Oscoz et. al., 2005). And to analyze the data I took data samples at Benoa Fishing Port, Bali. From the research, it is expected to provide a basis for information on big eye tuna to support sustainable fisheries management.

2. MATERIALS AND METHODS

This research were held at the Bali Tuna Fisheries Research Station, Ministry of Fsiheries and Marine Sciences, Denpasar, Bali Province on July 9 to August 10 2018. Data collection at the enumeration station for the Tuna Fisheries Research Station in Benoa Fishing Port.

Identification of big eye tuna is to find out the type of fish landed by tuna longline vessels by observing special characteristics. It must be identified that is almost similar to the type of fish that resembles the same characteristics as big eye tuna, so careful observation is needed to identify it such as; eyes, color, body, tail, fins, etc.

The relationship of fish length and weight was analyzed by the Hile equation model (1936) in Effendie (2002) as follows:

$$W = Lb$$

Information:

W = fish weight (kg)
L = fish length (cm)
a = constant (intercept)
b = regression coefficient (slope)

The equation can be seen the pattern of fish growth by looking at the value of b obtained. Criteria for growth patterns are in accordance with (Bal & Rao 1984 in Restiangsih & Wagito 2016) as follows:

a) If $b = 3$, growth is isometric, that is, the increase in length is equal to the growth of its weight,

b) If $b > 3$, then the growth pattern is positive allometric, i.e. weight gain faster than the increase in length,

c) If $b < 3$, then the growth pattern is negative allometric, which is the increase in weight slower than the growth in length.

To find out whether the value of b obtained is greater, equal to or smaller than 3 a t-test is performed on the confidence interval of 95% (Steel & Torrie, = 1993) with the hypothesis:

- ✓ H0: same as 3 (isometric)
- ✓ H1: b is not the same as 3 (allometric)

Long and Weight Distribution data collection was carried out by measuring the length and weight of bigeye tuna in Benoa Fishing Port in July 2018 for 3 weeks. Length measurements are carried out using calipers which have accuracy up to 1 cm. While the weight is weighed with scales with accuracy of 1 kg. The data collected was then analyzed to determine the distribution of length and distribution of weights, as well as the length of the relationship.

The Average Length of the Length at First Maturity (Lm). Lm of big eye tuna in Indian Ocean is 110 cm (IOTC, 2013; Zhu et al., 2011). Percentage of abundance of bigeye tuna which has a length> Lm in areas of 5×5° latitude (longitude) and longitude (longitude) compared to the total catches of large tuna fish in that area. The percentage of bigeye tuna whose length> 110 cm for each area of 5×5° latitude (latitude) and longitude (longitude) is grouped into three categories, namely: low (< 50%), medium (> 50% - 70%) and high (> 70%). This category was created to find out the status of big eye tuna who were suspected of having spawned before being caught (Jatmiko et al. 2014)

3. RESULT / EXPERIMENTAL

Bigeye Tuna (*Thunnus obesus*) can be seen that this report sampled landed at Benoa Fishing Port, Bali to be clearly identified and can be expected to become a sustainable biological study. Big eye tuna have special characteristics including; body rounded, body marked with blue lines, yellow finlet with thick black edges, fork fin without any protrusion, pectoral fin pointed and exceeding base of dorsal fin, generally there are irregular vertical lines on the sides, have maximal fork length 250 cm, minimum fork length 30-180 cm (IOTC 2013).

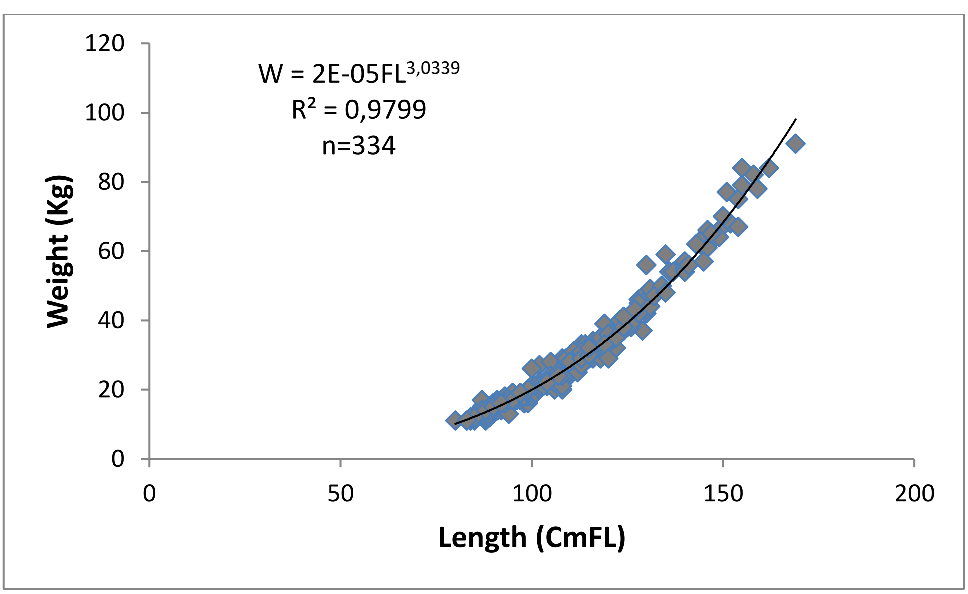

Figure 1. Relationship between the length and weight of large eye tuna landed at Benoa Fishing Port

While the characteristics of big eye tuna (*Thunnus obesus*) are based on observations in the field was has large eyelids, more rounded and shorter length body shape, no pattern curve on the tail fin. There is a yellow finlet with a finlet edge more than the yellow fin and a finlet is far apart.

Relationship Length and Weight. Individual measurements of 334 caught bigeye tuna fishes obtained a range of fork lengths between 85-170 cm with a range of weights between 11-95 kg. The analysis of the relationship length and weight is obtained by the following equation W = 2E-05FL 3,0339 with the value of the correlation coefficient (R2) 0.9799. This is explained in the curve of the length and weight of bigeye tuna (Fig. 1).

Based on the results of the t-test on parameter b on the confidence interval 97, 9% (α = 0.05); obtained t count <ttable; (b = 3,0339), which means that the growth pattern of bigeye tuna tends to be isometric, namely the growth of length equal to the growth of its weight. Long Frequency Distribution and Weight of Big Eyes Tuna. Using a fork length of 334 large eye tuna (*Thunnus obesus*) Regarding the method of length and weight of big eye tuna landed in Benoa Fishing Port, Bali with a duration of 3 weeks sampling based on data in the field that has been recorded formed a graph that is as follows:

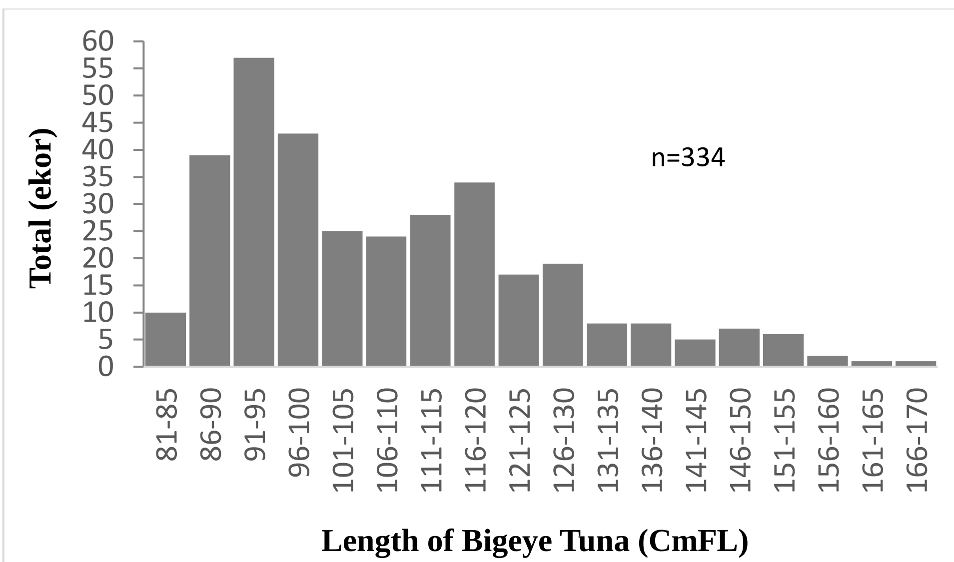

Figure 2. Length distribution of big eye tuna

Based on Figure 2 the long distribution of large eye tuna longline catches collected in July 2018 obtained a range between 81-170 cmFL with a total sample of 334 tails. There is a dominant length size from the graph is a length of 91-95 cmFL with 57 tails. Based on Figure 3, the weight of big eye tuna landed in Benoa Port is between 11-95 kg. In the graph table above shows the weight of the most caught fish is the size of 16-20 kg with a total of 94 tails of the number 334 fish. Whereas tuna measuring 86-90kg were not obtained by one ecoregion and 91-95 were caught at least one tail. Length at First Maturity (Lm). Based on Figure 4, tuna with the first length of gonad maturity are in the size of 110 cm (IOTC, 2013; Zhu et al., 2011), and are located on the graph between the sizes of large eye tuna 106-110 cmFL.

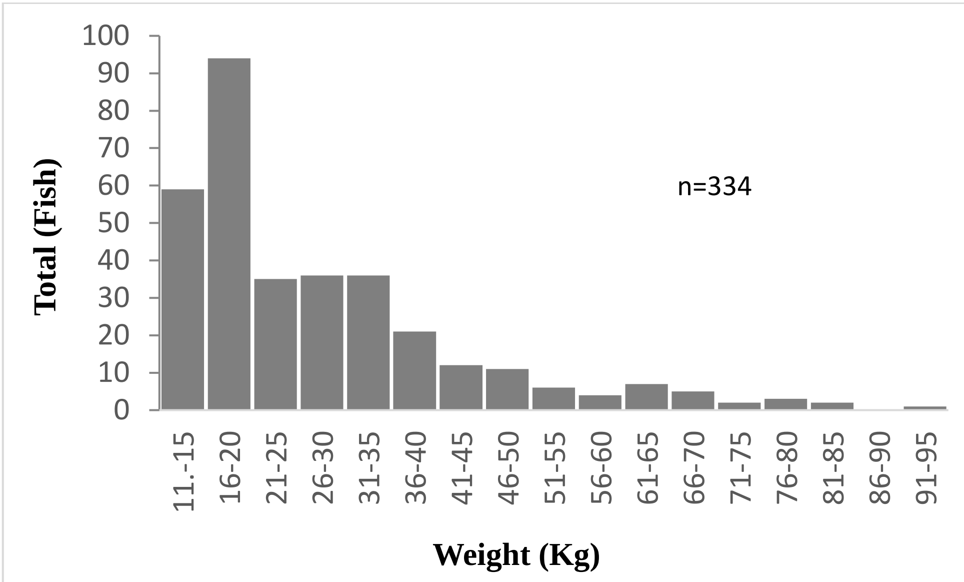

Figure 3. Weight distribution of big eye tuna

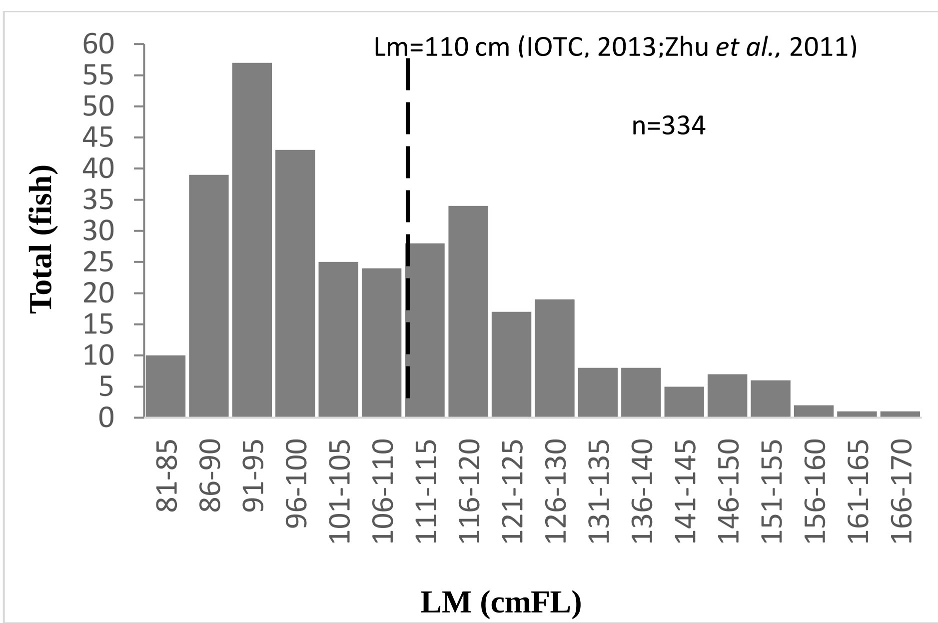

Figure 4. Length at first maturity (Lm) large eye tuna on land in Benoa Fishing Port

4. DISCUSSION

Big eye tuna in Indian Ocean, especially in Benoa Fishing Port, Bali tuna fish that can be identified in the field have large eyelid characteristics, have a rounded body shape and shorter length, no pattern curvature on the caudal fin, there is a yellow finlet with a finlet edge more than the yellow fin and a finlet far more apart, finlet more than yellow fin and finlet distance.

If compared based on one of the results of the institution which mentions big eye tuna has special characteristics including; body rounded, body marked with blue lines, yellow finlet with thick black edges, fork fin without any protrusion, pectoral fin pointed and exceeding base of dorsal fin, generally there are irregular vertical lines on the sides, have maximal fork length 250 cm, minimum fork length 30-180 cm (IOTC 2013).

Length - weight relationship is one of the factors that need to be known in terms of fisheries resource management. According to Richter (2007) and Blackweel (2000), size of fish weights aims to determine variations in weight and length of fish individually or in groups of individuals, so that it can be used as a guide to obesity, health, productivity, physiological conditions and gonadal development.

The results analyzed from this report with the equation of the relationship of weight length to parameter b in the confidence interval 97.9% (á = 0.05), obtained tcount < t table, which means b is equal to 3. Thus the relationship of length weights has a growth pattern isometric, where the increase in length is equal to the increase in weight. Analysis of relationship length and weights obtained the following equation W = 0.023 FL2.9652 with a correlation coefficient (r =) 0.9554. The degree of closeness of the relationship is determined by each coefficient of determination (R2), which is 0.9066. Obtained value of b (slope) 2,9652. According to Effendie (2002 Fisheries Biology, Yayasan Pustaka Nusantara, Yogyakarta, p. 97.), if the value of b is outside the range between 2,4-3,5, then the body shape of the fish is outside the boundary of the general form of fish. Based on the results of the t-test on parameter b at the confidence interval of 95% (α = 0.05), it was obtained t hit> t tab (b "'3) which means that the growth pattern of bigeye tuna tends to be negative allometric, ie weight growth is not as fast as growth in length.

Bigeye tuna species are thought to have a maximum length of more than 200 cm, but most fish reach a length of 180 cm or the equivalent of at least 3 years of age (Collete & Nauen, 1983 in Jatmiko et. al., 2014). In this report, the length of big eye tuna is dominated by fish measuring 91-95 cm in length with a maximum length of 170 cm. With this length, fish still have the opportunity to reproduce, where the Lm value is 110 cm (IOTC, 2013 in Zhu et al., 2011). The results of this report indicate that more than 60% of caught big eye tuna have a length of <110 cm. This means that more than 60% of big-eyed tuna caught are indicated not to have spawned before being captured landed in Benoa Harbor, Bali.

5. CONCLUSIONS

- Identification of bigeye tuna (*Thunnus obesus*) will be easier if you see it visually, when the first one is seen is the size of the eye that tends to be large.
- The growth pattern of bigeye tuna (*Thunnus obesus*) landed in Benoa Harbor is isometric where length increase is equal to its weight gain.
- The length distribution of bigeye tuna fish is in the range of 81-170 cmFL as many as 334 fishes are obtained, and the distribution of weights is in the size of 11-95 kg with the most caught size which is in the range of 16-20 kg as many as 95 fishes fish.
- The catch of big eye tuna in July 2018 for 3 weeks of data collection at Benoa Port, most fish still did not spawn with a percentage of 60%.

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