The biological characteristics of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean, south of Nusa Tenggara (FMA 573), Indonesia

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Abstract. The production of yellowfin tuna (*Thunnus albacares*) in West Nusa Tenggara (NTB) Province has continued to increase from 2011 to 2021. The data from the Indian Ocean Tuna Commission (IOTC) shows that yellowfin tuna (YFT) originating from the Indian Ocean has been over-exploited since 2018. Thus, it is necessary to carry out research related to the biology of YFT, to aid making fisheries management policies. The data collection was carried out at the Labuhan Lombok Fishing Port. The primary data were collected from 2017 to 2021. The data were collected using stratified sampling for the size of tuna fishing vessels and systematic sampling for YFT <10 kg in size. The length frequency, the relationship between length and weight of fish, length at first catch, growth parameters, mortality, and exploitation rate were determined. The results of this study indicate that the growth of YFT landed at the Labuhan Lombok Fishing Port is negatively allometric. The size of the dominant YFT caught and landed was under 100 cm, with a length of 65.7 cm at first catch. The YFT growth parameters were: growth coefficient (K), of 0.28 $year^{-1}$ and maximum body length (L_∞), of 176.4 cm, with a fishing mortality rate (F) of 0.19 $year^{-1}$ and a natural mortality rate (M) of 0.48 $year^{-1}$. The exploitation rate (Z) of YFT landed at the Labuhan Lombok Fishing Port was 0.28.

Key Words: Labuhan Lombok Fishing Port, tuna, West Nusa Tenggara, YFT.

Introduction. The yellowfin tuna (*Thunnus albacares*) is a fish that migrates long distances. This tuna migration route covers almost all waters in the world, especially in the Indian and Pacific Oceans. Until now, yellowfin tuna (YFT) has been fished relentlessly. Thus, its stock is vulnerable to collapse. YFT is the second main fishing target in the world after skipjack (*Katsuwonis pelamis*) (Vincent et al 2020). The Indian Ocean Tuna Commission (IOTC) has determined that YFT in the Indian Ocean has experienced overfishing (IOTC 2022). Hence, all countries that are members of the IOTC carry out management in a massive and coordinated manner to sustain the life of this species in the future.

As one of the countries involved in the IOTC, Indonesia contributes with 16% to the world's production of tuna, skipjack, and mackerel (TCT) and 20% to the national fishery (FAO 2020). The province of West Nusa Tenggara (NTB), located in the Indonesian fisheries management area FMA 573, has a significant contribution to the production of TCT, especially YFT. The Indian Ocean in the south of West Nusa Tenggara is a tuna fishing ground for fishermen both from NTB and from other provinces such as Bali and East Nusa Tenggara. Based on the statistics data of NTB Province Capture Fisheries, YFT production in NTB from 2011 to 2016 fluctuated and tended to increase from 3534.6 tons to 4330.2 tons (DKP 2012, 2013, 2014, 2015, 2016, 2017). Afterwards, in 2021, NTB Provincial Marine and Fisheries Service published that YFT's production in the Province of NTB reached 7062.04 tons (Pemerintah Provinsi NTB 2023). The YFT's production in NTB Province has increased. Following up on this, the Ministry of

Marine Affairs and Fisheries and the local government have carried out supervision and management by encouraging research related to the species, research that can become references for the government, for making policies at the local, national, and regional scope. The research can also influence international recommendations on the subject.

In the southern waters of Nusa Tenggara, research on YFT fisheries has not been carried out consistently and continuously. Therefore, the basic profile of the policy cannot be highly accurate yet in this location. The essential data that should be obtained are the biological characteristics of YFT, in order to be able to explain the population structure of the school of YFT in the southern waters of NTB. Knowing changes in population structure will help understand the issues of population decrease due to habitat destruction, predation, or fishing pressure (Kaymaram et al 2014). The illustration of these biological characteristics can be used to formulate a strategy. Research has been conducted for FMA 573 in the Indian Ocean comprehensively, but this has never been done specifically for the southern waters of NTB. Ghofar et al (2021) researched population dynamics from 2013 to 2017, covering all of FMA 573, but partial research per area is also essential because the profile of tuna fisheries is not even, so the strategy formulated will vary between regions. Therefore, research on the biological characteristics of YFT in the southern waters of NTB needs to be conducted. The aim of this paper is to determine the biological characteristics of tuna in the aforementioned region, including: the relationship between the length and weight of YFT, the YFT size distribution, the YFT growth parameters, the length of YFT at first catch, and the mortality and exploitation rates of YFT.

Material and Method

Research time and location. Data collection in this study was carried out for five years, from January 2017 to December 2021. The data collection was carried out on YFT landed at the Labuhan Lombok Fishing Port, East Lombok Regency, NTB, Indonesia. The YFT data collection in this study was carried out at Labuhan Lombok Fishing Port because that location is the dominant YFT landing site in NTB Province. Figure 1 shows the YFT landing site at the Labuhan Lombok Fishing Port.

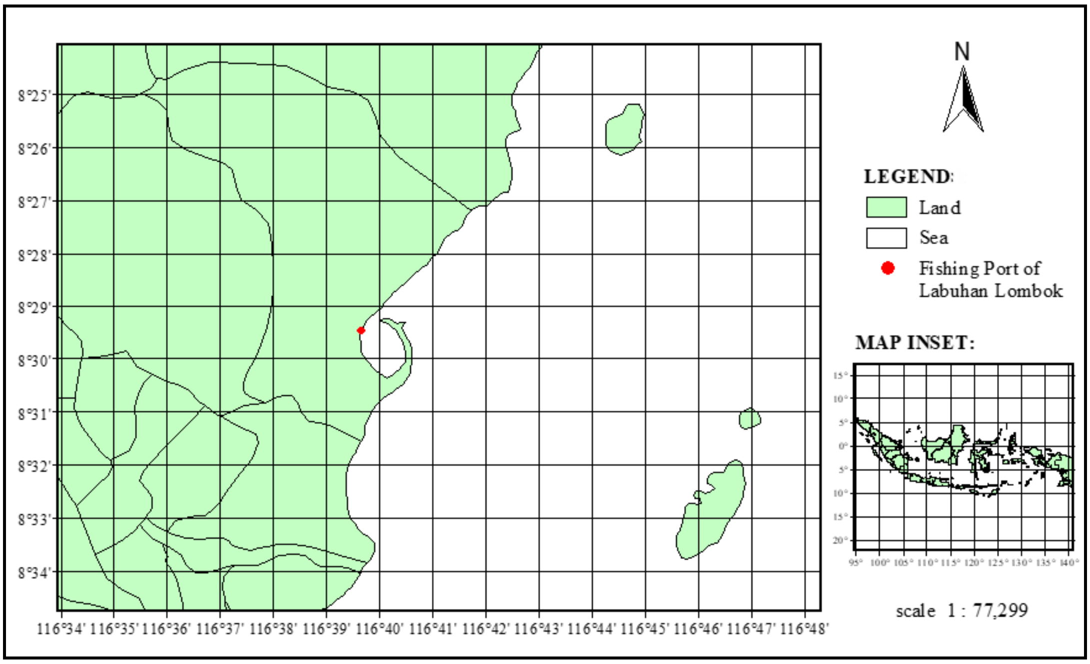

Figure 1. Yellowfin tuna (*Thunnus albacares*) landing site at the Labuhan Lombok Fishing Port.

Tuna fishing units. YFT landed in Labuhan Lombok Fishing Port was caught by fishermen using a hand line. The size of hooks used to catch YFT of more than 10 kg was numbers 3 and 4. Meanwhile, YFT less than 10 kg were caught by fishermen using hook size numbers 9 and 10. In performing the fishing activities, tuna fishermen at the Labuhan Lombok Fishing Port used fishing vessels with a length of 8 to 12 m.

YFT landed by fishermen at the Labuhan Lombok Fishing Port was caught at FMA 573 and FMA 713 (Gigentika et al 2017). In FMA 573, south of Nusa Tenggara, the YFT fishing area utilized by fishermen is at 9-13ºS latitude and 115-122ºE longitude (Figure 2). The fishing area has a depth of 1000 m. However, YFT is generally caught at depths between 1 and 60 m.

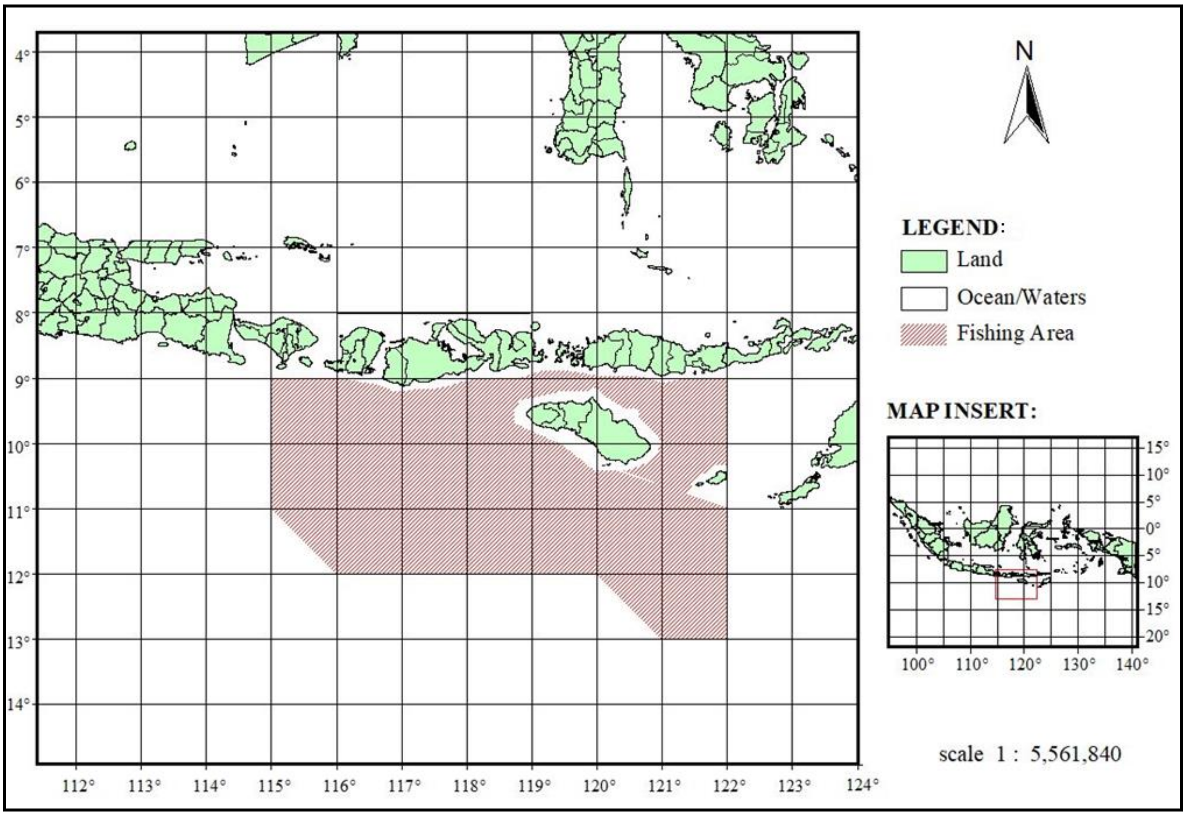

Figure 2. Fishing area of yellowfin tuna (*Thunnus albacares*) landed at Labuhan Lombok Fishing Port.

Data collection. The research collected YFT data from 2-3 YFT suppliers around the Labuhan Lombok Fishing Port. From 2017 to 2019, data were collected from 3 YFT suppliers, while from 2020 to 2021, data was collected from 2 YFT suppliers. The data collection was carried out by sampling based on the data collection protocol for small-scale handline fisheries in Indonesia (MDPI 2019).

This study used two forms in collecting the data; the daily sampling form and the monthly landing form. The daily sampling forms collected data from daily fish landing activities, where each state is for one ship per day. Information collected from everyday sampling forms includes fish landing locations, names of suppliers, descriptions of fishing units and fishing gear, descriptions of fishing areas, descriptions of catches, and descriptions of fishing operations. Meanwhile, the monthly landing form was used to collect monthly summary data on each fishing vessel at a fish landing site, filled out by suppliers. Information collected from the monthly landing forms includes the identity of fishing vessels, descriptions of fishing operations, information on fishing areas based on Indonesian fisheries management areas (FMA), and reports of catches.

The daily data collection in this research used two types of sampling: stratified sampling and systematic sampling. Stratified sampling is a sampling technique in heterogeneous populations, but can be divided into homogeneous sub-populations, where sampling in each sub-population is carried out independently (Pirzadeh et al 2013; Ballin et al 2016). Systematic sampling is a sampling technique carried out by selecting the first unit randomly, the rest being assigned automatically according to a predetermined pattern (Mostafa & Ahmad 2016; Zhao et al 2018). In this research, stratified sampling was carried out on the size of the tuna fishing vessels. The vessels were grouped in <3 GT and 3-30 GT. Systematic sampling was carried out on the size of YFT landed, being selected YFT <10 kg. Efforts were made daily to collect data for at least 20% of the total fish landing activities during the research (WCPFC 2003; WCPFC 2008). The number of samples is considered a representative sample of all fishing vessel landings and the number that is feasible to be recorded.

Sampling on fishing vessels sized 3-30 GT with large catch volumes was implemented with a subsampling system. For YFT sized ≥10 kg, a separate measurement was carried out, with all fish landed on the sampled vessel measured for length and weight. For YFT sized <10 kg, systematic sampling was carried out on the baskets that are landed. The systematic sampling was used in this study also to measure the length and weight of the YFT in the 1st, 5th, 10th baskets, and so on for basket numbers in multiples of five. The number of baskets sampled stopped when the number of YFTs measured reached 200 fish. However, the baskets used for sampling were conditioned to meet specific requirements, namely: contain >5% tuna, and the fish in the baskets should not be sorted by size (MDPI 2019). If the basket sample did not meet these requirements, another basket meeting the criteria was selected. Meanwhile, the subsampling system was not applied for fishing vessels of less than 3 GT with small catch volumes, but all YFTs that landed were measured for length and weight.

In this research, the YFT fork length (FL) was measured, from the tip of the maxilla to the fork of the tail (Onsoy et al 2011). The FL of YFT measuring ≥10 kg was determined using calipers, while the FL of YFT measuring <10 kg was determined using a measuring board (Figure 3).The weight measurements of YFT were done by using scales. YFT weighing ≥10 kg was carried out individually, while for YFT <10 kg the weighing was carried out per basket. Figure 4 shows the scales used to measure YFT weight in this study. The number of YFTs measured for length and weight in this study was 32299 fish originating from 666 landing frequencies of tuna fishing vessels.

Figure 3. The measurement of yellowfin tuna (*Thunnus albacares*) fork length with caliper (a) and measuring board (b) carried out by enumerators.

Figure 4. The scales used to measure yellowfin tuna (*Thunnus albacares*) weight at the location of the research.

Data analysis. Length frequency analysis was conducted to determine the number of YFTs based on the length size group (Abdel-Barr et al 2012; Kaymaram et al 2014). Microsoft Excel was used to process histogram data (Ilaboya & Otuaro 2019).

The analysis of the relationship between the length and the weight of YFT was conducted using the equation $W=aL^b$, where W is the total weight of the fish (g), L is the fork length of the fish (cm), while a and b are the constants of the regression results (Jatmiko et al 2016; Yosuva et al 2018). The constant value (b) indicates an isometric or allometric fish growth pattern. If b=3, then the fish growth pattern is isometric, whereas if b≠3, the fish growth pattern is allometric (Mariasingarayan et al 2020).

The length at first catch (L_c) was calculated through the value of the frequency distribution of fish lengths. The value of this distribution was then analyzed by using the Spearman-Karber standard logistic equation approach, where the length class with the highest FL value is the length at first capture (L_c). The equation is the following (Sparre & Venema 1998):

$$S_L = \frac{1}{1 + \exp(S_1 - S_2 * L)}$$

$$\text{Ln} \left|\frac{1}{S_L} - 1\right| = S_1 - S_2 * L$$

$$S_L 50\% = \frac{S_1}{S_2}$$

Where: S_L - logistic curve; S_1 - a; S_2 - b; S_1 and S_2 - constants of the logistic curve formula. L_c or L_{50} represents a fish length that of a fish that has 50% chances to be either retained or to escape. If the L_c value is >½ L_∞ (maximum body length), then the size of the fish is declared fit for catching (Soukotta et al 2022). In addition, L_c should be close to or more prominent than the length at first maturity to avoid overfishing (Kindong et al 2022).

The growth parameters analyzed in this study consisted of the growth coefficient (K), maximum body length (L_∞), theoretical age of fish at 0 cm (t_0), and maximum age of fish (t_{max}). The ELEFAN I analysis contained in the FISAT II software was used to estimate the value of K and L_∞ used, with the assumption that the dynamics of the fish are in a state of equilibrium. Meanwhile, the estimated value of t_0 was calculated using the following equation (Pauly 1983):

$$\text{Log-}t_o = -0.3952-0.275 \text{ Log } L_\infty - 1.038 \text{ Log } K$$

Longevity or maximum age (t_{max}) was estimated using the following equation (Pauly 1984):

$$t_{max} = t_0 + \frac{2.996}{K}$$

The total mortality rate (Z) was estimated using a length-converted catch curve (Sparre & Venema 1998; Gayanilo & Pauly 2001). The mortality of fish populations that have been exploited is a combination of natural mortality and fishing mortality (Pauly 1983; Sparre & Venema 1999; Welcomme 2001). The natural mortality rate (M) was estimated using the empirical equation as follows (Pauly 1983):

$$\text{Log } M= -0.0066-0.279 \text{ Log } L_\infty+0.6543 \text{ Log } K + 0.4634 \text{ Log } T$$

Where: M - natural mortality coefficient; L_∞ - asymptotic fish length (cm); K - Von Bertalanffy's growth rate; T - average water temperature (°C).

Fishing mortality (F) can be calculated with the following formula:

$$F=Z-M$$

Where: Z - total mortality rate; F - fishing mortality rate; M - natural mortality rate. Based on the fishing mortality rate value (F) assumption, the value is divided by the total mortality rate (Z). The assumption is then determined using the exploitation rate (E) using this formula (Pauly 1983):

$$E=F/Z$$

Optimal fish resources have an exploitation rate of 0.5, and natural mortality is equal to fishing mortality. When E is higher than 0.5, it indicates over-exploitation (Mudjirahayu et al 2017).

Results

Length-weight relationship. The YFT length-weight relationship equation is $W=0.00006264L^{2.72730313}$, with a determination coefficient $R^2=0.996\%$ (Figure 5). This means that 99.6% of the weight was gained from an increase in fish length, while 0.4% was caused by other factors. Meanwhile, the fish growth pattern (b) was in a negative allometric state ($b<3$), which means that the length growth is more dominant than the weight growth.

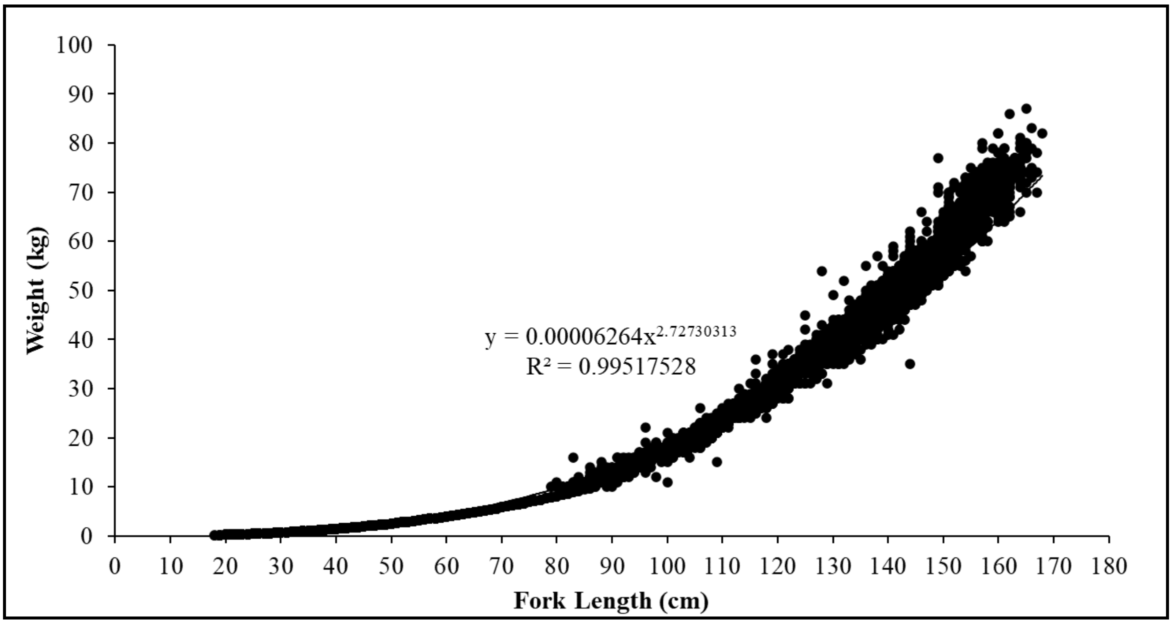

Figure 5. The length-weight relationship of yellowfin tuna (*Thunnus albacares*) in the South of Nusa Tenggara waters, Indian Ocean.

Length distribution frequency. Fork length-frequency fish distribution was carried out from 32299 fish divided into 16 classes (Figure 6). The minimum FL measured was 18 cm, while the maximum FL was 168 cm. The highest number of fish was in the 38-47 cm range. Figure 6 shows two size groups, namely the 28-87 cm size group and the 88-177 cm size group. The fish from the 28-87 cm size group were mostly was caught in February to mid-April, while the fish from the 88-177 cm size group were mostly caught in October.

The length distribution of tuna caught between 2017 and 2021 varies. There is a tendency for the number of large tuna to decrease from 2017 to 2019. However, in 2020 and 2021 the number of large fish appears to have increased.

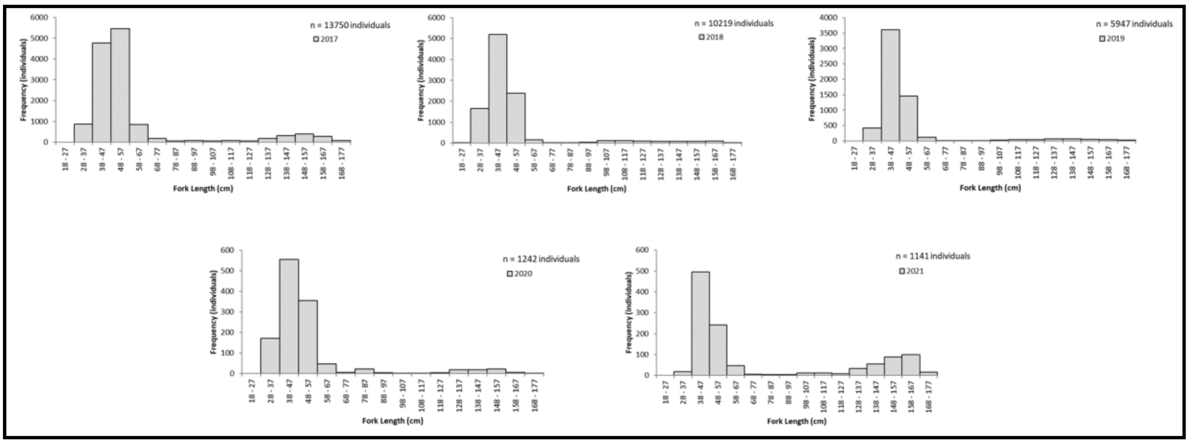

Figure 6. Fork length-frequency distribution of yellowfin tuna (*Thunnus albacares*) in the south of Nusa Tenggara waters, Indian Ocean 2017–2021.

Length at first catch. The analysis of L_c in the catch period of 2017-2021 is presented in Figure 7. L_c values relate to the fishing gear used and may vary depending on its selectivity performance. L_c was estimated at 65.7 cm FL.

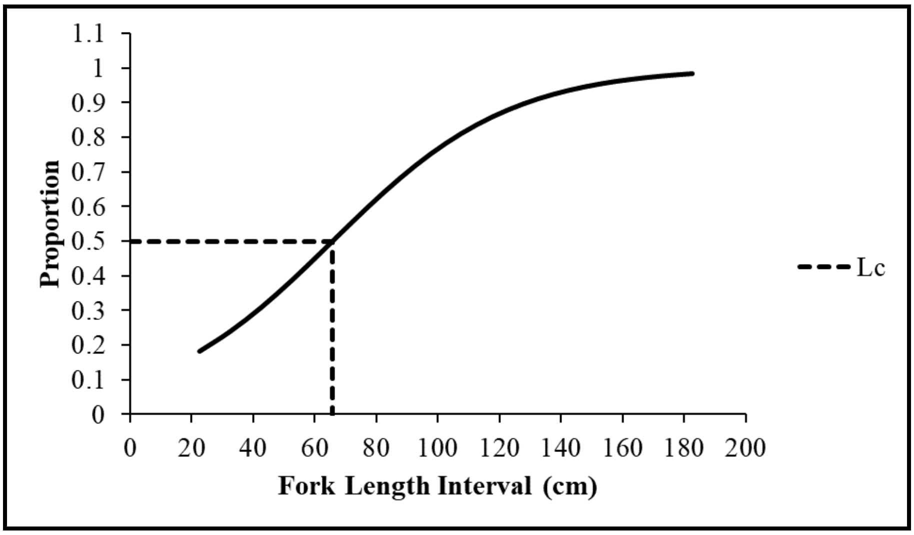

Figure 7. Length of first capture determination of yellowfin tuna (*Thunnus albacares*) in south of Nusa Tenggara waters, Indian Ocean.

Growth parameters. The YFT from south of Nusa Tenggara waters, Indian Ocean, had a K of 0.18 $year^{-1}$, L_∞ of 204 cm FL, t_0 of (-)0.556 years, and t_{max} of 16.11 years (Table 1 and Figure 8).

Table 1
Estimation of growth parameters for yellowfin tuna (*Thunnus albacares*) in south of Nusa Tenggara waters, Indian Ocean

K ($year^{-1}$)	L_∞ (cm)	t_0 (year)	t_{max} (year)
0.18	204	-0.56	16.11

Note: *K* = growth coeficient; L_∞ - maximum body length; t_0 - theoretical age at 0 cm; t_{max} - maximum age.

The analysis carried out resulted in the von Bertalanffy growth function equation for YFT, as shown in Figures 8 and 9. The von Bertalanffy growth function equation of YFT was L_t=204 [1-$e^{-0.18(t+0.56)}$]. Based on Figure 8, YFT growth is relatively fast toward 10 years and slows down after (>10 years) (Figure 9).

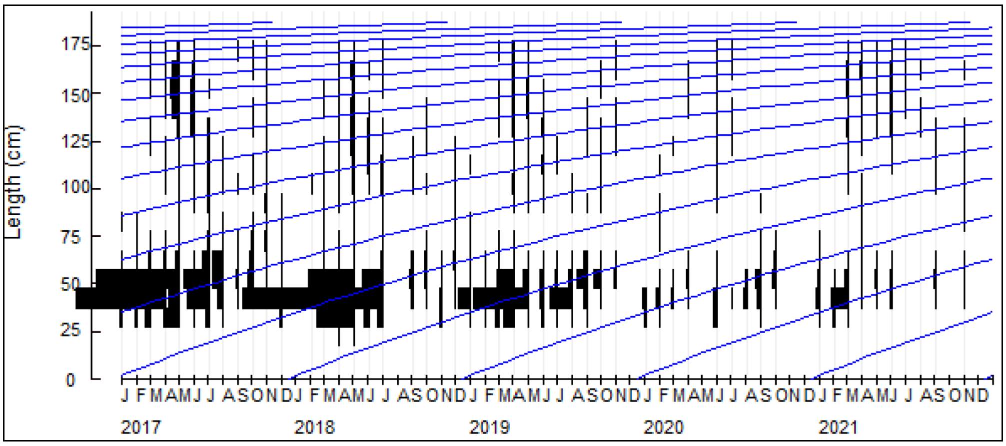

Figure 8. Von Bertalanffy growth plot of yellowfin tuna (*Thunnus albacares*) in the south of Nusa Tenggara waters, Indian Ocean.

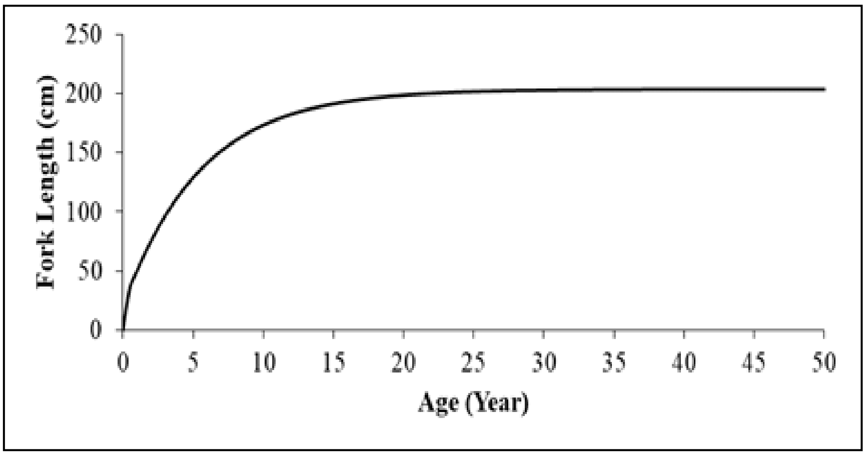

Figure 9. Estimated growth curve of yellowfin tuna (*Thunnus albacares*) exploited in the south of Nusa Tenggara waters, Indian Ocean.

Mortality parameters. The results of the analysis in this study showed that F for YFT during the study period was 4.64 year^{-1}, while M for YFT was 0.34 year^{-1} (Table 2). Therefore, the Z value for YFT in the Indian Ocean the south of Nusa Tenggara (FMA 573) is 4.98 year^{-1} (Figure 10). The value of E for YFT is 0.93 (Table 2).

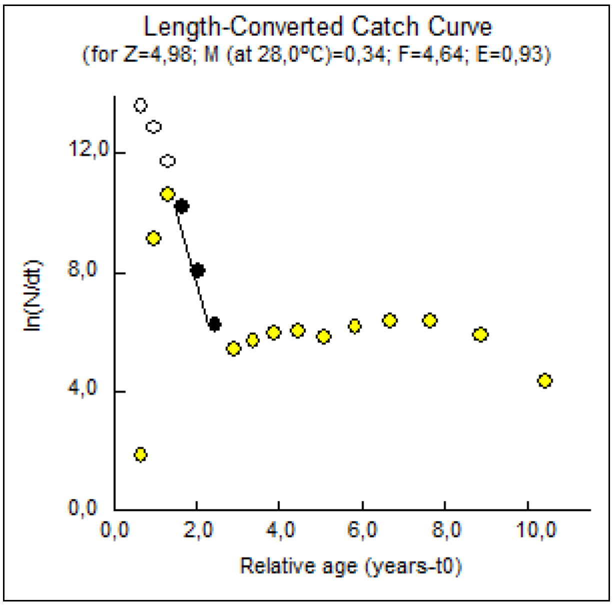

Figure 10. Length-converted catch curve of yellowfin tuna (*Thunnus albacares*) in the south of Nusa Tenggara waters, Indian Ocean.

Table 2

Estimation of mortality and exploitation for yellowfin tuna (*Thunnus albacares*) in the south of Nusa Tenggara waters, Indian Ocean

M (year^{-1})	*F (year^{-1})*	*Z (year^{-1})*	*E*
0.34	4.64	4.98	0.93

Note: *M* - natural mortality; *F* - fishing mortality; *Z* - total mortality; *E* - exploitation rate.

Discussion. This research aims to complete information for the 2017-2021 period regarding yellowfin tuna fisheries. It is expected to aid the references needed by policy owners in managing sustainable tuna fishing. Determining the relationship between length and weight is essential to identify changes in tuna shape as a result of growth.

During this study, the value of R^2 was close to 1, meaning that YFT's weight increased as its length increased (Nugraha et al 2020). The analysis of the relationship between length and weight produced a value of b<3 indicating that YFT has a negative allometric growth, which is commonly found in the Indian Ocean (Hartaty & Sulistyaningsih 2014; Triharyuni & Iskandar 2012; Perera & Weerasiri 2020; Yosuva et al 2018). These differences in growth patterns can be influenced by the reproductive cycle, food availability, and environmental factors (Jisr et al 2018).

The size distribution of the catch needs to be analyzed to describe the profile of the shoal of YFT at the study site. Two groups that were assumed to have come from old and new recruitments have been obtained with different numbers. More than 80% of the shoal of YFT at the study sites is dominated by small sized fish. The intense fishing of small tuna will trigger recruitment overfishing, with small fish not reaching maturity, or, if they do reach maturity, their numbers will be low (Ben-Hasan et al 2021). Assessing the profile per year of observation, there was a tendency for the increase of large YFTs in 2020 and 2021. This was allegedly due to a decrease in effort related to the Covid-19 pandemic, which also indirectly affected fish production and consumption in NTB (Partelow et al 2023). Therefore, the tuna had time to reach larger sizes. However, the increase in the number of large YFTs has not been profoundly noticeable.

The growth rate of YFT caught in the southern waters of Nusa Tenggara is very low, at 0.18 $year^{-1}$. The slow growth is indicated by a K value of less than 1 (Gulland 1983). This growth value is in line with research from Amaliani et al (2022), where the K value at FMA 573 was around 0.2 $year^{-1}$ with L_∞ 171.5 cm. Hartaty & Sulistyaningsih (2014) noted that the value of K in FMA 753 once reached 0.59 $year^{-1}$, with L_∞ 185.85 cm in 2011. Ghofar et al (2021) stated that during a 2013-2017 study at FMA 573, the K value was 0.51 $year^{-1}$ with L_∞ 194.25 cm. This explains that there has been a decrease in the value of K and L_∞ in the last five years in the southern waters of Nusa Tenggara (FMA 573). Particularly in the Indian Ocean, the growth rate has been low before 2012 (Rohit et al 2012). As for YFT in the Atlantic Ocean, Lessa & Duarte-Neto (2004) noted that YFT had a low growth rate, of 0.27 $year^{-1}$. The downward trend in K values also occurs in the Banda Sea. Before 2012, the value of K was above 0.5 $year^{-1}$ and L_∞ 223 cm (Zhu et al 2011; Damora & Baihaqi 2013), while in 2016 the values of K and L_∞ decreased to 0.33 $year^{-1}$ and 159 cm, respectively (Amri et al 2021). The K value is influenced by several factors, including the availability of food sources, fish internal factors, and aquatic environmental conditions (Nurdin et al 2016). A lower K value means a longer time to reach L_∞ (Sparre & Venema 1998). In reaching L_∞ of 204 cm, YFT in this study takes up to 16.11 years.

To support responsible tuna fishing, the selectivity of the fishing gear is also a major factor that must be considered. The selectivity of the fishing gear is defined as the performance of the fishing gear in catching the target fish above their maturity length (L_m). Therefore, ideally, the size of L_c should be above L_m, where L_c should permit at least once spawn. Based on the data, it can be seen that the catch is dominated by YFT with sizes below the proper catch size, reflected by the L_c value obtained, 65.7 cm. It is known that the value of L_m of YFT in the Indian Ocean is in the range of 100-110 cm (Lehodey & Leroy 1999; FAO 2010), while in the tropical western and central Pacific the value of Lm is higher, namely above 110 cm for males and 119 cm for females (Shi et al 2022). Different L_m values can be caused by stressors from the environment or from the fish itself (Arula et al 2017).

L_c values below L_m, namely 42 cm, were also obtained by Amaliani et al (2022). This indicates that there is a tendency for fishermen in the research location and its surroundings to use fishing gear that is not selective for YFT. Previous research at the same location in 2013-2017 showed an L_c of 140 cm (Ghofar et al 2021), so it can be concluded that there has been a change in the selectivity of the fishing gear used in the last five years. As for the Banda Sea, the L_c obtained is above the L_m value, which is above 100 cm (Damora & Baihaqi 2013; Chodrijah 2015; Amri et al 2021). The selectivity of fishing gear is determined by the design and construction, as well as the the fishing method used. A hand line is a fishing gear classified as selective if the size of the hook and the fishing method are adjusted to the characteristics of the target species.

There are four sizes of hooks used by YFT fishermen in the southern waters of Nusa Tenggara, namely hooks number 3 and 4 for large YFT and 9 and 10 for small YFT. Likewise in the research of Maspeke et al (2018), in the Celebes Sea, Halmahera Sea, and around Tomini Bay, fishing hooks number 2-3 produced YFT with very small sizes, namely in the size range of 35-40 cm. Therefore, choosing a larger hook size is expected to improve the selectivity performance of the fishing gear used. Fishing exploitation should be selective to the size of the fish, being intended to avoid the occurrence of overfishing (Saranga et al 2018).

Based on the current research data, it is known that fishing is carried out during the day and the night at a depth of 1-60 m. This depth range corresponds to small-sized YFT. Barata et al (2012) argued that 88% of YFTs sized >100 cm are caught in a depth range of 100-200 m, while 77% of YFTs <100 cm are caught in a depth range of 0-100 m. However, Soepriyono (2009) explained that large tuna will swim near to the surface at night. Thus, both of these pieces of information need to be considered in order to be able to accurately target YFT of proper size. The depth is one of the main factors in the size distribution of tuna because it is related to the temperature preferences required in each tuna age group. The thermocline or the deep water zone is favored by YFT (Collette & Nauen 1983).

YFT's natural mortality in the Indian Ocean, south of Nusa Tenggara, is lower compared to the mortality due to fishing. This indicates significant fishing pressure on YFT in the Indian Ocean, south of Nusa Tenggara. The results of the mortality analysis align with the results of the level of exploitation analysis in this study, where the E value is higher than 0.5, meaning that there has been overexploitation of YFT between 2017-2021. These findings are consistent with several similar studies conducted in the Sea of Oman and the Banda Sea, which also indicate the over-exploitation of YFT (Damora & Baihaqi 2013; Kaymaram et al 2014). However, several similar studies in Palabuhanratu port, East Cost of India, and the eastern and central Pacific Ocean indicate a suboptimal utilization of YFT (Zhu et al 2011; Rohit et al 2012; Nurdin et al 2016). The differences in the value of E in different waters is determined by the effort in fishing activities, with a greater level of exploitation corresponding to a greater effort, causing a decrease in fish biomass (Watson et al 2012; Costello et al 2016; Tickler et al 2018).

The data on the status of tuna fishing issued by the IOTC (2022) shows that YFT in the Indian Ocean has been over-exploited in the 2018-2021 period. This finding aligns with the results of this research. It is important to note that this research was conducted in a small part of the Indian Ocean, which only sampled 2-5 companies that act in tuna fishing, so there are data that did not fully record the YFT status conditions in the Indian Ocean, south of Nusa Tenggara. Effort and production in this study decreased along with the reduced number of fishing companies in the sample. Therefore, there is a need for thorough research to be able to produce a more comprehensive utilization status of YFT's fishing activities in the Indian Ocean, south of Nusa Tenggara.

Conclusions. YFT must spawn at least once in its life to remain sustainable. Based on the data, it can be stated that most of the YFT caught in the southern waters of Nusa Tenggara (FMA 573) in 2017-2021 have not spawned. A catch like this is a sign that there has been growth and recruitment overfishing. The high dominance of YFT under the proper catch size cannot be separated from the size of the hook used. The use of hooks by fishermen produces an L_c of 65.7 cm, so the selection of a larger fishing hook must be made immediately. In addition, information from the literature study found that the operating depth of fishing gear by fishermen needs to be increased to a depth of 100 m to be able to catch large YFT. As for growth, a negative allometric model was obtained with a low growth rate, namely K=0.18 year^{-1}, with a mortality rate due to fishing of 4.64 year^{-1} and a natural mortality rate of 0.34 year^{-1}. The exploitation rate of YFT landed at the Labuhan Lombok Fishing Port is 0.93. This value is aligns with the IOTC findings regarding overfishing for YFT in the Indian Ocean region. This research is only limited to YFT caught at FMA 573, which is located in the southern waters of Nusa Tenggara and landed at the Labuhan Lombok Fishing Port. In addition, the research data used sampling data, which does not cover the entire production, so it is necessary to conduct more thorough research to obtain more comprehensive data.

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Conflict of Interest. The authors declare that there is no conflict of interest.

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