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HIGH EXPLOITATION RATE OF ORANGE-DOTTED TUSKFIS *CHOERODON ANCHORAGO* IN WALLACE LINE, SPERMONDE ISLANDS, MAKASSAR STRAIT, INDONESIA

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ABSTRACT

Orange-dotted tuskfis *Choerodon anchorago* is Labridae or Wrasse live in coral reefs ecosystem around the world. Wrasse is the second largest marine fish family, was found about 70 genera and about 504 species. Orange-dotted tuskfis is mostly caught by fishermen on the Wallace line on the Spermonde Islands. The Spermonde Islands consists of 60,000 ha of coral reefs. This study aims to assess the exploitation rate of Orange-dotted tuskfis in the Wallace line in the Spermonde Islands, Makassar Strait, Indonesia. Fish samples were collected from the catch in the Spermonde Islands landed at the Fish Landing Port, Makassar City in 2020. Age groups were analyzed by using Bhattacharya method. The growth rate was estimated by using Von Bertalanffy method. Total mortality (Z) was estimated by using the catch curve method. The natural mortality rate (M) was estimated by using Pauly empirical formula. The fishing mortality rate (F) was estimated by using equation $F = \mathrm{Z} - \mathrm{M}$. The exploitation rate (E) was estimated by using the Beverton and Holt equations, $E = F/Z$. The growth rate equation was $Lt = 65.50\ [1 - e^{-\{-0.10(t+1.3995)\}}]$. The total mortality rate of was 1.38, the natural mortality rate was 0.32, the fishing mortality rate was 1.06, and the exploitation rate was 0.77. Exploitation rates greater than 0.50 indicate that the Orange-dotted tuskfis *C. anchorago* in on the Wallace line on the Spermonde Islands is overexploited.

Keywords: Reef fish, wrasse, growth, mortality, overexploited.

INTRODUCTION

One of the islands located in the Makassar Strait is the Spermonde Islands (Knittweis *et al*., 2009). The waters of the Spermonde Islands, which contain 120 small islands, are a fairly widespread area of coral reefs (Hasrun and Kasmawati, 2018). In the waters of the Spermonde Islands, there are about 60,000 ha of coral reefs inhabited by coral fish species with very diverse reef fish populations (Tresnati *et al.*, 2019a; Tresnati *et al.*, 2019b; Yanti *et al*., 2019; Yasir *et al.*, 2019; Tresnati *et al.*, 2020a; Tresnati *et al.*, 2020b; Tresnati *et al.*, 2020c; Tuwo *et al.*, 2020a; Tresnati *et al.*, 2021; Tuwo *et al*., 2021). One of the reef fish families caught by many is Labridae. Labridae, known as Wrasse, is the most abundant fish on tropical reefs around the world. Wrasse is the second largest family of marine fish and the third most prominent family in the order of Perciformes. The number of wrasse species is not known with certainty, but it is estimated that there are about 504 species which are divided into about 70 genera that are distributed in various areas of coral waters (Shea and Liu, 2010).

Labridae fish have varied colors, shapes, and sizes (Parenti and Randall, 2000). Labridae fish can be found in almost all coral ecosystems. Labridae fish can live well in coral reef ecosystems because there is food that can be used, for example, small fish, crustaceans, and shellfish that live on coral fragments (Putra *et al.*, 2019). The main diet of Labridae is small invertebrates that live in the bottom of the waters (Arthana, 2009).

One of the species of Labridae or Wrasse that many fishers catch in the waters of the Spermonde Islands is the orange-dotted tuskfis *Choerodon anchorago*. Orange-dotted tuskfis has an essential ecological role in the food chain of coral ecosystems. Orange-dotted tuskfis also has economic value because it has white and savory flesh. Orange-dotted tuskfis is traded in the form of live, fresh and dried fish (Tuwo *et al*., 2020b). Orange-dotted tuskfis sold live in Hong Kong restaurants has a high price (Lee and Sadovy, 1998). Orange-dotted tuskfis is also caught for trade as an ornamental fish. Orange-dotted tuskfis is listed on the IUCN Red List of Threatened Species with the least concern status (Shea and Liu, 2010)

Market demand and high prices have caused the catch of orange-dotted tuskfis to continue to increase. Increasing catch can lead to overfishing or extinction. Previous research has shown that orange-dotted tuskfis in the Spermonde Islands

have been studied in terms of their reproductive biology (Tuwo *et al.*, 2020b), but the utilization rate of orange-dotted tuskfis in the Spermonde Islands has never been studied. Therefore, it is necessary to study the rate of exploitation of orange-dotted tuskfis in the Spermonde Islands. The study aims to assess the exploitation rate of orange-dotted tuskfis in the Wallace line in the Spermonde Islands, Makassar Strait, Indonesia. The study was expected to reference the use of orange-dotted tuskfis, especially in the Spermonde Islands, Makassar Strait.

MATERIALS AND METHODS

Samples of orange-dotted tuskfis were obtained from fishers' catch in the waters of the Spermonde Islands, South Sulawesi Province, which landed at the Fish Landing Port, Makassar City in 2020. Each sample of orange-dotted tuskfis was measured in length with an accuracy of 1.0 mm (Figure 1).

Figure 1. Orange-dotted tuskfis *Choerodon anchorago* captured in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia

The age group or cohort orange-dotted tuskfis was estimated using the Bhattacharya method (Sparre and Venema, 1998), namely by dividing the fish into body length groups in a length frequency list, then calculating the logarithm of the frequency of each body length group. From the logarithmic calculations, the difference in logarithms (Δ log F) was found between the existing groups, then mapping the mean value of each body length class as the X-axis to the difference in logarithms and the frequency of the body length class as the Y-axis. By drawing a straight line from the largest point to the smallest point, an age group intersecting from the X-axis was obtained. The intersection of a straight line with the X-axis gives the average individual length value for each age group ($\bar{x}$) (Tilohe *et al.*, 2014).

The growth rate of orange-dotted tuskfis was estimated using the Von Bertalanffy method (Sparre and Venema, 1998) according to the equation:

$$L_t = L_\infty (1 - e^{-K(t-to)})$$

where Lt was total length at age t (cm), L∞ was asymptote length (cm), K was growth rate coefficient (year^{-1}), t_o was theoretical life of orange-dotted tuskfis at length was equal to zero (years), t was the age of the fish (years). The growth parameters of orange-dotted tuskfis were calculated by using the FISAT program (FAO-ICLARM Stock Assessment Tools) II version 1.2.2 using the ELEFAN I (Electronic Length Frequency Analysis) method. The values of L∞ and K were used to estimate the theoretical lifespan of orange-dotted tuskfis when the length was equal to zero (t_0) by following the empirical equation (Pauly, 1983):

$$\log(-to) = -0{,}3922 - 0{,}2752(\log L\infty) - 1{,}038(\log K)$$

The total mortality rate (Z) of orange-dotted tuskfis was estimated using the length converted catch curve method in the FISAT II program package (Pauly, 1983), namely:

$$\ln [C(L1 - L2)/\Delta t(L1 - L2)] = C - Z\, t[(L1 - L2)/2]$$

The above equation was estimated using a simple linear regression equation $y = b_0 + b_1 * X$ with $y = \ln [C(L1 - L2)/\Delta t(L1 - L2)]$ as ordinate. $X = t[(L1 - L2)/2]$ as absis, dan $Z = -b_1$

The natural mortality rate (M) using empirical equations (Pauly, 1983), namely:

$$\log (M) = -0{,}0066 - 0{,}279 \log L\infty + 0{,}6543 \log K + 0{,}4634 \log T$$

The average temperature of the Spermonde Islands waters in 2020 was 28.92°C. The natural mortality rate (M) was calculated using the FISAT II program

The catch mortality rate (F) was estimated using the equation (Sparre and Venema, 1998):

$$Z = F + M \text{ or } F = Z - M$$

The rate of exploitation (E) was estimated using the Beverton and Holt equation (Sparre and Venema, 1998):

$$E = F / Z.$$

RESULTS AND DISCUSSION

The number of orange-dotted tuskfis obtained during the study was 215 individuals. The total length was 11 to 29.5 cm. The length was grouped into 20 classes, using 1.0 cm intervals.

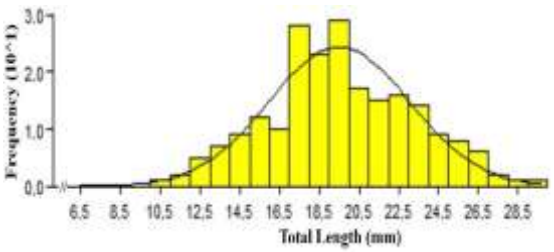

Figure 2. Length distribution of orange-dotted tuskfis *Choerodon anchorago* in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia.

The results of the age group analysis showed that the population of orange-dotted tuskfis caught in the catch in the Spermonde Islands waters consisted of one age group with an average length of 19.5 cm (Figure 2).

Based on the growth parameters of orange-dotted tuskfis (Table 1), the von Bertalanffy growth curve was: $L_t = 65.5[1-e^{-0,10(t+1,3995)}]$ (Figure 3).

Table 1. Growth parameters of orange-dotted tuskfis *Choerodon anchorago* in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia.

Parameters	Values
L_∞ (cm)	65.50
K (year^{-1})	0.10
t_0 (year)	-1.3995

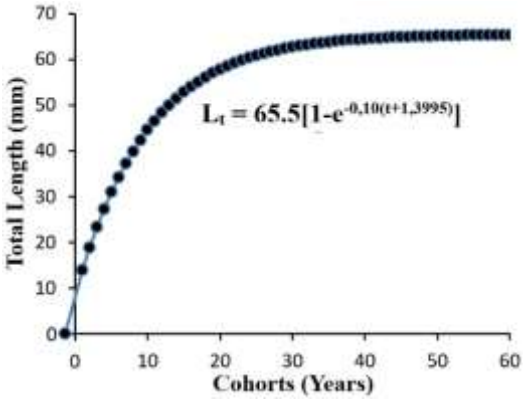

Figure 3. Growth curve of orange-dotted tuskfis *Choerodon anchorago* in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia.

The analysis of mortality and exploitation rates (Table 2) shows that orange-dotted tuskfis in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia, has suffered from high exploitation.

Table 2. Mortality and exploitation rates of orange-dotted tuskfis *Choerodon anchorago* in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia.

Parameter	Estimated values (year^{-1})
Total mortality rate (Z)	1.38
Natural mortality rate (M)	0.32
Fishing mortality rate (F)	1.06
Exploitation rata (E)	0.77

The Bhattacharya method is based on the assumption that each birth will form a normal distribution. Calculation of this normal distribution is impractical so that it is transformed into a parabolic curve; then this parabolic curve is linearized. This linear process makes the Bhattacharya method more practical to use in cohort separation. The cohort separation based on the Bhattacharya method in the FISAT II program must pay attention to the separation index. If the separation index in a size group is less than two, it should not be separated because there is a significant overlap between the size groups (Sparre and Venema, 1998). In this study, the orange-dotted tuskfis group separation index size was too small, so that cohort separation should not be done. The catch that only consists of one age group is an indication of high exploitation.

The low growth coefficient (0.10) indicates that the growth of orange-dotted tuskfis in the waters of the Spermonde Islands was slow. A growth coefficient of less than 0.5 is categorized as slow growth. Meanwhile, a growth coefficient of more than 0.5 is categorized as a fast growth (Sparre and Venema, 1998). About 70% of the length of the orange-dotted tuskfis asymptote was achieved in the tenth cohort. The rapid growth in the early stages of life is thought to be the reason for the uniting of several cohorts at small sizes, and it is this small size that is caught so that the catch only consist of one cohort. The slow growth of old fish is thought to be related to food allocation. Old fish will allocate most of the energy from their food for maintenance and movement (Effendie, 2002). In addition, slow growth can be influenced by biological factors such as genetics, gender, age, disease, food, and water temperature (Yudasmara, 2014). The growth rate is an important parameter because it can determine when the fish first matured gonad, the age composition of the stock, the yield potential of a stock, and mortality (Aziz, 1989).

The natural mortality rate for orange-dotted tuskfis was much lower than the fishing mortality. Natural mortality rates are influenced by predators, including cannibalism, disease, hunger, old age (Effendie, 2002), stress, spawning, and food availability (King, 1995). Fishing also affects the natural mortality rate. The low natural mortality rate will cause the fish to grow to old age and die if they are not caught (Monika *et al.*, 2020).

The fishing mortality rate of orange-dotted tuskfis was relatively high. The high fishing mortality rate indicates a considerable exploitation pressure on the stock of orange-dotted tuskfis in Wallace Line, Spermonde Islands. The factor of continuous fishing causes the high fishing mortality value. High fishing mortality rates, low natural mortality rates, and a small number of old fish indicate overfishing (Sparre and Venema, 1998). The ideal or optimum condition occurs when the fishing mortality rate is the same as the natural mortality rate (Monika *et al.*, 2020).

The total mortality rate is a description of the rate of decline in the abundance of an individual at a certain time. High total mortality in waters can reduce reproductive diversity, which begins with a decrease in the first gonad mature fish (Kartini *et*

al., 2017). In females, decreasing the size of the first time, the gonad mature fish will reduce fecundity to reduce the success of fish recruitment in nature (Ernawati and Kamal, 2010). The decrease in the number of stocks can be caused by two factors, namely natural mortality and fishing mortality (King, 1995).

The exploitation rate of orange-dotted tuskfis in Wallace Line, Spermonde Islands, which was much higher (0.77) than 0.50, indicates the high exploitation. The optimum exploitation rate is 0.5 (Gulland, 1983). Species that are overexploited will have an impact on reducing the number of adult fish. Overexploitation can cause fish to be caught before spawning at least once in their life cycle. If the catch occurs before the fishes have spawned, it can result in number recruitment coming into the stock, and in the end, the stock will run low (King, 1995). It is necessary to make exploitation restrictions to minimize the risk of recruitment failure and decrease catch (Adam and Surya, 2013).

The results should be clearly presented with accompanying figures and tables, and directly relevant to the research questions. The discussion is aimed at interpreting and/or explaining your results based on theories and previous publications. Point out significant contributions of your findings to new knowledge and/or applications. Results and discussion may be combined in one section or separated.

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CONCLUSION

The population of orange-dotted tuskfis caught in Wallace Line, Spermonde Islands, consists of one cohort. One cohort was an indication of high exploitation. The growth of orange-dotted tuskfis was slow. The total mortality rate for orange-dotted tuskfis was higher than the natural mortality rate. The very high exploitation rate indicates that the population of orange-dotted tuskfis in Wallace Line, Spermonde Islands, has been high exploited (overexploited). Because overexploitation has occurred, it is necessary to arrange for capturing not to cause the extinction of the orange-dotted tuskfis in Wallace Line, Spermonde Islands, Makassar Strait, Indonesia.

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