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POPULATION DYNAMICS OF CLIMBING PERCH FISH (*Anabas testudineus*) IN THE WATERS OF TEMPE LAKE, WAJO REGENCY, SOUTH SULAWESI

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ABSTRACT

Climbing perch (Anabas testudienus) is one of the inhabitants of Lake Tempe exploited throughout the year, so it is feared that its population has decreased. This study aims to analyze aspects of the dynamics of the climbing perch population, including age group, population growth, mortality, exploitation rate, and yield per recruitment. Data on the total length of fish were collected by measuring all catches of fishermen from October to December 2021. Age groups were analyzed using the Battacharya method, L∞ and K used the Ford and Walford method, M used the Empiris Pauly method, Z, F, and E used the Beverton and Holt method. Data analysis using FISAT-II software and Microsoft Excel. The results showed that the climbing perch in the waters of the Lake Tempe Wajo Regency had a total length range of 6 – 20.8 cm, the highest catch was in the middle-class size of 11.5 – 13.5 cm, and the average length is 13.03±2.15 cm. The population consists of two age groups, the estimated value L∞ = 26.3 cm, K = 0.5 year-1 and t0 = -0.3384 years. The estimated Z, M and F values are 3.41 year-1, 1.22 year-1, and 2.19 year-1, respectively. The exploitation rate is 0.64 year-1, and the actual and optimal Y/R are 0.015gram recruitment-1 and 0.0163 gram recruitment-1, respectively. The conclusion is that climbing perch in the waters of Lake Tempe Wajo Regency require a short time to reach the maximum length, the main cause of population death due to fishing, and the recruitment process is not optimal due to the high rate of exploitation.

Keywords: *A. testudineus*, exploitation, growth, mortality, recruitment

INTRODUCTION

Climbing perch (Anabas testudineus) is a freshwater fish that lives in tropical waters, precisely in the territory of Indonesia, one of which is Lake Tempe which is surrounded by three districts, namely Wajo Regency, Soppeng Regency, and Sidenreng Rappang Regency. Biodiversity in Lake Tempe is relatively abundant. Based on the Ministry of Maritime Affairs and Fisheries (2010), the research results found approximately 21 species of aquatic plants other than phytoplankton and approximately 15 species of freshwater fish that breed in the lake. So that, the fish production in Tempe Lake is high. Much research has been done on this climbing perch fish in Indonesia, including related to ichthyological and ecobiological aspects (Akbar, 2017). Several researchers have conducted studies on climbing perch fish, according to Utomo and Wijaya (2008), climbing perch fish have a high level of

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adaptation to fluctuations in dissolved oxygen and low pH.

Research related to (Anabas testudineus) in Indonesian waters includes parameters of climbing perch fish population in the flood exposure ecosystem of the Musi River (Nurdawati et al., 2019), ecobiology, habitat, and cultural potential of climbing perch fish in Indonesia (Akbar, 2017), fish growth climbing perch in the Melintang Lake environment, East Kalimantan (Mustakim et al., 2009), population dynamics of climbing perch caught in the swamp waters of Telok Selong village, Banjar Regency (Mu'awanah, 2021). Research on climbing perch in the waters of Tempe Lake, Wajo Regency, has never been done, so this research is very important. For this reason, it is necessary to conduct research related to population dynamics of climbing perch (Anabas testudineus), including age groups, growth, mortality, exploitation rates, and yield per recruitment.

This study aimed to analyze aspects of the climbing perch population dynamics, including age group, population growth, mortality, exploitation rate, and yield per recruitment in the waters of Tempe Lake, Wajo Regency, South Sulawesi.

MATERIAL AND METHOD

This research was carried out for two months, namely in October-December 2021, in the waters of Tempe Lake, Wajo Regency, South Sulawesi. The research location is shown in Figure 1.

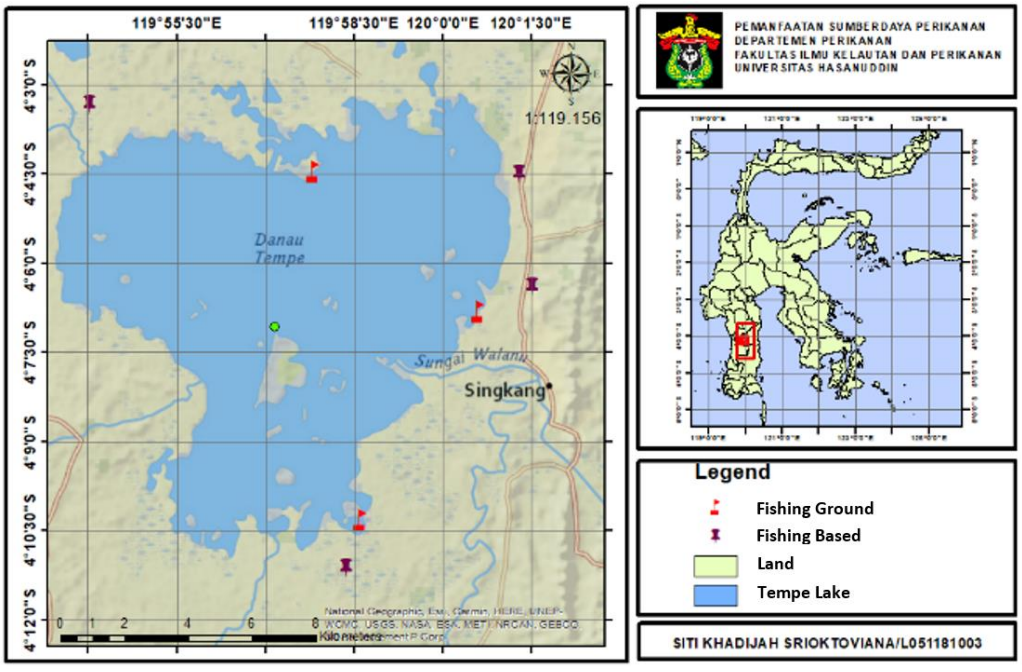

Figure 1. Research location map

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The materials and tools used in this research are a climbing perch, camera, stationery, laptop, FISAT-II software, ruler, and thermometer.

Data Collection Method

This study uses a survey method. Data on the total length of 1090 climbing perch (TL, cm) were obtained by measuring fish of various sizes caught by fishermen using fixed gill nets, pot traps, handline, and cast nets.

Data Analysis

Size Structure and Age Group of Climbing Perch

The size structure of the fish was analyzed using the Column Diagram or Histogram formula, which mapped the median value of fish length class and fish frequency. Based on the results obtained, the smallest fish size, largest fish size, dominant fish size, and number of age groups were obtained.

Age groups were analyzed using the Battacharya length-frequency method (Sparre and Venema 1999). The observed length frequencies were normalized using the normal distribution equation (Sparre and Venema, 1999), namely

$$Fc = \frac{n.dl}{S\sqrt{2\pi}} \exp\left[\frac{-(X-\bar{x})^2}{2S^2}\right]$$

Where Fc is the calculated frequency, n is the number of fish, dL is the class interval, S is the standard deviation, is the mean length, X s is the median total length, and 3,1415.

The Battacharya method estimated the age composition based on the long frequency. The basis of this method is the separation of age groups that have a distribution, and each age group is a cohort. Calculations for this age group used the FAO-ICALRM Fish Stock Assessment Tools II (FISAT-II) program.

*Climbing Perch Population Growth Rat*e

Estimation of climbing perch population growth parameters were analyzed using the Von Bertalanffy growth formulation (Sparre and Venema, 1999) as follows:

$$Lt = L\infty[1 - e^{-K(t-to)}]$$

Where Lt is fish length at age t, L∞ is asymptote length, K is growth rate coefficient, t is fish age, and fish age at zero fish length. Furthermore, in determining to use Pauly's (1980) Empirical formula, namely:

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

Mortality

The natural mortality rate was estimated using the formulation proposed by Empirical Pauly (1980) namely Ln M = 0,8 x exp (-0,152-0,279 ln L∞ + 0,6534 ln K + 0,4634 ln T°C). Where M is natural mortality, L∞ is fish asymptote length, K is growth rate coefficient, and T is water surface temperature. The total mortality rate was estimated using the catch curve method in the FISAT-II software. Then the fishing mortality rate is estimated by using the equation F = Z-M.

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Exploitation Rate

The exploitation rate is obtained using the Beverton and Holt (1956) equation (Sparre and Venema, 1999), namely:

$$E = \frac{F}{Z}$$

Where E is exploitation rate, F is fishing mortality, and Z is total mortality.

Yield per Recruitment

Yield per Recruitment (Y/R) was obtained using the formulation of the Beverton and Holt (1956) equation (Sparre and Venema, 1999) as follows:

$$\left({}^{Y}/_{R}\right) = E.U^{m}[1 - \frac{3U}{1+m} + \frac{3U^{2}}{1+2m} + \frac{U^{3}}{1+3m}$$

$$U = 1 - \frac{Lc}{L\infty}$$

$$m = \frac{1-E}{M/K}$$

Where E is the exploitation rate, Lc is the length of the smallest fish caught ≥50%, M is the natural mortality, K is the growth rate coefficient, and L∞ is the asymptote length of the fish.

RESULTS AND DISCUSSION

Size Structure and Age Group

Size Structure

The size structure of climbing perch fish based on the overall catch of fishing gear in the waters of Lake Tempe, Wajo Regency, can be seen in Figure 2.

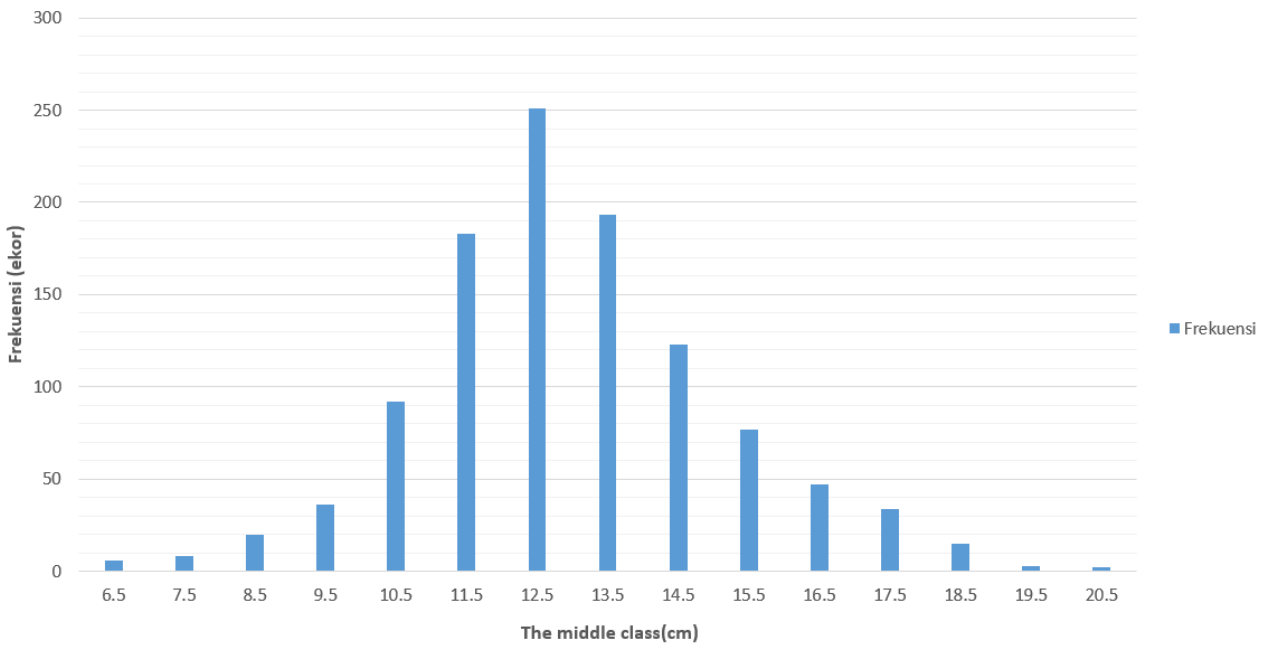

Figure 2. Size structure of climbing perch fish catch in Tempe Lake

Fish obtained during the study from October to December 2021 were 1090 fish with a total range of 6 - 20.8 cm, with the largest catch size being in of 11.5 - 13.5 cm. The average length is 13.03±2.15 cm.

The length range of climbing perch fish in the waters of Lake Tempe, Wajo Regency, has a

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different from the length range of climbing perch fish in other waters, namely in Lake Lubuk Siam, which has a length range of 11.5-20.0 cm (Felni et.al., 2019), in flood exposure. Musi River has a length range of 2.75-19.75 cm (Nurdawati et.al., 2019), in flood swamps the Mahakam River has a length range of 7.1-19.5 cm (Ernawati et.al., 2009), in The Peat Swamp has a length range of 12-16.2 cm (Putri et.al., 2019) and in the Tapung Kiri River, it has a length range of 6-16.2 cm (Situmorang et.al., 2014). The difference in fish size in this study with previous research is due to differences in a location where differences in the number of fish sizes in a population in water within a population can be caused by differences in growth patterns, migration, etc.

Age Group

Based on the results of the FISAT-II analysis, it can be seen that the population of climbing perch fish in the waters of Lake Tempe, Wajo Regency, consists of two age groups (Figure 3).

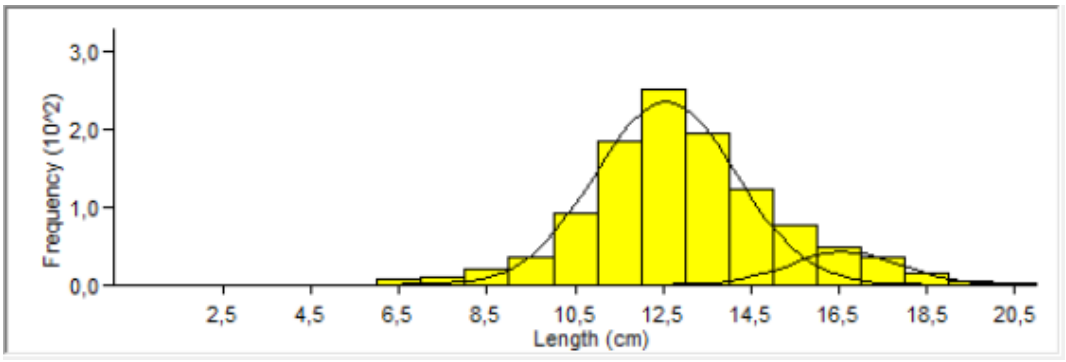

Figure 3. Histogram graph of the relationship between class mean and frequency of climbing perch fish (*Anabas testudineus*) in the waters of Tempe Lake, Wajo Regency

The results obtained from the mapping between the middle class and the frequency (Figure 3) obtained two age groups with a length range of the first age group between 6.5 - 15.5 cm with the number of individuals 989 individuals and the length range of the second age group between 16.5 - 20.5 cm with a total of 101 tails. Because there were less than three age groups, it was analyzed using the Bhattacharya's method in the FISAT-II program. Logarithmic mapping was analyzed using Microsoft excel, which can be seen in Figure 4.

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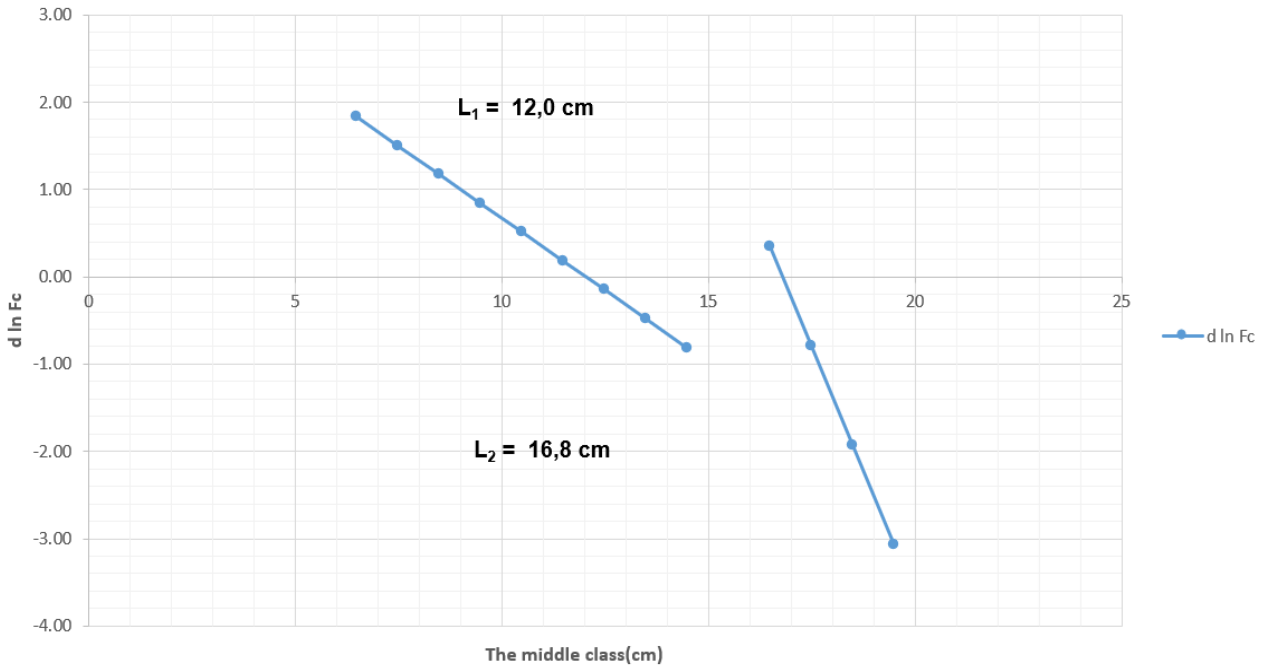

Figure 4. Mapping the difference in the natural logarithm of the theoretical frequency to the mean class value in the age group of climbing perch fish (*Anabas testudineus*) caught in the waters of Tempe Lake, Wajo Regency

Based on the analysis of the age group of climbing perch fish in the waters of Tempe Lake, Wajo Regency, only two age groups stated that the fish were under stress. One of the characteristics of a population experiencing stress is that the number of age groups is small (Mallawa et.al., 2017). Then, if a population does not exceed three age groups, the population is not in good condition.

Growth Rate

Estimation of growth parameters using length-frequency data at each sampling can be processed using the ELEFAN I method in the FISAT-II program. In this method, it can be seen that the highest Rn value will appear in the ELEFAN I table as a condition for estimating the approximate value of the growth parameter. From the input length-frequency data, the highest Rn is 0.956, with the starting sample (SS) being one and the starting length (SL) being 12.5 cm. So that the asymptote length (L∞) is 26.3 cm, the growth coefficient (K) is 0.5 per year, and the theoretical age of fish at zero-length (t0) is -0.3384 per year. The K value obtained is 0.5 per year, indicating that the climbing perch fish in Tempe Lake, Wajo Regency, has a short time to reach the maximum length value. The growth rate of climbing perch fish in the waters of Tempe Lake is greater than the growth rate of climbing perch fish in the Musi Bengkulu River Flood Exposure, which is 0.24 per year (Nurdawati et.al., 2019), but lower than the growth rate of climbing perch fish in Melintang Lake, East Kalimantan. I.e. 0.66 per

year (Mustakim et.al., 2009) and Bangladesh 1.4 per year (Mustafa and Graaf, 2008).

The difference in the growth rate of climbing perch fish in the waters of Tempe Lake, Wajo Regency, with other waters can be caused by external and internal factors. External factors, namely water temperature, and food availability, are very difficult to control, while internal factors, namely heredity, age, disease, and parasites. However, it is still unknown which factors have a significant impact on growth. The food availability can be obtained from dissolved oxygen, carbon dioxide, hydrogen sulfide, salinity, and alkalinity (Sparre and Venema, 1999).

Based on the values of L∞, K and t0 obtained, the equation for the growth of Von

Bertalanffy climbing perch fish in the waters of Lake Tempe, Wajo Regency is as follows:

$$\boldsymbol{Lt = 26,3(1 - e^{-0,5(t+0,3384)})}$$

The equation obtained can form a growth curve that shows the relationship between length and age of climbing perch fish in the waters of Tempe Lake, Wajo Regency, until it reaches the asymptotic length (Figure 5).

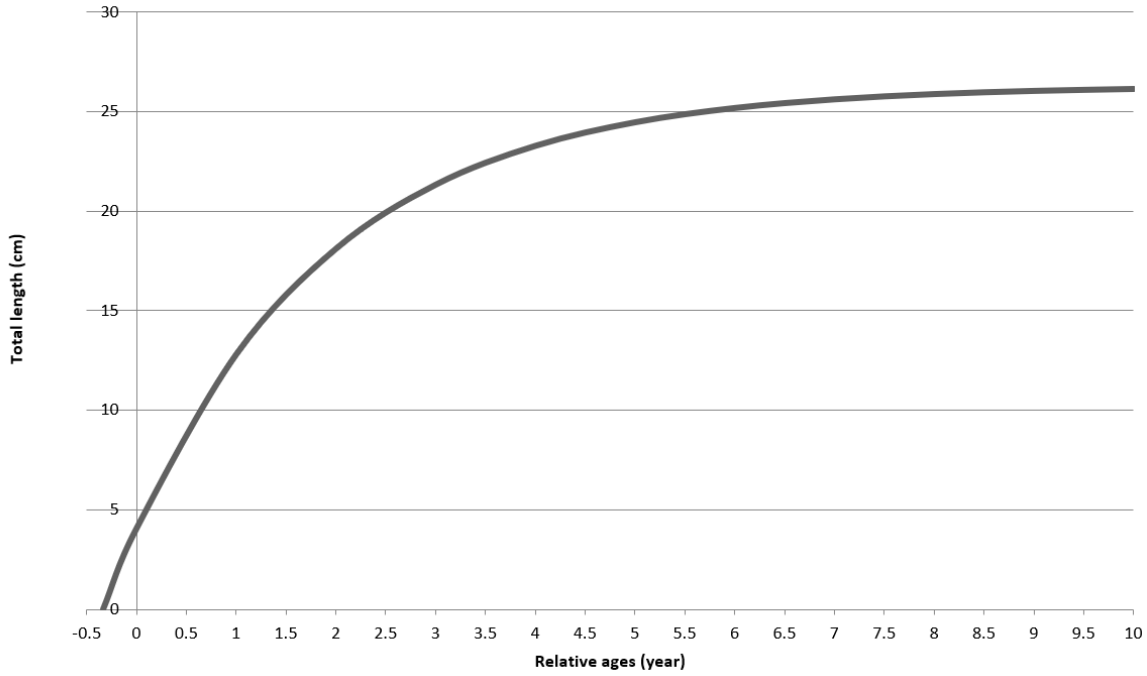

Figure 5. Von Bertalanffy curve of climbing perch fish in the waters of Lake Tempe, Wajo Regency

Based on the growth curve (Figure 17), the length growth of the climbing perch fish is quite fast when it is young and starts to slow down when it reaches the asymptotic length, which can no longer be increased.

Mortality Rate

Climbing perch fish in the waters of Lake Tempe, Wajo Regency, is thought to have a total mortality rate (Z) of 3.41 per year, a natural mortality rate (M) of 1.22 per year, and a mortality rate due to fishing (F) of 2.19. Per year. The mortality rate of catching fish in the waters of Tempe Lake, Wajo Regency, is higher than the natural mortality rate, which means that the mortality of climbing perch fish in the population is mostly due to fishing.

The total mortality rate, natural mortality, and fishing mortality in Lake Tempe have different values from other waters, namely, the Musi River Flood Exposure has a total mortality rate (Z) of 0.99 per year, natural mortality (M) of 0.42 per year and a mortality rate of 0.42 per year. Catch (F) 0.56 per year (Nurdawati et.al., 2019), in Bangladesh has a total mortality rate (Z) of 3.79 per year, natural mortality (M) of 2.52 per year, and fishing mortality (F) of 1.27 per year (Mustafa and Graaf, 2008), in Lake Rudrasagar India has a total mortality rate (Z) 1.95 per year, natural mortality (M) 1.54 per year and fishing mortality (F) 0.41 per year (Mauraya et.al., 2020), in Lake Semayang, East Kalimantan has a total mortality rate (Z) of 1.63 per year, natural mortality (M) 0.76 per year and fishing mortality (F) 0.87 per year (Mustakim et.al., 2018).

The difference in the value of the natural mortality rate is caused by the availability of food, predators, and environmental conditions such as water temperature. While the difference in the value of the fishing mortality rate is caused by the intensity of fishing and the selectivity of fishing gear used by fishermen.

Exploitation Rate

Climbing perch fish in the waters of Lake Tempe Wajo Regency obtained the estimated value of exploitation rate (E) shows a value of 0.64 per year, which indicates that climbing perch fish has a high level of exploitation that is the value exploitation is higher than the optimal exploitation value of 0.5 per year. The exploitation rate of climbing perch fish in other waters, namely in the Musi Bengkulu River Flood Exposure has a value of exploitation rate (E) 0.57 per year (Nurdawati et.al., 2019), in Lake Semayang East Kalimantan has an exploitation rate value (E) 0.47 per year (Mustakim et.al., 2018), in Rudrasagar Lake India it has an exploitation rate value (E) of 0.21 per year (Maurya et.al., 2020) and in Bangladesh it has an exploitation rate value (E) 0.34 per year (Mustafa and Graaf, 2008).

Yield per Recruitment

The estimated value (Y/R) can be analyzed using the Beverton and Holt method by entering the calculated value of the coefficient of growth rate (K), asymptote length (L∞), mortality value, and exploitation rate (E). The estimation curve (Y/R) can be seen in Figure 6.

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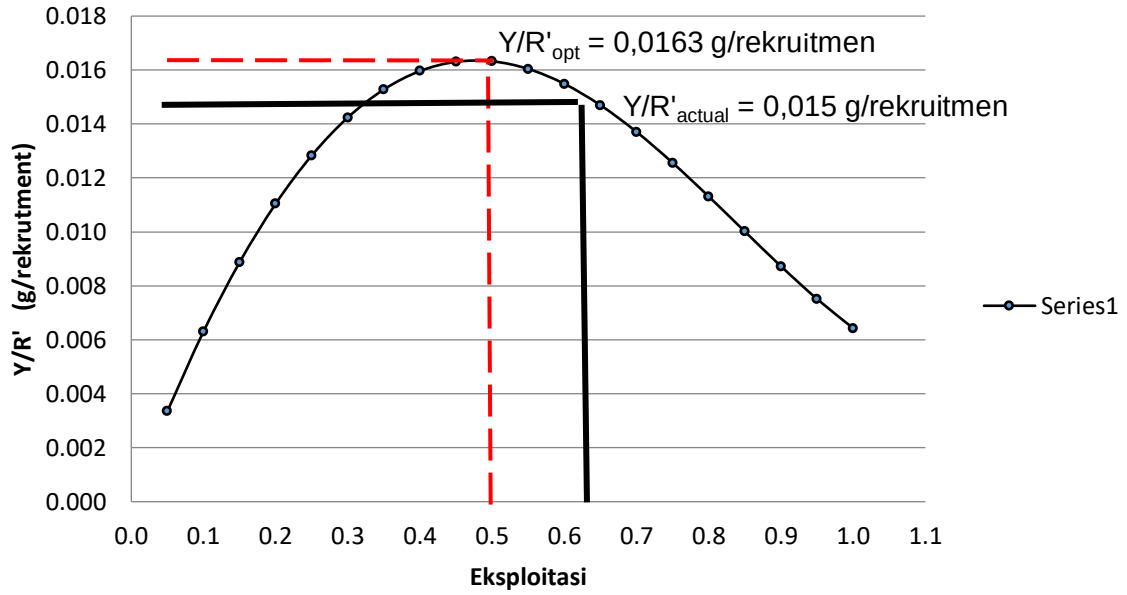

Figure 6. Yield per recruitment curve

Based on (Figure 6) the estimation results obtained that the actual Y/R value of climbing perch fish in the waters of Lake Tempe, Wajo Regency is 0.015 g/recruitment which is found in the exploitation rate value of 0.64, then the optimum Y/R value is 0.0163 g/recruitment Contained in the exploitation rate value of 0.5, which means the current Y/R value is smaller than the optimum Y/R value or the recruitment process is not optimal.

CONCLUTION

Based on the research objectives, it can be concluded that the population of climbing perch fish in the waters of Lake Tempe, Wajo Regency, consists of 2 age groups. The first age group has a length range of 6.5-15.5 cm and the second age group has a length range of 16.5-20.5 cm. Climbing perch fish in the waters of Lake Tempe, Wajo Regency, has a K value of 0.5, indicating that the climbing perch fish in the waters of Lake Tempe, Wajo Regency, has a short time to reach its maximum length. The mortality of the climbing perch fish population in the waters of Tempe Lake, Wajo Regency, is mostly due to fishing. The actual exploitation rate is 0.64 > 0.5, indicating that the climbing perch fish in the waters of Lake Tempe, Wajo Regency, is experiencing a high rate of exploitation. The low actual Y/R value compared to the optimal Y/R value or the non-optimal recruitment process is caused by the high annual exploitation rate.

Based on the results of the study, it can be seen that the condition of the waters in Lake Tempe, Wajo Regency, has overfished and the mortality value due to catching is quite high so that it can cause damage to the habitat of climbing perch fish in the waters of Lake Tempe, Wajo Regency. Therefore, the population of

climbing perch fish in the waters of Lake Tempe, Wajo Regency, needs special attention from the government to overcome overfishing so as not to increase the rate of exploitation.

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