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POPULATION DYNAMICS OF SILVER BARB (*Barbonymus gonionotus*) IN TEMPE LAKE WATERS, WAJO REGENCY, SOUTH SULAWESI

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ABSTRACT

Silver barb (Barbonymus gonionotus) is a catch that is commonly found in the waters of Tempe Lake, Wajo Regency, South Sulawesi. Catching Silver barb (Barbonymus gonionotus) in the waters of Tempe Lake uses several types of fishing gear, including gill nets or lanra' (gill nets) with mesh sizes of 4, 4.5, 5, 6.5, 7, and 9 cm, dragon traps or ja'ba, traps, and lift nets. The purpose of this study is to analyze aspects of the population dynamics of Silver barb (Barbonymus gonionotus), which includes age group, growth, mortality, exploitation rate, and yield in a recruitment, and to analyze the catch of Silver barb (Barbonymus gonionotus) caught using gill nets, dragon traps, and lift nets. This research was conducted over two months, in November and December 2021. Stratified random sampling was used to select the participants. The fish were grouped into small, medium, and large sizes, and fish were randomly selected from each age group. The total sample obtained was 1600 tails with a total length range of 10-33 cm TL and an average length of 19.8 cm TL. The results of the analysis obtained two age groups: the first was in the length range of 10-18 cm, and the second was in the length range of 18-33 cm. Fish asymptote length (L∞) was 45 cm with a coefficient value (K) of 0.5 in a year, and fish age at length was zero (t0) = -0.2919 years. Natural mortality (M) was 1.05 per year, fishing mortality (F) was 2.19 per year, and total mortality (Z) was 3.24 per year. The exploitation rate value was 0.68, which exceeded the optimum exploitation rate (0.50). The value of yield in recruitment (Y/R') was 0.0166 g/recruitment, and the recruitment process was not normal.

Keywords: Silver barb (Barbonymus gonionotus), population dynamics.

INTRODUCTION

Tempe Lake is a flooded swamp lake and the estuary of 13 rivers originating from various regions, including the Cenranae and Walanae rivers. The Walanae River is the only river that discharges into the sea (Samuel and Makmur, 2012).

Silver barb (Barbonymus gonionotus) is a type of fish found in Tempe Lake, Wajo Regency. The local name for the silver barb is usually bale kandea. Silver barb (Barbonymus gonionotus) is one type of a fish with a large potential for development because of its economic value. The existence of silver barb has long been used by the surrounding community as a source of income and food. This encourages fishermen to make arrests so that the sustainability of fish resources will one day be threatened.

Silver barb live habitat is in the type of waters of lakes, rivers and reservoirs. One of the

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distributions is in Tempe Lake, Wajo Regency, South Sulawesi (Fisesa, 2017). Silver barb (Barbonymus gonionotus) has an almost triangular and flat body and relatively large scales with a silvery or grayish-white color (Susanto, 2000).

Silver barb is a fish with commodity value in the rapidly growing freshwater fishery sector. The demand for silver barb consumption continues to increase annually. With the increasing needs of the community, the stock of resources can decrease. Fishermen make arrests without adjusting to the conditions of the population in the water. If the catch is carried out continuously to meet consumer needs without adjusting it to the current population conditions in the waters, the silver barb (Barbonymus gonionotus) resources will be overfished and can result in the disruption of resource sustainability.

The purpose of this study is as follows:

1. To analyze aspects of the population dynamics of silver barb (Barbonymus gonionotus), including age group, growth, mortality, exploitation rate, and yield, in the waters of Tempe Lake, Wajo Regency.

2. To analyze the catch of silver barb (Barbonymus gonionotus) caught using gill nets, dragon traps, and lift nets.

MATERIAL AND METHOD

Materials

This research was conducted for two months, from November to December 2021, in four sub-districts, namely Sabbangparu, Belawa, Tempe, and Tanasitolo sub-districts in the waters of Tempe Lake, Wajo Regency, South Sulawesi. A map of the research location is shown in Figure 1.

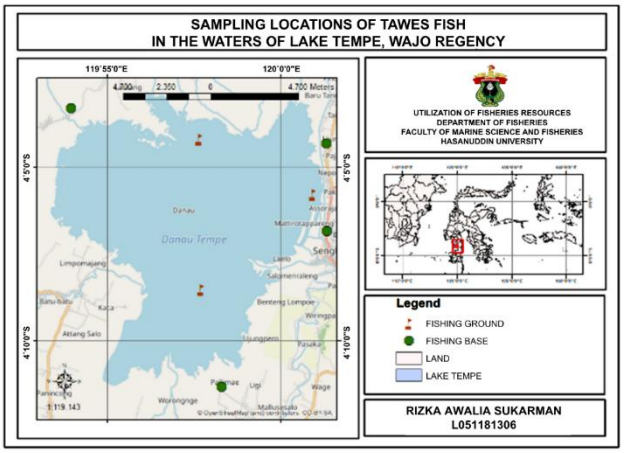

Figure 1. Research site map

Sampling was carried out using the stratified random sampling method, in which the fish were grouped into small, medium, and large sizes, and from each age group, the fish were taken randomly. Stratification was carried out based on fish size and type of fishing gear used. In this study, 1600 silver barb (Barbonymus gonionotus) samples were obtained, with a length range of 10-33 cm and an average length of 19.8 cm. The silver barb in Tempe Lake, Wajo Regency, is shown in Figure 2.

Figure 2. Silver barb in the Tempe lake, Wajo Regency

The data used in this study were primary data generated from the measurement of the total length. The total length of the fish was measured from the leading edge of the head to the outermost tip of the tail fin using a ruler or roll meter with an accuracy of 0.1 cm.

Data analysis

Age group estimation

The method used to estimate the age group of silver barb (Barbonymus gonionotus) is the length frequency method proposed by Bhattacharya (1967), which divides fish into several class lengths using a certain class interval (dl) by calculating the frequency (f) of each class length. and the middle of the class (x) to create a graphic image of the age group.

The size structure was obtained by mapping the mean length and frequency classes to obtain the largest, smallest, and dominant fish sizes and the number of age groups. Calculations were performed in age groups using the FISAT II program.

If the distribution in the age group is not normally distributed, then normalization will be carried out by calculating the calculated frequency (Fc) with the following equation (Sparre et. al., 1989):

$$Fc = \frac{n.dl}{s\sqrt{2\pi}} \exp\left[\frac{-(x-\bar{x})^2}{2S^2}\right] \quad \text{.....(1)}$$

Explanation:

Fc : Calculated frequency or theoretical frequency

n : Number of fish

dl : class interval

S : Standard deviation

X : Average length

x : Middle class

π : 3.14159

Growth forecast

The estimation of growth parameters of silver barb (Barbonymus gonionotus) can be calculated using a growth model related to fish length following the Von Bertanffly growth equation (Sparre et al., 1989):

$$\mathbf{Lt = L\infty\ (1 - eK(t-t0))} \quad \text{.....(2)}$$

Explanation:

Lt : Length of fish at age t (cm)

L : Assymptote length (cm)

K : Coefficient of growth rate (in a year)

t0 : The theoretical age of the fish when its length is zero (years)

t : Age of fish

The asymptotic length (L∞) and coefficient of fish growth rate (K) were obtained using the FISAT II program on the ELEFAN I feature. Subsequently, t0 was determined using the following formula (Pauly, 1980):

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Log (–t0) = -0.3992 – 0.2752 (Log L∞) – 1.038 (Log K).....(3)

Explanation:

L : Fish asymptote length (cm)

t0 : The theoretical age of the fish when the length is equal to zero (years)

K : Coefficient of growth rate (years)

Mortality estimation

Natural mortality can be estimated using Pauly's (1980) empirical formula as follows:

M = -0.0152 – 0.279 (ln L∞) + 0.6543 (ln K) + 0.4634 (ln T).....(4)

Explanation:

M : Natural mortality rate (in a year)

L∞ : Fish asymptote length (cm)

K : Growth coefficient (in a year)

T : Water temin aature (°C)

Estimates of total mortality can be estimated using FISAT II on the catch curve by entering the value of fish asymptote length (L∞), coefficient of growth rate (K), and theoretical age of fish when the length is equal to zero (t0).

After obtaining the results of estimating natural mortality (M) and total mortality (Z), fishing mortality can be estimated using the following equation:

So that:

Z = F + M or F = Z – M.....(5)

Explanation:

F : Catch mortality rate (in a year)

Z : Total mortality rate (in a year)

M : Natural mortality rate (in a year)

Exploitation rate

The exploitation rate (E) can be determined by comparing the fishing mortality rate (F) with the total mortality rate (Z) using the equation proposed by Beverton and Holt in Sparre et al. (1989), as follows:

E= F/Z.....(6)

Explanation:

E : Exploitation rate (in a year)

F : Catch mortality rate (in a year)

Z : Total mortality rate (in a year)

Yield in a recruitment

The Yield in a Recruitment Silver barb (Barbonymus gonionotus) can be determined using the equation proposed by Beverton and Holt in Sparre et al.. (1989), as follows:

$$Y/R' = E.U^m\left[1 - \frac{3U}{1+m} + \frac{3U^2}{1+2m} - \frac{U^3}{1+3m}\right]$$.....(7)

Explanation

U = 1 -L'/L_∞

m =(1-E)/(M/K)

E : Exploitation rate (in a year)

M : Natural mortality (in a year)

K : Coefficient of growth rate (in a year)

L' : The smallest length of the caught fish (cm)

L : Fish asymptote length (cm)

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RESULTS AND DISCUSSION

Catching tool

Gill nets

Gill net fishing gear is a fishing gear is generally rectangular in shape and consists of several parts, namely the main net, lower ris line, upin a ris line, sling rope, and buoy (Rasdani, 1988). In Wajo Regency, the gill net is known as Lanra'. Fish caught with gill nets are entangled in the oin aculum.

The gill nets used have different mesh sizes according to the target catch. Catching Silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency using mesh sizes of 4 cm, 4.5 cm, 5 cm, 6.5 cm, 7 cm and 9 cm. The gill net fishing gear is shown in Figure 3.

Figure 3. Fishing geargill net

The use of nets that are too small results in the catching of fish that are not suitable for catching and will have an impact on the population of silver barb (*Barbonymus gonionotus*) in the waters. A large number of fish were caught in the range of total length (total length) 10-14 cm. The population of silver barb (*Barbonymus gonionotus*) can decline if small fish are the target of fishermen's catches.

Responsible and sustainable management of fishery resources must be carried out so that their contribution to the availability of nutrients and improvement of the social and economic welfare of the community can be maintained and even increased (Rapi and Hidayani, 2016).

Dragon trap

The dragon trap, commonly called Ja'ba by the people in Wajo Regency, is a type of fishing gear that is classified as a trap. A trap is a passive fishing gear that can trap fish. Fish can easily enter the traps, but it is very difficult for them to get out because they are blocked in various ways (Von Brandt, 2005). The dragon trap fishing gear is shown in Figure 4.

Figure 4. Dragon trap fishing gear

The fishing gear used to catch silver barb (Barbonymus gonionotus) has a length of 5 – 30 m, or usually there are 14 boxes in the front and 14 boxes on the back. The operation of dragon

traps in the waters of Tempe Lake, Wajo Regency, has been prohibited because the fishing gear is not selective and can catch fish that are still very small. This can also affect the decline in the population of silver barb (*Barbonymus gonionotus*) in the waters.

Although fish resources are renewable, they are not unlimited. Therefore, it is necessary to maintain sustainability. Efforts to preserve fish resources from the threat of extinction must be carried out immediately, and it is hoped that the development of fishing technology in the future will consider and pay attention to aspects of environmental friendliness (Syafriadi, 2018).

Anco lift net / barge (lift net)

Anco or Barge fishing gear is a lift net that has an equilateral rectangular shape, which is usually located on the banks of rivers, swamps, and lakes, especially at the estuary of the water flow, where there will be many small fish gathering because of the nature of the fish that like to challenge the direction of water currents (Hermanto et al., et.al. 2012). Anco lifting net fishing gear is shown in Figure 5

Figure 5. Lift net/anco fishing gear (lift net)

Silver barb (*Barbonymus gonionotus*) were caught using a lift net that was 5 m long and 5 m wide with a mesh size of 4.5 – 6.5 cm. The frame was made of four bamboo blades, and the rope used was 3 m long and iron 4 4m long. The boat used to operate the barge or anco fishing gear uses a 13 Pk engine, and has a length of 5 m, height of 45 cm, and width of 85 cm.

The use of anco lift nets to catch silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency, has been prohibited by the local government. This is because the fishing gear has a small mesh size, so it is included in the category of non-selective fishing gear. However, some fishermen still operate fishing gear.

Fishing gear, as the main means in the capture fishery business, is regulated in such a way that it does not have a negative impact on users of fishery resources and the aquatic environment, as well as other users of aquatic services. Users of fishing gear must pay

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attention to balance and minimize the negative impacts on other biota (Syafriadi, 2018).

Population dynamics parameters
Size structure and age group

The catch of silver barb (*Barbonymus gonionotus*) using gill nets, dragon traps, *ja'ba* traps, and lift nets was 1600 samples, with a total length range of 10-33 cm, an average length of 19.8 cm, a standard deviation of 5.5, and the largest catch at 24-26 cm in size. The size structure of silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency, is shown in Figure 6.

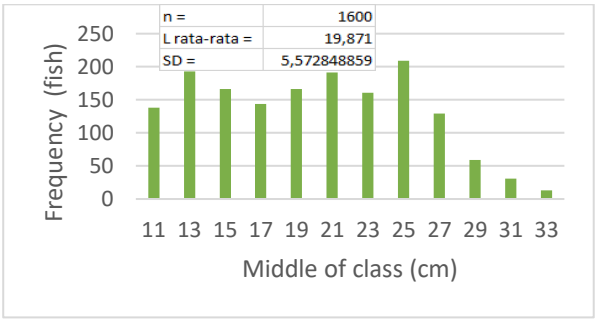

Figure 6. Size structure of Silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake

For gill nets, 1,572 silver barb (*Barbonymus gonionotus*) fish were obtained, 22 for dragon traps or *ja'ba* traps, and 6 for lift nets. The catch from the three fishing gears had an average length of 19.8 cm.

Dahlan *et. Almeida et al.* (2015) suggested that the pattern of growth, migration, and addition of new types of fish to an existing population can cause differences in the number of sizes in the population in the waters.

The results of the age group analysis using the Battacharya method in FISAT II obtained two age groups of silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency, as shown in Figure 7.

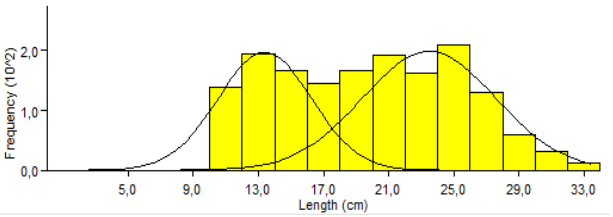

Figure 7. Age group of silver barb (Barbonymus gonionotus) in the waters of Tempe Lake, Wajo. Regency

Based on the cohort analysis, two age groups were obtained: the first age group with a length range of 10-18 cm and the second age group with a length range of 18-33 cm. The average length value in the first cohort was 13.0 cm with a standard deviation of 2.870 and a total population of 709.95 individuals. The average length in the second cohort was 22.6 cm, with a standard deviation of 4.100 and a population of 1015.42 individuals. The mapping of the difference in the natural logarithm of the theoretical frequency to the mean class value for each age group (cohort) of silver barb (*Barbonymus gonionotus*) caught in the waters of Tempe Lake, Wajo Regency, is shown in Figure 8.

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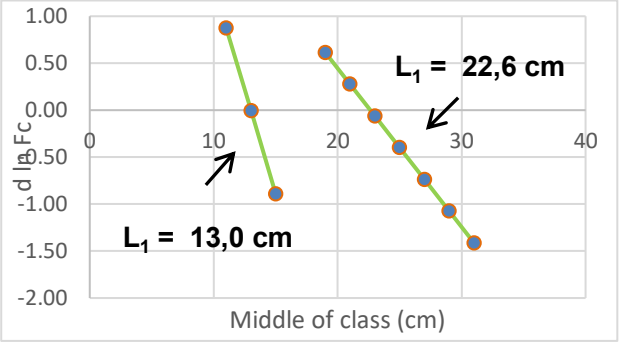

Figure 8. Mapping the difference in the natural logarithm of the theoretical frequency to the mean class value in each age group (cohort) of Silver barb (*Barbonymus gonionotus*) caught in the waters of Tempe Lake, Wajo Regency.

In the picture above, we can see the mapping of the natural logarithm of the theoretical frequency to the class mean, which forms two straight lines of regression as two cohorts formed from the x-axis intersection as the average length of the fish.

The number of fish in each class in the composition in the waters at a certain time depends on the recruitment that occurs every year and the number of fish that are lost from the waters because they are taken by humans (catch) or because the fish die naturally. Fluctuations in the number of individuals in each age group that make up the population can provide a history of fish loss cycles from each group (Effendie, 2002).

Growth

Based on the analysis of growth parameters, the length of the asymptote (L∞) was 45 cm, the coefficient of growth (K) was 0.5 in a year, and the theoretical age of the fish when the length was equal to zero (t0) was -0.2919 years. This shows that the coefficient value of the growth rate of silver barb (*Barbonymus gonionotus*) is high because it is at 0.5 in a relative time, so its growth is fast because it takes a short time to reach its symptom length (L∞). The growth curve of the silver barb (*Barbonymus gonionotus*) is shown in Figure 9.

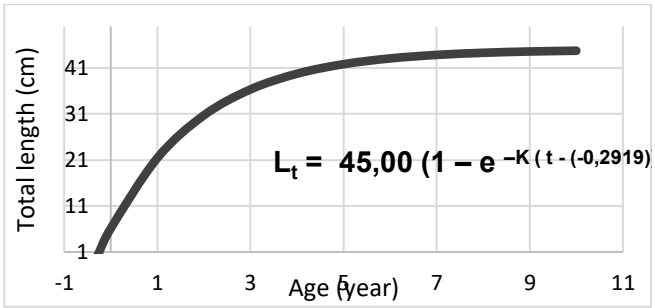

Figure 9. Growth rate curve of Silver barb (Barbonymus gonionotus)

When the fish are young, they grow relatively fast, and the adult fish will reach their asymptotic length slowly. This is because the energy obtained is not used for growth but to replace damaged cells (Effendi, 2002).

Mortality

Based on the analysis of the estimated mortality and exploitation rate of silver barb (*Barbonymus gonionotus*), the natural mortality value (M) was 1.05 per year, fishing mortality (F) was 2.19 per year, and total mortality (Z) was 3,24 per year.

The high rate of fishing mortality is caused by the lack of supervision over the use of mesh size in fishing gear, the absence of restrictions on fishing areas, and the lack of socialization from related parties or agencies to fishermen to provide an understanding of the importance of preserving fishery resources (Rapi and Hidayani, 2016).

Exploitation rate

The exploitation rate of silver barb (*Barbonymus gonionotus*) in Tempe Lake, Wajo Regency, was 0.68, which exceeded its optimum exploitation rate (E = 0.50). The value of the current exploitation rate (E present) is greater than the value of the optimum exploitation rate; therefore, it can be said that more capture of growth occurs together with more capture of recruitment.

A species that is exploited will have an impact on the education of these adult fish, which are first ensnared by fishing activities before reproduction. This can result in no recruitment of stock. Therefore, fishing influences changes in fish populations in waters (Masrikat, 2012).

Yield per Recruitment

The rate of exploitation of fishing gear for silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency, is shown in Figure 10.

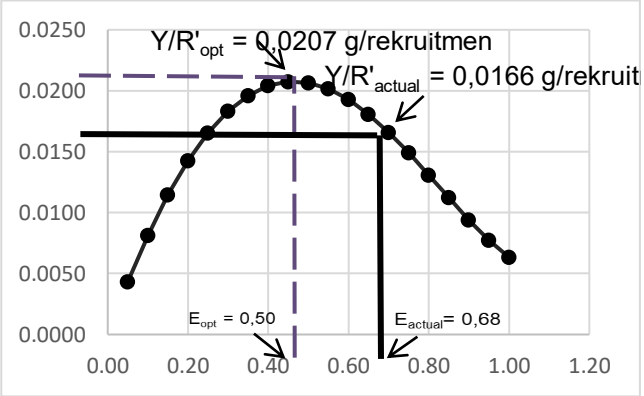

Figure 10. Curve yield in a recruitment

Based on the figure above, the maximum Y/R' value of silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency, was 0.0166 g/recruitment at E = 0.68, and the optimum Y/R' value was 0.0207 g/recruitment at E = 0.50.

CONCLUSION

Based on the results of research conducted on the population dynamics of Silver barb (*Barbonymus gonionotus*) in the waters of Tempe Lake, Wajo Regency, it can be concluded that the catch of Silver barb (Barbonymus gonionotus) obtained in the waters of Tempe Lake, Wajo Regency has 2 age groups (cohorts),the growth rate is relatively fast and requires a short time to reach its assymptote length, the value of the fishing mortality rate is higher than natural mortality., the exploitation rate value obtained has exceeded the optimum exploitation rate and the recruitment process is not normal.

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