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Growth of Betutu fish (*Oxyeleotris marmorata* BLEEKER, 1852) in Tondano Lake, North Sulawesi

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Abstract

The introduction of non-natural species to new environments is one of the main factors reducing and extinction of local diversity. The purpose of this study was to analyze the growth of betutu fish (*Oxyeleotris marmorata* Bleeker, 1852) in Tondano Lake. This research was conducted using a purposive sampling method, fish samples were obtained from the catch in a time series every month, sampling using gill nets at five stations and calculating fish growth based on the frequency of total length measurements. Data were analyzed using FiSAT II software. The results showed that the growth of the betutu fish was relatively fast in terms of the growth coefficient (K) value obtained of 1,700 per year so that the breeding of this fish was increasingly dominant compared to the growth of local fish.

Keywords: Tondano Lake; Betutu fish; Species introduction; Growth

1. Introduction

One of the organisms that lives and breeds in fresh waters is the Betutu Fish (*Oxyeleotris marmorata* Bleeker). The Betutu fish is a fish that was introduced to the waters of the lake in 2004, so the local people who discovered this fish first called it the "new Payangka" fish because it is similar to the Payangka fish that have been living in Lake Tondano for a long time. Betutu fish species are foreign, non-native fish species that are introduced into fresh waters with the intention of providing benefits that are no less important as an additional source of animal food for the people living around the lake. The introduction of new species increases the number of types of aquaculture commodities and increases fisheries production.

The types of fish in Tondano Lake are Payangka (*Ophieleotris aporos*), Tilapia (*Tilapia niloticus*), Mujair (*Oreochromis mosambicus*), Nilem (*Osteochilus haselti*) and Mas (*Cyprinus carpio*), Sepat (*Trichogaster trichopterus*), Betok (*Anabas testudinius*) and Cork (*Chana striata*) and Catfish (*Clarias batrachus*) in Soeroto, (1989). After being introduced, the Betutu fish species seems quite adaptive and now the population has grown rapidly shifting other fish species, one of which is the Payangka fish. According to Wargasasmita, (2005) foreign fish have had a negative impact on isolated lake fish communities and river ecosystems. The introduction of nile perch (*Lates niloticus*) from the Nile to Lake Victoria in 1950 resulted in 60% of endemic fish from the Cichlidae family in the lake being threatened with extinction.

In the past, several types of fish appeared to be dominant and large in size, now due to unfavorable environmental conditions and being unable to compete with the new species introduced, this has caused a shift in the composition of fish species and size. The Payangka fish population is getting smaller and smaller in size. The interaction of fish with habitat and lack of food sources and unsupportive ecosystem stability cause the ability to grow to be hampered or threaten the sustainability and diversity of fish resources.

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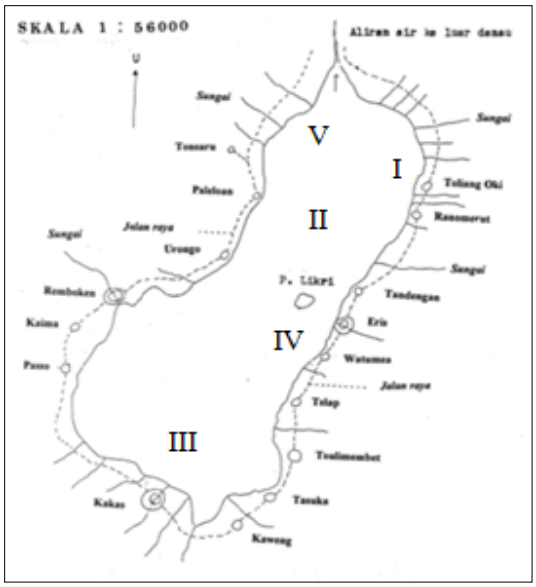
Therefore, this research is important so that the level of stability and stability of an ecosystem is maintained with the aim of analyzing the growth of Betutu fish to become information material, reference in efforts to manage resources and develop aquaculture and conserve fish in Tondano Lake.

2. Material and methods

This research was conducted in a time series for 6 months, with the research location in Lake Tondano, Minahasa Regency. Sampling design through purposive sampling method. Determination of station points is done deliberately based on certain considerations, for example based on the environmental situation, at 5 stations, namely 1. Areas with lots of water hyacinth plants. And 2). The middle area of the lake as well as 3). Water inflow area (inlet) and 4). Areas with high community activity such as floating net cages (KJA), 5). Water outlet areas. Map of Lake Tondano as shown in Figure 1.



(Source: Department of Fisheries of Dati II Minahasa in Soeroto, 1988)

Figure 1 Map of Tondano Lake

Fish samples were obtained from fish caught using gill nets with one inch mesh and 50 meters long. Retrieval of fish data as many as the catch at each station and measurement of length using a ruler with an accuracy of 0.1 cm with a capacity of 50 cm and measuring the weight of fish using a digital scale with an accuracy of 0.01 g with a capacity of 2000 g. Furthermore, sex identification was carried out based on observations of fish gonads.

Betutu fish growth parameters are calculated based on the length size group. using the ELEFAN I method (Pauly 1983a, Spare and Venema 1998) which is accommodated in the FiSAT II software. Growth estimation was analyzed using the growth model from Von Bertalanffy with the following mathematical equations (Beverton and Holt, 1957; Ricker, 1975; and King (1995):

$$L(t) = L\infty\ (1 - e\text{-}\ K\ (t - to)).$$

Note:

- L t = length of fish at age t (mm);
- L∞= Length infinity (mm)
- to = theoretical age of fish at 0 mm in length;
- K = Von Bertalanffy growth coefficient.

Then the data were analyzed using the Bhatacharya method through the Model Progression Analysis (MPA) subprogram in the FiSAT II program.

Figure 2 Betutu fish (*Ophieleotris aporos*, Bleeker 1852) 205 mm long

3. Results

Estimating growth, the total number of Betutu fish caught in Tondano Lake was analyzed, amounting to 1150 individuals, the total length range between 110 to 352 mm. The entire data analyzed was divided into 11 class intervals and 22 class widths. The distribution of the length distribution of fish obtained a median value of 121 – 341 mm, can be seen in Figure 3.

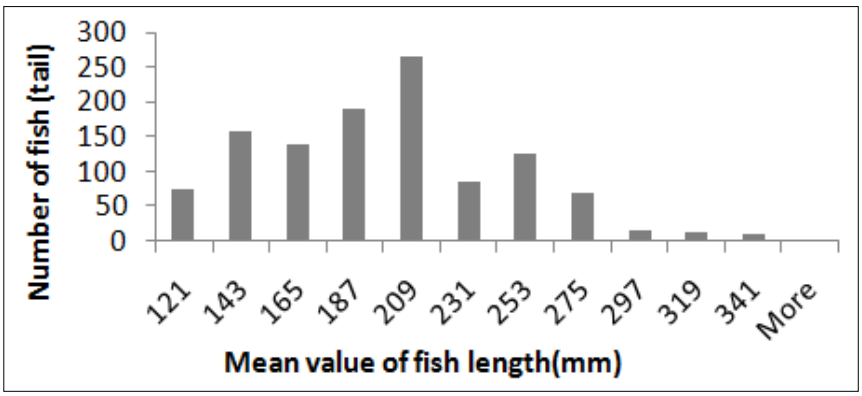


Figure 3 Distribution of number and length (mm) of Betutu fish during study

Through the FiSAT program, the ELEFAN I sub-program, from monthly frequency data, it can be estimated that the infinity length (L∞) is 358.05 mm, meaning that male and female Betutu fish reach the maximum growth limit in length which is relatively the same and the growth coefficient (K) obtained is 1,700 per year can be seen in Figure 4. This shows that the growth of the Betutu fish is relatively fast as shown in Figure 5.

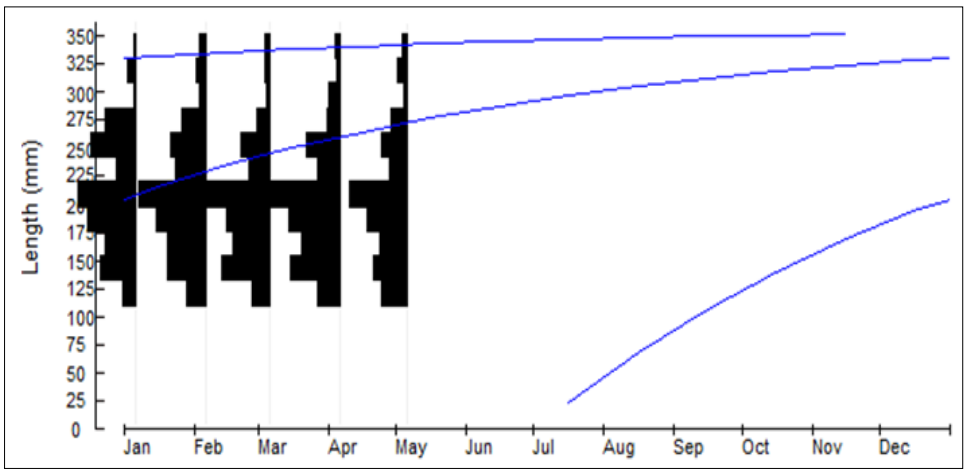


Figure 4 Growth and distribution of Betutu fish length frequency based on time/month in Tondano Lake

Based on Pauly's empirical formula (1983a), the age of the Betutu fish was obtained to = 0.14, from this to value, the von Bertalanffy growth equation was obtained, namely Lt = 358.05 [1-e -1.700(t-0.14)]. Entering the maximum length (L∞ max) = 358.05 mm into the equation t = loge (l-L∞)/K + to, the longest fish is three years old. Betutu fish are classified as short-lived demersal fish, which quickly reach adulthood. According to the results of the theoretical calculations above, the growth of the Betutu fish reaches a length of 358.05 mm. This length value is almost the same as the data found during the study, namely 352 mm.

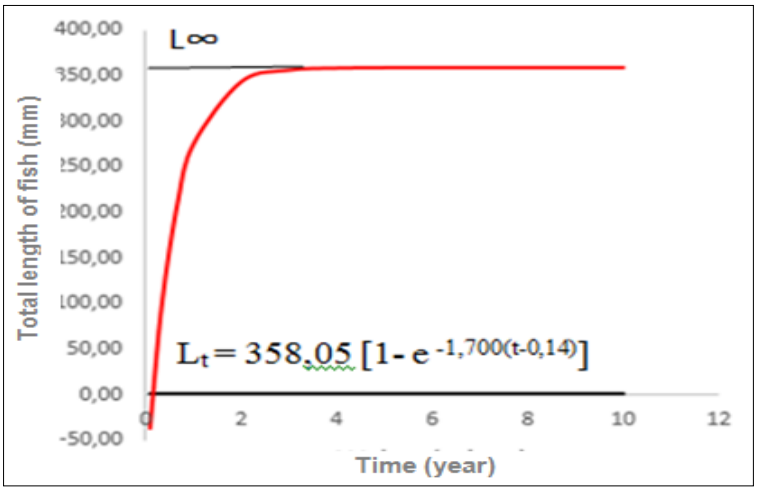


Figure 5 Predicted growth curve for Betutu fish based on total length

The analysis uses the Bhattacharya method to determine the age group of the Betutu fish. The results of the analysis based on the time/month of observation show that in total there are three (3) size groupings of Betutu fish in the population (Table 1).

Table 1 Age group and length size of Betutu fish in Tondano Lake waters

Gender	Age group	Mean length (mm)	Standard deviation	Number of population
Total	I	191,06	43,240	180,00
	II	263,21	9,720	39,00
	III	308,00	21,330	8,00
Male	I	177,83	36,140	86,00
	II	247,56	9,510	30,00
	III	308,00	21,110	4,00
Female	I	147,31	16,340	28.00
	II	211,43	33,520	90.00
	III	308.00	21,360	4.00

The grouping data shows that the age group I has more populations caught with an average length of 191.06 mm, compared to other groups it is suspected that this size group is the size group in its infancy, and these three age groups are always caught by fishermen in lake waters. Tondano. The largest population of male fish caught in age group I was 86.00 with a size of 177.83 mm and female fish in age group II amounted to 90.00 with a length of 211.43 mm.

4. Discussion

Many new species are accidentally picked up or carried by humans elsewhere. As a freshwater fish, the Betutu fish is often considered easy to move or enter into a new freshwater habitat. Fish species introduced as a result of human

actions are called exotic, alien, or non-native species. The introduction of exotic species sometimes has positive as well as negative impacts that cause habitat changes.

Fish interaction with habitat is needed to understand the functional status of fish in the environment they occupy. This will be seen if fish life is associated with the availability of suitable habitat for various activities and the presence of food sources and the maintenance of natural ecosystems.

This case study shows that in the past the Payangka fish was the most dominant fish species and the population structure was 135 – 290 mm (Soeroto, 1988) and had important economic value. According to Tamanampo *et al* (2007), the results of sampling the Payangka fish population are still the dominant fish in Lake Tondano. After the Betutu fish were introduced to Lake Tondano and grew rapidly, a negative impact appeared on the growth of the Payangka fish which had long inhabited the waters of this lake. Decreased population and reduced size, namely a total length of 8.5 to 14.6 cm (Mamangkey & Nasution, 2014).

The results showed that the growth of Betutu fish was very fast, reaching a growth coefficient (K) of 1,700 per year. According to Spare *et al*, (1987) the coefficient value (K) indicates the growth rate of fish reaching infinity length ($L\infty$) = 358.05 mm. Furthermore, Beverton and Holt (1957) and Pauly (1983b) stated that fish with a large growth coefficient value of 1,700 per year generally have a relatively short lifespan. like Betutu fish can reach the age of 3 years. The growth rate of fish depends on environmental conditions and the availability of food that can be used to support its survival and growth. According to Munira et al, (2010) fast growth for young fish occurs because most of the energy obtained from food is used for somatic growth. In adult fish most of the energy used for gonad development. For old fish, the energy obtained from food is no longer used for growth, but is only used to defend itself and replace damaged cells.

Betutu fish can achieve rapid growth due to the availability of natural food in the waters in the form of Payangka fish and snails as well as crustaceans and microscopic animal plankton because Betutu fish are carnivorous fish. Payangka fish and Betutu fish are classified as demersal fish. According to Wargasasmita (2005) predatory fish can directly reduce the population of fish that become their prey. Local species cannot compete well for space and food, so they are pushed into population decline.

According to Morgan and Beatty (2007), the impacts of alien freshwater fish species include predation, competition for food, habitat and behavior. These fish tend to result in changes in the structure and function of many aquatic ecosystems. Meanwhile, according to Chapin *et al.* (2000) effects of invasiveness on other species interactions, including predation, herbivory, parasitism, and mutualism, can change the abundance of species with certain traits that influence ecosystem processes.

Changes in the structure of species and communities can affect the existence of ecosystems both directly and indirectly. The direct effect includes a decrease in the abundance of economically valuable species. According to Krebs (1998), a community has several characteristics, namely: species diversity, growth forms and structure, dominance and relative abundance. A community is said to have high species uniformity if the abundance of each species is high otherwise species diversity is low if there are only a few abundant species. According to Callaway and Ridenour (2004), invasive species can change the community structure through competitive exploitation (direct interactions such as resource use).

Currently the population of Betutu fish in the lake far exceeds the number of Payangka fish. Because of this, Betutu fish is more dominant in the market compared to other fish such as Payangka fish which has experienced a decline. One of the factors causing the decline in the number of fish species according to Moyle & Leidy (1992) can be the introduction of foreign fish and (Froese & Pauly (2004), namely habitat degradation and extinction, pollution, introduction of foreign fish, and exploitation. In addition to global climate change (global climate change) is also a threat to the survival of fish (Allan and Flecker 1993), and the threat of extinction to fish is classified according to IUCN (2001) levels into 3 groups namely Critically Endangered, Endangered and Vulnerable. Invasive species are a major element of global change and contribute to loss of biodiversity, ecosystem degradation and ecosystem disturbance Communities with high diversity are more stable than communities with low species diversity.

5. Conclusion

Betutu fish is an introduced fish whose growth is relatively fast, namely 1,700 per year. Reaching the asymptotic length requires a relatively short time, namely at the age of 3 years ($L\infty$ = 358.05 mm).

Compliance with ethical standards

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Disclosure of conflict of interest

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