



Size Structure, Long-Weight Relations And Growth Angel Ornamental Fish (*Pomacanthus Imperator*) In Spermonde Waters, South Sulawesi, Indonesia

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Abstract

Angel Ornamental Fish (Pomacanthus imperator) is species most expensive from group fish angelfish and has a higher bargaining value than other types of ornamental fish, making it a target fish for fishermen fish ornamental. Production fish This Still depends from arrest in natural because cultivation Not yet successfully developed, so there is a possibility that this species is experiencing overfishing. The purpose of this research is to know the status of the candidate parent, structure size, growth Angelfish (Pomacanthus imperator) in waters spermonde South Sulawesi. The research method is based on parallel sampling in the waters of the Spermonde Islands from April to November 2022 with using the dependent survey method with sampling techniques, interviews, observation, and documentation. Absolute age and growth of angelfish determined with analysis plot Gulland and Holt. Results study show that mode long total fish angelfish in Fisheries spermonde (9.5-11.5 cm) relatively many and is a group fish mature. The relationship between length and weight is allometric, the growth pattern is 0.4934 cm/ year with a maximum length 41.7 cm at the age of 10 years and the majority are adult fish or adult groups.

Keywords: size structure, length weight, growth, angelfish, Ornamental fish

INTRODUCTION

Indonesia is located in the coral triangle area (*coral triangle*) which has diversity species coral and fish coral very high. More than 500 coral species were recorded in an area of approximately 51,000 km², spread across Indonesian waters, and 2,057 species have been

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identified fish from 113 families which estimated around 4,234 species (Allen and Adrim, 2003). Therefore, the potential for fish resources, including ornamental fish, in Indonesia is very large. It is not surprising that Indonesia is the largest marine ornamental fish exporter to two after Philippines (Wabnitz *et al.*, 2003; Cashmere *et al.*, 2010).

Angelfish (*Pomacanthus imperator*) is a type of ornamental fish with high economic value, traded under the name *blue faces angelfish* (Quiter and Tono-zuku, 2001). This fish is the most expensive species of the Angelfish fish group and has a high market value compared to other types of ornamental fish, so it becomes a target of hunting by ornamental fish fishermen. Based on data from the Association of Coral Shell and Fish Ornamental Indonesia (AKKII) and the Association of Coral and Fish Ornamental Sulawesi (AKIS) in 2002 - 2009 (*unpublished*), the number of catches of Angelfish, especially those with a size of 10.1 – 15 cm, experienced a significant decrease very drastic. In 2002 the number of catches was 2,480 tails, whereas in 2009 the catch was only 302 tails. In addition to the reduced number, the size of the fish caught is dominated by the larger size small.

Angelfish (*Pomacanthus imperator*) including the Pomacanthidae fish group. In Indonesia, this fish is widely distributed in the waters of Aceh, Pelabuhan Ratu, Labuan, Ujung Genteng, Sibolga, Lampung, Binungaeun, Sulawesi and Kalimantan waters (Marine Fisheries Research Center, 2006). Nelson (2006) put forward that the Angelfish (*Pomacanthus imperator*) spends its entire life in the channels and outer slopes of coral reefs. As a teenager, the type of Angelfish Fish (*Pomacanthus imperator*) settles in coral reef caves with algae growth with a depth of 5 to 25 m, has a rainbow-like color, changes color during the growth phase, lives solitary and in pairs. This fish can be marked from the fin back, fin chest and yellow caudal fin. The dorsal fin is weak and on the part behind there is a black dot. The caudal fin is round or circular in shape with a blue edge. The stomach and the anal fin are white with a blue border. The dorsal fin has 13–14 rays and 16–18 rays. The anal fin has 3 hard rays and 16–18 weak rays (Sea Fisheries Research Institute, 2006, Fig. 1).



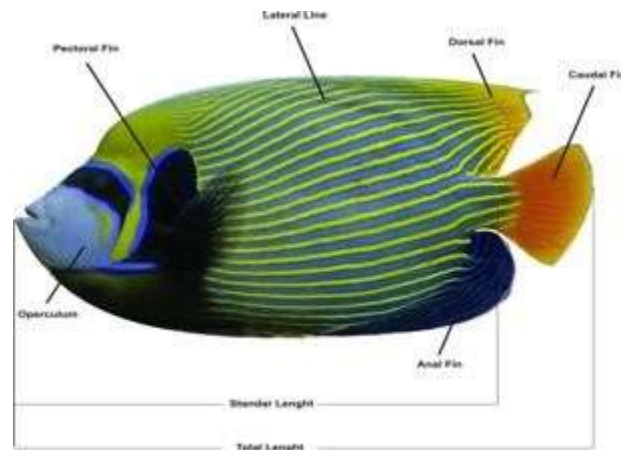


Figure 1. Morphology of Angelfish (*Pomacanthus imperator*)

In addition to the distribution and morphological characteristics, information on angel fish (*Pomacanthus imperator*) is not widely known. Previous research was only related to the reproduction of the prospective parent Angelfish (*Pomacanthus imperator*) (Setiawati *et al.*, 2008). In fact, Angelfish fish have been exploited for a long time and are showing signs of *overfishing*. until now, production fish This depends from arrest in nature Because cultivation not yet succeed developed. Therefore, in the context of sustainable fisheries resource management, information related to the biological aspects of Angelfish fish is needed. This study aims to determine the recruitment potential of Angelfish fish in South Sulawesi waters based on size and age structure, sexual ratio and fecundity.

METHOD

This research was conducted in the waters Spermonde Island South Sulawesi which is located in Makassar Waters, Pangkep (Figure 1) and a grace period of 6 (six) months starting from April to september 2022 on period season transition second. Taking Sampling was conducted by surveyors every Saturday/Sunday (4-8 times a month), each numbering between 41-93 individuals/sampling. Overall, 12 samples were taken for 163 individuals obtained from fishermen of ornamental fish vessels different (24 fisherman). Angel ornamental fish samples only come from results catch group fishermen who are members of GAPEKHI stay in around broadcast coast of South Sulawesi.

The research location is in the district Pangkep is in the waters of the Liukang District Islands Tuppabiring , covers Island Baking (S 04° 41' 58.0" and E 118° 58' 00"), Lean Bali (S 04°

43' 28.4" and E 119° 03' 16.8"), Sarappo Keke (S04°39.1'12.6" and E 119°07'54.0") and Archipelagic waters of Liukang District Tangaya which includes Sapuka Island Small (S 7° 13' 151" and E 118° 13' 189"), Koko Coral Island (S 7° 09' 535" And E 118° 11' 470"), Island stay (S 7° 08'979" and E 118° 09' 183"). Taking sample fish use cleopatra net and clove oil as a substitute for cyanide and otherequipment to support fishing activities. Next, Angelfish fish Which caught observed in laboratory.

Material and Equipment

Ornamental fish samples the main target is angelfish caught in the waters Island Spermonde South Sulawesi, as well as landed in Harbor Paotere For for sale to Ornamental Fish UKMSample fish (784 tail) Which caught use angelfish nets And wooden boat obtained from group fisherman Which lower it in fishing port. Taking sample fish done in a manner random in harbor fishery and election sample fish entrusted to the group fisherman. Sample fish packed in a container (box wrapped styropharma _ with plastic with ratio of 1: 2 (seawater : oxygen) and transported from the fishing port to the Ornamental Fish Farm with use box car about 30 minutes.



Figure 2. Research Locations In The Waters Spermonde South Sulawesi

To complete the biological data collection is carried out data *time series* (run time) And *cross section* (cross place) production of Angelfish from the organization company exporter fish ornamental, that is AKKII and AKIS.

Data collected

Collection data use method survey dependent with technique taking sample,



interview, documentation, and observation (measurement, weighing, observation). Fork length (FL) and total weight (BB) data were obtained from observations, recording of measurement results, and weighing of each sample. Data FL is dimensions' fish from end mouth until tail base. The activity of measuring and weighing sampled fish has been carried out from April 01 to April 30 September 2022 in Laboratory Fishery Major Cultivation Fishery Polytechnic Pangkep State Agriculture.

Data analysis

approached by analyzing the attributes of growth patterns and condition factors. These attributes show a correlation with appropriateness utilization source Power fish, show that they unique and different from type animal other.

Size Structure

In determining the size structure (length and heavy) amount specimen Which used as many as 163 tail obtained from waters Pangkep, South Sulawesi. The length used is long total Which be measured with using a plastic ruler. Fish weight was measured using a scale electronic.

Age Determination

Determination age fish done with *Otolith* analysis. The *otolith* stones were removed from the fish sample and given *apoxi resin* and then dried. *Otoliths* smoothed with fine sandpaper no. 1500 and 2000 until the central core of the *otolith* appeared. Next, the *otoliths* mashed with use pasta diamond size 3 μm or sandpaper no. 3000 until core *otoliths* clearly visible. Final observations were made using a BX-50 series microscope from Olympus brand with magnification up to 1000 times, *otolith* cleaned with distilled water and given a solution of 5% EDTA (*ethylenediamine tetraacetate*) for 45 seconds (Budimawan, 1997; Amir, 2010)

Pattern Growth

Data long fork and heavy total Also used to count pattern growth. The formula is (Ndymele *et al.*, 2010), Where BW = heavy body (g), FL = long fork (cm), a = intercept, and b = exponent growth. Logarithm natural ($\ln$) is also used because of the Angelfish (*Pomacanthus imperator*) live in water areas Which No under control or in a manner experience without mix human hand. This will create a zero line which means one day Angelfish (*Pomacanthus imperator*) neritik will die (Fahurriadi *et al.*, 2020). Growth



patterns (b) and condition factors (K) can show group age fish (Asriel *et al.*, 2020b). Mark b on the LWR and the growth pattern equation have the same value. Model/equation of Angelfish (*Pomacanthus imperator*) is displayed in the processing results section data.

Furthermore, the growth pattern of Angelfish (*Pomacanthus imperator*) bullet is the coefficient value of the independent variable, namely the fork length coefficient. The status is divided into 3 (three) categories as follows: (a) $b < 3.0$: *minor* allometric, namely the rate of growth in weight is slower than in length (thin body shape), (b) $b = 3.0$: isometric, namely the rate of growth in weight and length is the same (form body slim), And (c) $b > 3.0$: allometric major, that is rate growth heavy more fast than growth in length (body shape plump).

Data Analysis

Fish Size and Age Structure

Composition of length and length-weight measures of Angelfish (*Pomacanthus imperator*) were analyzed in a manner descriptive in tables and or graphs with percentage units. In order to distinguish the size of length and length of weight in between location arrest, done t-test.

Analysis of the age of Angelfish (*Pomacanthus imperator*) is based on a photo reading at 1000x magnification. The daily circles that were photographed and clearly visible were counted one by one until they reached 20 growth circles, the radius was measured with a compass which was then extrapolated as a whole to determine the absolute age from hatching to the age of being caught from the *printout out*.

Determination of Long-Weight Relations

Enhancement long heavy fish (W) on every stadium his life is function from increase in length (L). Therefore, in looking for a relationship long heavy fish Angelfish This general formula is used (Ricker, 1975 in Amir, 2010):

$$W = a \cdot L^b \quad (1)$$

Information:

W = fish weight (g)

L = fish length (cm) a and b = constant

Equation (1) can be transformed to a linear equation in logarithmic form to:

$$\log W = \log a + b \log L \quad (2)$$

This equation is used to determine relative growth. The value of $b = 3$ indicates an *isometric* relative growth pattern, namely the weight gain is proportional to the increase in length. Mark $b \neq 3$ show pattern Relative growth that is *allometric*, namely weight gain No comparable with increase length (Ricker, 1975 in Amir, 2010). To emphasize value b The same or No The same with 3, so testingis carried out mark b with t-test.

The increase in length (L) of angelfish *Pomacanthus xanthurus* at each life stage is a function ofthe increase in length (L), which can be expressed using the Von Bertalanffy growth equation in the logarithmic form (Efendiansyah, 2018) to estimate growth parameters.The growth of angelfish (*Pomacanthus xanthurus*'s) was assumed to follow the Von Bertalanffy growth formula as described (Pauly, 1983).

$$L_t = L_{\infty} (1 - \exp^{-K(t-t_0)}) \quad (3)$$

where :

L_t = fish length (cm) at the age of t

(relative time) L_{∞} = asymptote length of fish (cm)

K = growth coefficient (per relative time)

T_0 = theoretical life at zero length (relative time)

To estimate growth (L_{∞} and K), the absolute age estimation results from the volumetric analysis weresubstituted into the plot method (Turchin, 2013) as follows:

$$\frac{\Delta L}{\Delta t} = K L_{\infty} K L(t) \quad (4)$$

Using $L(t)$ as a free variable and $\Delta L/\Delta t$ as a non-free variable, the above equation becomes a linear regression i.e.:

$$\frac{\Delta L}{\Delta t} = a + b \cdot L(t) \quad (5)$$

Parameters K and L_{∞} are specified from:

$$K = -b \text{ and } L_{\infty} = -a/b \quad (6)$$

The estimated value of " t_0 " is considered zero.

RESULTS AND DISCUSSION

Size Structure

Total fish angelfish Which observed is 163 heads. As much 120 tail originate from waters Pangkep (22 individuals were obtained in July and 98 in July August), . The results of the analysis of variance show no there are differences in the length and weight of the fish caught at different times in Pangkep waters ($P > 0.05$), so the two data are combined For analysis furthermore.

Length of fish caught in Pangkep waters respectively $10.70 \text{ cm} \pm 3.34$ and $8.79 \text{ cm} \pm 3.9$. The highest sample size class (19-20 cm) and the lowest (4.0-5.0 cm) were caught in Pangkep waters each represented by 9 And 4 tail. Based on distribution size fish sample Which collected, it can be seen that Angelfish (*Pomacanthus imperator*) caught in both waters they have pattern deployment almost the same length with a narrow size range, as well as the dominant class interval on range of 9.5-11.5 cm (Figs. 3 and 4). However, the results of the analysis of variance showed that the fish caught. long from that fish caught in waters Pangkep ($P < 0.05$), but did not show a difference in the average value of body weight. Results of analysis of variance on fish length and weight can see on attachment 3 And 4. Size structure of Angelfish based on trade classification of Angelfish shown in Figure 5. Sizes starting from the most caught during study is size S (38.1%), M (29.4%), TT (14.1%), T (11.7%), and L (6.7%)

Production size fish angelfish from waters South Sulawesi based on secondary data originating from angelfish exporters between 2013 until 2021 Which generally taken from area Archipelago capture Liukang Tangaya can be seen in Figure 3.

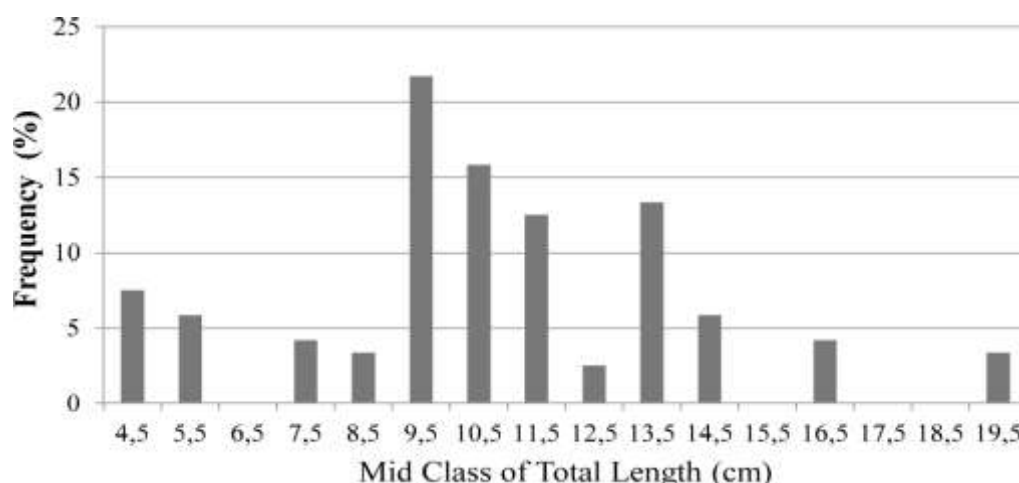
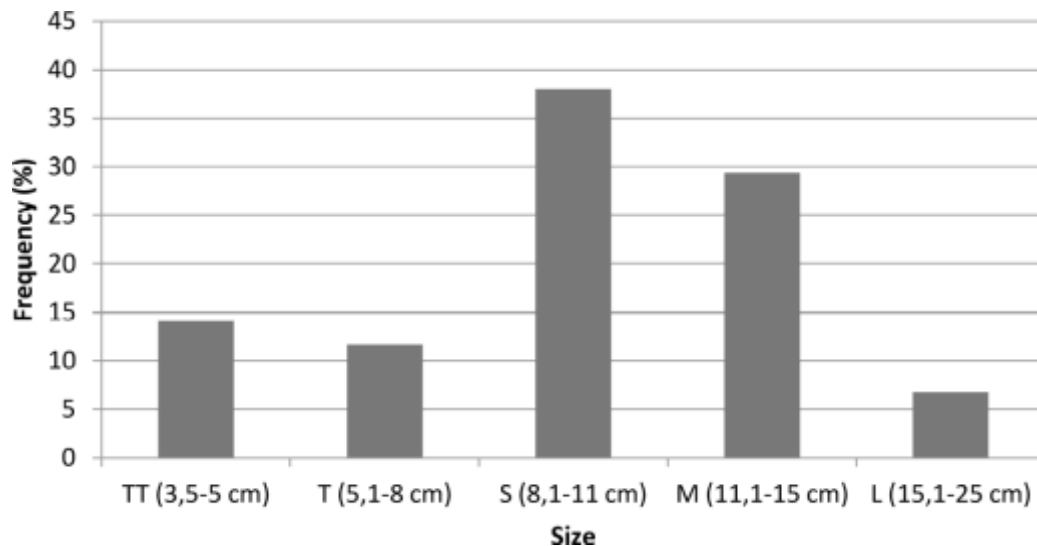
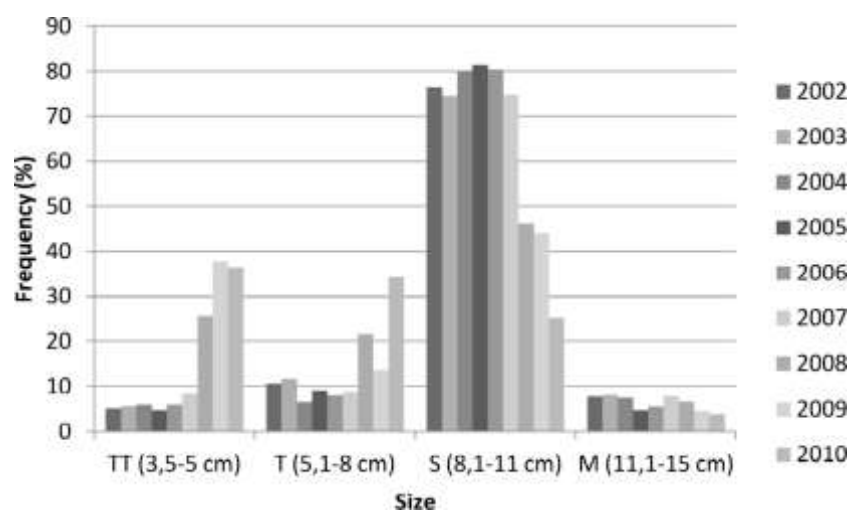


Figure 3. Size structure of Angelfish cathed in the waters of Pangkep



Figures 4. Size structure of Angelfish caught during the study according to fish trade classification.



Picture 5. Size structure of Angelfish (*Pomacanthus imperator*) based on trade classification caught in South Sulawesi Waters, 2002 – 2010

Source: AKKI (2022) and GAPEKHI (2022) (*unpublished*, modified)

Size structure of Angelfish catches during study (Picture 5) it turns out not much different from those caught so far in South Sulawesi waters (Figure 6) (GAPEKHI 2022, *unpublished*). The most dominant sizes are S and M, followed by T (sissy) and TT (*Bluston*) sizes.

The size from year to year is almost the same composition. From that information got from exporter fish ornamental, it turns out the M and S sizes are in great demand by the market because of their variety consideration, that is on moment maintenance in the aquarium is more resistant and the color is very bright. In addition, consumer aquariums abroad have standard sizes with a length of 1-2 m, so they must be adjusted to the size of the pet fish.

This shows that all this time the use of angelfish as an ornamental fish using a size that is still small (*juvenile*). Thus, it is suspected that the Angelfish fish population has decreased besides being *overexploitation*, the fish also don't have enough opportunities to reproduce in natural caused fish Angelfish Those caught are generally young (*juvenile*). Angelfish fish that are used as ornamental fish are included in the *recruitment category overfishing*, that is fish young (*juvenile*) Which caught excessively, so that No There is growth stock adult fish from younger age group fish (Kasmi, 2012). In other words, the growth of mature fish stocks is just happening by increasing the size of the remaining mature fish. Indra (2007), argues that in the management of fishery resources that are not carried out well, eventually there will be overfishing (*overfishing*). There are various types of *overfishing categories* at the level of seriousness, namely *recruitment overfishing*, *biologically overfishing*, *economically overfishing* and *malthusine overfishing*.

Heavy Long Relations

The results of the analysis of the long-weight relationship of Angelfish fish by using a linear regression model can be seen in Table 1 below:

Table 2. Intercept, Estimated Parameters And R^2 Of Length Weight Model Of Angel fish
Linear Regression Model

Fishing Ground	N	Intercepts	Parameter	Estimated R^2
Liukang Tuppabiring	120	- 0.420	2,434	0.963
Liukang Tangaya	43	- 0.192	2,282	0.936

Table 1 shows that the two long-weight relationship models of Angelfish fish have nearly the same b values. This b value indicates that every 1 cm increase in Angelfish length causes an additional 2 g in weight. The value of b which is not equal to 3 ($P > 0.05$) also indicates that growth from species This is allometric negative, that is The increase in length is

not proportional to the increase in weight. Results plot long And heavy fish Angelfish caught during research that follow Ricker's equation (1975) in Amir, (2010) can be seen in Figure 6.

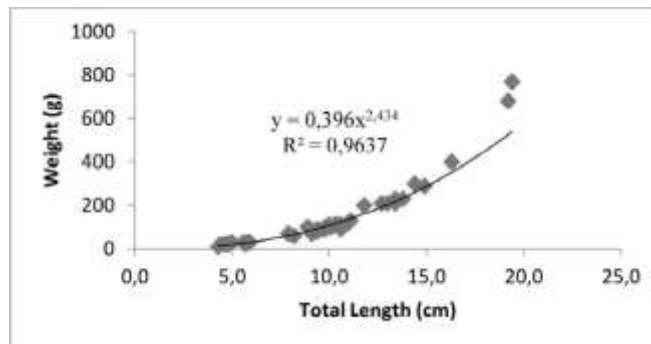


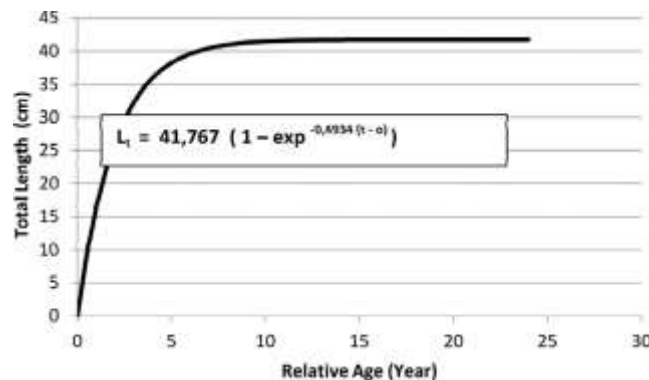
Figure 6. Long-weight relationship of Angelfish (*Pomacanthus imperator*) caught

Age and Growth

Amount sample otoliths Which succeed analyzed as many as 4 pieces originating from Angelfish (*Pomacanthus imperator*) with a total length of 5.8 cm, 10.4 cm, 13.0 cm and 14.9 cm. Each sample shows age 86 day (0.24 year), 187 day (0.51 year), 252 day (0.69 year), And 302 day (0.83 year). The age is calculated based on the circledaily formed on otoliths.

Results prediction age absolute fish Next Angelfish substituted to equality plot Gulland and Holtand the estimated maximum length is obtained (L'') is 41.7 cm at the age of 13 years with a growth rate (K) of 0.4934 cm/year. Assuming to = 0, then the von Bertalanffy from Angelfish (*Pomacanthus imperator*) can be described as in Figure 7.

From the results of the Von growth model Bertalanffy made a relationship between the body length of the Angelfish and its age (Table 2). Based on the table, it can be seen that Angelfish (*Pomacanthus imperators*) which caught during study This still young, that is under 1.5 year



Figures 7 . Growth Curves Of Angelfish Using Von Bertanffy Growth Model.

Table 2. Length and age predictions of Angelfish using Von Bertanffy growth models.

Relative age (Years)	Total Length (cm)	Relative age (Years)	Total Length (cm)
0.00	0.00	10.50	41.53
0.50	9.13	11.00	41.58
1.00	16.27	11.50	41.62
1.50	21.84	12.00	41.65
2.00	26.20	12.50	41.68
2.50	29.60	13.00	41.70
3.00	32.26	13.50	41.71
3.50	34.34	14.00	41.73
4.00	35.96	14.50	41.73
4.50	37.23	15.00	41.74
5.00	38.22	15.50	41.75
5.50	39.00	16.00	41.75
6.00	39.60	16.50	41.75
6.50	40.08	17.00	41.76
7.00	40.45	17.50	41.76
7.50	40.73	18.00	41.76
8.00	40.96	18.50	41.76
8.50	41.14	19.00	41.76
9.00	41.27	19.50	41.76
9.50	41.38	20.00	41.76
10.00	41.47	20.50	41.77



CONCLUSION

Population structure of Angelfish (*Pomacanthus imperator*) in the waters Spermonde South Sulawesi . Absolute age and growth of angelfish determined with analysis plot Gulland And Holt . Results study show that mode long total fish angelfish in Fisheries spermonde (9.5-11.5 cm) relatively many and is a group fish mature . The relationship between length and weight is allometric , the growth pattern is 0.4934 cm/ year with a maximum length 41.7 cm at the age of 10 years and the majority are adult fish or adult groups , total length mode of fish (9.5-11.5 cm) . Angelfish growth rate (*Pomacanthus _ imperator*) is estimated at 0.49 per year.

REFERENCE

- Amir. F, 2010. Dynamics population And aspect tropical eel fishery (*Anguilla* spp .) in Malunda waters , W e s t Sulawesi . Postgraduate Dissertation . Hasanuddin University , Makassar
- Allen, G and M. Adrim . 2003. Corals reef fishes of Indonesia . Zoological Studies , 42 (1): 1-72.
- Marine Fisheries Research Institute. 2006. Indonesian marine ornamental fish . Independent Spreader, Jakarta. 176 pp.
- Budimawan . 1997. The early life history of the tropical eel *Anguilla marmorata* (Quoy and Gaimard , 1824) from four Pacific estuaries , as revealed from otoliths microstructural analysis . J. Appl . Ichthyol ., 13 : 57 - 62 .
- Effendi, IM 1997. Fisheries biology . Nusantara Library Foundation. Bogor. 210 pp
- Kasmi , M. 2012. Bio-ecology and status utilization of ornamental fish Injel Angelfish *Pomacanthus xanthotopone* in waters Sulawesi South. Dissertation . UNHAS, Makassar. 126 p.
- Kasmi , M., D. Yanuarita, J. Jompa , NM Nessa, Budimawan ., N. Buhari, and AA Husain. 2010. Trends and Management Challenges of Ornamental Reef Fishes Trading in South Sulawesi. proceeding at International Symposium on small islands and corals Reef in Ambon, August 4-5, 2010, Indonesia, 74 pp.
- Kasmi M. 2013. Utilization Status Based on Size of Ornamental Fish Injel *Pomacanthus xanthometopon* *Pomacanthus Xanthometapon* in South Sulawesi Waters. Journal of Tropical Galung 2. DOI: 10.31850/jgt.v2i1.41.
- Kasmi M, Amir SM, Aman A, Haruna B, Usman AF. 2022. Implementation of Science and Technology for Regional Development: Improving the Quality of Ornamental Fish Production with a Concentration of Clove Oil Alternative to Sustainable Fishing Gear. Mattawang: Journal of Community Service 3. DOI: 10.35877/454RI.mattawang1223





- Kappus , SM 2012. The influence of population density and sex ratio on reproduction . Dissertations .University of California Los Angeles.
- Quiter , RH and Takana , T. 2001. Pictorial guide to : Indonesian reef fishes part II. zoonics , Australia.
- Nelson, J. S. 2006. Fishes of the world , 4 th edition , John Wiley and Sons, New York , NY, USA. 601 pp
- Sadovy de Mitchell , Y. and M. Liu. 2008. functional hermaphroditism in teleosts . Fish and Fisheries , 9:1–43 .
- Setiawati, KM, D. Kusumawati, and Wardoyo. 2008. Research on Strengthening Sea Ornamental Fish Cultivation Technology . Increasing Clown Fish Productivity (*A. ocellaris*) and Observation of Reproduction of Prospective Angelfish Broodstock Angelfish (*Euxhipops xanthotopon*) and Letter Fish Six (*Paracanthurus hepatus*). Research Report 2007.BBRPBL, Gondol , Bali: 237- 247.
- Wabnitz , C., M. Taylor, E. Green, T. Razak. 2003. From ocean to aquarium . UNEP-WCMC, Cambridge, UK .
- Walker, Stefan P. W., L. Thibaut , and M.I. McCormick . _ 2010. Density-dependent sex ratio adjustments and the allee effect : A and model a test using a sex- changing fish . The American Naturalist , 176: 3.

