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Length catch and growth analysis of hairtail fish (*Trichiurus* spp.) in southern off West Java Sea (Case study: Pangandaran fishing base)

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Abstract
Hairtail Fish (*Trichiurus* spp.) one of the important demersal fish species, *Trichiurus lepturus* has also known as a marketable fish in the local market. *Trichiurus spp.* is a major commodity of high economic value in Indonesia. The influence of changes in the environment on survival and growth of fish can be explained by analysis of age groups (cohort). This study aims to determine growth and mortality indicator of *Trichiurus* spp. in southern of West Java Sea waters. The frequency sample of the total length of hairtail fish (*Trichiurus* spp.) was collected in Pangandaran, West Java in 2018. Data analysis consisted of sustainable potential, age group and growth of *Trichiurus* spp. Analysis used Microsoft Excel and FISAT II software. The results of the study showed asymptotic body length (L∞) of hairtail fish (*Trichiurus* spp.) of 1291.5 mm and the first length of fish caught (Lc) of 230 mm. The growth coefficient (K) of hairtail fish (*Trichiurus* spp.) is 0.38 per year.

Keywords: hairtail fish, length, growth, west java, pangandaran, high economics commodity, Indonesia

1. Introduction
Much of fish produced and traded within low-income countries derives from capture fisheries (Thilsted *et al*. 2016) [16]. According to Simbolon *et al.,* (2011) Fisheries resources are very abundant and have the ability to recover (renewable resources), but if fishing activities are not carried out carefully and although the amount does not exceed the carrying capacity of a fishery resource, then it can enlarge the occurrence of overfishing and decrease in fish catches in a waters and even in some fishing areas. West Java capture fishery products experienced a total decline of all types of fish caught, where in 2015 fish catches reached 284,125.50 tons, while in 2016 fish catches amounted to 232,890.30 tons (BPS West Java 2018).
Potential of fish resources Pangandaran Regency consists of crustaceans, demersal fish, large pelagic fish and small pelagic fish. There are five main commodities that have high economic value, namely shrimp (dogol, jerbung, windu), lobster, white pomfret, black pomfret and hairtail fish. As much as 54% of demersal fish production is hairtail fish (Planer Department of West Java Provincial Government 2016). Hairtail fish is one of the important demersal fish species, *Trichiurus lepturus* has also known as a marketable fish in the local market. This is a cosmopolitan demersal species that is found in warm shelf waters worldwide (Nakamura and Parin 1993; Mwakiti *et al*. 2016; Filho 2017; Mariem, *et al*. 2011) [18, 5, 7]. According to Muhammad, *et al*. (2017) [8] Hairtail fish within 10 years have slowly become the dominant marine commodity.
The influence of changes in the environment on survival and growth of fish can be explained by analysis of age groups. Age groups can also understand the factors that influence the success of recruitment and the estimation of the effects of fishing on stocks, policies in management, events that occur in the fish life cycle, and maximum catches by promoting sustainability and sustainability (Sparre and Venema 1999) [15]. Fish growth is one of the important aspects in knowing how fast fish growth and population. Changes in the amount in a fish stock are described in the mortality rate. The mortality of fish stocks is divided into two, namely mortality caused by natural capture and mortality which can be caused due to predation, disease or age (Sparre and Venema 1999) [15]. The rate of exploitation predicts the rate of capture that occurs in fish stocks or it can be said that the rate of exploitation is the number of fish caught compared to the total number of fish that die because of all the factors of both capture and natural. (Sparre and Venema 1999) [15].
Information on fish resources can help policy makers to consider management options objectively in allocating fish resources efficiently (Rizal and Dewanti 2017) [3]. In order for the management of hairtail fish resources to run well, information is needed on the dynamics of the pollulation and the rate of exploitation of hairtail fish. Thus the hairtail fish resources can be utilized optimally and their sustainability is maintained. The purpose of this study was to analyze the age group and growth of hairtail fish.

2. Materials and Methods
The study was conducted during the last month, starting from June to December 2018 located in Pangandaran Regency, West Java. The data collection method used in fish sampling is simple random sampling and for the method of retrieving data from resource persons using purposive sampling method.

2.1 Research procedure
The procedure of this study is as follows:

i) Data collection
The data used are Primary data in the form of data taken directly from the field in the form of long hairtail fish

ii) Measurement of fish samples
Fish samples that have been obtained are measured in total length by using a meter with accuracy of 0.1 cm. The data obtained is then recorded.

iii) Data Processing
Analysis of age group, growth, mortality rate and rate of exploitation of hairtail fish (Trichiurus spp.) Were carried out with Microsoft Excel and FiSAT II software.

2.2 Data analysis for Cohort
Bhattacharya (1967), stated that the estimation of the age group of hairtail fish can use long frequency separation methods, namely:

1. Hairtail fish are divided into several long groups.
2. Then each total length frequency (N1 +) is calculated by its natural logarithm
3. Next calculate the logarithmic difference of two adjacent frequencies (n ln N1 +). Δ ln N1 + = ln N1 + from the current line, minus ln N1 + from the previous line.
4. Make a complete plot by entering the middle class value of each total length (x axis) to the difference in logarithm of the frequency of the length of the hairtail fish Δ ln N1 + (y axis).
5. The intersection of the regression straight line with the x axis gives the value of the average length of each group. The average number of each age group, the value is –a / b.

2.3 Growth rate
Estimation of the parameters of hairtail fish growth was carried out using the simplest method in estimating the Von Bertanlanffy equation by using the Ford Walford plot approach (Sparre and Venema 1999) [15]. Von Bertalanffy's growth equation is as follows:

$$Lt = L\infty (1-e-k(t-to))$$

Note;
Lt = Fish length at age t (time unit)
L∞ = The maximum fish length theoretically (asymptotic length)
K = Growth Coefficient (per unit time)
t0 = Theoretical age when the length is zeroK= -ln (β)
L∞= α/(1-β)

3. Results and Discussion
3.1 Length Frequency Distribution
Long frequency data is one of the important components in the need for stock assessments that can be used as an indication of fishing pressure seen from the movement of the average length of hairtail fish caught at a certain time. Hairtail fish observed at the time of the study for 3 months from August-October 2018 totaled 963 birds. 264 in August, 358 in September and 341 in October. The minimum length of caught hairtail fish is 230 mmTL and the maximum length of fish caught is 942 mmTL (Figure 1).

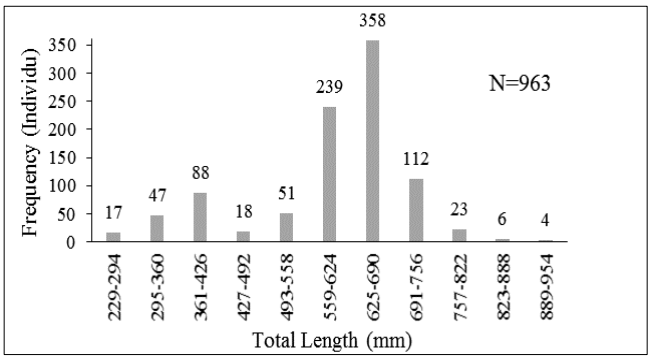

Fig 1: Frequency Distribution of Hairtail Fish Based Length

The highest frequency of hairtail fish is 358 at intervals of 625-690 mmTL, with a minimum length caught 230 mmTL and the maximum length captured is 942 mmTL.
Overall the frequency of most hairtail fish is 358 at intervals of 625-690 mmTL, with a minimum length that is captured 230 mmTL and the maximum length captured is 942 mmTL.The results of long frequency analysis can be seen in Figure 13, the long frequency obtained during the study ranged from 230-942 mmTL. Based on the search of literature by Badrudin and Wudianto (2004) [4], in the Sunda / Malacca Strait periran, the total length of hairtail fish is wider, ie between 160 mmTL to 1240 mmTL. The maximum length of hairtail fish found in Pangandaran Regency is 942 mmTL, whereas according to Ahmad (2008) [17] in the maximum length of the harbor-sea waters hairtail fish reaches 1250 mmTL, based on Rachmawati and Hartati (2017) [11] conducted in Pangandaran, the maximum length of fish caught is 100 cmTL.
The size of hairtail fish when it first ripens gonads, in Pangandaran waters 473.2 mmTL (Rachmawati and Hartati 2017) [11]. In the coastal waters of Bantul Regency 655.5 mmTL (Novianingrum, *et al*. 2017) [9]. Based on the results of research on hairtail fish in the waters of Pangandaran Regency there are 793 fish from a total of 963 fish (82%) fish caught at the age of gonadal maturation.
Based on the results of the study, the smallest size of hairtail fish caught was 230 mmTL. This value is much greater based on literature searches by Badrudin and Wudianto (2004) [4] compared to hairtail fish in the waters of Rio Granse do Sul, Brazil and Sunda / Malacca Strait, which were 89 mmTL and 160 mmTL respectively.
Differences in the size of fish in Pangandaran waters with the research conducted in Palabuhanratu, PPP Morodemak, Bantul regency beach are thought to be due to differences in fishing gear used, environmental conditions, and variations in fishing intensity (Sofijanto, Kristina and Subagio 2016) [14].
The difference in frequency of each size class is caused by several factors, among others, according to Effendie (1979) internal factors that can affect the growth of fish include heredity, gender, age, parasites and disease. While external factors that influence fish growth are temperature and food. The maximum total length of hairtail fish caught in Pangandaran waters is 942 mmTL smaller than the maximum total length of hairtail fish originating from the same waters based on the results of the study (Rachmawati and Hartati 2017) [11] which is 1000 mm TL. According to (Yuanda, Mulya and Muhtadi 2015) [17] this could indicate a high arrest pressure on fishtail fish.

3.2 Age group (cohort)

The results of the separation of the age group using the Bhattacharya method which was analyzed using the help of FiSAT II software showed that hairtail fish in Pangandaran waters consisted of two age groups as shown in figure 2.

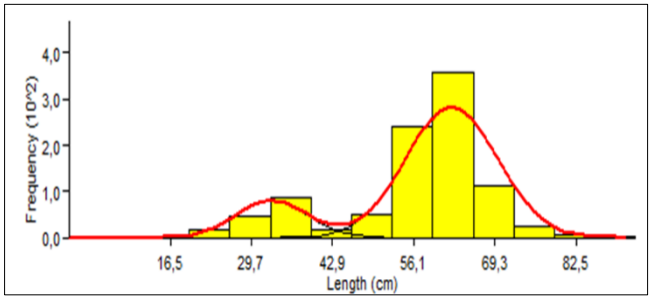

Fig 2: Hairtail fish cohort based on the moon

Each sample taken during the research of hairtail fish measured in several different length groups. As seen in Figure 15, the analysis of the separation of the long-size group with the ELEFAN I method also provides information about the number of population and the value of the average length of each size group. The following are the results of the analysis of the size group separation based on these values.

Table 1: Distribution of Length Average

Size Group	Average of Length (mmTL)	Number of Sample
1	329	177
2	622,7	786
Total		963

The fish age group is described by the average length of the cohort. The length of fish of the same age tends to form a normal distribution so that the age can be determined from the long frequency distribution through analysis of the age group. Age groups can be determined by grouping fish in long classes and using the modes of display of the class to represent the length of the age group. Fish of the same length come from the same birth. The size of hairtail fish is separated using the Bhattacharya method.

Calculation of age groups other than with the help of Microsoft Excel software can also be done with long analysis methods, such as ELEFAN (Electronic Lengths Frequency Analysis) which can be found in the FiSAT (FAO-ICLARM Fish Stock Assessment Tools) program. The basic principle of the method is based on the fact that in a cohort, the individual will be spread out following normal distribution. Therefore the method is carried out by identifying the number of normal curves found in a long frequency spread curve obtained from sampling.

Each sampling was conducted from August to October for two long-size groups. The second size group of hairtail fish can almost be found in each observation, but for the first age group not found in each observation (Table 1). This is presumably due to the migration almost simultaneously (Badrudin and Wudianto 2004) [4].

3.3 Estimated Growth Parameters

The growth rate of hairtail fish using the ELEFAN I program obtained asymptotic length (L∞) of 1291.5 mmTL with a growth coefficient (K) equal to 0.38. Based on the analysis of long frequency data using the ELEFAN I method, the results as shown in Figure 3 are obtained.

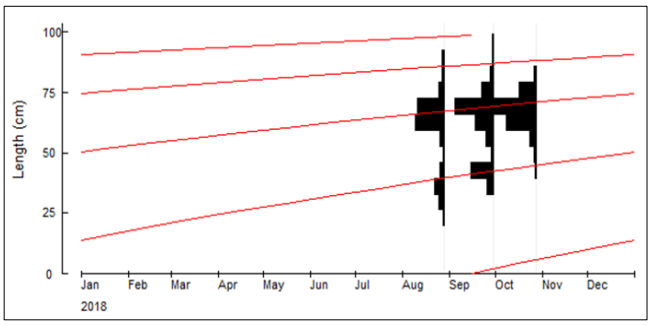

Fig 3: Von Bertalanffy's growth curve of fish Hairtail fish (L∞ = 1291.5 mmTL, K = 0.38)

From the estimated equation of hairtail fish growth, Lt = 1291.5 (1-e-0.38 (t)), it can be made an age relationship to the length of the body of the fish hairtail fish. Based on the results of the study if it is related to the relationship of length and age (Table 2), it can be seen that hairtail fish in Pangandaran waters have an age range of 1-3 years.

Table 2: Relationship between the length and age of fishtail fish

Length (mm)	Age (tahun)
229	0,5686
295	0,7543
361	0,9521
427	1,1636
493	1,3909
559	1,6366
625	1,9039
691	2,1970
757	2,5213
823	2,8842
889	3,2965
955	3,77336

The relationship between the length and age of hairtail fish in table 2 if transformed into a curve of the age relationship of fish to the body length of the hairtail fish can be seen in Figure 4 The growth curve of hairtail fish in Pangandaran waters by entering the age data (years) and data on theoretical length (mm) of fish, theoretically the length is 1291.5 mmTL and the growth rate of hairtail fish begins to stop at the age of 20 years.

Estimation of the value of the growth rate of hairtail fish using the ELEFAN I program obtained asymptotic length (L∞) of 1291.5 mmTL with a growth coefficient value (K) equal to 0.38. According to Jamal *et al*. (2011) the uncertainty tendency of fish growth parameter values is influenced by the composition of the sample fish analyzed by the method or method used.

The L∞ value obtained from the calculation is greater than that of hairtail fish in the same waters in different years of 1110 mmTL (Rachmawati and Hartati 2017) [11]. As for the K value, this value tends to be lower than that of Rachmawati and Hartati (2017) [11] which is 0.56 / year. For the value of t0 in this study obtained equal to zero. This makes sense because the age at 0 cm is equal to zero (Ahmad 2008) [17].

The difference in K and L values obtained by Menurut Effendie (1997) can be caused by two factors, namely internal factors and external factors. Internal factors that can influence are hereditary factors, parasites and diseases, while external factors that can influence are temperature and food availability.

From the estimation of the growth equation of hairtail fish Lt = 1291.5 (1-e-0.38 (t)), it can be made a relationship of age to the length of the body of the fish hairtail fish. Based on the results of the study if it is related to the relationship of length and age (Table 2), it can be seen that hairtail fish in Pangandaran waters have a range of ages 1-3 years.

Figure 4 shows that hairtail fish in the early phase of their life experience rapid growth and will be followed by slow growth in old age (Fofandi 2012). According to Effendi (1997) states that fish with young age have relatively fast growth while adult fish will be slower to reach asymptotic length. This is because the energy obtained from food is no longer used for growth but is used to replace and repair damaged body cells. The growth curve of hairtail fish in Pangandaran waters by entering the age data (years) and data on theoretical length (mm) of fish, theoretically the length is 1291.5 mmTL and the growth rate of hairtail fish begins to stop at the age of 20 years. Fitrianingsih *et al*. (2015) explained that the fast growth curve of fish occurs at a young age and slows down with increasing age until it reaches its asymptotic length.

4. Conclusion

Calculation of growth parameters used of FiSAT II software found 2 age groups (cohort) with an average length of the first age group of 329 mm and the second age group of 622.7 mm with age range of 1-3 years. Growth coefficient value (K) is 0.38 and asymptotic length ($L\infty$) = 1291.5 mm.

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