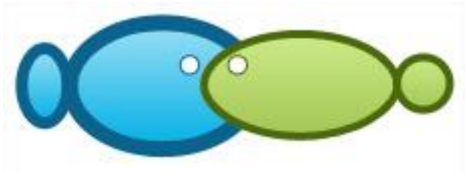

Length-weight relationship and condition factor of endemic jielabu betta fish (*Betta dennisyongi* Tan, 2013) in the water canals of Beutong Hills, Aceh Province, Indonesia

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Abstract. Jielabu (*Betta dennisyongi*) is a fish endemic to the water canals of the Beutong Hills, Aceh Province, Indonesia. This research aims to determine the growth patterns and condition factor of jielabu. Sampling was carried out from August 2023 to October 2023. During the study, 151 fish samples were obtained, consisting of 107 males and 44 females. Total body length ranged from 2.1 to 5.3 cm, and weight ranged from 0.05 to 0.85 g. The results showed that the male growth pattern was negative allometric, and the female growth pattern was positive allometric, with condition factors ranging from 0.5463 to 1.7686. All fish samples had a condition factor K=1.0235, meaning good growth conditions.
Key Words: allometry, endemic betta, growth patterns, sampling fish.

Introduction. Beutong is one of the areas located in the western and southern regions of Aceh Province. Beutong is in direct contact with Mount Singgah Mata and is part of the Leuser Mountains ecosystem. Muchlisin (2013) stated that there are 21 fish in Aceh Province that have the potential to be used as ornamental fish, one of which is *Betta* sp. According to Nur et al (2022a), an endemic species of *Betta* sp. in the Beutong area is *B. dennisyongi*. This fish has the local name "jielabu". Interest in this fish has risen when the Covid-19 pandemic hit Aceh Province because many employees were working from home. To have a home activity, many employees started to keep ornamental fish. This fish is one of the choices for freshwater ornamental fish hobbyists.

This fish has a high selling value (Nur et al 2022a), making it a target for fishermen. Continuously increasing fishing pressure causes the status of this fish to become vulnerable (Low 2019). Deforestation and land conversion into plantations are also increasingly threatening these fish in their natural habitat (Nur et al 2022a). There is more information needed about this fish, especially on its growth pattern and condition factor. This information is essential in the context of sustainable management and conservation of fisheries resources (Muchlisin et al 2014).

Studying the relationship between length and weight in fish may provide information about the general growth patterns, health, habitat conditions, life history, fatness and condition, as well as on morphological characteristics of fish (Okgerman 2005; Froese 2006; Jisr et al 2018). Iyabo (2015) and Putra et al (2021) added that the condition factor value could describe the life cycle of fish species and is essential in species management to maintain ecosystem balance.

Distribution of *Betta* sp. in Aceh Province has been reported by Nur et al (2022b), but research on the relationship between the length and weight of the endemic jielabu has not been carried out, according to our knowledge. Therefore, this research aims to evaluate

the growth patterns and condition factors of endemic jielabu in the water canals of the Beutong hills, Aceh Province.

Material and Method

Period and location. This research was carried out in the water canals of the Beutong Hills, Aceh Province, Indonesia (Figure 1). This research was conducted for three months, from August to October 2023. Sampling was carried out at one-month intervals. The number of jielabu fish collected during the research was 151 fish. The sampling location was located at GPS coordinates N 04°13'20.83'' and E 096°26'04.58'', with an elevation of 112 m.

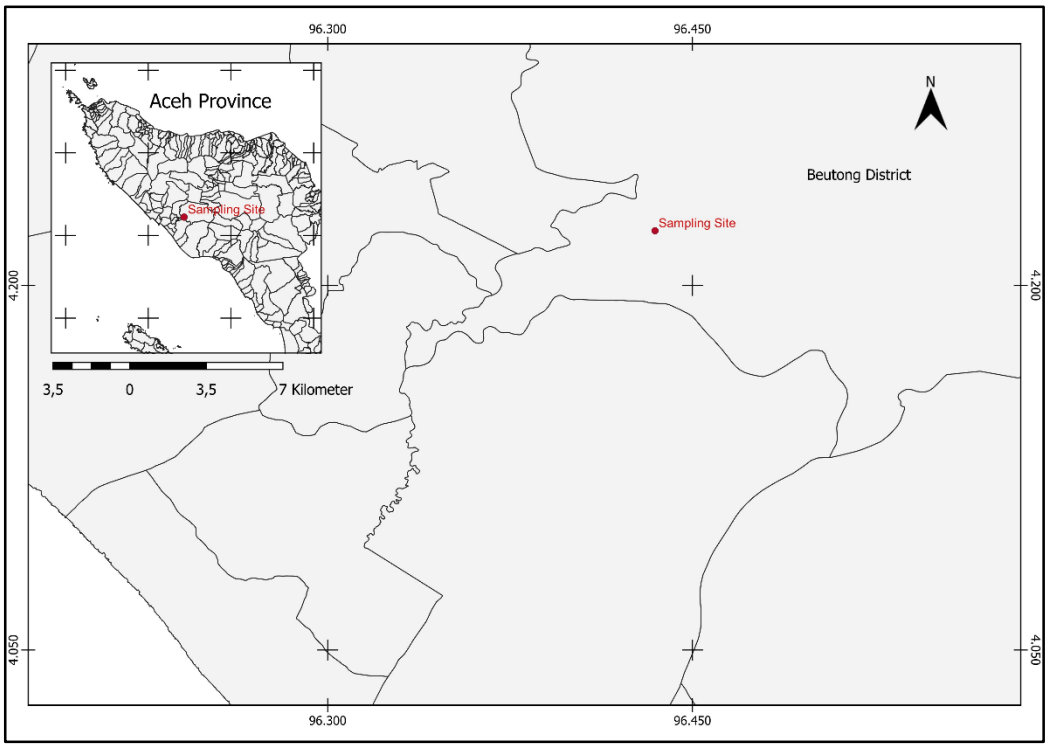

Figure 1. The location of jielabu (*Betta dennisyongi*) sampling in the water canals of Beutong Hills.

Sampling and sample handling. Sampling was carried out using a dip net made of nylon material and a mesh size of 5 mm. Two fishermen caught the samples. One fisherman held the dip net, and the other directed the fish towards the dip net. At the research location, there were three sampling locations. Fish data was collected from each sampling point once a month for three months.

The collected jielabu fish were transported to the laboratory to be reared. The purpose of rearing is to domesticate jielabu fish. The results of domestication will be used as an effort to develop jielabu fish cultivation, which can be used for restocking and conservation in nature.

The length-weight relationship of jielabu fish was analysed in the Aquatic Productivity Laboratory, Faculty of Fisheries and Marine Sciences, Teuku Umar University. The total length of the fish was measured, starting from the tip of the snout to the end of the tail fin, using callipers with an accuracy of 0.01 mm and weighed using a digital scale with an accuracy of 0.01 g. The sex of a fish was based on morphology and color. Hui (2013) added that jielabu males are more colorful and have black bars on the body, whereas females are paler or uniform in the color pattern, with a black stripe on the body and a distinct white roundish genital papilla.

Determination of the environmental habitat parameters. The environmental habitat parameters values greatly determine the survival and growth of fish. If the environmental habitat is polluted, the survival and growth of fish will be disrupted, which can lead to the extinction of the fish. The environmental habitat parameters measured in this research are physical and chemical factors

Data analysis. The formula used to determine the length-weight relationship was:

$W = aL^b$

Where: W is the body weight (g), L is body length (cm), and a and b are constants (Ayoade & Ikulala 2007). T-test ($p<0.05$) was carried out to determine whether the b value is significantly different from 3, to determine isometric, allometric negative or positive growth. Isometric growth is balanced between the length and weight of the fish, while allometric growth is an unbalanced growth between length and weight (one being a dominant parameter). Positive allometries are obtained if the b value is higher than 3 (meaning the increase in weight is more dominant than the increase in length), and negative allometry is obtained if the b value is lower than 3 (the increase in size being more prevalent than the increase in weight) (Nur et al 2023).
The condition factor was calculated using the equation:

$K=W/W^*$

Where: K - condition factor; W - fish weight (g); W* - calculated weight obtained from the length-weight relationship; $K\geq1$ - good fish condition; $K\leq1$, bad fish condition (Ragheb 2023).

Results

Length-weight relationship. The total number of jielabu fish caught during the study was 151, consisting of 107 males and 44 females. The analysis results of the length and weight can be seen in Table 1.

Table 1
Length, weight and growth type of jielabu fish (*Betta dennisyongi*) in the Beutong Hills water canal

Parameter	*Male*	*Female*
Total sample (individuals)	107	44
Total length range (cm)	2.1–5.3	2.6–4.7
Total weight range (g)	0.05–0.78	0.09–0.85
Regression coefficient (b)	2.8641	3.1545
Growth type	negative allometric	positive allometric

The regression coefficient (b) for males was less than 3 ($b<3$), whereas the b value for males was 2.8641. This shows that the growth of males was negative allometric. The regression coefficient (b) for females was higher than 3, namely 3.1545. This shows that the growth of females was positive allometric.

The analysis of the length-weight relationship shows a substantial correlation value (R) between the length and weight of the jielabu fish in the water canals of the Beutong hills. The correlation coefficient (R) value of the length-weight relationship obtained for males was 0.9876, and for females it was 0.9977 (Figure 2).

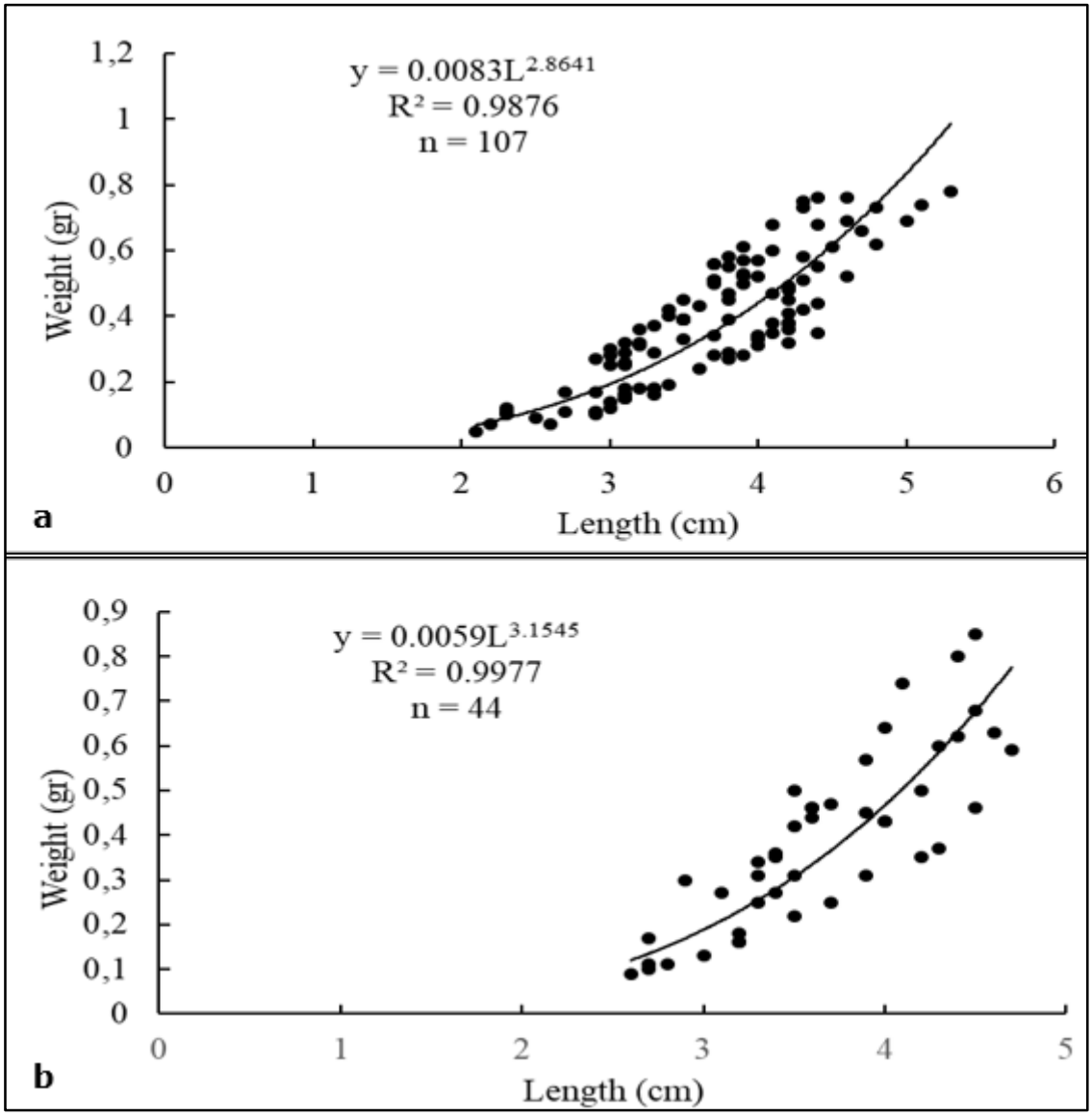

Figure 2. Relationship between length and weight of jielabu fish (*Betta dennisyongi*) in the Beutong hills water channel: a) males; b) females.

Condition factor. In three months, the monthly condition factor values of jielabu fish experienced relatively similar condition factor values between males and females. The average value of the condition factor in three months ranged from 0.5463 to 1.5911, with a mean of 1.0470±0.3070 for males, and from 0.6296 to 1.7686 with a mean of 1.0391±0.2994 for females. The highest condition factor for males was in September, while the lowest was in October. The highest condition factor for females was in September, while the lowest was in October (Figure 3). The condition factor value was above 1 in each month. The average value of the condition factor for male fish was 1.047±0.307 and for females it was 1.0391±0.2994.

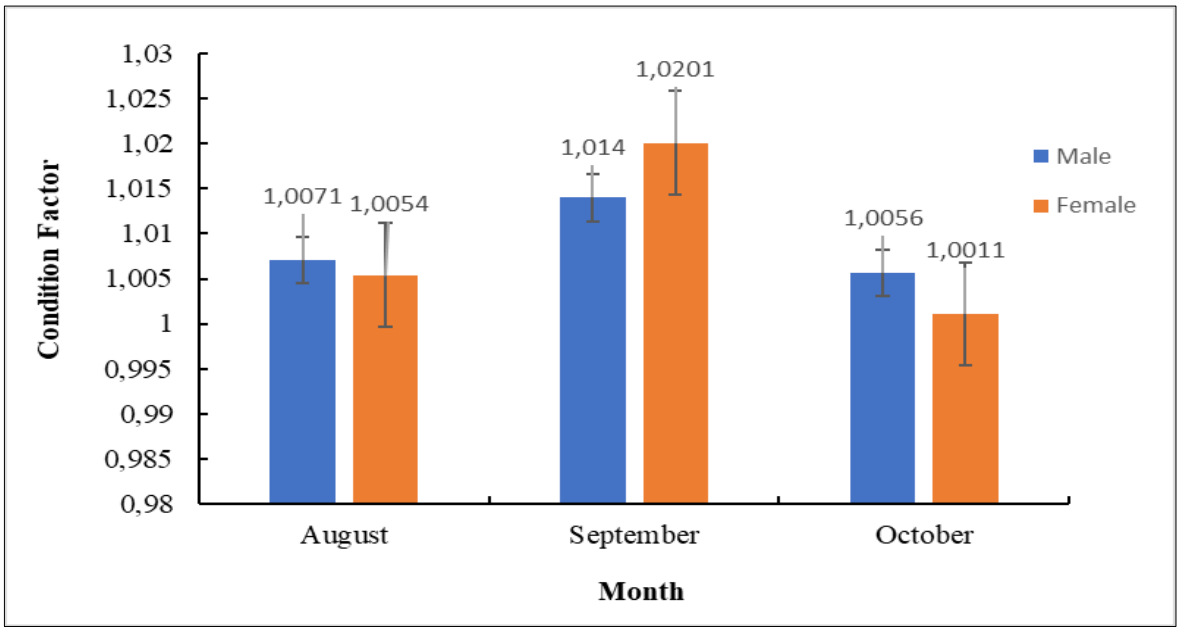

Figure 3. Condition factors of jielabu fish (*Betta dennisyongi*) for three months in the water canal of the Beutong hills

Table 2 shows that the range of condition factors of males and females was relatively close, so it could be said that males and females have similar ability to adapt to their environment.

Table 2

Condition factors for jielabu fish (*Betta dennisyongi*) in the water canals of the Beutong Hills

Station	*Male*				*Female*			
	N	*Range*	*Average*	*SD*	*N*	*Range*	*Average*	*SD*
Beutong Hills	107	0.5463-1.5911	1.0470	0.3070	44	0.6296-1.7686	1.0391	0.2994

Environmental parameters. Table 3 shows the results of environmental habitat parameters observations in the Beutong Hills water canals for three months, which were in normal conditions. The environmental habitat parameters for both physical and chemical factors support the survival and growth of jielabu fish.

Discussion

Length-weight relationship. The relationship between the length and weight of fish represents the growth dynamics of a fish population over a specific time (Harteman 2015). Growth is one of the population parameters that is widely used for fisheries stock analysis. The speed of growth is influenced by several factors, including the availability of suitable food in sufficient quantities, stress factors caused by density, diseases and parasites, genetic factors, and natural environment parameters (Muhsoni 2019).

There were differences in correlation coefficient (b) values between males and females. This difference in growth type between males and females is thought to occur because females focus more on gonad development in preparation for spawning (Patimar et al 2011). Even though there are differences between males and females, the growth pattern was expected. The normal range for growth patterns is with a b value between 2.5-3.5 (Froese 2006).

Table 3

Environmental habitat parameter values measured in the water canals of the Beutong Hills

Characteristics	*Methods*	*Observation Month*			*Normal range*
		August	*September*	*October*	
Physical factors					
Temperature (°C)	Thermometer	26.9–28.8	26.9–29.6	26.9–28.0	26.8-30.2[1]
Depth (cm)	Measuring tape	15-60	20-70	20-80	50-100[1]
Brightness (cm)	Secchi disk	30-40	30-50	25-43	≤285[2]
Turbidity (NTU)	Turbidity Meter	4.00–4.20	3.93–4.10	3.98–4.07	≤25[3]
Sediment	Sand Sieve	Silty sand	Silty sand	Silty sand	
Chemical factors					
pH	pH Meter	6.6–7.5	6.1–7.4	6.5–7.6	≤7.68[2]
Dissolved oxygen (mg L^{-1})	DO Meter	5.75–5.86	5.79–5.87	5.61–5.86	5.27-8.24[1]
Ammonia (mg L^{-1})	Spectrophotometer	0.01–0.03	0.02–0.16	0.06–0.13	0.002-1.13[4]
Nitrate (mg L^{-1})	Spectrophotometer	0.2–2.1	1.6–2.4	1.2–3.4	≤9.923[5]
Nitrite (mg L^{-1})	Spectrophotometer	0.023–0.042	0.026–0.114	0.005–0.036	≤0.370[5]
Hydrogen sulfide (mg L^{-1})	Spectrophotometer	0.001-0.02	0.001-0.02	0.001-0.13	≤0.1[2]
Alkalinity	Spectrophotometer	100-200	80-140	80-90	53-121[6]
Total organic substances (mg L^{-1})	Spectrophotometer	12.00-12.64	25.00-25.28	12.00-12.64	≥20[7]

Note: [1] - Syarif et al (2023); [2] - Pagoray et al (2023); [3] - Bash & Berman (2001); [4] - Mustapha & Akinshola (2016); [5] - Andriani et al (2022); [6] - Basak & Fahad (2020); [7] - Moore (1998).

Growth patterns of fish can change and differ within a population depending on environmental conditions, food and habitat availability, and gonad development (Moutopoulos & Stergiou 2002; Patimar et al 2009, 2011; Nugroho et al 2018).

Condition factor. The condition factor (K) of fish reflects physical and biological conditions and fluctuations through interactions between food availability, parasite infections, and physiological factors (Le Cren 1951; Datta et al 2013). The value of the condition factor is influenced by food, age, sex, environmental factors, and physiological conditions (Morato et al 2001; Effendie 2002; Jisr et al 2018; Rinandha et al 2020; Rachmanto et al 2020). The condition factor of the jielabu fish in this study shows that the growing conditions are good (Ragheb 2023). According to Li et al (2023), habitat environmental factors influence fish condition factors. If environmental habitat factors are typical, then the survival and development of fish will be optimal. Environmental habitat factors in the water canal of the Beutong hills are in optimal conditions (Table 3). In addition, the value of the condition factor tends to increase with increasing gonad maturity (Suwarni et al 2022). Increased gonad maturity will increase the overall body weight of the fish. This was also reported by Deka & Barman (2020), who stated that the average condition factor of *Macrognathus aral* found in the Deepor Beel Freshwater Lake of Guwahati, Assam, had a value of more than 1. This indicates that the growth conditions of *M. aral* is good. Ouahb et al (2021) reported that the condition factor value for *Micropterus salmoides*, *Cyprinus carpio*, and *Oreochromis niloticus* in the Al-Massira Dam Lake, Morocco, was higher than 1, being in good condition. Ezung & Pankaj (2022) reported that the condition factor of *Garra langlungensis* in Langlung River, Nagaland, India, was above 1, categorized as being in good condition.

Conclusions. The study results conclude that the growth pattern of males jielabu fish is negative allometric, meaning that the acceleration of body length is faster than that of body weight, and the growth pattern of females jielabu fish is positive allometric, meaning that the acceleration of body weight is faster than that of length. The condition factors of males jielabu fish are relatively the same as for females jielabu fish, both being in good

condition. Based on these condition factors, it can be concluded that the fish have good environmental habitat conditions.

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Conflict of Interest. The authors declare that there is no conflict of interest.

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