E3S Web of Conferences **322**, 01036 (2021) https://doi.org/10.1051/e3sconf/202132201036
ISFFS 2021

Length-weight relationship and condition factor of endemic fish Bilih (*Mystacoleucus padangensis* Blkr.) in Lake Singkarak, West Sumatra, Indonesia

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Abstract. Bilih (*Mystacoleucus padangensis*) is an endemic species of Lake Singkarak and has important economic value. Overfishing of Bilih fish using non-selective fishing gear has led to a decline in its population. High demand, resulting in decreased production and size of Bilih fish. This research aims to determine this endemic fish's length-weight relationship and condition factor as basic data to the effort conservation. The fish was captured with experimental gillnet mesh sized 5/8, ¾, and 1 inch in Sumani, Batu Taba, Paninggahan, and PLTA intake stations. The total length and the weight of Bilih fish ranged from 40 – 95 mm and 10 – 74 mg, respectively. The highest length and weight of Bilih were 80.3 mm, and 45.0 mg were found at the Sumani station. The growth pattern of male and female fish was a negative allometric characteristic. The length-weight relationship of male and female fish was $W = 0.00137\ L^{2.368}$ and $W = 0.00179\ L^{2.312}$, respectively. Condition factors of males and females are 1.02 and 1.004, respectively. The result of condition factor value for males is higher than the female. The water quality values are within the normal range that supports fish life.

1 Introduction

Lake Singkarak is located in West Sumatra with an area of 10,908 ha and an average depth of 179 m. The inlet of this lake comes from several rivers, namely the Sumpur River, Paninggahan River, and Muaro Pingai River in the west and the Sumani River in the south. Water from this lake is channeled through the Ombilin River in the Northeast, which then becomes the upstream of the Indragiri River, which flows into the Riau region, and the hydropower gate, which is located in the west of Lake Singkarak. Lake Singkarak outlet naturally flows eastward through the Ombilin River and empties into Riau Province. Since 1996, it has flowed through the hydropower tunnel to the Asam Pulau area to generate 175 MW of electricity and empties into the west coast of the island of Sumatra [1].

The lake Singkarak has various functions: water source, irrigation, hydroelectric power plant, recreational facilities and tourism, and fisheries objects, both capture fisheries and fish

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farming using floating net cages. *Mystacoleucus padangensis* is an endemic fish of Lake Singkarak and has significant economic value and has become one of the typical foods because of its delicious and savory taste. The price of fresh Bilih fish is quite expensive at Rp. 80.000/kg (personal communication with local fishermen). The diversity of fish in Lake Singkarak is relatively high, where there are 19 species of fish, with the dominant fish being Bilih (*M. padangensis*) and Asang (*Osteochilus brachmoides*) [2].

The level of effort to catch *M. padangensis* fish continues to increase every year. This is due to the high demand of the community for this fishery commodity. Overfishing using non-selective fishing gear (dipnet) has led to population decline. In addition, the dominant economic impulse towards resources has resulted in a decrease in the production and size of the *M. padangensis* fish catch in Lake Singkarak. This has an impact on the decline in fishermen's income. In addition, a more dominant economic push for resources has resulted in a decrease in the production and size of the *M. padangensis* fish catch in Lake Singkarak. This research aims to determine the length-weight relationship and condition factor of the endemic fish as primary data their management and conservation for the sustainability of the resources.

2 Materials and methods

2.1 Study site

The research was conducted in four stations (Sumani, Batu Taba, Paninggahan, and PLTA Intake) of the Lake Singkarak, West Sumatra (Fig. 1. and Table 1) in May 2021. Sampling locations were chosen by habitat characteristics and anthropogenic impact, such as floating net cages. Sample analysis was performed at a laboratory in Cibinong.

Fig. 1. Sampling location in Lake Singkarak.
(Scale = 1 cm : 500 m)

Table 1. Sampling location in Lake Singkarak

Stations	Description	Pictures
1. Sumani S: 0^{o} 41' 53" E: 100^{o} 35' 12"	In Nagari in District X Koto Singkarak, Solok Regency, West Sumatra, At this station, there is also an inlet to Lake Singkarak with a reasonably large discharge, but at the mouth of the river and its surroundings there are many aquatic plants such as water hyacinth (*Eichhornia crassipes*), household waste and wood carried from the upper reaches of the Sumani River. The water that comes out of the Sumani River is very cloudy and brings a lot of garbage into the lake and the trash stretches for approximately 200 meters on the edge of the lake or river.	
2. Batu Taba S: 0^{o} 32' 47" E: 100^{o} 31' 33"	Nagari Batu Taba Village which is one of the villages included in the South Batipuh sub-district, Tanah Datar Regency. This Nagari is located on the shores of Lake Singkarak, Batusangkar, the capital of Tanah Datar Regency. Batu Taba is a village that is passed by the Sumatran causeway, which has beautiful views, and there is a tourist attraction of Tanjuang Mutiara. On the west side, in addition to tourist attractions.	
3. Paninggahan S: 0^{o} 39' 11" E: 100^{o} 32' 24"	In Nagari Junjung Sirih District, Solok Regency, West Sumatra. This Nagari is located on the western edge of Singkarak River and is bordered by Bukit Barisan. There is a river estuary which is quite wide divided into two medium lanes for more than two meters as a “Alahan” (for trapping fish), the water conditions are good, clean, and quite clear. The Paninggahan watershed contributes to the flow to Lake Singkarak, and this area has a rock structure of a combination of granite and limestone and currently has the highest forest cover ratio compared to other sub-watersheds in Singkarak. At the estuary to the lake, a little muddy sediment was found, the current was moderate, and on either side of the estuary, there were many trees whose trunks and leaves fell into the water.	
4. PLTA Intake S: 0^{o} 36' 8" E: 100^{o} 29' 59"	In Nagari Guguak Malalo, Tanah Datar Regency. The edge of the lake around the intake of this hydropower plant is overgrown with shady trees and agricultural/plantation areas. The water on the surface looks clean, the bottom of the waters is generally sandy and sedimentary, but garbage is found at the bottom of the waters.	

2.2 Fish sampling

The Bilih fish (Fig. 2.) was captured with experimental gillnet mesh sized 5/8, ¾, and 1 inch. Each piece of fishing gear is 50 m long and 2 m high so that the total length of the net for one unit is 150 m. The net is equipped with floats and weights. Gill nets are installed at each station at [3] from 06:00 to 9:00 am (Fig. 3a). These observations include data on the number and composition of fish caught, fish size distribution, and growth patterns (length-weight relationship) (Fig. 3b and Fig. 3c).

Fig. 2. Bilih fish (*Mystacoleucus padangensis*, Blkr).
Foto by: Nasution (2021)

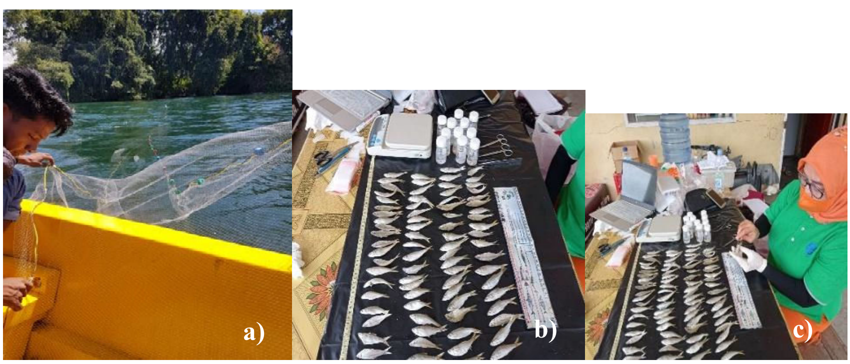

Fig. 3. Installation of experimental gillnet (a) and Bilih fish measurement (b) and (c).

Fish samples are preserved in the field with 4-10% formaldehyde labeled containing location data and sampling time. The catches obtained from each station were sorted and separated sexually. The measuring instrument used was a measuring board (1 mm accuracy) to measure the length (total length) of the fish and the ACIS BC 500 series digital scale (accuracy 0.1 g) to measure the weight of the fish. To obtain a standard fish population size structure, the fish are grouped into several length classes.

2.3 Data analysis

2.3.1 Length-weight analysis

The relationship between length and weight of fish is calculated by the formula [4], namely:

$$W = a\,L^b \tag{1}$$

where : W = fish weight (grams);
L = fish length (mm);
a and b = constants

This formula can be linearized to logarithmic form, namely:

$$Log_{10}\,W = Log_{10}\,a + b\,Log_{10}L \tag{2}$$

To get the parameters a and b, regression analysis is used with Log W as Y and Log L as X, so the regression equation is obtained:

$$Y = a+bX \tag{3}$$

To test the value of b=3 or b≠3 a t-test was performed. If b=3 then the relationship between length and weight is isometric and if b≠3 then the relationship between length and weight is allometric [5]. The allometric growth pattern is divided into two, namely positive allometric, (if b>3, weight gain is faster than length increase) and negative allometric, (if b<3, length increase is more rapid than weight growth).

2.3.2 Condition factor

The condition factor value is an effective instrument and can show changes in fish conditions throughout the year [5]. By knowing the growth pattern, it is possible to calculate the relative condition factor that describes the bulkiness of the fish following [6] with the general formula:

$$FK = \frac{W}{\hat{W}} \tag{4}$$

where : FK = relative condition factor,
W = fish weight (g),
$\hat{W}$ = expected weight, estimated using length-weight regression as following = aL^b

Fish grow well if the value of the condition factor is more than 1, while the fish grow weakly if the value of the condition factor is less than 1 [6].

2.3.3 Water quality

The environmental parameters measured from each station consist of water physics, water chemistry, and surface sediment parameters. Direct measurements in the field include Temperature, pH, Dissolved Oxygen (DO), Conductivity, Oxidation-Reduction Potential (ORP), and Total Dissolved Solids (TDS) using the Water Quality Checker-Horiba U 20, and Secchi depth using a scaled rope.

 https://doi.org/10.1051/e3sconf/202132201036

3 Result

3.1 Fish size distribution

The relative frequency of the total length distribution of *M. padangensis ranged* from 40.0 – 95.0 mm for males and 52.0 – 95.0 mm for females (Fig. 4.). The relative frequency of bodyweight distribution of male and females of *M. padangensis* in Lake Singkarak was 10.0 – 66.0 mg and 17.0 – 74.0 mg, respectively (Fig. 5.).

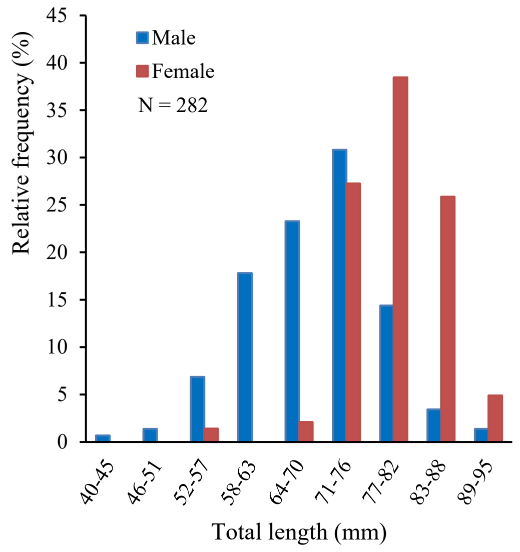

Fig. 4. Frequency distribution of total length of *M. padangensis* male and female in Lake Singkarak.

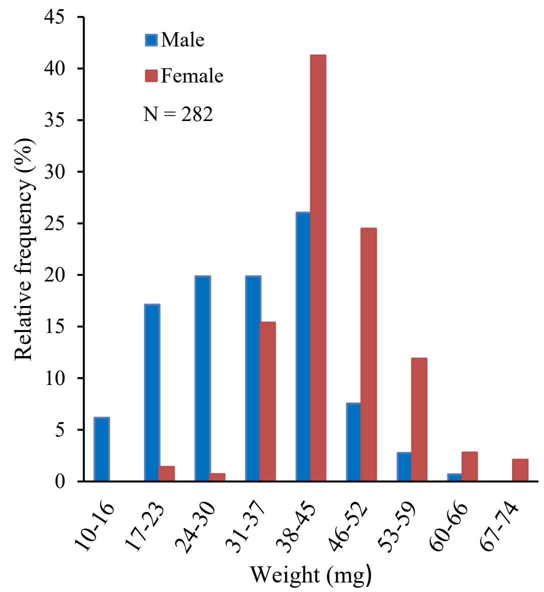

Fig. 5. Frequency distribution of weight of *M. padangensis* male and female in Lake Singkarak.

3.3 Length-weight relationship

Fish growth patterns can be identified by analyzing the length-weight relationship of the fish [7]. This relationship can also explain growth. The growth pattern of fish can be known by analyzing the relationship between length and weight. Fat or skinny fish body can be obtained from the pattern of growth. Internal and external factors can affect fish growth patterns [8]. Figures 6 and 7 show the relationship between the length and weight of male and female *M. padangensis*.

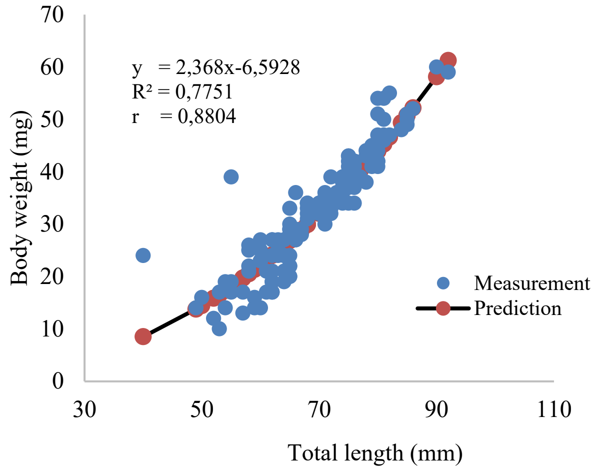

Fig. 6. The relationship between the length and weight of male *M. padangensis* in Lake Singkarak.

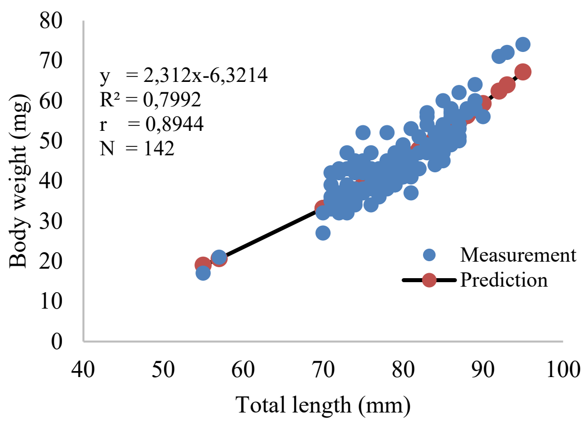

Fig. 7. The relationship between length and weight of female *M. padangensis* in Lake Singkarak.

The relationship between length and weight of *M. padangensis* fish at each station can be seen in Fig. 8, 9, 10, and 11.

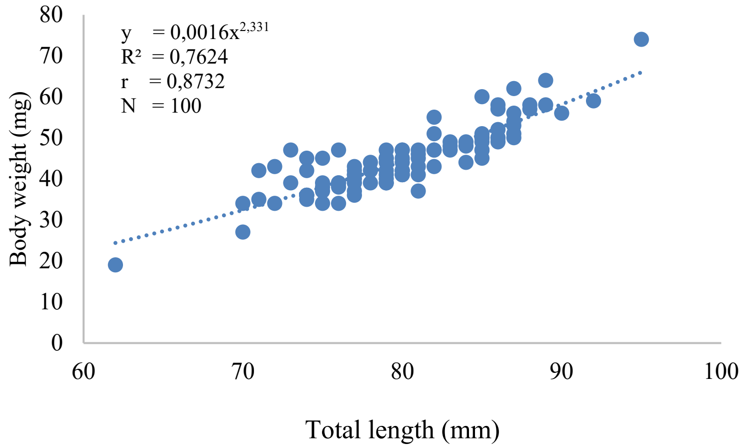

Fig. 8. The relationship between length and weight of *M. padangensis* at Sumani station.

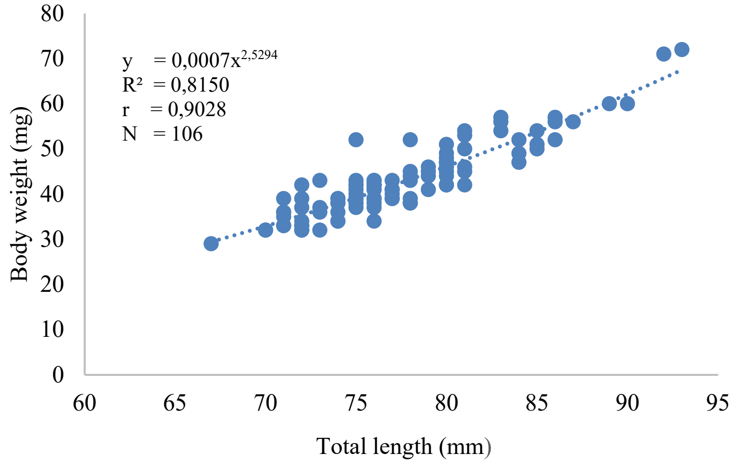

Fig. 9. The relationship between length and weight of *M. padangensis* at Batu Taba station.

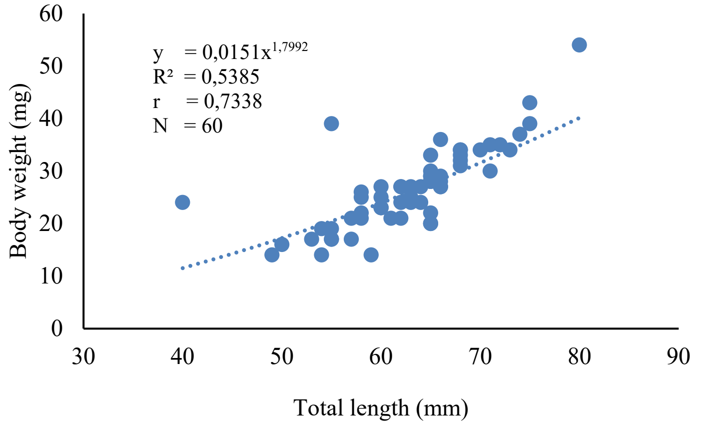

Fig. 10. The relationship between length and weight of *M. padangensis* at Paninggahan station.

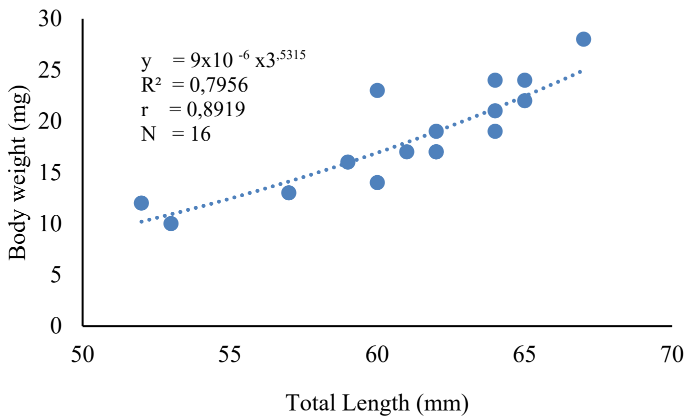

Fig. 11. The relationship between length and weight of *M. padangensis* at PLTA Intake station.

Table 2. The results of length-weight analysis of male and female *M.padangensis* at each station in Lake Singkarak.

M. padangensis	Sumani		Batu Taba	
	Female	Male	Female	Male
N	84	16	55	51
Total Length (mm)	80,7	77,9	78,3	76,7
TL min-max (mm)	70-95	62-92	70-93	67-90
W (mg)	46	41,3	45	41,2
W min-max (mg)	27-74	19-59	32-72	29-60
W' Equation	$0{,}0039L^{2{,}1335}$	$0{,}0003L^{2{,}7483}$	$0{,}0006L^{2{,}5675}$	$0{,}0013L^{2{,}3785}$
a	0,0039	0,0003	0,0006	0,0013
b	2,1335	2,7483	2,5675	2,3785
W' (mg)	45,5	41,3	53,5	41,1
W' min-max (mg)	33,5-64,2	21,7-64,1	53-54,6	29,7-59,8
R^2	0,6936	0,9141	0,8146	0,8092
Growth Pattern	(-) allometric	(-) allometric	(-) allometric	(-) allometric

M. padangensis	Paninggahan		Intake PLTA	
	Female	Male	Female	Male
N	3	57	16	-
Total Length (mm)	61,7	62,8	61,1	-
TL min-max (mm)	55-73	40-80	52-67	-
W (mg)	24	26,8	18,5	-
W min-max (mg)	17-34	14-54	10-28	-
W' Equation	$0{,}0021L^{2{,}2644}$	$0{,}0176L^{1{,}7639}$	$0{,}000001L^{3{,}5315}$	-
a	0,0021	0,0176	0,000001	-
b	2,2644	1,7639	3,5315	-
W' (mg)	24	26,3	23,7	-
W' min-max (mg)	18,1-34,3	11,8-39,9	16,2-29,2	-
R^2	0,9658	0,5172	0,7956	-
Growth Pattern	(-) allometric	(-) allometric	(+) allometric	-

N: Total sample; L: Lenght; W: Weight; W': Predicted weight; a and b: Regression coefficient; R^2: Determination coefficient

3.4 Condition factor

To see the effect of the environment on the physical condition of the fish, which is formulated as a function of body weight compared to the length of the fish's body, the condition factor can be determined. Theoretically, the condition factor value is directly proportional to the bodyweight of the fish. The fish condition expressed in numbers based on the length and weight data is a condition factor. The excellent condition of fish in terms of physical ability to survive and breed can be shown as a condition factor [9].

3.5 Water quality of Lake Singkarak

Water quality parameters measured at each research station include physical and chemical parameters. In general, the measurement results of water quality in Lake Singkarak during the study ranged from 26.79 – 29.24 °C for temperature, pH 8.19 – 9.43, dissolved oxygen (DO) ranged from 1.18 – 8.01 mg/L, Oxidation Reduction Potential (ORP) ranged – 12 – 180 mV, Conductivity ranges from 0.137 – 0.150 mS/Cm, Total Dissolved Solids (TDS) ranges from 0.089 – 0.097 mg/L and the Sechi depth ranges from 2.27 – 3.78 meters. Based on the physical and chemical parameters of the waters at each observation station, it can be seen that the presence of fish in Singkarak Lake is more influenced by the activities carried out by the community around the lake waters. The results of the measurement of quality parameters can be seen in (Table 3).

Table 3. Water quality of Lake Singkarak.

No	Location GPS	Level depth	Temp °C	pH -	DO (mg/L)	ORP (mV)	Conduct (mS/cm)	TDS (mg/L)	Sechi Depth (m)	Depth (m)
1	Sumani	*Surface*	29.24	8.63	8.01	141	0.137	0.089	2.27	12.5
	S: 0° 41' 53"	*Sechi Depth*	29.08	8.45	6.81	180	0.137	0.089		
	E: 100° 35' 12"	*Bottom Depth*	28.41	8.69	6.23	136	0.138	0.090		
2	Batu Taba	*Surface*	28.93	9.32	5.71	142	0.141	0.092	3.28	14.15
	S: 0° 32' 47"	*Sechi Depth*	28.53	9.43	5.11	146	0.141	0.091		
	E: 100° 31' 33"	*Bottom Depth*	26.97	8.96	3.22	147	0.142	0.092		
3	Paninggahan	*Surface*	28.66	8.73	7.06	161	0.141	0.091	3.78	15.4
	S: 0° 39' 11"	*Sechi Depth*	28.34	8.63	4.60	158	0.142	0.092		
	E: 100° 32' 24"	*Bottom Depth*	27.64	8.64	2.01	147	0.152	0.097		
4	Intake PLTA	*Surface*	28.39	8.89	6.28	37	0.139	0.090	3.62	33.3
	S: 0° 36' 8"	*Sechi Depth*	28.44	8.82	6.59	65	0.139	0.090		
	E: 100° 29' 59"	*Bottom Depth*	26.79	8.19	1.18	-12	0.150	0.097		

4 Discussion

4.1 Fish size distribution

The highest of length frequency was the *M. padangensis* fish with class intervals of 71.0–76.0 mm (73.5 mm) and 77.0 – 82.0 mm (79.5 mm) in males and females, respectively. The highest frequency of weight in male and female fish is in the same class interval, 38.0 – 45.0 mg (41.5 mg). It can be seen that the length of the male *M. padangensis* fish is smaller than the female *M. padangensis* fish at the same body weight. The same thing was also reported from the study results [10] that the male *M. padangensis* fish are smaller than female fish. From the research results [10], the average length of female and male bilih fish is 92.60 mm and 75.70 mm, respectively.

The relatively high economic value impacts increasing the exploitation of *M. padangensis* fish resources regardless of the sustainability of the resources. The indicator is a decline in the population and individual size of *M. padangensis* fish from 186.0 mm in 1988 [10] to 59.0 mm in 2003 [11]. The total length of *M. padangensis* fish caught using gillnets according to 2015 [12] was 76.5 mm, and in 2020 [13], it was around 73.5 mm. The length of *M. padangensis* research results [13] in 2020 is the same as the results of this research, which is 73.5 mm. Since 2015 the length of the caught *M. padangensis* fish has decreased in size (in 2020).

The most extended frequency of *M. padangensis* fish length at each station is at Sumani Station, which is 80.3 mm (62 – 95 mm), followed by Batu Taba Station, which is 77.5 mm (67 – 93 mm), Paninggahan Station, which is 62.8 mm (40 – 80 mm), and the PLTA Intake Station, which is 61.1 mm (52 – 67 mm). The highest total weight of *M. padangensis* fish was also found at Sumani Station, which is 4.5 g (1.9 - 7.4 g), followed by Batu Taba Station, which is 4.3 g (2.9 – 7.2 g), Paninggahan Station which is 2.67 g (1.4 – 5.4 g), and PLTA Intake Station which is 1.85 g (1.0 – 2.8 g).

The Institute for Regional Economic Research reported that in 1988, the caught *M. padangensis* fish weighed 17.00 grams. [13] stated that the body length of *M. padangensis* fish was never more than 116 mm. The variation in the weight and length of *M. padangensis* fish found by each researcher was probably due to the different fishing gear used and the influence of various environmental factors due to the different timing of the research [15]. There is an indication of a decrease in the length and weight of the fish caught based on the results of this study.

4.2 Length-weight relationship

Male fish have a value of b = 3.1 and female b = 3.1 or equal to 3.0, based on the t-test. Growth following an isometric pattern is indicated by a b value of 3.0 and a $b \neq 3$ value indicates the allometric pattern.

The length-weight relationship of male and female *M. padangensis* has the following equation (Fig. 6 and 7), namely $W = 0.00137L^{2.368}$ and $W = 0.00179L^{2.312}$, where the coefficient of correlation (r) were r = 0,8804 and r = 0,8944. The correlation coefficient value obtained is high. This shows a close relationship between weight gain and length gain and vice versa. The coefficient determination value (R^2) of male and female *M. padangensis* were 0.7751 and 0.7992, respectively.

The value of the coefficient of determination (R^2) ranges from 0.78 to 0.80, this means that 70% - 90% of the value (R^2) of the relationship between the length and weight of the *M. padangensis* fish collected is quite large, indicating that the diversity influenced by other variables is quite large. Small while the diversity of the relationship between length and weight of fish is very close. Fish length and weight have a close relationship based on the coefficient of determination. The exponent b values of male and female fish were 2.368 and 2.312, respectively (Fig. 6 and 7). In this research, the b value for males and female is not equal to three, and growth patterns of *M. padangensis* are allometric negative ($b < 3$), this showed that the increase in fish length is not balanced with weight gain. This indicates that *M. padangensis* has a negative allometric growth pattern. The growth rate of fish weight is slower than the growth rate of body length. This suggests that *M. padangensis* has a negative allometric growth pattern. The growth rate of fish weight is slower than the growth rate of body length. The growth pattern of *M. padangensis* with various fishing gears carried out by

[16] in Singkarak Lake is also negative allometric, and it can be seen that the value of b is smaller than 3 ($b<3$).

M. padangensis seen from its physical appearance, is estimated to be a fast-swimming fish and a migratory type. According to [17], the body shape of this fish is similar to that of Tuna fish. *M. padangensis* was found distributed in all research stations in Singkarak Lake.

The correlation coefficient (r) value for each station (Sumani, Batu Taba, Paninggahan, and PLTA Intake stations) were 0.8732, 0.9028, 0.7338, and 0.8919, respectively (Fig. 8, 9, 10, dan 11 dan Table 2). The correlation coefficient value obtained is high, this shows a close relationship between weight gain and length gain and vice versa.

The growth pattern of male and female *M. padangensis* fish at each station had a negative allometric growth pattern at Sumani, Batu Taba, and Paninggahan stations, while at hydropower stations, the allometric intake was positive ($b\neq3$) (Table 2). This is in accordance with a study conducted by [18] that the growth pattern of male Bilih fish is positive allometric. According to [19], the factors that cause differences in the value of b are differences in the number and variation of fish sizes observed, environmental factors, differences in fish stocks within the same species, fish developmental stages, sex, gonad maturity level, and even differences in time of day because of the difference in food.

4.3 Condition factor

The condition factor value of *M. padangensis* for males and females were 0.90 and 0.98, respectively. The condition factor of male *M. padangensis* was higher than that of female. This shows that males reach their maximum length faster than females. Based on the results of research by [20], the average value of the relative condition of *M. padangensis* each month varies, which for female fish ranges from 0.86 - 1.07 and male fish between 0.85 - 1.06.

The condition factors of male and female *M. padangensis* fish in Lake Singkarak were 1.02 and 1.004, respectively. At the Paninggahan station, the highest condition factor value was obtained, namely 1.10, followed by Batu Taba (0.92), Sumani (0.87), and PLTA Intake (0.80) stations. The Paninggahan watershed, which contributes flow to the Singkarak River and this area, has a rock structure of a combination of granite and limestone and currently has the highest forest cover ratio compared to other sub-watersheds in Singkarak. At the estuary to the lake, a little muddy sediment was found, the current was moderate, and on either side of this estuary, there were many trees whose trunks and leaves fell into the water. Water quality is quite good, clean, and clear enough with dissolved oxygen values ranging from 2.01-7.06 mg/L, Conductivity values (0.152 mS/Cm), and TDS (0.097 mg/L) relatively higher than other locations, but still categorized as good. Environmental factors are factors that influence condition factors [5]. From the results of this study, the condition factor is influenced by good ecological factors. Differences in these condition factors are estimated or suspected to be influenced by differences in age, environmental conditions, stages of gonad maturity, food availability, and behavior. In addition, this conditioning factor is also influenced by the relative index of food. In female fish, it is also influenced by the gonadal maturity index. This is because, in general, fish will tend to use their fat reserves as an energy source during the spawning process so that the condition factor will decrease. The high value of the condition factor indicates that there is a match between the fish and its environmental conditions.

Differences in age, environmental conditions, gonad maturity level, food availability, and behavior are factors that cause the condition factor of females to be greater than males. Water quality and fisheries management can also influence conditional factors other than food availability [22 and 23]. Condition factors can also be affected due to fish stress [21]. Stress causes a deficient fish condition factor in Lake Turkana Kenya [24].

This *M. padangensis* fish is categorized as a fish that lives in the water column from the bottom to the surface (bentho-pelagic), especially in shallow or littoral waters, and is classified as a plankton feeder (FISHBASE). *M. padangensis* fish are euryphagic plankton feeders, with the leading food being the Bacillariophyceae class [25]. M. padangensis fish favor the entire water habitat of Lake Singkarak with the same level of preference (relatedness). This can be seen from the almost even distribution of *M. padangensis* fish in all waters, so the opportunity for these fish to utilize the available natural resources is relatively large when compared to other types of fish that live in Singkarak Lake [26].

4.4. Water quality of Lake Singkarak

Generally, endemic fish species are relatively more challenging to adapt and cultivate outside their natural habitat, but *M. padangensis* has been successfully introduced from Lake Singkarak to Lake Toba [27].

Based on the results of research [28] in Lake Towuti that the endemic fish *Telmatherina celebensis* is challenging to adapt to an environment outside its natural habitat. In general, bilih fish prefer clear waters, low water temperatures (26.0 - 28.0 ^{o}C), and littoral areas with gravel and/or sandy waters [15].

When conducting research in Sumani, the weather conditions were a rainy season, so the water conditions were quite cloudy with a Secchi depth value of 2.27 meters and turbidity of 54 NTU. The lake's condition during the rainy season experiences high tides, making the fish move to the edge of the lake and towards the river mouth. At the mouth of this river, there is a lot of garbage and waste from the upper reaches of the Sumani River which is carried into the lake, so it isn't easy to get fish in that location. Communities around Sumani Village use charts and land to catch fish, especially Bilih fish.

The condition of water quality in Batu Taba is generally still relatively good, with temperatures ranging from 26.97 – 28.93 ^{o}C, but at a depth of Secchi (3.28 m) the pH value is higher than other areas. This is thought to occur due to fertilization and water flow from agriculture by bringing nutrients and directly into the waters of the lake.

The Paninggahan watershed, which contributes flow to the Singkarak River and this area, has a rock structure of a combination of granite and limestone and currently has the highest forest cover ratio compared to other sub-watersheds in Singkarak. At the estuary to the lake, a little muddy sediment was found, the current was moderate, and on either side of this estuary, there were many trees whose trunks and leaves fell into the water. Water quality is quite good, clean, and clear enough with dissolved oxygen values ranging from 2.01-7.06 mg/L, Conductivity values (0.152 mS/Cm), and Total Dissolved Solids (TDS) (0.097 mg/L) relatively higher than other locations, but still categorized as good. Water quality can also be determined from the value of electrical conductivity (Electrical Conductivity, EC). The higher the EC value, the worse the water quality, for example, the water will taste brackish to salty. The smaller the EC value, the more difficult it is for the water to conduct currents to improve the water quality [28]. The dissolved solids contained in the solution are the cause of the increase in the TDS value. The number of ions contained in the waters affects the value of the electrical conductivity in the waters. The more the number of dissolved solids, the more the number of ions in a solution because the number of dissolved solids contains ions arranged into compounds in dissolved solids. This allows the value of TDS and electrical conductivity to be estimated to have a close relationship [30].

The water quality at this location is relatively good, but some values such as DO, ORP and temperature at the bottom of the water are lower than in other areas. The dissolved oxygen content will decrease with increasing depth. The decomposition process at the bottom of the water will require a lot of oxygen to decompose organic matter. The dissolved oxygen content in the hypolimnion layer is minimal and even reaches zero so that if decomposition occurs under anaerobic conditions, toxic gases such as H2S, NH3, and CH4 will be produced [31]. Seeing the condition of oxygen at the bottom of this water, it is suspected that benthic animals and fish in this location will find it challenging to live. The range of ORP values in this location is -12 – 65 mV, much lower than in natural waters [32], which is 450-520 mV. The value of the brightness of water is very dependent on the color and turbidity. The Secchi disk was used to measure the intelligence (a measure of water clarity), which was determined visually [33]. During observations, the brightness values for all locations in Lake Singkarak did not show many different values at each station, ranging from 2.27-3.78 meters. According to [34], the brightness of waters is one indicator that can be used to describe algae biomass. The higher the phytoplankton biomass, the more obstructed the light from entering the water column, which is indicated by the short brightness value measured. According to [35], brightness depends on color, cloudiness, and weather conditions. Visually, the color of the water at each observation station is relatively straightforward and slightly greenish, making it difficult for light to penetrate the water column.

The measured water quality parameters can still support the survival of *M. padangensis* based on Government Regulation No. 82 of 2001 concerning Water Quality Standards.

5 Conclusion

The total length and the weight of Bilih fish ranged from 40 – 95 mm and 10 – 74 mg. The highest length and weight of *M. padangensis* were 80.3 mm, and 45.0 mg were found at Sumani station. The growth pattern of male and female *M. padangensis* fish is negative allometric. The length-weight relationship of male and female *M. padangensis* was $W = 0.00137\ L^{2.368}$ and $W = 0.00179\ L^{2.312}$. Condition factors of males and females are 1.02 and 1.004, respectively. The condition factor value of male *M. padangensis* is higher than the female. The water quality values are within the normal range that supports *M. padangensis* life.

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