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Diversity and length-weight relationships of fishes from Lake Cala in tide season

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Abstract. Lake Cala, a fishery potential oxbow lake, is located in Musi Banyuasin, South Sumatra. Lake Cala is a wetland that flooded during high tide and become land in dry season. The study was conducted to determine present status of the diversity and the condition of fish. This study has been done at Lake Cala in February until March 2017. On this tide season, data were collected by fishers. The fish sampling was conducted using hook line, cast nets, gillnets and fish traps (corong). A total of 27 fish species belongs to three ordo, 11 families, and 19 genera were recorded during the study. Diversity of fish in Lake Cala on the tide season is dominated by whitefishes. Based on its potency, most fish species are 59% consumption, 33% double potency, and 8% ornamental fish. Aro (*Osteochilus melanopleura*) and palau (*O. vittatus*) from Cyprinidae family, and baung (*Mystus nemerus*) from Bagridae family were dominant. The length-weight relationship showed that dominant two species of fish (baung and palau) had positive allometric growth patterns, while aro is isometric. Those parameters obtained from the study are useful fundamental information applicable in the future population dynamics studies. Furthermore, based on these result it was necessary to manage the fishing gears operation and regulating tributaries to maintain the process of fish on search for feed, distribution, and colonization of various species and populations.

1. Introduction

Lake Cala is an oxbow lake which was originated from Musi River flow and located in its middle zone. This lake is 120 ha with range of the depth of 9-13 m. During tide season, fishes would migrate from Musi River to the lake and spread to Musi River canal. While during dry season, they would migrate back to the river [1]. The environmental factors, like temperature, salinity, food, sex and stage temperature, salinity, food, sex and stage of maturity also affected the variation of distribution of fish [2]. Distribution and variation of morphological on fish are responses from its inhibited condition. The growth pattern of fish also depends on several factors such as age, body shape and amount of fat present, sex, maturity stage, season, temperature, salinity, and available nutrient food.

Lake Cala is a potential area for nursery ground and spawning area. This lake has high fish resources potency, but recently the production trend was declined [1]. The reduction could be attributed to over-fishing, illegal fishing gear, and non-selective methods of fishing which may be destructive to young fishes.



The review of fish diversity is needed for a sustainable fish population. Some studies about diversity in Lake Cala have been conducted [1, 3]. This research was aimed to determine the status of diversity and condition of fish, especially during tide season. The result of this study is expected to provide information for the sustainable fishery resources in Lake Cala.

2. Materials and Methods

2.1. Sample collection

The study was conducted in Lake Cala, Lais, Musi Banyuasin, South Sumatra (figure 1 and table 1). The samplings were done in tide season from February to March 2018. The stations of the sampling were determined by the characteristic from the habitat zone and the fishing ground. The high season in Lake Cala on 2018 were occurred during November to March. The Fish samples were taken from local fisher. Fishes were caught using hook line no. 10 and 11; gillnets 1.5 inches, 2 inches, 2.5 inches, with each height of 12.5 m x 400 m,—and fish traps (corong) with dimension of 20 x 20 m². The sampling by gillnets were performed three times per a week from 4.00 PM to 8.00 AM. The operation of gillnets and hook line were taken along the lake. While corong was taken in Dua Besak River and Pisang River station.

The fish samples were put into storage and then preserved with 4% formalin [1]. Identification of the fish samples were carried out in BRPPUPP Palembang Laboratory. Fishes were identified by comparing morphometric and meristic features to the reference guideline developed by Kottelat *et al.* and Fishbase [4, 5].

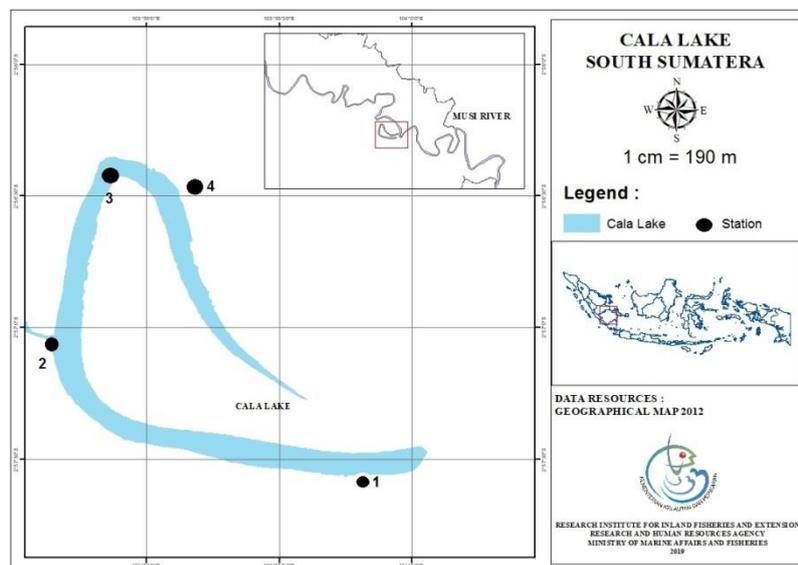


Figure 1. Lake Cala, South Sumatra

Table 1. Research station

No	Station	Coordinat	Remark
1	Pisang River	S 2°95'93.0" E 103°99'63.1"	Connect with Musi River
2	Dua Besak River	S 2°95'07.8" E 103°97'81.5"	Inlet from Dua Besak River
3	Cala Lake's lubuk	S 2°94'03.6" E 104°98'14.9"	The deepest station
4	Suluk	S 2°94'03.6" E 103°98'76.5"	Potential catch sampling point

2.2. Length-Weight relationship

Three of the highest abundance fish types from the catch result were used to determine the length-weight relationship. The total length of fish was measured by measuring board with a precision of 0.1

cm. The total weight of fish was weighed by a digital scale with accuracy of 0.1 gram. The relationship between the length and weight of a fish is expressed by the equation:

$$W=aL^b \quad (1)$$

Where W is body weight (g), L is total length (cm), a is coefficient number related to body form, and b is an exponential number indicating isometric growth [6, 7]. b value was tested using the standard t-test with 95% confidence level ($\alpha = 0.05$). This value provides information on fish growth. Isometric growth pattern would be indicated by $b=3$. It would imply that there is no change from the body shape as an organism grows. Allometric growth pattern would be indicated by $b \neq 3$. Thus, a growth involves a changing proportion of the body shape as an organism grows would be found. Negative value of allometry ($b < 3$) occurs when the fish gets relatively thinner as it grows, while a positive value of allometric ($b > 3$) indicates heavier weight for a particular length [7].

2.3. Determining class interval

Analysis of length size was then continued with determining class of fish length. Data would be grouped into graphs that connect the length of fish in certain classess with the number of fish in that class. Determining class of fish length expressed by the equation:

$$k = 1+3.3\log n \quad (2)$$

Where k = amount of class and n is total of individual or data. Further, determining of class interval expressed by the equation:

$$c = (xn-x1)/k \quad (3)$$

Where c is interval class, xn is the biggest data, $x1$ is the smallest data, and k is amount of class [8].

3. Results and Discussion

3.1. Diversity and fish potential

Total fish during the study consisted of 596 individuals within 27 species, 19 genera, 11 families, and 3 ordo (table 2). The study result showed that the total number of fish found was higher to previous research in 2014 [1], but less than result of other study in in 2007 [3]. Results of 14 and 41 of fish species were reported in 2014 (tide season) and in 2007 study, respectively. These results showed that seasonal conditions were factors affecting fish distribution in lake.

Table 2. Fish composition in Lake Cala

No	Family	Name	Local Name
1	Cyprinidae	1 <i>Puntius bulu</i>	Tebengalan
		2 <i>Osteochilus vittatus</i>	Palau
		3 <i>Labeo chrysophekadion</i>	Sihitam
		4 <i>Puntius</i> sp.	Keperas
		5 <i>Cyclocheilichthys enoplos</i>	Lumajang
		6 <i>Labiobarbus leptocheilus</i>	Siumbut
		7 <i>Albulichtys albuloides</i>	Coli
		8 <i>Puntius fasciatus</i>	Semuringan
		9 <i>Barbodes schwanefeldii</i>	Lampam
		10 <i>Rasbora borneensis</i>	Seluang
		11 <i>Osteochilus melanopleura</i>	Aro

No	Family		Name	Local Name
2	Channidae	1	<i>Channa striata</i>	Gabus
		2	<i>Channa micropeltes</i>	Toman
		3	<i>Channa malanopterus</i>	Bujuk
3	Belontiidae	1	<i>Trichogaster</i> sp.	Sepat tando
		2	<i>Trichogaster trichopterus</i>	Sepat mata merah
		3	<i>Trichogaster pectoralis</i>	Sepat Siam
4	Bagridae	1	<i>Mystus nemerus</i>	Baung
		2	<i>Mystus nigriceps</i>	Berengit
5	Anabantidae	1	<i>Helostoma</i> sp.	Tembakang
		2	<i>Anabas testudineus</i>	Betok
6	Pristidae	1	<i>Pristolepis fasciata</i>	Sepatung
7	Polynemidae	1	<i>Eleutheronema tetradactylum</i>	Senangin
8	Siluridae	1	<i>Kryptopterus</i> sp.	Lais
9	Eleotridae	1	<i>Oxyeleotris marmorata</i>	Betutu
10	Clariidae	1	<i>Clarias batrachus</i>	Lele
11	Ambassidae	1	<i>Ambassis kopsii</i>	Sepengkah

The dominant fish in Lake Cala was Cyprinidae (11 species) and followed by Channidae (3 species). Belontiidae, Bagridae, Anabantidae consisted of 2 species each. Moreover, 1 species of Pristidae, Polynemidae, Siluridae, Belontiidae, Eleotridae, Clariidae, and Ambassidae were found. The phenomena of Cyprinidae domination is similiar with the several study [1, 3, and 9]. Cyprinidae is the common type in several Sumatra freshwater ecosytems [1, 9, and 10]. This family can adapt easily in freshwater condition.

The 133 individuals of *Osteochilus melanopleura* (aro) from Cyprinidae were found in Lake Cala. These fish is widely distributed throughout South-east Asia (Sumatra, Borneo, Malay Peninsula, and Thailand) [12]. *Osteochilus melanopleura* migrates seasonally to Lake Cala that would supply its feed. These fish feeds on periphyton, phytoplankton, filamentous algae, and benthic algae [13].

The second most abundance family in Lake Cala was Bagridae *Mystus nemerus* (baung) and *M. nigriceps* (berengit) were Bagridae species found in this study. They have ability to live in various condition or environmental changes within the riverbed [9]. *Mystus nemerus* also as domination species on tide season [1].

Most fishes found in Lake Cala during this study were white fish type. Based on behavior and ecology, river fishes are divided into blackfishes and whitefishes. Cypriniformes and Siluriformes were whitefishes, while Perciformes was blackfishes. The presence of Cypriniformes and Siluriformes in Lake Cala was affected by enviroment condition. The water quality of Lake Cala on rainy season (tide) were similar with river [3]. These fish would migrate into lake as a floodplain area for spawning or feeding on tide season. Similiar to the previous research [14], this research findings also found a domination of whitefishes on the rainy season. In contrast, blackfishes were tend to only migrate locally within a restricted area and were generally benthomic by inhabiting floodplain pools and residual channels. This habitat that were often low in dissolved oxygen [15].

Cyclocheilichthys enoplos, *Albulichtys albuloides*, *Osteochilus melanopleura*, *Channa striata*, *C. micropeltes*, *C. malanopterus*, *Trichogaster trichopterus*, *Mystus nemerus*, *M. nigriceps*, *Helostoma* sp, *Eleutheronema tetradactylum*, *Kryptopterus* sp, *Trichogaster pectoralis*, *Oxyeleotris marmorata*, *Clarias batrachus*, and *Ambassis kopsii* were found in Lake Cala. These species are categorized consumption fish. This category comprised of 59% of the total fish found. While *Labeo chrysophekadion* and *Puntius fasciatus*, were categorized as ornamental fish with 8% abundance. The rest of the fish caught in Lake Cala were *Anabas testudineus*, *Pristolepis fasciata*, *Trichogaster* sp,

Barbodes schwanenfeldii, *Rasbora borneensis*, *Labiobarbus leptocheilus*, *Puntius* sp, *Osteochilus vittatus*, and *Puntius bulu*, that have double potency (33%) as consumption and ornamental fish.

Lake Cala's fish have a high economic value. The price of *C. striata* in the market ranging from \$3-6 USD/kg or around Rp40.000,00-90.000,00, while *C. micropeltes* is around \$2 USD/kg or around Rp30.000,00/kg, and *A.testudineus* is around \$5 USD/kg [16]. Moreover, *Helostoma* sp is a freshwater ornamental fish commodities because of its unique appearance and behavior. In other countries, the price of 12-15 cm *Helostoma* sp is Rp27.000,00-54.000,00/individual [17].

3.2. Length-Weight relationship

Osteochilus melanopleura, *M. nemerus*, and *O. vittatus* were three most dominant Cala Lake fish species. A total of 133 *O. melanopleura* was analyzed. The total length of fish ranged from 120 cm to 214 cm. They were grouped into 7 classes of total length frequency. Table 3 shows that the total length frequency of *O. melanopleura*. This species was found with length modus of 14.5 cm and was measured mostly in ranged between 14.0-15.0 cm length distribution. *Osteochilus melanopleura* fish in Lake Cala were smaller than what were found in Perak, Malaysia and Kampar River, Riau [12, 17]. Both Perak and Kampar study areas have species with 15.8-39.5 cm and 19.28-78.2 cm in length, respectively. The equation of length-weight relationship (LWR) was $W=0.016L^{2.983}$, where the coefficient of determination (R^2) was 0.98 (figure 2). These coefficients indicated that there were close relationships between length and weight of the fish found. The calculation b value was 2.983, which showed that fish have isometric growth pattern. This growth pattern implies that there were no changes of the body shape as the organisms grow. The isometric growth pattern could be interpreted that the condition of fish habitat were ideal and not degraded, there were enough food sources, and the water qualities for the predator and competitors were still balanced [21].

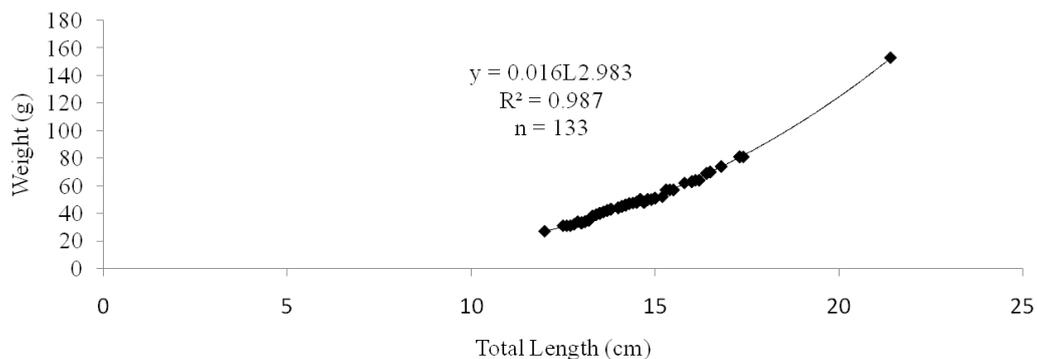


Figure 2. Length-weight relationship of *Osteochilus melanopleura* in Lake Cala

Mystus nemerus were found as the second abundance fish in Lake Cala. A total of 84 *M. nemerus* fish were analyzed. Lengths of these fish were ranged from 10 cm to 20 cm. They then were grouped into 10 classes based on the total length frequency. This fish species were also found with length modus of 16.5 cm and were measured mostly in ranged between 16-17 cm of the length distribution. The equation of length-weight relationship (LWR) of *M. nemerus* was $W= 0.003L^{3.501}$, where the coefficient of determination (R^2) was 0.996 (figure 3). This coefficient value indicated that the length and weight might have a close relationship. The b value was 3.501, which showed that fish have positive allometric growth pattern. Thus, fish have a faster growth rate of the body weight compared to the length.

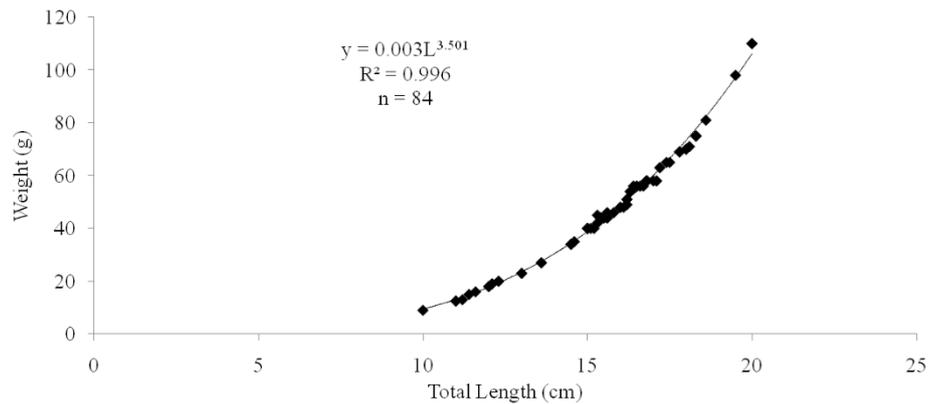


Figure 3. Length-weight relationship of *Mystus nemurus* in Lake Cala

Furthermore, a total of 49 *O. vittatus* were analyzed. The total length of fish ranged from 5.5 cm to 19.4 cm. They were grouped into 12 classes based on total length frequency. Total length frequency of *O. vittatus* tended to have a normal distribution. This species were found with length modus of 10.5 cm and were measured mostly in range between 9.0-10.0 cm of the length distribution. *O. vittatus* inhabited in Lake Cala have smaller size than what were found in Rawa Pening, Central Java [19]. *Osteochilus vittatus* inhabited Rawa Pening had length size between 11.0-25.0 cm . Unfortunately, the authors did not put the information of fishing gears they used to catch the fish. The difference of *O. Vittatus*'s total length could be caused by different types and mesh size of fishing gears used. The equation of length-weight relationship (LWR) of *O. vittatus* was $W = 0.002L^{3.655}$ with the coefficient of determination (R^2) was 0.997 (figure 4). This coefficient indicated that the length and weight of *O. vittatus* in Lake Cala have a close relationship. The b value was 3.655, which showed that fish have positive allometric growth pattern. Therefore, the fish have a faster growth rate of the body weight compared to the length. The allometric growth pattern showed the pressured condition due to the increasing amount of food at particular location and time [21]. The allometric growth pattern was also affected by food or algae bloom as a main food for this fish [22].

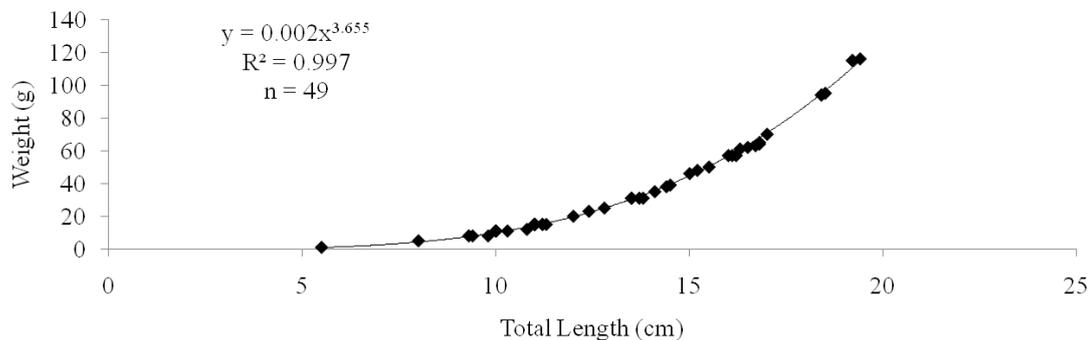


Figure 4. Length-weight relationship of *Osteochilus vittatus* in Lake Cala

Table 3. Length and weight of three dominant species in Lake Cala

Species	N	W,	L,	W-L equation	Determination Coefficient (r^2)	Growth Type
		mean±SD	mean±SD			
		Wmin- Wmax (gr)	Lmin- Lmax (cm)			
<i>Osteochilus melanopleura</i>	133	47.68±15.10 27-153	14.37±1.33 12-21.4	$W = 0.016L^{2.983}$	0.98	Isometric

Species	N	W,	L,	W-L equation	Determination Coefficient (r ²)	Growth Type
		mean±SD	mean±SD			
		Wmin- Wmax (gr)	Lmin- Lmax (cm)			
<i>Mystus nemerus</i>	84	48.38±20.36 9-110	15.64±2.14 10-20	$W = 0.003L^{3.501}$	0.996	Allometric (+)
<i>Osteochilus vittatus</i>	49	38.45±31.79 1-116	13.40, ± 3.33 5.5-19.4	$W = 0.002L^{3.655}$	0.997	Allometric (+)

4. Conclusion

Total species of fish in Lake Cala during the study was 27 species, which belong to 3 ordo, 11 families, and 19 genera. Diversity of fish in Lake Cala on tide season was dominated by whitefishes. Based on its potency, most fish species found were 59 % consumption, 33% double potency, and 8 % ornamental fish. The length-weight relationship showed that two dominant species of fish, *Mystus nemerus* and *Osteochilus vittatus*, have positive allometric growth patterns, while *O. melanopleura* was found to be an isometric. These results could be useful for the future population dynamics studies.

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