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Biological Aspects and Feeding Ecology of Sembilang *Plotosus canius* in Langsa Estuary

Agus Putra Abdul Samad[1*], Nur Fazillah[1], Rindhira Humairani[2], Ilhamdi[3], Nan Fan Hua[4]

[1]*Department of Aquaculture, Faculty of Agriculture, Universitas Samudra, Langsa, Indonesia*
[2]*Department of Aquaculture, Faculty of Agriculture, Universitas Almuslim, Bireun, Indonesia*
[3]*Sekolah Usaha Perikanan Menengah Negeri, Pariaman, Sumatera Barat, Indonesia*
[4]*Department of Aquaculture, National Taiwan Ocean University, Keelung, Taiwan*

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ABSTRACT

The knowledge of the biological aspects and feeding activity of fish is required to manage the lack of data on fisheries. In this study, a total of 200 *Plotosus canius* were caught and examined to obtain information on their biological aspects, length-weight relationship, and feeding activity. The fish were captured using a gill net and traditional fishing trap called *Bubu*. Subsequently, all samples were examined for total body weight, total length, condition factor, gonad maturity, and feeding activity. The results showed that the specimens captured were 156 males and 44 females weighing between 95-280 gr and 117-214 gr with the length of 26-39 cm and 28-36.3 cm, respectively. The length-weight relationship showed a negative allometric growth pattern. The mean condition factors of males and females were 1.1048 and 1.0102, respectively. At the same time, the maturity level of gonads was at I and II. Moreover, it was discovered that most organisms in the digestive tract were shrimp, worms, small fish, and crabs, while the highest index of preponderance was in shrimp with 42%. In conclusion, this study showed the new information about length-weight, biological condition, and feeding habits of Plotosus canius, which can be inventoried to strengthen data on sustainable fisheries management.

1. Introduction

The fisheries sector plays an important role in improving the economic value of the coastal zone (Putra *et al.* 2021; Samad *et al.* 2020; Syahrial *et al.* 2020). Therefore, appropriate management in this area is highly recommended to sustain the communities' income. Previous studies have stated that it is required to know the characteristics of organisms, fish species, age, size, length-weight, and sexual maturity (Bwanika *et al.* 2007) to support good fisheries administration. Population dynamics (Bonfil 2005) as material for fisheries management and development policies have also helped conserve fish species (Midhat *et al.* 2015).

The coastal zone is also called the Estuary area, characterized by semi-enclosed water masses directly related to the sea (Wijaya 2015). Estuaries are considered as the transition zones between marine and freshwater habitats with differences in salinity and tidal strength (Stewart 2002; Wilson 2002). However, there is still a shortage of understanding on the structuring and control of the estuary area. Studies on estuarine waters are still limited, although it was reported that estuarine fisheries are being over-exploited with several highly endangered species.

Indonesia has large estuarine waters, including Langsa estuary (BPS 2021), where several types of fish, such as Sembilang fish (*Plotosus canius*), inhabit. This fish belongs to the catfish group (De Bruin *et al.* 1994) and is still related to the anatomy and morphology. Sembilang has three venomous patils on the first dorsal fin and two right and left pectoral fins. Among carnivorous species in estuarine waters, it prey on small fish, gastropods, mollusks, and crustaceans (Gunawan *et al.* 2020).

Sembilang is among the commercially important species for brackish water (Thumronk *et al.* 2018) and can potentially be cultivated in aquaculture systems. However, the efforts to manage the fish resources have not been carried out. The continuous increase in consumers' interest has led to more catches by fishers, causing a decline in fish populations in nature. Even

* Corresponding Author
E-mail Address: agus.putra.samad@gmail.com

though sembilang is popular to be consumed by the local people, there is no scientific report mentioned about the population, characteristics or biological aspects of this species. Therefore, this study aims to analyze several biological aspects such as length-weight relationships, condition factors, gonad maturity levels, and feeding habits to collect data that can be used as initial information in developing coastal and estuarine areas, especially in Sembilang (*Plotosus canius*) cultivation management.

2. Materials and Methods

2.1. Site and Time

This study was carried out from January to June 2021 using a total of 200 fish that were collected from fishers in the Langsa estuary as samples. The catching areas were in Seuriget, Simpang Lhee, Kuala Langsa, and Langsa Lama. The fish were caught using a gill net of size 1.5 inches and fish trap *Bubu*. Subsequently, the samples were analyzed and examined in the fisheries laboratory of the Faculty of Agriculture, Samudra University, Aceh, to investigate the length-weight relationship, condition factor, gonad maturity level, and eating habits. Plotosus canius catching area is shown in Figure 1.

2.2. Data Collection

During this study, a total of 200 fish (156 males and 44 females) were collected from the Langsa estuary (Figure 1). The fish total length (cm) data were measured using a ruler in cm, while the weight (g) was measured using a digital scale with an accuracy of 0.01 gr. The gonad observation and stomach analyses were carried out using dissecting set. Moreover, the stomach and intestines were removed, measured for length and weight, preserved using 70% alcohol, and their contents were observed under a microscope to determine their eating habits. The water quality of the Langsa estuary was monitored using a multimeter checker.

2.3. Length-weight Relationship

The relationship between the length and weight were calculated using the following linear equation (Effendi 1997): $W = aL^b$.

Where:

W = weight of fish (g)
L = fish length (cm)
a and b = constants of calculations

The pattern of fish growth was determined from the value of the constant b, which describes the body shape comprising thin, ideal, and fat. When b = 3, the growth of fish is isometric, indicating that the increase in length is proportional to the increase in weight. When b≠3, it is allometric, which showed that the increase in length is not proportional to the increase in weight. When b>3, the relationship is positive allometric, where the increase in weight is more

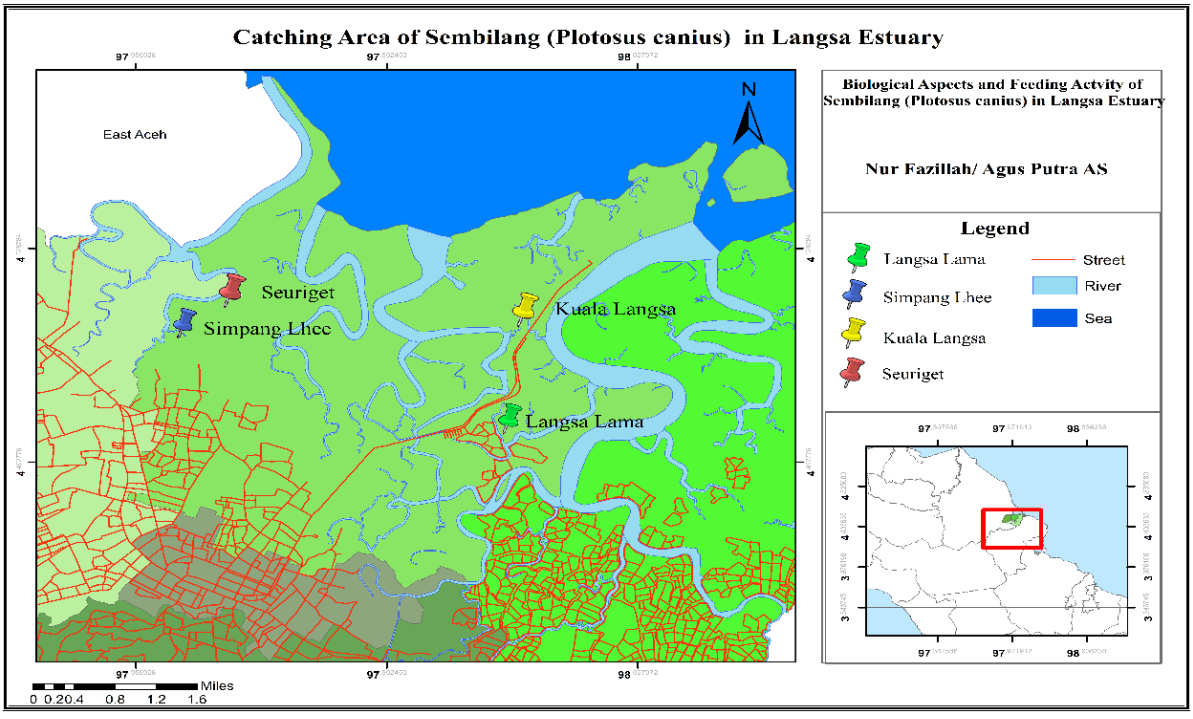

Figure 1. Catching area of Sembilang *Plotosus canius* in Langsa Estuary

dominant than the increase in length. Meanwhile, b<3, the relationship is negative allometric, showing that the increase in length is more dominant than in weight.

2.4. Condition Factor

The condition factor is the state or fatness of the fish, which is expressed in numbers based on numbers based on fatness of the fish expressed in numbers based on the length and weight data. The data represent whether the fish is fat, thin or normal.

When the isometric growth (b=3), the weight of the fish is proportional to the increase in length, it is calculated by the formula (Effendi 1997): $Kn = \frac{W.}{aL^b}$

However, when the allometric growth (b≠3), the increase in length and weight is not proportional, the formula below is used: $Kn = \frac{10^5}{L^3} W.$

Where:
Kn = condition factor
W = average weight of fish (g)
L = average length of fish (cm)
a and b = regression constant

2.5. Gonadal Maturity Level

The gonadal maturity level was determined morphologically, including the color, shape, and size of the gonads. Meanwhile, the gonad development was determined by observing the stages of the morphological gonad development of fish (Effendi 1997).

2.6. Feeding Habit

Analyses of stomach and intestines contents were carried out using the preponderance method index (Effendi 1997).

$$IP = \frac{Vi \; x \; Oi}{\sum Vi \; x \; Oi} x \; 100$$

Where:
IP = index of preponderance (%)
Vi = percentage of the amount of one type of food
Oi = percentage of the frequency of occurrence of one type of food
$\Sigma Vi \; x \; Oi$ = the sum of *Vi x Oi* of all kinds of food

Moreover, the index of preponderance (IP) values range between IP >40% as main food, IP 4-40% as food additive, and IP <4% as complimentary food.

2.7. Data Analysis

Data analysis was carried out descriptively and quantitatively. All obtained data such as total weight, total length, condition factors, gonadal maturity level, eating habits, and water quality shown in tables and graphs.

3. Results

3.1. Length,Weight, and Regression Coefficient

Data on the mean of the total length and body weight, regression coefficient, and growth pattern of captured fish are shown in Table 1.

Table 1 showed that the length of Sembilang males ranged between 26-39 cm and weight of 95-280 g. Meanwhile, ,varies. The length ranges between 28-36.3 cm for females with a weight of 117-214 g. The length-weight relationship is shown in Figures 2 and 3.

The b values were 2.582 and 1.526 for males and females, respectively, based on statistical analysis. Therefore, the equation of the length-weight relationship of males was $W = 0.020L^{2.582}$, where $W = 0.809L^{1.526}$ for females. Coefficients of determination (R2) for males and females were 0.777 and 0.512, respectively. Based on the t-test, each b value of males and females showed that the growth pattern was allometric negative, where the increase in length is more dominant than the weight gain.

3.2. Condition Factor (CF)

The condition factor value describes the fatness of fish based on the length and weight data. Results of the condition factor of *P. canius* are shown in Table 2.

The table showed that the highest CF in males was in the range of 147-172, which attained 1.42, while the lowest CF was discovered in the range of 121-146 with a value of 0.65. However, females' highest condition factor value was discovered in the weight range of 193–211, which reached 1.19, while the lowest was in the range of 136-154 with the CF value of 0.79. These results also indicated that a weigher body weight can overcome the higher CF value.

3.3. Gonadal Maturity Level

Based on the level of gonadal maturity, as shown in Table 3, it was discovered that 109 fish had gonadal maturity level I in males, while others reached level II. However, out of 44 females, 30 fish were in maturity level I, while another 14 reached level II. It also showed that gonadal maturity is related to the

Table 1. Mean total length, mean body weight regression coefficient, and growth pattern of *Plotosus canius*

Parameters	Male	Female
Sampled fish (n)	156	44
Range of Total length (cm)	26–39	28.0–36.3
Mean total length (cm)	30.8±3.1	32.2±2.7
Range of body weight (g)	95–280	117-214
Mean body weight (g)	147.73±45.79	163.73±29.27
Log a	-0.7286	-0.5856
Regression coefficient (a)	0.020	0.809
Regression coefficient (b)	2.582	1.526
Determination coefficient (R^2)	0.777	0.512
Correlation coefficient (r)	0.8815	0.7155
Regression equation (power)	$W = 0.020L^{2.582}$	$W = 0.809L^{1.526}$
t-test b-value toward-3	$t_{value} > t_{table}$	$t_{value} > t_{table}$
Growth pattern	Negative allometric	Negative allometric

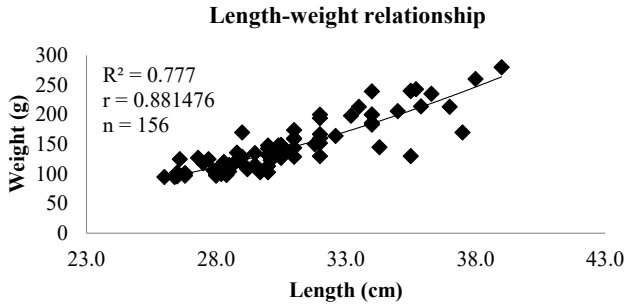

Figure 2. Length-weight relationship of *P. canius* males

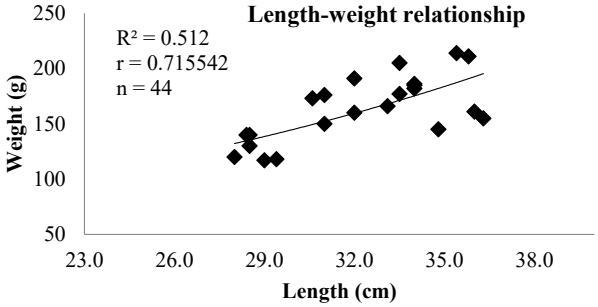

Figure 3. Length-weight relationship of *P. canius* females

Table 2. Condition factor value of *P. canius*

Males			Females		
Weight (g)	CF range	Mean ± SD	Weight (g)	CF range	Mean ± SD
95-120	0.79-1.13	0.96±0.08	117–135	0.83-0.97	0.89±0.06
121–146	0.65-1.31	1.01±0.15	136–154	0.79-1.04	0.97±0.12
147–172	0.73-1.42	1.07±0.16	155–173	0.79-1.16	0.96±0.14
173–198	1.02-1.26	1.14±0.11	174–192	1.03-1.19	1.09±0.07
199–224	0.95-1.29	1.11±0.12	193–211	1.11-1.19	1.15±0.04
225–250	1.10-1.33	1.20±0.08	-	-	-
251–276	1.08-1.09	1.09±0.01	-	-	-
	0.65-1.42	1.10±0.10		0.79-1.19	1.01±0.09

Table 2. Condition factor value of *P. canius*

Gonad maturity level	Samples (n)	Body weight (g)	Total length (cm)
Male (I)	109	105–260	28.2–34.0
Male (II)	47	160–280	31.0–39.0
Female (I)	30	130–186	28.5–34.3
Female (II)	14	130–214	28.5–36.3

fish size, where a bigger size leads to a higher gonadal maturity level.

3.4. Feeding Activity

Based on observations, it was discovered that all specimens consumed were crabs, shrimps, worms, leaves, and small fish. Meanwhile, based on the type of consumed food, this species is categorized as carnivore fish. The data on the index of preponderance (IP) are shown in Figures 4 and 5.

The food groupings are based on the Index of preponderance (IP) values ranging from IP >40% as the main food, IP 4-40% as supplementary food, and IP <4% as a complementary food. Based on the main food, the males mostly consumed shrimp with a value of 42%, whereas the complimentary food was 17% of worms, 17% of leaves, 15% of small fish, and 9% of crabs. Meanwhile, the females only consumed shrimp, worms, small fish, crabs, and leaves with 37, 24, 17, 14, and 8%, respectively.

3.5. Water Quality

Water quality measurement was carried out at 4 locations, namely Seuriget, Simpang Lhee, Kuala Langsa, and Langsa Lama. Water quality parameters including pH, temperature, dissolved oxygen, and salinity were collected in situ using a digital water quality tester. The data on water quality are shown in Table 5.

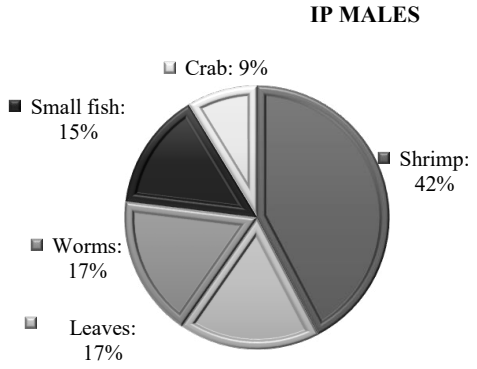

Figure 4. Index of preponderance *P. canius* males

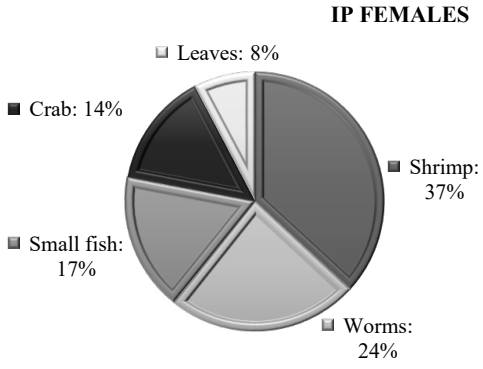

Figure 5. Index of preponderance *P. canius* females

Table 5. Water quality in Langsa Estuary

Parameter	Water quality
pH	7.2–7.3
Temperature	30.9–31.8°C
DO	3.8–4.7 mg/L
Salinity	32.3–34.1 ppt

4. Discussion

In this study, the analyses of the length-weight relationship of *P. canius* showed a negative allometric growth. This is similar to the previous studies by Yulianto *et al.* (2020), which reported that the length-weight relationship of *P. canius* in Bintan Bay, Riau Islands showed a negative allometric pattern, where males fish gained $W = 0.00542L^{2.3347}$ with b = 2.3347 and females $W = 0.0268L^{2.5378}$ with b = 2.5378. Moreover, Verawati *et al.* (2019) and Nurhayati *et al.* (2016) also mentioned a negative allometric growth of *P. canius* caught in Tanjung Pinang, Riau Islands, and Musi river estuary, respectively.

Condition factor is a physiological situation in fish that has an irreversible effect on various factors, including intrinsic and extrinsic values to determine obesity rates (Rahardjo and Simanjuntak 2008). Meanwhile, the differences in the value of the condition factor show a variation in fish growth. In this study, the value of the condition factor of *P. canius* ranged from 0.65-1.42 for males and 0.79-1.19 for females, which indicated that they were classified as thin fish. This result was similar to a study conducted by Muharram (2016), where the condition factor of *P. canius* Singaraja-Majakerta estuary was 1.1 and 1.0 for males and females, respectively. However, Jumiati *et al.* (2018) reported an average condition factor value for males with 1.06 and 2.07 for females, which showed that the female was fatter than the male. According to Dewanti *et al.* (2013), the low value of the condition factor is caused by the high population density in the environment where the fish live, leading to stunted fish growth. Wahyudewantoro and Haryono (2013) also stated that the value of the condition factor depends on several elements such as the number of organisms in nature, the organism's condition, the abundance of food, and the condition of the aquatic environment. The development of gonads with an increase in gonadal weight also increases the condition factor.

The maturity period of each species is different because it is affected by several conditions such

as environmental or genetic aspects (Nuning *et al.* 2017), nutrition (Canyurt and Akhan 2008), feeding ratio (Ibrahem *et al.* 2010; Martins *et al.* 2016), and spawning frequency (Yones *et al.* 2016). In this study, the gonadal stage maturation of the fish was observed, and it was discovered that the fish sizes are big, where the male has 28.2-39.0 cm with 105-280 g and the female has 28.5-36.3 cm with 130-214 g, while the gonad somatic index (GSI) was still in stage I and II. This result was different from previous studies carried out by Dewanti *et al.* (2013), where P. canius were first found to mature at 36.808 cm. This condition commonly occurs because different habitats can affect fish maturation. Senen *et al.* (2011) stated that variation in the maturation period could also occur in the same species when their habitat. It was reported that when fish are continuously caught or under pressure, they tend to mature at a smaller size. Based on the results, it is assumed that *P. canius* in the Langsa estuary were still in good condition. However, their reproduction process can be delayed due to the long maturation period.

This study also showed that shrimp is the most common organism in *P. canius* in the Langsa estuary. This result was similar to a previous study conducted by Safitri *et al.* (2021) which stated that the most common organisms in *P. canius* are shrimp and crab, with a range of 34.4 -50.2%. Muharram (2016) also showed that crustaceans are the most common organisms in *P. canius*, with 58-65% value range. Furthermore, Makri *et al.* (2021) stated that crustacean organisms are the main food of *P. Canius*, with a value of 79%. According to Syahputra *et al.* (2016), the number of organisms eaten by fish varies due to the spread of different organisms in each region. Generally, fish feeding habits are influenced by several factors such as habitat, substrate, season, age, fish preference for certain types of food, food size, and color.

The pH in each location (Seuriget, Simpang Lhee, Kuala Langsa, and Langsa Lama) showed an optimum range of 7.2-7.3, which is in line with Ekamaida (2017), who stated that pH 7.3-7.9 is suitable for supporting the life of water organisms in brackish water or estuary area. In this study, the temperature was 30.9-31.8°C, and is the same as Novita's (2016) and Yusuf *et al.* (2012) results, where the optimum temperature was in the range of 30.1-32.8°C. The DO obtained in this study was 3.8-4.7 mg/L, which is similar to Saraswati *et al.* (2017), who obtained DO values ranging from 3.0- 4.4 mg/L. Moreover, the salinity of 32.3-34.1 ppt was in line with the study by Yusuf *et al.* (2012), who obtained an average salinity, which ranged from 32-35 ppt and supported seawater organisms.

In conclusion, this study contributed to the limited data of *Plotosus canius*, especially in some biological aspects and its feeding activity. The distribution of length-weight of *P. canius* during January–June 2021 was within the range of 95-280 g and 26-39 cm. Based on the results, *P. canius* showed an allometric negative growth pattern. The average value of the male and females condition factors ranged from 1.1048 to 1.0102. This indicated that the male condition was better than the female. However, the estuary can still support the presence of *P. canius*. Furthermore, the main food of this species was shrimps, with an IP index of 42%.

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