**Sepat Siam fish community** (*Trichopodus pectoralis Regan, 1910*) in Semayang Lake, East Kalimantan

Samuel\(^1\), M Dwirastina\(^2\) and Y C Ditya\(^1\)

\(^1\) Institute Research inland fisheries and extension, Indonesia
\(^2\) Researcher Inland Fishery Resources Development and Management Department, Indonesia

Email: mirna.rastin@gmail.com

**Abstract.** Siam sepat (*Trichopodus pectoralis*) is a fish that lives with the characteristics of its life in mainland public waters such as rivers, lakes and flooded swamps. The Siam sepat is classified as a consumption fish, has morphological characteristics with a small mouth with a pointed snout and a flat body shape. The research was conducted from March to October 2018 in Semayang Lake, East Kalimantan. Fish samples obtained from fishermen's catch using fishing gear, including nets, nets, tangkul, scoops and traps. This study used an enumerator to record the length and weight of the fish. The results of the research analysis showed that the size of the individuals who dominate the Siam sepat fish population is at the size of 14.0-17.0 cm (60.8%), the allometric growth pattern (-) with the equation \(W = 0.0393 \times L^{2.6409}\). The size of the first caught (\(L_c\)) of the Siam Sepat fish was 17.31 cm, the maximum average length (\(L_\infty\)) was 22.75 cm and the growth coefficient (\(K\)) was 0.78 per year. Natural mortality (\(M\)) and fishing mortality (\(F\)) were 1.64 and 2.64 per year, respectively. Thus the rate of exploitation (\(E\)) = 0.62 has exceeded the optimum value indicating that the fishing effort of Siamese septic fish in Lake Semayang has occurred overfishing.

**I. Introduction**

East Kalimantan has a wide area of fresh water of about 2,643,400 ha, including lakes (95,456 ha), swamps (142,474) and rivers (2,405,470 ha). According to [1] Almost 80% of the total water area is located in the interior of the Regency. The sub-district in East Kalimantan which is the centre of fishery production is the Kota Bangun sub-district. In this district, there are 3 large lakes, namely Semayang, Melintang and Jempang Lakes. One of the large lakes is Lake Semayang which has an area of 13,000ha which has a meaning and an important role for the lives of the people who live around it. Lake Semayang has an annual water level fluctuation of up to 4 m, and at low tide it only leaves permanent water in a narrow area [2]. Semayang Lake is located in Kutai Regency, East Kalimantan with an area of 13,000 ha with a length of this river reaching 920 kilometres with an area of about 149,277 km\(^2\) and a depth of 50 meters in the downstream and about 100 meters in the upstream and located in the Mahakam watershed is a type of flood swamp lake. (*Flood plain*). The flooded swamp pattern is more dominant due to the influence of river flow than the influence of sea tides, and is categorized as swamp [2] [3]. This lake is one of the potential fish habitats for conducting *Spawning Ground* and *Nursery Ground*. The source of livelihood for the community, both as fishermen and business means of transportation[4] [5]. This is supported by several studies, [6] stated in their research that there are 25 types of fish found in these waters [5] and other research states that this river holds hundreds of different types of freshwater fish.
Siam Sepat Fish is not native to Indonesian freshwater but is a type of freshwater fish from mainland Southeast Asia, especially Cambodia, Laos, Thailand and Vietnam as well as Thailand's Chao Phraya River. [7] In 1934 this fish species was introduced to Indonesia (during the Dutch East Indies) and was developed into rice fields. The Siam sepat Fish is a land-based fish whose natural habitat is in flooded swamps and muddy waters. [8] stated that this fish belongs to the order Perciformes, the family Osphronemidae with the genus Trichopodus and the species Trichipodus pectoralis Regan, 1920 and is often referred to as snakeskin gourami [9]. Siam sepat fish habitat besides living in flooded swamps, canals, rivers, canals that are overgrown with vegetables or water plants. In Indonesia, you can find many Siam Sepat Fish because this fish is a consumption fish that is often found in flooded swamps and includes black fish, a small mouth with a pointed snout and a flat body shape of a jorong [8] [10].

Various studies on Siamese Sepat fish have been widely conducted. One of the studies that was carried out in 1937 was the introduction of Lake Tempe in South Sulawesi and the results were around 70% dominating in just two years [11]. [12] [13] stated that the results of research in the provinces of Jambi, South Sumatra, Riau, Central Kalimantan, South Kalimantan and the Asahan River found small Siam Sepat fish which indicated that the fishing had been carried out intensively. Until now, Siam Sepat fish production is still largely derived from fishing in the wild. Cultivation efforts have not been done much to preserve the existence of this fish species, it is feared that it will decrease and even experience extinction as well as various human activities that cause disruption to the fishery resource environment and as a consequence the diversity of fish species faces the threat of decreasing fish diversity [14] [15]. Therefore, it is necessary to study the population dynamics of the Siam Sepat fish in order to get the rarity from good and optimal management so that these fish can live in their habitat and be used sustainably. Evaluation and estimation of population parameters of the Siam sepat fish stock is currently very necessary.

The study was conducted to estimate the population parameters of the Sepat Siam fish in the Semayang Lake, East Kalimantan. This research is also expected to provide up-to-date information to stakeholders, especially fishermen, in terms of catching and utilizing Siamese septic fish in Semayang Lake, East Kalimantan.

2. Material and methods

2.1 Time and location
The research was conducted from March to October 2018 in Semayang Lake, Kutai Kartanegara Regency, East Kalimantan Province (Fig 1).

2.2 Data analysis
The analysis of the length-weight relationship of the Siam Sepat fish used data from the measurement of fish length and weight. Analysis of growth parameters, mortality, catch rate, and average size for first caught, used length frequency data measured by enumerators from March to October 2018. The procedure was carried out by measuring the length of the fish using a measuring board with accuracy 0.1 cm and weight weighed to accuracy 1.0 gram for each individual Siam sepat fish.

The equation of the relationship between length and weight of fish was analyzed using the formula proposed by[16], namely:

\[ W = a \times L^b \]  

where: \( W \) = fish weight (grams), \( L \) = total length (cm), \( a \) and \( b \) = constant.

The value of the constant \( b \) from the equation \( W = a \times L^b \) is tested for its accuracy against the value of \( b = 3 \) using the t-test at the 95% confidence level [17-19].

If the test result of the constant value of \( b \) is not different from 3, it means that the fish growth pattern is isometric, on the other hand, if the test result of the value of \( b \) is different from 3, the growth pattern will be allometric.
Growth parameters were analyzed using the Von Bertalanffy growth model [19] with the following equation:

\[ L_t = L_\infty \times (1 - \exp(-K \times (t - t_0))) \]  

(2)

Where \( L_t \) = length of fish at age t, \( L_\infty \) = asymptotic length / average maximum length, \( K \) = growth coefficient and \( t_0 \) = theoretical age at 0 cm length.

Asymptotic length (\( L_\infty \)) and growth coefficient (\( K \)) were calculated using the Elefan I program in the FISAT II computer program package [20].

The \( t_0 \) value is calculated using the [22] equation, namely:

\[ \log(-t_0) = -0.3922 - 0.2752 \log(L_\infty) - 1.038\log(K) \]  

(3)

The natural mortality rate (\( M \)) was analyzed using [21] empirical formula, namely:

\[ \log(M) = -0.0066 - 0.279\log(L_\infty) + 0.6543\log(K) + 0.4634\log(T) \]  

(4)

where \( L_\infty \) = asymptotic length, \( K \) = growth coefficient, and \( T \) = mean temperature of Semayang Lake waters (28°C).

The total mortality rate (\( Z \)) was analyzed from the converted catch curve based on the length of the converted catch curve, [22].

The calculations were computerized using the FISAT II program package [20]. The catch mortality rate (\( F \)) is calculated from the equation:

\[ F = Z - M \]  

(5)

The rate of exploitation (\( E \)) is calculated by the [22] equation:

\[ E = F / Z \]  

(6)

The average length for the first time caught (\( L_c \)) was analyzed by making a graph of the relationship between fish length as the X-axis and the number of fish as the Y-axis. The value of \( L_c \) (L50%) was calculated by the formula proposed by [19] as follows:

\[ SL = SL-est = 1 / [1 + \exp(S1-S2 \times L)] \]  

(7)

\[ \ln \left( \frac{1}{SL} - 1 \right) = S1-S2 \times \]  

(8)

L50% = S1 / S2  

(9)

where: SL = logistic curve; S1 and S2 = constants in the logistic curve formula.

3. Result and discussion

3.1 Result

The Siam sepat fish (Fig 2) in Lake Semayang has a blackish gray body, darker back and bright belly, is the type of Trichopodus pectoralis and has stripes on its sides [8] [9]. Taxonomically, the Siam sepat fish belongs to the family Osphronemidae, order Perciformes and the Actinopterygii class [8] [9]. Siam sepat fish as herbivorous fish and these fish are often found in waters that are protected by aquatic plants [23].

![Figure 1. Research locations at Semayang Lake](image-url)
Figure 2. Sepat Siam fish (*Trichopodus pectoralis*)

The growth pattern of Siam Sepat fish in Lake Semayang based on the length-weight relationship equation is shown in Fig 3. The functional equation is: \( W = 0.0393 \times L^{2.6409} \) with a regression coefficient value \( R^2 = 0.84 \).

The results of the t test on parameter \( b \) with a confidence level of 95% get the value of \( t\text{-count} = 9.82 \), which is greater than \( t\text{-table} = 1.96 \), thus the value of parameter \( b \) is different from 3 or the value of parameter \( b \) is not the same as 3 (\( b <3 \)) which shows the growth pattern of Siam sepat fish in Semayang Lake is negative allometric (-). The results of analysis of long frequency data (length frequency data) from March-October 2018, showed that the population of the Siam sepat fish (*Trichopodus pectoralis*) in Lake Semayang was dominated by individuals measuring 14.0-17.0 cm with a frequency of 60.8%. (Fig 4).

The results of long frequency data analysis using the FISAT II program package showed that the infinity length (\( L_\infty \)) was 22.75 cm, the growth coefficient (\( K \)) was 0.78 per year and the theoretical age (to) was - 0.22 years. With these 3 parameters, the growth model of the Siam sepat fish (*Trichopodus pectoralis*) in Semayang Lake follows von Bertalanffy's equation, namely: \( L_t = 22.75 \times (1 - \exp (-0.78 \times (t + 0.22))) \) or \( L_t = 22.75 \times (1 - 0.78 \times (t + 0.22)) \) (Fig 5). Entering the growth parameter value and the average water temperature value of Semayang Lake (28°C), the natural mortality rate (\( M \)) is 1.6377 or \( M = 1.64 \) per year (Fig 6). Analysis of the length-converted catch curve model (Fig 7) obtained a total mortality (\( Z \)) of 4.28 per year. Capture mortality (\( F \)) is \( Z - M \) which is 2.64 per year and exploitation rate (\( E \)) is \( F / Z \) which is 0.62. The value of the siam sepat fish population parameters from the analysis results are listed in Table 1. The average length of the first siamese fish caught at \( L_{50\%} \) (\( L_c \)) was 17.31 cm TL (Fig 8). The functional equation for the logistic curve is \( SL_{\text{est}} = \frac{1}{1 + \exp (S1 - S2 \times L)} = 1 / (1 + \exp (11.849 - 0.6846 \times L)) \).
**Figure 4.** Frequency distribution of the length Sepat siam Fish

**Figure 5.** Growth curves of Sepat siam fish

**Figure 6.** Analysis of natural mortality (M) of Sepat Siam fish
Figure 7. Analysis of the Z value of the Sepat Siam Fish

Figure 8. The first average length of fish caught

Table 1. Value of Siam sepat fish population parameters in Semayang Lake

| No | Parameters                              | Simbol | Value  |
|----|-----------------------------------------|--------|--------|
| 1  | Slope equation W=aL<sup>b</sup>         | b      | 2.6409 |
| 2  | Long infinitif                          | L∞     | 22.75  |
| 3  | Koeifisen Growth                        | K      | 0.78   |
| 4  | Age teoritis moment L<sub>c</sub> = 0 cm | t<sub>0</sub> | -0.22 |
| 5  | Natural mortality                       | M      | 1.64   |
| 6  | Arrest mortality                        | F      | 2.64   |
| 7  | Total mortality                         | Z      | 4.28   |
| 8  | Exploitation rate                       | E      | 0.62   |
| 9  | Average the first length was caught     | L<sub>c</sub> | 17.31 |

3.2 Discussion

The results of the analysis of length and weight data, obtained a functional equation of the length-weight relationship of Siam sepat fish (Trichopodus pectoralis) with the following equation: \( W = 0.0393 \times L^{2.6409} \) with an negative allometric (-) growth pattern. The negative allometric (-) growth pattern indicates that the individuals of the Siam sepat fish in Lake Semayang have a thin body condition. Compared with the growth pattern of Siam sepat fish in the Barito River which is also negative allometric (-) with a value of \( b = 2.3693 \) [12] and Siam sepat fish in Lake Tempe with a value of \( b = 2.1448 \) [11], the condition of siam sepat fish in Semayang Lake is still better.

The results of the analysis of the long-weight relationship of Siam sepat fish in the tropics of Southeast Asia showed a better growth pattern, namely isometric with a constant value \( a = 0.01230 \) (0.00752-0.02012) and a constant \( b = 3.05 \) (2.91-3.19), in terms of total length cm [9]. The growth pattern of fish species based on the constant value \( b \) can be influenced by the development of gonad maturity levels, differences in sex, age, geographical position, environmental conditions and seasons [24]. Fish growth can be influenced by environmental factors, including: type and size of food, Fish size, environmental quality and fish condition...
The relationship between the length-weight of the Siam sepat fish with a value of $b$ is less than 3 (allometric (-), indicating that growth is not good and one the reason is because the fishing rate of the fish population has exceeded the optimum value as shown in Table 1, the exploitation rate (E) is $0.62 > E_{opt} = 0.50$.

The growth curve of von Bertalanffy shows that the individuals of Siam sepat can grow to an average maximum length / infinity length ($L_\infty$) = 22.75 cm with a growth coefficient (K) of 0.78 per year. Siam sepat fish, whose distribution is spread across tropical Southeast Asia, can reach an average maximum length of 25 cm [9]. Lake Semayang Siam sepat fish can reach an average maximum length of 22.75 cm, slightly smaller than those mentioned above. The size of the most caught Siam Sepat fish ranged from 14.0 to 17.0 cm with a frequency of 60.8% (Fig 4) and their ages ranged from 1.0 to 1.5 years (Table 2).

Table 2. The relationship between age and length growth of the Siam sepat fish (*Trichopodus pectoralis*) in Semayang Lake, East Kalimantan

| No | t/umur (year) | Lt/Length (cm) | No | t/age (Year) | Lt/length (cm) |
|----|---------------|----------------|----|--------------|----------------|
| 1  | 0.1           | 5.03           | 16 | 1.6          | 17.25          |
| 2  | 0.2           | 6.36           | 17 | 1.7          | 17.66          |
| 3  | 0.3           | 7.59           | 18 | 1.8          | 18.04          |
| 4  | 0.4           | 8.72           | 19 | 1.9          | 18.40          |
| 5  | 0.5           | 9.78           | 20 | 2.0          | 18.72          |
| 6  | 0.6           | 10.75          | 21 | 2.1          | 19.03          |
| 7  | 0.7           | 11.65          | 22 | 2.2          | 19.31          |
| 8  | 0.8           | 12.48          | 23 | 2.3          | 19.56          |
| 9  | 0.9           | 13.25          | 24 | 2.4          | 19.80          |
| 10 | 1.0           | 13.97          | 25 | 2.5          | 20.02          |
| 11 | 1.1           | 14.62          | 26 | 2.6          | 20.23          |
| 12 | 1.2           | 15.23          | 27 | 2.7          | 20.42          |
| 13 | 1.3           | 15.80          | 28 | 2.8          | 20.59          |
| 14 | 1.4           | 16.32          | 29 | 2.9          | 20.75          |
| 15 | 1.5           | 16.80          | 30 | 3.0          | 20.90          |

The growth coefficient (K) of Sepat Siam in Lake Semayang $0.78 < 1.00$ is low [19]. When compaerd with the K of the barito River Sepat Siam Which is 0.6 [12], the growth of the Siam Sepat fish in Lake Semayang is still better.

The fishing mortality value $F = 2.64$ is greater than the natural mortality $M = 1.64$ indicates the catch rate / exploitation rate of Siam sepat fish in Semayang Lake is $E = 0.62$, greater than the optimum value. This shows that the fishing of sepat sepat in this lake is classified as intensive. It can also be seen from the constant value $b < 3$ in the allometric growth pattern (-). [26] and [27] that if the exploitation rate (E) of a fish population is higher than the optimum value, it indicates that the fish stocks in these waters are still quite large, however, siam sepat fishing efforts in Semayang Lake which tends to increase need to be limited until the value of E approaches the optimum value (Eopt = 0.50). Most of the siam sepat caught by fishermen in Lake Semayang have an average size of caught ($L_c$) = 17.31 cm (Table 1), while the length of the Siam sepat fish caught in Southeast Asian countries is generally an average size of 15 cm [10].

The population of Sepat Siamese fish (*Trichopodus pectoralis*) in Lake Semayang is dominated by individuals measuring 14.0-17.0 cm long with a frequency of 60.8%. Length-weight relationship with functional equation $W = 0.0393 * L^{2.6409}$ with allometric growth pattern (-). Asymptotic length/ average maximum length ($L_\infty$) = 22.75 cm and growth coefficient (K) = 0.78 per year. Natural mortality (M) and fishing mortality (F) were 1.64 and 2.64 per year, respectively. The exploitation rate (E) = 0.62 is greater than the optimum value (E = 0.5), indicating that the effort to catch Sepat Siam fish in Lake Semayang has exceeded its optimum value (over fishing). The average size caught ($L_c$) is 17.31 cm which is classified as consumption size.
4. Conclusion
The population of Sepat Siam fish (Trichopodus pectoralis) in Lake Semayang is dominated by individuals measuring 14.0-17.0 cm long with a frequency of 60.8%. Length-weight relationship with functional equation $W=0.0393 \times L^{2.6409}$ with negative allometric (-) growth pattern. Asymptotic length/ average maximum length ($L_{\infty}$) = 22.75 cm and growth coefficient (K) = 0.78 per year. Natural mortality (M) and fishing mortality (F) were 1.64 and 2.64 per year, respectively. The exploitation rate (E) = 0.62 is greater than the optimum value (E = 0.5), indicating that the effort to catch Sepat Siam fish in Lake Semayang has exceeded its optimum value (over fishing). The average size caught (Lc) is 17.31 cm which is classified as consumption size.

Acknowledgements
This paper is the contribution of the research "Study of fish stock and potential resources in the Mahakam watershed, East Kalimantan Province", in 2018. The author would like to thank the Head of the Center for giving confidence in conducting research in Semayang Lake, part of the Mahakam watershed. To colleagues from the research team and also from the staff of the local Fisheries Service and the fishermen who catch eel in Semayang Lake, the authors would like to thank for their participation.

References
[1] Haryono 2006 Iktiologi Indonesia 6 75
[2] Lukman, Fakhrudin M, Gunawan and Ridwansyah I 1998 Laporan Rehabilitasi Lingkungan Danau Semayang 15.
[3] Widjaja-Adhi I P G 1984 Dalam Prosiding Pertemuan teknis Penelitian Pola Usaha Tani Menunjang Transmigrasi 49
[4] Zehrfield H E, I Mulyana, Sugiharti, S Didik 1985 Technical Cooperation for Area Development Project.
[5] Sulistianto E, Erwiantono 2015 Jurnal Harpodon Borneo 8 88
[6] Suyatna I, Syahrir M, Mislan, Wijaya Y I, Abdunnur A 2017 Omni-Akuatika 13 89.
[7] Iskandariah, D T Soelistyowati, R Gustiano, I I Kusmini, and G H Huwoyon 2015 Berita Biologi 14
[8] Kottelat M, J A Whitten, N Kartikasari & S Wiryoatmojo 1993 Periplus Edition and EMDI Project Indonesia 221 p.
[9] FishBase 2013 Diakses dari http://www.fishbase.org, tanggal 1 April 2019.
[10] Rumondang, J P batubara, K F Simbolon 2020 Prosiding Seminar Nasional Multidisiplin Ilmu Universitas Asahan ke-4. Kalimantan.
[11] Makmur S, Samuel, Pongmasak P R, Farid A, Adiansyah V, Selamet S, Burnawi & Hifni T 2010 Laporan Teknis Penelitian. Balai Penelitian Perikanan Perairan Umum, Palembang.
[12] Utomo A D 2015 Naskah Orasi Pengukuhan Profesor Riset Bidang Sumberdaya dan Lingkungan. Balitbang KP, Kementerian Kelautan dan Perikanan.
[13] Laila K, Romondang, J P Batubata , K Gibran, A Sikta and D Purnama 2020 Prosiding Seminar Nasional.
[14] Mamatkey J J, Sulistiono, D S Sjafei, D Soedarma, S Sukimin, dan E Nugroho 2007 Jurnal Riset Akuakultur 2 389
[15] Dunham R A 2004 Aquaculture and fisheries biotechnology: genetic approach 85
[16] Effendie, M. I. (1979). Metoda biologi perikanan. Penerbit Yayasan Dewi Sri. Bogor. 112 p.
[17] Steel R G D & J H Torrie 1976 McGraw-Hill Book Company, New York. 382
[18] Walpole R E 1995 PT Gramedia 515.
[19] Sparre P & S C Venema 1999 Manual 438.
[20] Gayanillo Jr F C, P Sparre & D Pauly 1995) ICLARM Contribution 1048 126.
[21] Pauly D 1980 FAO Fish Circ 729. 54 p.
[22] Pauly D 1983 ICLARM Fishbyte 2 9.
[23] Ditya Y G, Samuel, Antoni R, Pratama S, Dwirastina M, Arisna D & Mersi 2018) Laporan Teknis Penelitian.
[24] Bagenal T B & F W Tesch 1978 IBP Handbook Unwin Bros Ltd. 365 .
[25] Umar C & E S Kartamihardja 2011 BAWAL 3 351.
[26] Hariati T 2011 Jurnal Penelitian Perikanan Indonesia 17 31.
[27] Nurulludin & Prihatiningsih 2013 Prosiding Forum Nasional Pemulihan dan Konservasi Sumberdaya Ikan ke-IV 8.