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FOOD HABITS OF SPOTTED BARB, SILVER BARB, THREE-SPOT GOURAMI, AND MARBLE GOBY IN RAWA PENING LAKE, SEMARANG

KEBIASAAN MAKAN WADER BINTIK DUA, TAWES, SEPAT RAWA, DAN BETUTU DI DANAU RAWA PENING, SEMARANG

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ABSTRACT

One of the fishery potentials in Rawa Pening Lake, Semarang Regency, is the indigenous fish. The indigenous fish in this lake have declined due to changes in water quality, intensive fishing activities, and interspecies competition for resources. Some indigenous fish species in this lake include the spotted barb, silver barb, three-spot gourami, and marble goby. The purpose of this study was to analyze the food composition of four indigenous fish species. This study was conducted from October to December 2023. The sampling locations consisted of three stations at different depths (0, 1, and 2 m). Food composition analysis used the index of preponderance. This study found that four indigenous fish of Rawa Pening Lake utilize litter as the main food, phytoplankton as a complementary and additional food source. Zooplankton serve as an additional food source for spotted barb and three-spot gourami. Small fish serve as additional food for the marble goby. These differences in fish diet composition are due to adaptation to available food sources in the water.

Keywords: food composition, indigenous fish, litter, phytoplankton, Rawa Pening Lake

ABSTRAK

Salah satu potensi perikanan di Danau Rawa Pening, Kabupaten Semarang adalah sumberdaya ikan *indigenous* (asli). Jumlah ikan *indigenous* di Danau Rawa Pening semakin menurun karena perubahan kualitas air, kegiatan penangkapan yang intensif, dan kompetisi sumberdaya antar spesies. Beberapa jenis ikan *indigenous* adalah wader bintik dua, tawes, sepat rawa, dan betutu. Penelitian ini bertujuan untuk menganalisis komposisi makanan empat jenis ikan *indigenous* di Danau Rawa Pening. Penelitian ini dilakukan pada bulan Oktober–Desember 2023. Lokasi Pengambilan sampel terdiri dari 3 stasiun dengan kedalaman berbeda (0, 1, dan 2 m). Analisis komposisi makanan ikan menggunakan *index of preponderance*. Hasil penelitian ini menemukan bahwa empat jenis ikan *indigenous* Danau Rawa Pening memanfaatkan serasah sebagai makanan utama. Fitoplankton dimanfaatkan sebagai pelengkap dan tambahan. Zooplankton sebagai makanan tambahan untuk ikan wader bintik dua dan sepat rawa. Ikan kecil sebagai makanan tambahan untuk ikan betutu. Perbedaan komposisi makanan ini sebagai bentuk adaptasi ikan dalam memanfaatkan sumber makanan yang tersedia di perairan.

Kata kunci: Danau Rawa Pening, fitoplankton, ikan *indigenous*, komposisi makanan, serasah

INTRODUCTION

Rawa Pening Lake is one of the largest lakes in Central Java Province, which covers the districts of Ambarawa, Bawen, Tuntang, and Banyubiru, Semarang Regency, with an area of approximately 2,670 hectares. The lake serves as an economic resource (Fadilah *et al*. 2018). One of the most widely exploited potentials is the capture fisheries and aquaculture sector. One of the fish populations in Rawa Pening Lake is an indigenous fish that naturally inhabits Indonesian waters and plays a vital role in maintaining the lake's biodiversity and ecosystem balance (Iskandar *et al*. 2020). Another population is exogenous fish, which are fish from outside Indonesia that are intentionally or unintentionally introduced into aquatic ecosystems for a specific purpose (Dewantoro and Rachmatika 2016). Some of the fish in Rawa Pening Lake are spotted barb, three-spot gourami, marble goby, bonylip barb, snakehead, tilapia, red devil, bronze featherback, and catfish (Ramadhan *et al*. 2023). Other research in this lake has found snakehead, spotted barb, silver barb, climbing perch, three-spot gourami, marble goby, and hampala barb, while exogenous fish found include tilapia, red devil, three-spot cichlid, and cachama (Weri and Sucahyo 2017).

Several studies have stated that there has been a decline in indigenous fish in Rawa Pening Lake. Haryani *et al*. (2023) reported that only three endemic fish species were found between March and October 2021. The number of native fish in the waters accounts for less than 10% of the total fish population in Rawa Pening Lake (Sitomorang *et al*. 2013 *in* Haryani *et al*. 2023). This is due to continuous fishing activities. Furthermore, the presence of exogenous fish that adapt easily, resulting in faster distribution, has led to the threat of extinction of indigenous fish. These fish species have different feeding habits, but some utilize the same types of food. This similar food composition leads to competition for food, which will affect the amount of natural food in the water (Sulardiono *et al*. 2022). Another factor could be anthropogenic activity around Rawa Pening Lake. This activity can affect water conditions and the availability of natural food. These changes are caused by changes in the aquatic environment, which can alter fish feeding habits (Noviani *et al*. 2021).

Variations in the amount of food available and utilized will affect the balance of a fish community. If the availability of food is less than the number of fish, competition for food occurs. This disrupts the food chain due to overlapping utilization of the same food types. Therefore, it is important to understand the dietary habits of indigenous fish to determine their food selection and utilization of the available food in Rawa Pening Lake. However, research on indigenous fish in this lake is still limited. This study is necessary to formulate appropriate fisheries resource management, especially to support the sustainability and preservation of indigenous fish in their natural habitat. The purpose of this study was to analyze the food composition of four indigenous fish species (spotted barb, silver barb, three-spot gourami, and marble goby) in Rawa Pening Lake.

METHODS

This study was conducted from October to December 2023 in Rawa Pening Lake. Identification of indigenous fish, analysis of plankton abundance, and fish food composition were conducted at the Laboratory of Fish and Environmental Resources Management, Department of Aquatic Resources, Faculty of Fisheries and Marine Sciences, Universitas Diponegoro, Semarang, Indonesia.

Fish sampling

The sampling location was determined using a survey method, a method used to collect data over a specific period. This survey was conducted by following the fishermen's fishing grounds according to the presence of fish traps scattered throughout Rawa Pening Lake. The sampling points consisted of three stations based on the presence of fish traps scattered throughout the waters (Figure 1). Descriptions of sampling points is presented in Table 1. This sampling was carried out three times over three months, with fish and water samples taken every month in Rawa Pening Lake.

The fish sampling method used was random sampling, which involved random sampling through field observations following fishermen's fishing grounds without regard to specific strata. The fishing gear used was wire and bamboo traps. The traps are shown in Figure 2.

Water sampling

Water sampling (for plankton filtering) and water quality measurement were conducted simultaneously. Water quality measurements consist of physical parameters (temperature, depth, and transparency) and chemical parameters (DO and pH) (Rahman *et al*. 2022).

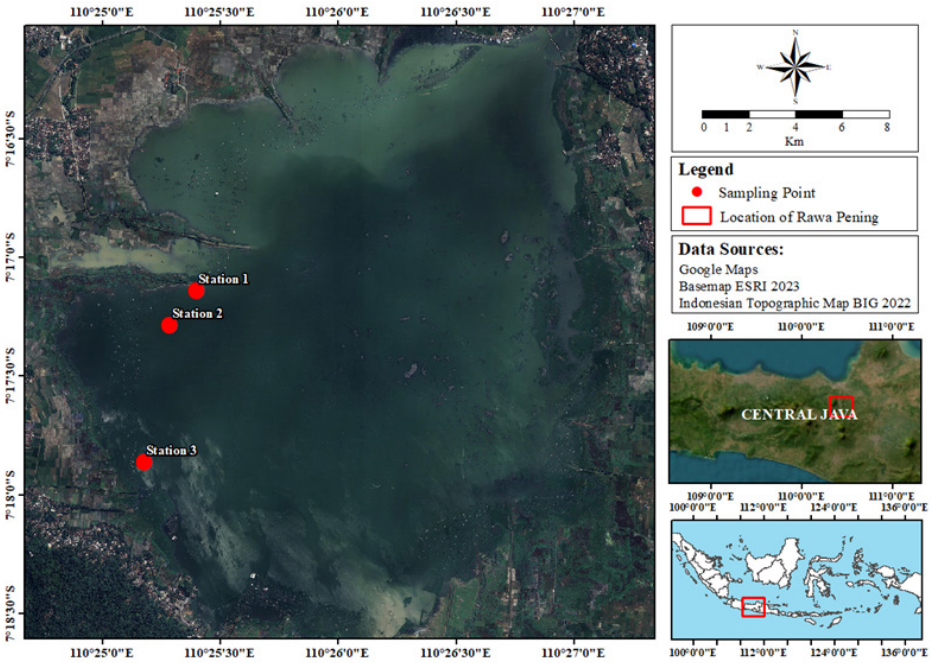
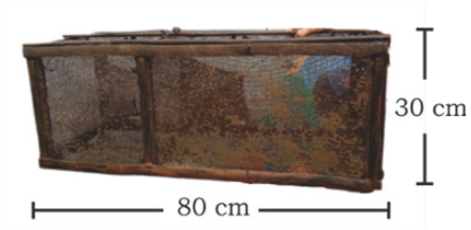


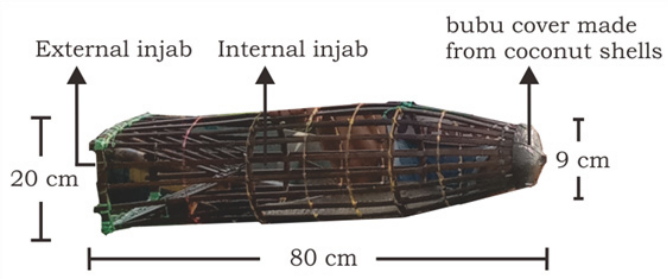
Figure 1. Map of sampling locations of Rawa Pening Lake, Semarang Regency.

Table 1. Coordinates and characteristics of fish sampling stations in Rawa Pening Lake.

Station	Coordinate Points	Description
1	7°17'08.7"S 110°25'24.1"E	An area with many fishermen catching fish and surrounded by water hyacinth.
2	7°17'18.1"S 110°25'17.5"E	An area close to fishing activity with a “branjang” (lift net).
3	7°17'53.5"S 110°25'10.7"E	An area close to community activity, tourist areas, and agriculture, as well as fishing activity.



(a)



(b)

Figure 2. Fish trap, (a) wire trap, (b) bamboo trap.

Data collection

Fish identification

Fish samples were identified according to Saanin (1984). Fish identification was carried out by observing their morphometric and meristic characteristics, including mouth type, scale shape, and head shape.

Fish food composition

Food composition data were obtained from the stomach contents of fish. Stomach contents were observed using a microscope with a 10x objective lens magnification. The types and quantities of plankton counted were recorded with two repetitions (Prahitaningtyas 2023). Plankton identification referred to Mizuno (1974) and Sulastri (2018). The plankton found were then grouped according to type.

Plankton abundance

Calculation of plankton abundance based on the APHA (2005),

$$N = n \times \frac{Vt}{Vo} \times \frac{Asrc}{Aa} \times \frac{1}{Vd}$$

Description:
N = Plankton abundance (ind/L)
n = Number of identified plankton (ind)
Vt = Volume of filtered water (ml)
Vo = Volume of water in Sedgewick Rafter (ml)
$Asrc$ = Sedgewick Rafter area (mm^2)
Aa = Observation area (mm^2)
Vd = Volume of water filtered (L)

Data analysis

Data analysis for food composition based on Effendie (1997) using the index of preponderance,

$$IP = \frac{N_i \times O_i}{\sum N_i \times O_i} \times 100$$

Description:
IP = Index of preponderance
N_i = Percentage of the amount of a specific food type (i)
O_i = Percentage of the frequency of occurrence of that specific food type (i)
$\sum N_i \times O_i$ = Total $N_i \times O_i$ of all food types

The percentage frequency of occurrence (O_i) is based on the following formula:

$$O_i = \frac{\text{Number of stomachs containing one food type}}{\text{Total number of stomachs contains food}} \times 100\%$$

Three categories of fish food composition based on IP percentage, consisting of IP > 25% (main food), IP 5–25% (complementary food), and IP<5% (supplementary food) (Febryanti *et al.* 2021).

RESULTS AND DISCUSSION

Indigenous fish species

There were four indigenous species caught, with a total of 21 individuals, namely spotted barb (*Barbodes binotatus*), silver barb (*Barbonymus gonionotus*), three-spot gourami (*Trichogaster trichopterus*), and marble goby (*Oxyeleotris marmorata*). The most abundant indigenous fish was the marble goby, with 8 individuals caught, representing 38.10% of the total catch. Other fish, silver barb (23.80%), spotted barb, and three-spot gourami, both had similar percentages (19.05%).

The indigenous fish caught in this study consisted of four species with a total of 21 fish. Indigenous fish species were dominated by the family Cyprinidae. The Cyprinidae family is a group of fish that dominates freshwater bodies. In general, this condition is commonly found in Indonesia, especially in Java, Sumatra, and Kalimantan (Faradiana *et al.* 2018). The most common species was the marble goby (38.10%). The dominance of the marble goby is due to its preference for living at the bottom of shallow waters such as Rawa Pening Lake. Marble goby prefer dark, calm waters with rocks or aquatic plants as shelter (Nugroho *et al.* 2016). The diversity of fish obtained was also affected by food availability. The high abundance of plankton as a food source for fish is caused by the optimal light intensity for photosynthesis, which produces oxygen and organic matter in the water (Desmawati *et al.* 2020).

Water quality

The type and number of fish in waters are influenced by water quality and food availability (Saha *et al.* 2022). The water quality in this study was classified as optimal for fish growth according to quality standards (Table 2). The pH values of the three stations ranged

from 6.55 to 6.88. The pH was classified as good for fish. The acceptable pH range for fish is between 6.5 and 9.0 (Dasharathbhai *et al*. 2025). Unsuitable pH causes inhibited fish growth, making fish susceptible to bacterial infection and even death (Bayumi *et al*. 2021).

The dissolved oxygen concentration at the three stations ranged from 3.6 to 9.1 mg/L, which is suitable for the survival of aquatic organisms (Ali *et al*. 2022). Dissolved oxygen concentration will decrease with increasing depth due to reduced sunlight, which decreases photosynthesis (Sofiana *et al*. 2022). This is also related to the transparency value, ranging from 50 to 54.5 cm. The low transparency is caused by the proximity of this location to human activities, tourism, and rice fields. The higher the organic matter content, the lower the transparency, which impacts photosynthesis, resulting in a decrease in dissolved oxygen concentration (Putrisia *et al*. 2022).

The temperature ranged from 27.4 to 30.5 °C. The temperature during the study was optimal for fish survival. Water temperature is influenced by water depth, weather, and sunlight. Temperature influences growth, metabolism, physiology, distribution, and survival of biota (Meliani *et al*. 2018). High temperatures can increase the metabolism and respiration of aquatic biota, thereby increasing oxygen demand. In tropical waters, optimal fish growth occurs at temperatures of 25–32 °C (Alfatihah *et al*. 2023).

The depth in this study ranged from 195 to 250 cm. The depth at Station 3 is high because it is located far from land. Depth affects water quality related to dissolved oxygen. Dissolved oxygen concentration will decrease if light intensity in the water decreases, thus inhibiting photosynthesis (Siswansyah and Kuntjoro 2023). Furthermore, this affects the survival and growth of fish. The presence of populations of various fish species indicates that these waters provide suitable habitat and food sources (Astuti and Fitrianingsih 2018).

Plankton abundance

Plankton found in Rawa Pening Lake comprised 34 genera from 8 classes of phytoplankton and zooplankton (Table 3). The highest abundance of plankton in Rawa Pening Lake was the genus *Coelastrum* sp. at 225,000 Ind/L (Figure 3). This species is included in the Chlorophyceae, which is the most dominant in Rawa Pening Lake.

Food composition

The food composition of indigenous fish in this study consisted of litter, phytoplankton, zooplankton, small fish, and unidentified material. Litter is the most common type found, consisting of crushed plant parts or leaves. This group was found highest in the marble goby (> 95%) and lowest in the three-spot gourami (70.30%). The phytoplankton group was found mostly in the three-spot gourami (25.46%). The highest zooplankton was found in the spotted barb (0.05%). Small fish were only found in marble goby (0.004%). The highest unidentified species were found in the three-spot gourami at 4.20% (Figure 4).

Based on the research results, the food composition of the marble goby is dominated by litter. Based on Figure 4, the main food of the marble goby is litter (99.44%). Hutauruk *et al*. (2022) stated that the litter found in the stomach of the marble goby indicates that this fish forages at the bottom of the waters. Additional food for the marble goby in this study included phytoplankton, small fish, and unidentified materials. The phytoplankton most consumed by this fish is *Chlorella* sp. (Chlorophyceae). In the stomach of this fish, small fish (3.5 cm in total body length and 0.29 g in weight) were also found. Hedianto *et al*. (2013) explained that the main food of the marble goby is fish, with supplementary food being insects and crustaceans (Riede 2004).

The spotted barb utilizes litter as its main food and phytoplankton as a supplementary food. The phytoplankton consumed by this fish is mostly Bacillariophyceae (*Navicula*, *Cyclotella*, *Nitzschia*, and *Synedra*). This fish also consumes zooplankton (*Philodina* sp.) as additional food. Pramana *et al*. (2023) explained that the composition of the spotted barb food types in Tamblingan Lake (Buleleng, Bali) was 6 classes of phytoplankton, 6 classes of zooplankton, 1 class of fungi, and 1 class of aquatic plants. Based on its food composition, the spotted barb is grouped as an omnivorous fish (tends to be herbivorous). Spotted barbs can eat all types of food around it, such as phytoplankton, zooplankton, algae, plants, aquatic insects, and even the eggs of other wader fish (Firmansyah *et al*. 2015).

The stomach contents of the three-spot gourami consist of plant litter, phytoplankton, zooplankton, and unidentified material. This fish consumed phytoplankton from the Chlorophyceae (*Coelastrum* sp., *Pediastrum*

sp., and *Oocystis* sp.), as well as zooplankton (*Keratella* sp. and *Rotifera* sp). Based on Figure 4, the three-spot gourami utilizes litter (70.30%) and phytoplankton (25.46%) as its primary food source. Its supplementary food consists of zooplankton and unidentified (IP < 5%). Muliah *et al.* (2020) stated that the three-spot gourami is a herbivorous fish that consumes parts of plants (as its main food) and phytoplankton (as a supplementary food source). Noviani *et al.* (2021) explained that the stomach contents of the swamp gourami are dominated by phytoplankton as its primary food source.

The silver barb utilizes litter as its primary food source, phytoplankton (as a supplementary food source), zooplankton, and unidentified materials as additional food sources. The phytoplankton consumed most by this fish is Chlorophyceae (*Coelastrum* sp., *Pediastrum* sp., and *Scenedesmus* sp.). Research by Ridwantara *et al.* (2019) in the downstream Begawan Solo River showed that silver barbs consumed a lot of phytoplankton (Chlorophyceae). This fish is classified as a herbivore, with its main diet consisting of phytoplankton (Chlorophyceae) (Ain *et al.* 2021).

In general, indigenous fish in Rawa Pening Lake utilize litter as their main food source. The litter found in fish's stomach is most likely prey for fish that eat leaves (Liana *et al.* 2020). A stomach filled with litter can also be caused by fish being hungry, resulting in an empty stomach. According to Sjafei (2001) *in* Hasibuan *et al.* (2023), the empty fish stomach can be caused by the food being fully digested. Phytoplankton is a type of food found in all indigenous fish and is the main food for the three-spot gourami, a supplementary food source for the spotted barb and silver barb, and an additional food source for the marble goby. Additional food sources include zooplankton, which are utilized by the spotted barb and three-spot gourami, and unidentified materials are utilized by all fish. Differences in food composition are influenced by the availability of environmental factors, fish size, and natural food (Effendie 2002).

Table 2. Water quality parameters of Rawa Pening Lake.

Parameter	Station									Standard (*)
	1			2			3			
	0 m	1 m	2 m	0 m	1 m	2 m	0 m	1 m	2 m	
Dissolved oxygen (mg/L)	7.6	4.9	3.6	8.6	6.4	4.9	9.1	5.9	4	> 3
pH	6.88	6.88	6.75	6.72	6.55	6.67	6.8	6.72	6.81	6–9
Temperature (°C)	30.5	29.1	28.5	30.4	28.4	27.4	30.4	28.9	28.6	Dev 3
Depth (cm)		195			226			250		-
Transparency (cm)		54.5			51			50		-s

(*) Government Regulation Number 22 of 2021, Appendix IV for Quality Standards for Lake Water and Similar Water Class 3.

Table 3. Plankton abundance in Rawa Pening Lake, Semarang Regency.

No	Class	Abudance (Ind/L)			Total Abundance (Ind/L)	Percentage (%)
		Station				
		1	2	3		
1	Bacillariophyceae	86,833	61,833	138,500	287,167	24.48
2	Chlorophyceae	203,167	135,833	410,333	749,334	63.89
3	Cyanophyceae	38,667	28,500	51,833	118,999	10.15
4	Dinophyceae	0	0	667	667	0.06
5	Euglenophyceae	2,167	1,833	1,500	5,500	0.47
6	Oligohymenophorea	333	0	167	500	0.04
7	Trebouxiophyceae	0	0	167	167	0.01
8	Zygnematophyceae	1,667	1,667	3,000	6,333	0.54
9	Zooplankton	500	167	3,500	4,167	0.36
	Total	**333.333**	**229.833**	**609.667**	**1.172.833**	**100**

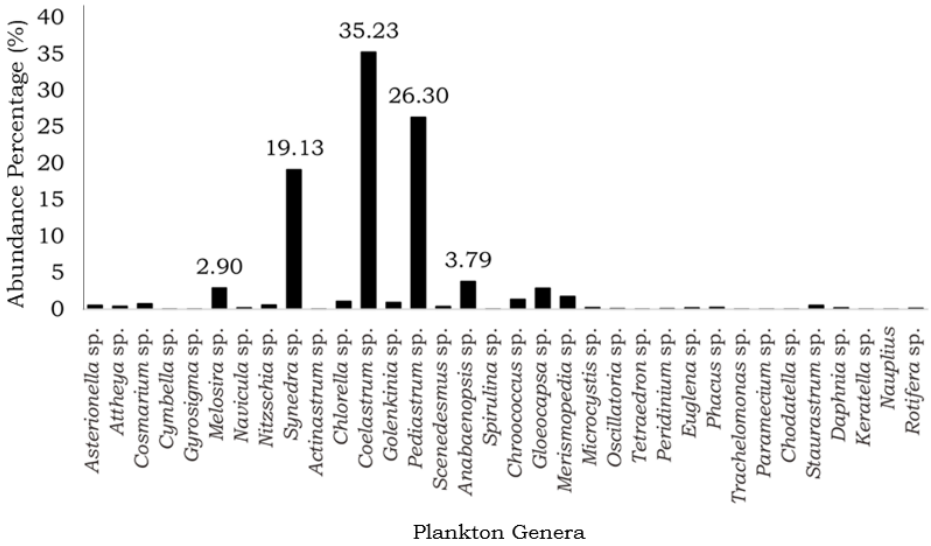


Figure 3. Percentage of plankton abundance in Rawa Pening Lake, Semarang Regency.

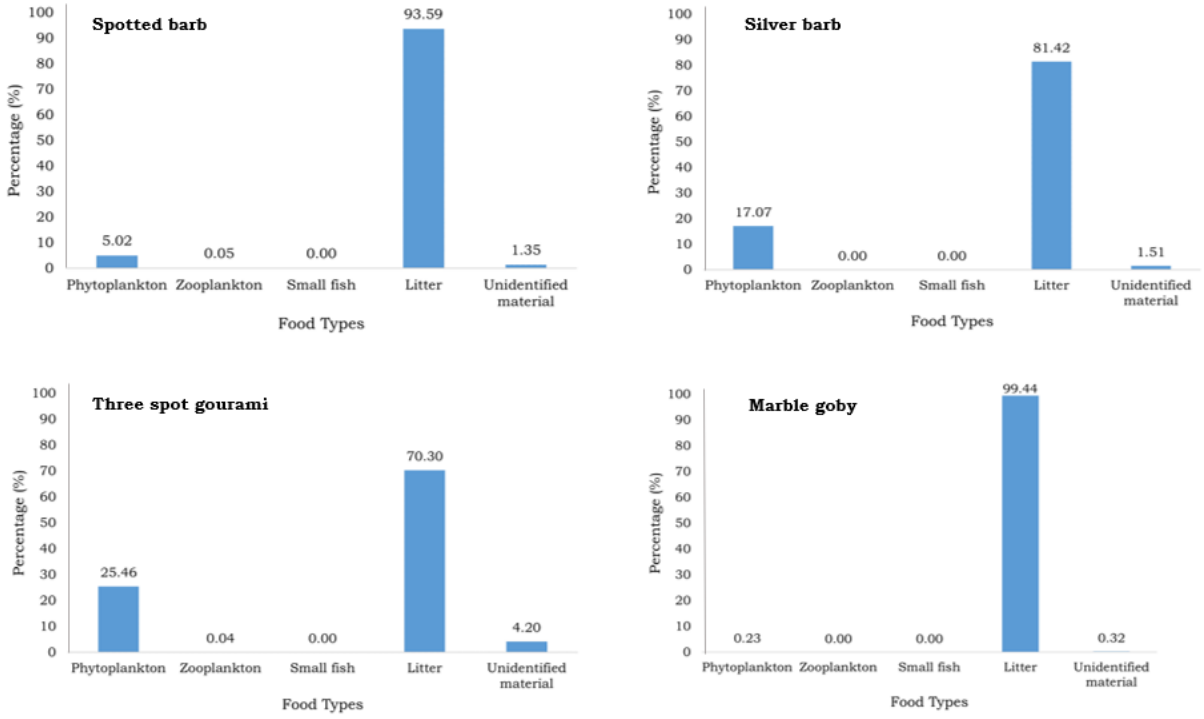


Figure 4. Percentage composition of food items in indigenous fish species.

Phytoplankton is consumed by all fish due to its association with the abundance of plankton in Rawa Pening Lake. The most consumed plankton comes from Chlorophyceae (*Coelastrum* sp. and *Pediastrum* sp.). This is similar to the abundance of plankton in the waters, where the most abundant plankton are Chlorophyceae, with the most dominant species being *Coelastrum* sp. and *Pediastrum* sp. The high abundance of these genera is influenced by good water conditions. Chlorophyceae can grow well in high nutrient content (nitrate and phosphate) and with appropriate sunlight intensity (Zikriah *et al.* 2021). The indigenous fish observed are thought to have adapted to the food availability in the waters. Several factors influence fish feeding habits, including habitat, food preferences, season, age, and food size (Safitri *et al.* 2021).

CONCLUSION

Indigenous fish species observed from Rawa Pening Lake consist of 4 species, including two-spotted barb (*Barbodes binotatus*), silver barb (*Barbonymus gonionotus*), three-spot gourami (*Trichogaster trichopterus*), and marble goby (*Oxyeleotris marmorata*). Spotted barbs are omnivorous fish, marble goby as carnivorous fish, silver barbs, and three-spot gourami are herbivorous fish. Indigenous fish groups of Rawa Pening Lake utilize litter as the main food, phytoplankton as the complementary and additional food. Zooplankton as additional food for spotted barb and three-spot gourami. Small fish are additional food for the marble goby. Differences in food composition occur due to adaptation to the food available in the waters.

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