JURNAL PERIKANAN DAN KELAUTAN
Volume 30 No. 3, October 2025: 344-349

e-issn : 2721-8902
p-issn : 0853-7607

Association of Aquatic Plants and Fish in Lake Bokuok, Aursati Village, Tambang Subdistrict, Kampar Regency, Riau

Asosiasi Tumbuhan Air dengan Ikan di Danau Bokuok Desa Aursati Kecamatan Tambang Kabupaten Kampar Provinsi Riau

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Received
2 September 2025

Accepted
25 September 2025

Abstract

Lake Bokuok is an oxbow lake located in Aursati Village, Tambang District, Kampar Regency, Riau Province. This lake has undergone changes due to human activities, affecting the existence of aquatic organisms, including plants and fish. This study aims to determine the relationship between aquatic plants and fish in Lake Bokuok. Data collection was carried out in February-March 2025 using a survey method. Aquatic plant samples were collected once for species identification and four times for density calculations, while fish samples were collected four times for fish count calculations. The study results showed differences in aquatic plant density and total fish numbers across the three stations. Among the three stations, four aquatic plant species and four fish species were identified. Station III had the highest aquatic plant density and relative density (57.32 Ind/m²), which also correlated with the highest fish count (59 individuals). Conversely, Station II had the lowest aquatic plant density (25.08 Ind/m²) and the fewest fish (33 individuals). Statistical analysis showed a positive correlation between aquatic plant density and fish abundance, though the relationship was not statistically significant. Water quality in the lake is still considered suitable for supporting aquatic organisms. This study provides an initial overview of the role of aquatic plants in supporting fish life in natural lakes. These results are significant as a basis for water management and the development of sustainable conservation policies to maintain the ecological balance of Lake Bokuok.

Keywords: Lake Bokuok, Aquatic Plants, Fish, Water Quality

Abstrak

Danau Bokuok adalah danau oxbow yang terletak di Desa Aursati Kecamatan Tambang Kabupaten Kampar Provinsi Riau. Danau ini mengalami perubahan akibat aktivitas manusia yang mempengaruhi keberadaan organisme akuatik termasuk tumbuhan air dan ikan. Penelitian ini bertujuan untuk mengetahui hubungan antara tumbuhan air dengan ikan di Danau Bokuok. Pengambilan data dilakukan pada Februari - Maret 2025 menggunakan metode survei. Sampel tumbuhan air dikumpulkan satu kali untuk identifikasi jenis dan empat kali untuk penghitungan kerapatan sedangkan sampel ikan dikumpulkan empat kali untuk perhitungan jumlah ikan. Hasil penelitian menunjukkan perbedaan kerapatan tumbuhan air dan jumlah total ikan di ketiga stasiun. Dari ketiga stasiun, ditemukan 4 jenis tumbuhan air dan 4 jenis ikan. Stasiun III memiliki kerapatan dan kerapatan relatif tumbuhan air tertinggi (57,32 Ind/m²), yang juga berkorelasi dengan jumlah ikan terbanyak (59 ekor). Sebaliknya, stasiun II memiliki kerapatan tumbuhan air terendah (25,08 Ind/m²) dan jumlah ikan paling sedikit (33 ekor). Analisis statistik menunjukkan hubungan positif antara

kerapatan tumbuhan air dan jumlah ikan namun tidak berpengaruh secara signifikan. Kualitas air di danau dinilai masih dalam kondisi mendukung kehidupan organisme perairan. Penelitian ini memberikan gambaran awal tentang peran tumbuhan air dalam mendukung kehidupan ikan di danau alami. Hasil ini penting sebagai dasar dalam pengelolaan perairan dan penyusunan kebijakan konservasi yang berkelanjutan untuk menjaga keseimbangan ekosistem Danau Bokuok.

Kata kunci: Danau Bokuok, Tumbuhan Air, ikan, Kualitas Air.

1. Introduction

Lake Bokuok, located in Aursati Village, Tambang Subdistrict, Kampar Regency, is an oxbow lake formed from the natural diversion of the Kampar River. The lake's ecosystem serves as an important habitat for various aquatic organisms, including aquatic plants and fish. Aquatic plants play a crucial role for other organisms, particularly fish. They can function as nursery grounds, feeding areas, and shelters from predators (Burhan, 2015). The presence of healthy aquatic plants creates high water productivity and results in high aquatic biodiversity (Hendri, 2023). If the presence of aquatic plants in Lake Bokuok is disrupted, causing a drastic increase or decrease in density, water conditions, and the sustainability of fish resources will be affected.

However, human activities such as agriculture, settlement, and tourism around the lake have altered water quality, potentially affecting the dynamics of the biological community within it, especially aquatic plants and fish. So far, research on Lake Bokuok has been limited to the morphometry of Selinca fish (Kampai, 2012), fisheries sanctuary management (Amri & Prasetyo, 2008), lake trophic status based on phytoplankton (Utami & Henny, 2025), and the distribution of periphyton in the lake (Sibarani, 2020). Information on the relationship between aquatic plants and fish is still lacking, so further research is needed to understand this connection.

This study aims to determine the relationship between the types and density of aquatic plants and the number and types of fish found in Lake Bokuok in Aursati Village, Tambang District, Kampar Regency, Riau Province. The results of this study can provide basic information or an overview for various parties and agencies needing guidance on the relationship between aquatic plants and fish to manage Lake Bokuok sustainably and continuously.

2. Material and Method

2.1. Time and Place

This research was conducted in February–March 2025 at Lake Bokuok in Aursati Village, Tambang Subdistrict. The research activities were divided into two stages: sampling was carried out in the field, and sample identification was conducted at the Aquatic Biology Laboratory of the Faculty of Fisheries and Marine, Universitas Riau.

2.2. Methods

This study used a survey method. Meanwhile, research stations were determined using purposive sampling. The data collected included primary data obtained during the study, such as aquatic plant species, fish, physical and chemical water quality, and secondary data.

2.3. Procedures

2.3.1. Aquatic Plant and Fish Sampling

Aquatic plant sampling was conducted once in the fourth week using 1×1 m quadrants with four replicates per station. Aquatic plant samples were taken to the laboratory for morphological identification. Fish samples were collected four times during the study, using dip nets swept across the quadrant area. The fish caught were collected, labeled, and stored in a cool box for further identification in the laboratory. Water quality measurements were taken twice (at the beginning and end), including parameters such as temperature, brightness, depth, pH, DO, free CO_2, nitrate, phosphate, and ammonia. The data were analyzed descriptively to see the relationship between aquatic plant density and fish presence.

2.3.2. Identification of Aquatic Plants

Aquatic plants were identified based on morphological characteristics such as leaf shape, stem, roots, flowers, and fruit. Aquatic plant samples were then identified at the Aquatic Biology Laboratory using Tjitrosoepomo's reference book (1988). To measure aquatic plants density, the following formula was used (Hendri, 2023):

$$A = \frac{\text{Number of individuals in a quadrant}}{\text{Quadrant area } (m^2)}$$

Description: A : Aquatic Plants Density (ind/m^2)

After the density is obtained, the relative density of aquatic plants is calculated using the formula (Fazli, 2013):

$$KR = \frac{\text{Types of Density}}{\text{Total density of each type}} \times 100\%$$

Description: KR : Relative Density (%)

The criteria for closing aquatic plants according to Kurniawan (2012) are: C < 5% = Very rarely; C 5% - < 25 = Rarely; C 25% - < 50% = Medium; C 50% - < 75% = Tight; and C ≥ 75% = Very tight.

2.3.3. Identification of Fish

Fish identification is based on external morphological characteristics such as body shape, fin type, color pattern, mouth shape, and scale type. The identification process used the reference books (Kottelat et al., 1993) and the FishBase website. Fish caught from each Station were recorded in numbers of individuals, then identified to the species level.

2.3.4. Water Quality Measurements

Water quality measurements were taken twice, at the beginning and end of the study. Water quality parameters measured in this study are: temperature, brightness, depth, pH, dissolved oxygen, and free CO_2, all carried out in the field. Parameters such as nitrate, phosphate, and ammonia were analyzed at the Riau University Fisheries Biology Laboratory.

2.4. Data Analysis

Research data on the relationship between aquatic plant density and fish, as well as measurements of water quality parameters, both physical (temperature, brightness, and depth) and chemical (pH, dissolved oxygen, and free CO_2, nitrate, phosphate, and ammonia), were collected in the field and in the laboratory during the study and tabulated in tables and figures. Then, it was discussed descriptively using simple linear regression analysis. This was followed by a correlation test using Pearson's test, which was then adjusted with related literature to conclude. To test the hypothesis, the field research results were compared with it.

3. Result and Discussion

3.1. Identification of Aquatic Plants and Fish

The results showed that there were four types of aquatic plants found, namely *Eichhornia crassipes*, *Cyperus rotundus*, *Ipomoea aquatica*, and *Limnocharis flava*, with *E. crassipes* as the most common type found. Four fish species were identified, namely *Thynnichthys thynnoides* (motan), *Cyclocheilichthys apogon*, *Helostoma temminckii*, and *Pristolepis grooti*, with *T. thynnoides* being the most dominant species found at all stations. For more details on the types of samples obtained, see Table 1.

Table 1. Results of aquatic plant and fish sampling

Station	Habitat	Aquatic plants (ind/m^2)	Fish
I	In the form of waters that have a depth of approximately 2.71 m. The water color at this Station is the same as that at Station II. The aquatic plants are evenly distributed (medium) on the surface of the lake.	• *E. crassipes* (28,6 Ind/m^2) • *C. rotundus* (10,08 Ind/m^2) • *I. aquatica* (2,67 Ind/m^2) • *L. flava* (2,08 Ind/m^2)	• *T. thynnoides* (23) • *C. apogon* (11) • *H. temminckii* (3) • *P. grooti* (11)
II	In the form of waters that have the highest depth of approximately 2.76m. The water color at this Station is brownish-green with the least distribution of aquatic plants among other stations.	• *E. crassipes* (11,83 Ind/m^2) • *C. rotundus* (11,08 Ind/m^2) • *I. aquatica* (0,92 Ind/m^2) • *L. flava* (1,25 Ind/m^2)	• *T. thynnoides* (19) • *C. apogon* (6) • *H. temminckii* (0) • *P. grooti* (8 ekor)
III	It is shallower than the other stations with a depth of approximately 2.58m. The water color at this Station is more brown than at other stations. The distribution of aquatic plants almost covers all water surfaces (height).	• *E. crassipes* (42,33 Ind/m^2) • *C. rotundus* (7 Ind/m^2) • *I. aquatica* (3,91 Ind/m^2) • *L. flava* (4,08 Ind/m^2)	• *T. thynnoides* (25) • *C. apogon* (13) • *H. temminckii* (5) • *P. grooti* (16)

3.2. Density and Relative Density of Aquatic Plants

Based on the results of research conducted at Lake Bokuok, the highest density of aquatic plants is found at Station III, with 57.32 individuals/m^2, while the lowest density is at Station II, with 25.08 individuals/m^2. The highest species density is *E. crassipes* (water hyacinth), which ranges from 11.83-42.33 individuals/m^2, and the lowest is from *I. aquatica* (water spinach), which ranges from 0.92-3.91individuals/$m^2$2. For more details, see Table 2.

Table 2. Aquatic plants density

No	Species	Density (Ind/m²)		
		Station I	Station II	Station III
1	*Eichhornia crassipes*	28,6	11,83	42,33
2	*Cyperus rotundus*	10,08	11,08	7
3	*Ipomoea aquatica*	2,67	0,92	3,91
4	*Limnocharis flava*	2,08	1,25	4,08
	Total	43,43	25,08	57,32

The high density of aquatic plants at Station III is due to the presence of oil palm plantations, large trees, and residential areas in the vicinity. Domestic waste and fertilizers from agricultural activities contain phosphate, which is an essential nutrient for aquatic plant growth. This element enters the lake through rainwater run-off or infiltration into the soil. Marpaung (2020) states that fertilization on plantation land can increase phosphate and nitrate levels in waters. This increase in nutrients encourages the rapid growth of aquatic vegetation (Hendri, 2023). In addition, the calm current at Station III causes aquatic plants to be retained and accumulate in the area.

The low density of aquatic plants at Station II is thought to be caused by the absence of plantation or settlement activities around the area, resulting in minimal nutrient input to the waters. In addition, the location of Station II in the curve and center of the lake causes aquatic plants, especially *E.crassipes* (water hyacinth), to tend to be carried by the current to the edge areas such as Stations I and III.

The aquatic plant with the highest density in Lake Bokuok is water hyacinth, with a range of 11.83 to 42.33 individuals/m². This is due to the ability of *E. crassipes* to grow easily in various water conditions. The abundance of aquatic plants is greatly influenced by the physical-chemical factors of the water and the plants' ability to adapt to the environment. Thus, the dominance of *E. crassipes* reflects its high adaptability to the water conditions of Lake Bokuok. Research at Lake Bokuok shows that the relative density of aquatic plants ranges from 3.67% to 73.84%. The species with the highest density is *E.crassipes* (water hyacinth) at 73.84% at Station III, while the lowest is *Ipomoea aquatica* (water spinach) at 3.67% at Station II. For further details, please refer to Figure 1.

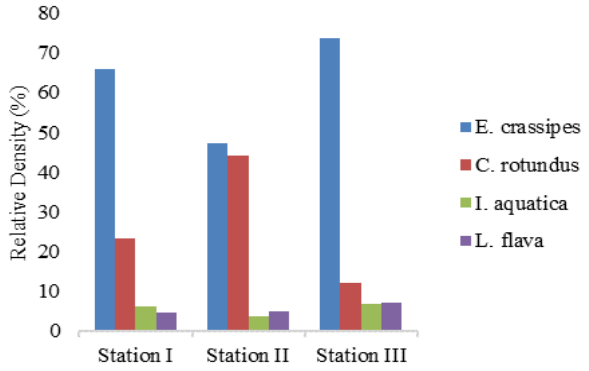

Figure 1. Relative density of aquatic plants in Bokuok Lake

3.3. Total and Types of Fish

Based on research conducted at Lake Bokuok, different numbers and types of fish were found. The fish found belong to three families: Cyprinidae with two species: *T.thynnoides* and *C. apogon*; Helostomatidae with one species: *H. temminckii*; and Pristolepididae with one species: *P. grooti*. The number of fish varied each week. Station I recorded 48 fish, Station II 33 fish, and the highest number at Station III was 59 fish. The difference in fish numbers between stations is related to the density and relative density of aquatic plants. Station III has the highest number of fish because it has the highest density of aquatic plants (57.32 Ind/m²), while Station II has the lowest (25.08 Ind/m²).

Station III is located at the end of the lake, characterized by shallow depth, a thick substrate, and dense aquatic vegetation that shades the water. In contrast, Station II is located in the middle of the lake, which is deeper, has a thin substrate, and few aquatic plants. This is in accordance with Chun *in* Sihombing (2017) that the growth of aquatic plants is influenced by water depth. The number of fish at Station I was moderate, with moderate depth and aquatic plant density of 43.43 Ind/m², higher than Station II but lower than Station III.

Aquatic plants play an important role as protection from sunlight, shelter from predators, feeding grounds for small fish, nursery grounds, and spawning grounds. As explained by Situmorang *in* Sihombing (2017), aquatic plants also function as primary producers, habitats for biota, shelters, and growth media for other organisms such as algae and small animals.

3.4. Regression Analysis and Pearson's Correlation Test of Aquatic Plants with Fish

Based on research conducted in the waters of Lake Bokuok, Aursati Village, for one month, the regression test results of aquatic plant density with fish were obtained. This can be seen in Table 3.

Table 3. Results of regression and Pearson tests on aquatic plants and fish

Model	R	R Square	Std. Error	Sig.	Pearson	
1	0,353	0,125	13,53187	0,260	1	0,353

Based on Table 3, the correlation/relationship value (R) is 0.353. From this output, the coefficient of determination (R Square) for aquatic plant density and fish is 0.125, or 12.5%. A significance value of 0.260 ≥ 0.05 was also obtained. This indicates that aquatic plant density does not have a significant effect on fish. The table also shows that the Pearson Correlation between aquatic plant density and fish is 0.353, indicating a low degree of correlation. The relationship is positive, meaning that the higher the density of aquatic plants, the higher the number of fish.

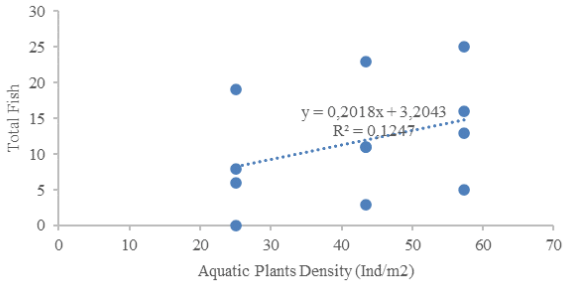

Figure 2. Regression diagram of aquatic plants and fish

Based on the diagram above (Figure 2), the regression test results obtained the regression equation value y = 0.2018x+3.2043, where the relationship between aquatic plant density and fish abundance is positive. This means that for every 1 unit increase in variable X, the value of variable Y will increase by 3.2043.

The results of the study at Lake Bokuok showed differences in the number and types of fish, as well as the total density of aquatic plants, between stations. Station III had the highest density of aquatic plants and the most significant number of fish, followed by Station I, while Station II recorded the lowest values. Four species of aquatic plants were found: *E.crassipes*, *C. rotundus*, *I. aquatica*, and Limnocharis flava, with *E. crassipes* being the dominant species. In terms of fish, four species were also identified, and *T.thynnoides* was the most commonly found species.

The highest number of motan fish was found at Station III (25 fish), followed by Station I (23 fish), and the lowest at Station II (19 fish). This difference in numbers is related to the aquatic environment, where Station III has dense aquatic vegetation that creates shaded habitats, serving as a shelter, spawning ground, and nursery for fish. Although the difference is not significant, this is likely because motan fish rely more on phytoplankton than aquatic plants as their primary food source (Putrayudha et al., 2024). *Cyclocheilichthys apogon* fish also showed the highest number at Station III (13 individuals) and the lowest at Station II (6 individuals), possibly influenced by the lack of aquatic vegetation at that station. Sipaku is an omnivorous and euryphagous fish that consumes aquatic plants, detritus, and other small organisms. Aquatic plants serve not only as a food source but also as habitat and shelter.

Pristolepis grooti is the second most abundant fish species, also showing a similar pattern: most abundant at Station III (16 individuals) and least abundant at Station II (8 individuals). This fish is omnivorous with a tendency toward herbivory, utilizing aquatic plants as a food source and habitat (Muslim et al., 2019). The presence of plantations and extensive vegetation around Station III also supports the availability of food such as aquatic insects and detritus. The number of *H.temminckii* fish also varied between stations, with the highest number found at Station III (5 fish) and none found at Station II. This fish prefers slow-moving waters with dense vegetation and feeds on a variety of foods, including plant debris, algae, and zooplankton. Spawning of tambakan generally occurs under floating aquatic plants. In general, differences in fish numbers between stations are closely related to the availability of natural food and the presence of aquatic vegetation. Aquatic plants serve as a source of food, shelter, and spawning sites. Other environmental factors, such as depth, temperature, and water surface area also influence the presence and feeding habits of fish.

Based on classification, Kurniawan (2012), this value falls into the “very rare” to “dense” category. The dominance of *E. crassipes* indicates the potential for extensive lake surface coverage. If left uncontrolled, the growth of this plant can block light from entering the water, causing dead plants to become litter, which accelerates siltation and reduces water quality. The decomposition process of litter can also reduce dissolved oxygen levels and increase free carbon dioxide, which has a detrimental effect on fish and other organisms.

3.5. Water Quality

Measurements of water quality parameters in Lake Bokuok show variations in values between observation stations. Water temperature ranges from 28°C to 30°C, still within the optimal range for aquatic life. The highest turbidity was recorded at Station II, which has few aquatic plants. In contrast, the lowest turbidity was found at

Station III, dominated by floating aquatic plants like *E.crassipes*, which can hinder light penetration. The most profound depth was found at Station II, which is in the middle of the lake, while the shallowest depth was found at Station III, which is at the end of the lake. The pH value of the water ranged from 6.5 to 7.2, which is neutral and suitable for the growth of aquatic organisms (Effendi, 2003). The dissolved oxygen (DO) content showed a reasonably good value to support biota activity, while free CO_2 was within a normal range that was not harmful.

Nitrate and phosphate concentrations are still within normal limits and serve as nutrients for aquatic plant growth. Low levels of ammonia have been detected, indicating no excessive organic pollution. According to Effendi (2003), waters with dissolved oxygen levels above 5 mg/L and neutral to slightly alkaline pH are generally capable of supporting fish and aquatic plant life well.

4. Conclusions

Research conducted at Lake Bokuok, Aursati Village, Tambang District, Riau Province, found four types of aquatic plants, namely *E. crassipes*, *C. rotundus*, *I. aquatica*, and *L. flava*. There were also four species of fish: *T. thynnoides*, *C. apogon*, *H. temminckii*, and *P. grooti*. The dominant species were *E. crassipes* and *T. thynnoides*. Based on the relationship between aquatic plant density and fish in the lake, a significance value of 0.260 ≥compared to 0.05) was obtained, indicating that aquatic plant density does not significantly affect fish abundance. However, the degree of the relationship is still positive, with a correlation coefficient of 0.353 being low. The study found that aquatic plants serve as feeding grounds, breeding sites, and shelters for fish from predators. Physical (temperature, turbidity, depth) and chemical (pH, dissolved oxygen, free CO_2, nitrate, phosphate, and ammonia) water quality measurements indicate conditions that still support the survival of aquatic plants and fish.

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