JPPIPA 9(12) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Population Study of Kedukang Fish (*Hexanematichthys sagor*) in The Waters of Percut River, Percut Sei Tuan District, Deli Serdang Regency, North Sumatera

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Received: October 25, 2023
Revised: November 30, 2023
Accepted: December 20, 2023
Published: December 31, 2023

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DOI: 10.29303/jppipa.v9i12.5814

Abstract: Kedukang fish (*Hexanematichthys sagor*) is a consumable fish that is widely caught by fishermen and the community. Kedukang fishing is carried out every day in the Percut River, resulting in a decline in its population. This study aims to analyze the population by looking at density, sex ratio, growth pattern, gonad maturity level, gonad maturity index and fecundity of kedukang fish and analyze the relationship between physical-chemical factors of waters with population density of Kedukang fish. Samples were taken using purposive sampling method at 3 observation stations with 2 repetitions. Fish samples were taken using a net fishing gear installed at low tide and lifted at high tide. The results showed that the population density of kedukang fish in Percut River was low ranging from 0.048-0.123 ind/m2. The sex ratio kedukang fish at each observation station has an average of 1:0.5. The growth pattern of fish is allometric negative. The frequency distribution of fish length ranged from 21.5-47.9 cm. The greatest number of fish caught had a length range of 30.3-34.7 cm as many as 9 fish. The level of gonad maturity kedukang fish is dominated by TKG V. The average gonad maturity index of female kedukang fish is highest at the TPI location which is 20.729% and the highest fecundity at station II which is 4622.6. The relationship between the density of the kedukang fish population is very strong and positively correlated with DO, light intensity and nitrate. The population density of kedukang fish was strongly and negatively correlated with pH and phosphate.

Keywords: *Hexanematichthys sagor*; Kedukang fish; Percut River; Population density

Introduction

Percut River is one of the major rivers that flows into the Malacca Strait and is located in Bagan Percut Village, Percut Sei Tuan Sub-district, Deli Serdang Regency. Administratively, the Percut River flows in three regencies and cities in North Sumatra Province, namely Karo Regency, Deli Serdang Regency, and Medan City. Geographically, the river is located at 3°10'40.87'' to 3°46'20.77'' N and 98°32'01.20'' to 98°48'02.88'' E (Machariyah et al., 2020).

The Percut River is widely used by the surrounding community for various activities such as residential areas, fish auctions, tourism areas, mangrove forest areas, pond fisheries, agricultural irrigation, and even domestic and industrial waste disposal sites (Machairiyah et al., 2020; Arifin, 2016; Elfiza et al., 2023). These activities have a negative impact on the waters of the Percut River. Percut River waters experience pollution caused by waste produced by residents and restaurants located right above the river flow. The presence of anchored ships also has an impact on the aquatic environment caused by ship fuel that can spill, so that the waters are polluted.

The Percut River is also utilized as a source of fish production for the people who live around it. One of the most common fish caught in Percut River waters is the Kedukang fish (*Hexanematichthys sagor*). Kedukang fish

How to Cite:
Sinaga, A. A. A., Wahyuningsih, H., & Berliani, K. (2023). Population Study of Kedukang Fish (Hexanematichthys sagor) in The Waters of Percut River, Percut Sei Tuan District, Deli Serdang Regency, North Sumatera. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11517–11527. https://doi.org/10.29303/jppipa.v9i12.5814

(*Hexanematichthys sagor*) has other names such as badukang, dukang, babukan, and duri, while in English, Kedukang fish is referred to as sagor catfish or Sundanese sea-catfish. Kedukang fish belongs to the Ariidae family, which has no scaly characteristics, generally has a length of 45 cm, and the head is flat towards the snout (Nasution et al., 2021). Kedukang fish also have 1-3 snouts on the lower side of their mouths, adipose fins, and two ventral bodies that are mostly white (Ridwan et al., 2016). Kedukang fish has a habitat in muddy seas, near the coast and estuaries, and is often located downstream of rivers to the high tide limit.

Kedukang fish, known for its high economic value, has reddish-white flesh and is rich in nutritional content (Taunay et al., 2013). It is considered economically valuable because it is a popular food fish among the local population, leading fishermen to rely on catching Kedukang as a source of livelihood. Kedukang fish are consistently found in fishermen's nets in the river's currents every day. The daily and unrestricted fishing of Kedukang, combined with the potential pollution entering the river, is cause for concern as it could disrupt or even harm the Kedukang fish population. Therefore, research on the population of Kedukang fish (*Hexanematichthys sagor*) is crucial as part of resource management efforts to ensure the sustainability and preservation of the Kedukang fish population.

Method

Location

This research will be conducted from January to February 2023. Sampling and observation of Kedukang fish samples were carried out in the waters of the Percut Sei Tuan River, Deli Serdang Regency, North Sumatra. The location of the Percut River can be seen in Figure 1.

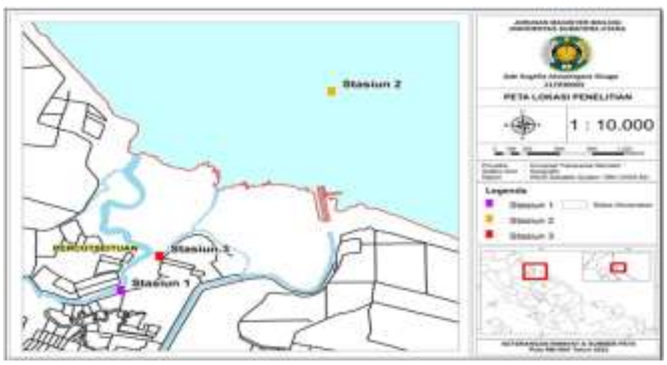

Figure 1. Map of Percut Sei Tuan

Samplings and Laboratory Observastion

Sampling of Kedukang fish (*Hexanematichthys sagor*) was conducted for three days, and two repetitions in the following month with the same water conditions. The study began around 10:00 am to 4:00 pm, starting at low tide and ending at high tide. Fish sampling was carried out using fishing gear in the form of nets with a length of 20 meters and a width of 1 meter. The fish sampling process begins with setting the net into the river at low tide. The net was left for some time until the river water level reached high tide, then the net was lifted to land. Fish caught were identified using the Kottelat et al. (1993) identification book to ensure that all species collected were correctly identified. Water quality sampling was conducted at the same time as fish sampling.

Data analysis consisted of fish data, water quality data, and correlation analysis. Fish data analysis includes fish density values, relative density, sex ratio, length-weight relationship, and fish length frequency distribution. Correlation analysis was calculated using Pearson correlation analysis using SPSS Version 26.

Data Analysis

The population density of Kedukang fish was calculated using the formula (Barus, 2004) (Equation 1). Sex ratio fish is calculated using the formula (Khairul & Siregar, 2019) (Equation 2). Relationship between the length and weight of fish is determined by the formula as follows (Rypel and Richter (2008) (Equation 3). The length frequency distribution is obtained by determining the number of class intervals, the width of class intervals, and the frequency of each class. The number of class intervals can be found using the Sturges formula (Equation 4). By using the range and class interval size, the number of class intervals can be found as follows on Equation 5. The basis used to determine the level of gonad maturity, among others, is the observation of macroscopic morphological characteristics, shape, weight, color and development of gonad contents. Analysis of Gonad Maturity Level of kedukang fish using Gonad Maturity Level Scale according to Cassie (1956). Gonad maturity index is calculated using the following formula (Araujo et al., 2019) (Equation 6). Fish fecundity was calculated using the following formula on Equation 7 (Brodziak, 2012).

$$\mathrm{Di} = \frac{Xi}{Ni} \tag{1}$$

$$\text{Sex Ratio} = (\Sigma\text{Male})/(\Sigma\text{Female}). \tag{2}$$

$$\mathrm{W} = aL^{b} \tag{3}$$

$$k = 1 + 3.3 \log n \tag{4}$$

$$\mathrm{k} = \frac{R}{i} \qquad \mathrm{i} = \frac{R}{k} \tag{5}$$

$$Gonad\ Maturity\ Index = \frac{Wg}{W} \times 100\% \quad (6)$$

$$F = G\ x\ f \quad (7)$$

Description:

Di	:	Density (individual/m)
Xi	:	Total number of individuals
Ni	:	Total area
W	:	Fish body weight (g)
L	:	Total length of fish (cm)
a	:	Constant
b	:	Growth coefficient
n	:	number of observations
k	:	number of class intervals
i	:	class interval size
R	:	range.
Wg	:	Gonad weight (g)
W	:	Body weight (g)
F	:	Fecundity
G	:	Total gonad weight (g)
f	:	Number of eggs in the gonad subsample (grains)
g	:	Weight of gonad subsample (g)

Correlation analysis was used to determine the environmental factors that correlate with fish density values. The correlation analysis was calculated using Pearson Correlation Analysis in the SPSS Version 26 software. According to Sugiyono (2018), the criteria for assessing the level of correlation can be found in table 1.

Table 1. Criteria for correlation index relationship value

Relationship level	Correlation coefficient interval
0.00 – 0.19	Very low
0.20 – 0.39	Low
0.40 – 0.59	Medium
0.60 – 0.79	Strong
0.80 – 1.00	Very strong

Result and Discussion

The density of the kedukang fish population is different at each observation station. The value of the density of the kedukang fish population obtained at each station is low, which ranges from 0.048 to 0.123 ind/m2. The value of the population density of Kedukang can be seen in table 2.

Table 2. Population density of kedukang fish (*Hexanematichthys sagor*) at each station

Station	∑n	KP (ind/m²)
Sea	7	0.04
Mangrove	18	0.12
TPI	8	0.05

Based on the catches that have been obtained, it is known that Station I have a population density of 0.048 ind/m2 of Kedukang fish (*Hexanematichthys sagor*). This station is located in a marine area that is right near the lighthouse, so many fishing boats are used to going to sea. This is one of the reasons for the low population density value of Kedukang fish at this station.

Based on the catch data obtained, Station II has a population density of Kedukang fish (*Hexanematichthys sagor*) at 0.123 ind/m². This station is located in a mangrove area, which is a habitat that supports Kedukang fish. Kedukang fish are known to inhabit muddy coastal waters, estuaries, and are often found downstream in rivers up to the high tide line. This location is highly suitable for Kedukang fish due to its characteristic habitat features, including proximity to mangrove vegetation, calmer water currents, and the presence of mud content. According to Setyobudiandi et al. (2016), mangrove ecosystems can enhance habitat conditions. The increase in mud substrate improves the habitat, promoting the growth of vegetation. Increased vegetation, in turn, can boost the density and diversity of marine life.

In general, the catch results of Kedukang fish obtained during the research at each station indicate low population density values. The low population density of Kedukang fish is suspected to be due to overfishing, which has resulted in a decline in the Kedukang fish population. Additionally, the low population of Kedukang fish may also be attributed to an imbalance in the sex ratio of Kedukang fish in the waters of Sungai Percut.

Sex Ratio is important information to assess the reproductive potential of fish for the survival of its population in nature (Jega et al., 2017). The number of Kedukang fish caught was 33 fish, of which 20 male Kedukang fish and 13 female fish (Table 3).

Table 3. Sex ratio of kedukang (*Hexanematichthys sagor*) at each research station

Station	Number of males	Number of females	Sex ratio
Sea	5	2	1:0.4
Mangrove	10	8	1:0.8
TPI	5	3	1:0.6

The sex ratio of male and female Kedukang fish in each research station has an average of 1:0.5, which indicates that the sex ratio of Kedukang fish in Percut waters is not in the right ratio. In a population, if the sex ratio is not balanced, the development of the fish population will be hampered. According to Gustomi et al. (2016), the ratio of the number of male and female fish in a balanced condition is necessary to maintain survival in a population, or at least more female fish. Effendi

(2002) stated that to maintain population sustainability, the ideal sex ratio in spawning is that the number of female fish must be greater than the number of male fish. This is also supported by the statement of Gultom (2022) that the sex ratio of 1:3 in male and female fish is the optimal ratio to produce high egg production.

According to Saputra et al. (2009) suggest that when the sex ratio of males to females is equal or when the ratio favors females, it indicates that the fish population in a water body is still ideal or balanced to maintain its sustainability. In a water body where the male-to-female sex ratio favors males, it is considered unbalanced and poses a threat to the fish population. A high male-to-female ratio in a population can disrupt the species' sustainability. When there are more males, but the females produce only a small number of eggs, even if there is an abundance of sperm in the water due to the limited number of females, it results in a smaller number of offspring or descendants. According to Alamsyah (2016), differences in fish sex rates in various water locations may be influenced by various factors, such as mortality rates, growth rates, fish habits, fish migration, and one of the sexes of fish that are vulnerable to being caught. This sex ratio difference can also be caused by overfishing and stressful environmental conditions (Sarangaa et al., 2018).

Table 4. Length-weight relationship data of kedukang fish.

Station	Average b value	Growth pattern
Sea	2.51	Negative allometric
Mangrove	2.85	Negative allometric
TPI	2.80	Negative allometric

The equation indicates that the obtained value of b<3, indicating that the growth pattern of kedukang fish in Sungai Percut is negatively allometric. In this pattern, the increase in fish length is more dominant compared to the increase in fish body weight. Several factors that can lead to this pattern include environmental factors, fish development, gender, fish stock, and even changes in stomach content due to temporal variations. Zulfahmi et al. (2021) suggest that as the fish body size increases, their food preferences also change. Additionally, Sasmita et al. (2018) state that the growth or increase in length and weight of fish is influenced not only by genetic factors, gender, food, parasites, and diseases but also by water quality, such as temperature, dissolved oxygen, and carbon dioxide in their habitat.

According to Efendiansyah (2018), digestion and food availability can influence fish growth. Fish growth is supported when the energy absorbed by the body is greater than that used for activities, digestion processes, and waste in the excretion process. The relationship between the length and weight of fish provides an indication of the fish's condition, both in terms of its own state and the external conditions related to the fish. Growth can be influenced by several factors, including external factors such as food availability, dissolved oxygen, temperature, water quality, fish size, age, and gonad maturity, as well as internal factors. Calculating the relationship between fish length and weight can be used to estimate the growth pattern and maturity of the fish (Effendie, 2002).

The number of fish observed during the study was 33. Kedukang fish caught during the research activities had a frequency distribution of length between 21.5 and 47.9 cm. The length-frequency distribution of Kedukang fish (*Hexanematichthys sagor*) can be seen in table 5.

Table 5. Table frequency distribution of class length of kedukang fish (*Hexanematichthys sagor*) at three stations in Percut River.

Class	Lower limit	Upper limit	Number of individuals
1	21.5	25.9	2
2	25.9	30.3	7
3	30.3	34.7	9
4	34.7	39.1	7
5	39.1	43.5	4
6	43.5	47.9	4

The kedukang fish caught during the study had a frequency distribution of length between 21.5 and 47.9 cm. The highest number of fish caught was in the length range of 30.3–34.7 cm, as many as 9 fish, while the lowest number was in the range of 21.5–25.9 cm, as many as 2 fish. This illustrates that kedukang fish (*Hexanematichthys sagor*) caught in the waters of the Percut River are dominated by medium-sized fish and are thought to be able to spawn.

The level of gonad maturity is a certain stage of gonad development before and after the fish spawns. The level of maturity of kedukang fish gonads, based on research, is seen morphologically (macroscopic). The gonad maturity level of female kedukang fish can be seen in table 6.

Kedukang fish (*Hexanematichthys sagor*) obtained during the study amounted to 33 fish, consisting of 12 female fish that obtained TKG I to TKG V, but the fecundity was calculated from TKG IV to TKG V, which amounted to 6 fish. At TKG IV and TKG V, fish eggs have very clear and easily separated egg grains. The number of eggs of female Kedukang fish in the three stations ranged from 2098–8112 eggs per individual, with the length of the female fish ranging from 42.5 cm to 44.8 cm and the weight of the fish ranging from 592–1801 g. The fecundity of the female Kedukang fish in

TKG IV and TKG V was calculated. The total fecundity of Kedukang fish at each research station can be seen in table 8.

Table 6. Gonad maturity level of female kedukang fish.

Station	Research Location	Gonad Maturity Level					Quantity
		I	II	III	IV	V	
1	Sea	-	2	-	-	-	2
2	Mangrove	1	2	-	1	4	8
3	TPI	-	-	-	1	2	3
Quantity		1	4	-	2	6	13

The results of fecundity calculations yielded varying numbers of eggs based on the total length of the fish, body weight, and gonad weight. Fish of the same size may not necessarily have the same fecundity. This is suspected to be due to differences in the way fish acquire their food and the fact that every individual, even within the same species and size, may have different and variable fecundity.

The average fecundity of female Kedukang fish was highest at Station II, with a value of 4,622.6, while the lowest was observed at Station I. The overall high fecundity value at Station II can be attributed to the larger number of fish, their average total length, body weight, and gonad weight, which were greater compared to the other two stations (Table 4). The research results indicate that as body weight and ovary weight increase, fecundity also rises. This finding aligns with Kantun et al, (2018) statement that the general characteristic of fecundity in fish increases with growth. Larger fish tend to have higher fecundity compared to smaller fish.

Table 7. Gonad maturity level of female kedukang fish

Gonad maturity level	Gonad	Description
TKG I		The gonads are still too small, thin, and translucent white in color.
TKG II		The size of the gonads looks larger than stage I; they are elongated to the front of the body cavity, clear in color, and have a smooth surface.
TKG IV		Gonads are yellowish-beige in color; eggs can already be seen with the naked eye
TKG V		Enlarged gonad size that reaches 2/3 to full in the body cavity; yellow-orange-colored eggs; visible blood vessels on the surface

The gonadosomatic index (GSI) is a value represented as a percentage (%) and is calculated by comparing the gonad weight to the total body weight of the fish. The gonadosomatic index (GSI) is widely used as a simple measure of reproductive capacity (Yoneda et al., 2013). The values of the Gonadosomatic Index for Kedukang fish can be seen in table 9.

The average Gonadosomatic Index (GSI) values for Kedukang fish in the Percut River ranged from 0.661 to 20.729. The highest average GSI value for female Kedukang fish was found at Station III, which was 20.729%. The increase in GSI values corresponds to the increase in the Gonadal Maturity Index (GMI). This is because as GMI increases, the size of the egg and the gonad weight also increase. The increase in gonad weight results in higher GSI values. This is supported by Effendie's statement (2002) that gonad weight will reach its maximum just before the fish spawns, and the GSI value will also reach its maximum at that time.

The low GSI in female Kedukang fish is due to a low level of gonadal maturity, indicating that the gonads are not yet fully mature. Based on the values above, it can be observed that the average gonadosomatic index tends to increase with the maturity level of the gonads. This is consistent with Effendie's statement (2002) that there is a relationship between the gonadosomatic index and the level of gonadal maturity. The gonadosomatic index will increase with the increasing level of gonadal maturity and decrease after the fish has finished spawning.

A water quality analysis was conducted to assess the water quality in the Percut River. Water quality analysis included physical and chemical parameters of the water. The measured water quality parameters in the Percut River were compared with the environmental quality standards according to the Government Regulation of the Republic of Indonesia No. 22 of 2021. The results of water quality measurements can be seen in Table 10.

Table 9. Gonad maturity index of kedukang fish (*Hexanematichthys sagor*) at three stations in Percut River.

Station	Gonadosomatic index (GSI) (%)
Sea	0.66
Mangrove	14.04
TPI	20.72

Table 10. Measurement data of water physical-chemical factors at each station

Parameter	Unit	Laut	Mangrove	TPI	Quality standart*
Temperature	^{o}C	30.1	30.2	30.2	28-32
Salinity	$^{o}/_{oo}$	25	0	0	33-34
pH	-	7.5	7.2	7.3	7-8.5
Turbidity	cm	18.7	17	14	>6
Light Intensity	Cd	279.5	650.5	469	-
Current Velocity	m/det	0.2	0.3	0.35	-
DO	mg/L	8.5	8.75	8.4	>5
BOD	mg/L	4,4	4.5	4.2	20
Nitrate	mg/L	0.03	0.045	0.04	0.06
Phosphate	mg/L	0.00	0.005	0.005	0.015
TSS	mg/L	26	136	128	80
TDS	mg/L	987	1053	1187	2000

*Government Regulation No. 22 Year 2021

Water physics and chemistry are part of water quality. Water quality measurements include physical and chemical factors of water, namely temperature, light intensity, light penetration, Total Dissolved Suspended (TDS), Total Suspended Solid (TSS), salinity, pH (potential of Hydrogen), DO (Dissolved Oxygen), Oxygen Saturation, COD (Chemical Oxygen Demand) (mg/L), BOD5 (Biochemical Oxygen Demand), nitrate and phosphate. The temperature at each observation location ranged from 30.1-30.2oC (Table 8). Based on the measurement results, it can be seen that the water temperature in the Percut River is still within the optimal water temperature. This is in accordance with the statement of Kordi (2010), The optimal temperature range for fish life in waters is between 28-32oC. Ridwantara et al., (2019) stated that low temperature values will cause fish growth to slow down because the metabolism of enzyme activity and fish growth hormones does not work optimally. High temperature, this will cause an increase in metabolic rate, respiration and oxygen consumption rate in fish. This is in accordance with the statement of Putra (2015) that an increase in temperature will cause an increase in the respiration process. Energy for respiration is energy included in the basal metabolic value (the minimum energy value required by fish to live) (Nadiro et al., 2023).

The salinity measurement showed the salinity of the water (Wahyudin & Merdekawati, 2019). The salinity of the waters at each observation location ranges from 0-25$^{o}/_{oo}$. The salinity levels observed fall within the acceptable water quality standards as per Government Regulation No. 22 of 2021. Different salinity levels influenced fish growth (Hamed, et al. 2016). Salinity is one of the limiting factors that affects the consumption rate of organisms. limiting factor that affects the consumption rate of organisms. Salinity as one of the water quality parameters directly affects the metabolism of the fish body, especially the process of osmoregulation.

The measured pH values at the research locations range from 7,2-7,5. Which falls within the optimal range for fish survival. This is in accordance with the statement of Tataningdatu et al, (2013) that the ideal pH for the life of freshwater biota ranges from 6.8-8.5. A degree of acidity (pH) that is too low can cause the solubility of heavy metals in water to increase or become toxic to aquatic organisms. In general, freshwater fish can live well at a slightly acidic pH ranging from 6.5 - 8, while water acidity for good fish breeding ranges from 6.4 - 7.0 according to the type of fish while the optimal pH range for fish ranges from 6.5 - 8.5 (Andria & Rahmaningsih, 2018).

The water clarity at each research location ranges from 14 to 18.7 cm. The highest clarity measurement was recorded in the sea, with an average of 18.7 cm, while the lowest clarity was found at the Fishermen's Shelter (TPI), with an average of 14 cm. The results showed that the Percut River is categorized as a very turbid river. Secchi depth of less than 20 cm indicates that the waters are eutrophic. According to Pramleonita et al. (2018), the higher the brightness level of a body of water, the better it will be for the life of aquatic organisms.

Light intensity measurements during the research activities ranged from approximately 279 to 650.5 cd. The lowest light intensity was recorded at the sea location, while the highest intensity was found in the mangrove location. According to Government Regulation No. 22 of 2021, the light intensity measurements during the research activities were within the water quality standard limits. Establishing these light intensity thresholds is essential to allow fish to conduct normal feeding processes and exhibit their usual behaviors (Yahya et al., 2011).

Flow velocity measurements at the three research stations varied between 0.2 and 0.35 m/second. Based on the research findings, the flow velocity at all three research locations exhibited a moderate flow pattern. According to Sese (2018), currents are divided into 5 namely very fast currents (>1 m/s), fast (0.5-1 m/s), medium (0.25-0.5 m/s), slow (0.1-0.25 m/s) and very slow (<0.1 m/s). Various factors, including geological conditions (soil characteristics) and meteorological factors (weather conditions), can influence flow velocity.

Dissolved oxygen (DO) concentrations at the research locations ranged from 8.4 to 8.75 mg/L. The DO concentration showed an inverse relationship with total suspended solids (TSS). Higher TSS concentrations led to lower DO concentrations. This occurred because the intensity of light penetrating the water was disrupted, which affected the photosynthesis processes of autotrophic organisms. Dissolved oxygen concentrations increased with decreasing temperatures and increasing salinity. This aligns with Government Regulation No. 22 of 2021, which specifies that the DO concentration required for aquatic biota to thrive is >5 mg/L. Therefore, it can be concluded that the DO concentration in the Percut River is suitable for the survival of Kedukang fish.

Biochemical Oxygen Demand (BOD) is the amount of oxygen needed for the aerobic degradation of organic matter (Supardiono et al, 2023). The concentration of biochemical oxygen demand (BOD) at the research locations ranged from 4.2 to 4.5 mg/L. According to Saraswati et al. (2017), high BOD values indicate a high concentration of organic substances in a water body. Water bodies with high BOD5 concentrations indicate organic pollution. However, based on Government Regulation No. 22 of 2021, the obtained values are still within acceptable water quality standards.

The average nitrate levels measured at the research locations ranged from 0.03 to 0.045 mg/L. The highest average nitrate levels were found at the mangrove location at 0.045 mg/L, while the lowest average nitrate levels were found at the TPI location at 0.039 mg/L. According to the water quality standards specified in Government Regulation No. 22 of 2021, nitrate levels in the Percut River are still within the acceptable limits for seawater. Hutagalung and Rozak (1997) noted that nitrate compound concentrations tend to increase as dissolved oxygen concentrations decrease. Domestic activities and aquaculture can introduce a significant supply of nutrients (N-P) into aquatic ecosystems (Nasir et al., 2018).

The concentration of phosphate during the research activities ranged from 0.005 to 0.006 mg/L. According to Government Regulation No. 22 of 2021, the phosphate concentration at each research location remains within acceptable water quality standards. One of the factors contributing to high phosphate levels in water bodies is the presence of domestic wastewater containing detergents.

Table 11. The results of correlation of fish density with physical and chemical factors of waters.

Parameter	Correlation	Category
pH	-0.91	Very strong
Temperature	-0.52	Medium
Salinity	-0.57	Medium
Turbidity	0.06	Very low
DO	0.97	Very strong
BOD	0.58	Medium
Current velocity	0.27	Low
Light intensity	0,90	Very strong
Nitrate	0.99	Very strong
Phosphate	-0.99	Very strong
TDS	-0.10	Very low
TSS	0.62	Strong

The content of total suspended solids (TSS) at each research location ranged from 26 to 136 mg/L. The lowest TSS content was found in the coastal location with an average of 26 mg/L, while the highest content was in the mangrove location with an average of 138 mg/L. Both the mangrove and TPI locations exceeded the water quality standards, which had set a threshold of 80 mg/L. This might be due to the presence of community waste disposal activities in both locations, and if observed visually, the river water in these locations appears murkier. According to Rinawati et al. (2016), the amount of TSS in the water can reduce the availability of dissolved oxygen. If the decrease in oxygen availability lasts for a long time, it will cause the waters to become anaerobic, so that aerobic organisms will die. The high TSS can also directly disturb aquatic biota such as fish because it is filtered by the gills.

The concentration of Total Dissolved Solids (TDS) at the research locations ranged from 987 to 1187 mg/L. The highest TDS concentration was recorded at the TPI location, with an average of 1187 mg/L, while the lowest concentration was found in the coastal location, with an average of 987 mg/L. These measurements indicate that TDS levels are still within the water quality standards outlined in Government Regulation No. 22 of 2021. Turbidity is positively correlated with Total Suspended Solids (TDS), meaning that as turbidity values increase, so does the concentration of suspended solids. Turbidity usually consists of inorganic particles originating from erosion and suspended sediments in the riverbed (Connel and Miller, 1995).

The results of the correlation analysis of the physical and chemical water factors with the population density of Kedukang fish can be seen in table 11. Based on the correlation analysis, it can be observed that pH and phosphate have a strong negative correlation with a significant impact on the population density of *Hexanematichthys sagor* (Kedukang fish). This indicates that an increase in pH and phosphate levels would decrease the population density of Kedukang fish. An increase in pH levels can lead to elevated ammonia concentrations in the water, which are toxic to aquatic organisms, including fish (Tatangindatu et al., 2013). Increased phosphate concentrations can disrupt metabolic processes and even result in fish mortality (Ebeling et al., 2006).

The accumulation of metabolic waste and leftover feed on the waterbed can lead to an increase in phosphate concentration and water turbidity.
On the other hand, the correlation analysis shows that dissolved oxygen (DO), light intensity, and nitrate have a strong positive correlation with a significant impact on the population density of Kedukang fish. This implies that higher levels of DO, light intensity, and nitrate would increase the population density of Kedukang fish. Increased DO levels stimulate fish's appetites, while a decrease in DO levels can lead to reduced food intake, affecting growth and population density.

Increased light intensity creates a brighter aquatic environment, making fish more sensitive to the presence of food. Light intensity plays a role in supporting survival, specific growth rate, absolute weight growth rate, and absolute length growth rate, all of which impact fish population density because higher light intensity creates a brighter environment and enhances fish sensitivity in detecting food (Kusuma et al., 2020). Nitrate also exhibits a strong positive correlation with a significant impact on the population of Kedukang fish. This is likely because nitrate is a nutrient required by organisms for growth and development (Barus, 2004). According to Effendi (2003), nitrate is the primary form of nitrogen in natural water and is the main nutrient for plant and plankton growth. In aquatic environments, plants produce oxygen through photosynthesis, and plankton serve as natural food for fish.

Conclusion

The population density of Kedukang fish in Percut River is low, Station I is 0.048 ind/m2, Station II is 0.123 ind/m2 and Station III is 0.055 ind/m2. The relationship of Kedukang fish population density is very strongly correlated and positive towards DO, light intensity and nitrate. Kedukang fish population density is strongly correlated and negatively related to pH and phosphate.

Acknowledgments
The authors would like to express their gratitude to Badan Riset dan Inovasi Nasional (BRIN) for research funding assistance provided to the author.

Author Contributions
A. A. A. S; contributed as a researcher and article writer, H. W; contributed as a research idea and article writing supervisor, and K. B; contributed as a supervisor in processing research data. All authors have read and agreed to the published version of the manuscript. or listed in this article contributed to the research and development of the article.

Funding
This research is supported by Program Riset Bagi Talenta Riset dan Inovasi (BARISTA) which is fully supported by the author.

Conflicts of Interest
In writing this article, we sincerely declare that there are no conflicts of interest that may affect the objectivity and integrity of the result.

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