Food and feeding habits of *Tor tambra* (Valenciennes, 1842) in Cibareno River, West Java, Indonesia

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Abstract. The Cibareno River in Sukabumi, West Java, is the habitat of *Tor tambra*, one of Indonesia's most highly valuable native freshwater fish species. The native fish population in this river may be threatened by the planned weir construction. The study aims to examine the food and feeding habits of *Tor tambra* in the Cibareno River. This study was carried out for four months (May, June, July, and September 2022) at six locations in the Cibareno River. A total of 61 individuals of *T. tambra* displayed an isometric growth pattern with good condition factor. Aquatic insects were the primary food, with nematodes and phytoplankton acting as supplements. Plant seeds were often eaten as an extra source of food. These results were supported by fish morphometric data such as relative mouthwidth and relative gut length, which showed that they are omnivorous and tend to be carnivorous. In addition, the relative eye diameter of the fish indicates that *Tor tambra* is a diurnal forager. The findings suggest that both in-situ and ex-situ conservation methods are viable options for the preservation of *Tor tambra* in the Cibareno River.

1 Introduction

Cibareno River is a river that flows between Banten and West Java Province along 36.82 km [1]. The source of Cibareno River water comes from Gunung Halimun National Park, Gunung, and Gunung Palasari, which will eventually head into the Indian Ocean [2]. According to [3], this river's characteristics are rocky substrates along the river flow, swift currents, and several waterfalls. The swift current of the Cibareno River is because of the significant elevation angle difference between the upstream and downstream parts of the river. The hills in the riparian part of the river causes the difference in elevation angle. Several

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fish families occupy this river, including the Anguillidae, Ophichthidae, Cyprinidae, Sisoridae, Poecilidae, Syngnathidae, Chandidae, Teraponidae, Channidae, Eleotrididae, and Gobiidae. One of the fish species from the Cyprinidae family in the Cibareno River is *Tor tambra* [2].

Tor tambra is one of the freshwater fish with high economic value in Indonesia and Malaysia [4]. *Tor tambra* is a consumable fish with a dense, sweet taste and rich in fish oil at high price [5]. According to [6], *Tor tambra* live in upstream of rivers in tropical forests, especially in mountainous areas. This fish in Indonesia is commonly found in fast-flowing rivers widely distributed in Sumatra, Java, and Kalimantan [7]. *Tor tambra* can reach more than 50 kg with a length of up to 100 cm [8]. Their large size makes them often called "king of rivers" [9]. The IUCN status of *Tor tambra* is Data Deficient. This is because research on *Tor tambra* is still rare. Currently, the population of *Tor tambra* in nature is also rare due to massive exploitation and disturbed habitat due to deforestation [6]. It has been very difficult to find large-sized *Tor tambra* over the past decade [4].

Cibareno River has been planned to be dammed to support the agricultural sector in the surroundings by irrigating the water needs of agricultural land. The dam is called Caringin Weir and is located in Sukabumi District. Caringin Weir is a water construction that raises the water level to irrigate the irrigation area above the base elevation of the Cibareno River. However, the construction of this weir has the potential to negatively impact the habitat and fish population in the river. According to the example from the Bumang River, dam construction is believed to result in habitat degradation and alterations in water quality [10]. The construction of a dam induces ecological changes in the aquatic environment, leading to the adaptation of fish to new conditions. Furthermore, diversity disparities between the upstream and downstream segments of a river can impact the feeding habits of fish species, such as *Tor tambra*.

Fish use food to maintain their bodies and replace damaged body cells while using the excess for growth [11]. Information on fish diet can be used to determine the food composition and feeding behavior and their role in the ecosystem's food web. In addition, information on fish diet is also useful to support fisheries management activities such as aquaculture and conservation efforts [12]. Knowledge of the food and feeding habits of *Tor tambra* is very important, considering that food and metabolic processes are the transfer of energy that will support the processes of growth, reproduction, and survival of *Tor tambra* [13].

Based on research by [14], *Tor tambra* found in Aceh Province were omnivorous with the main food proportion of green algae and earthworms. Other research showed that *Tor* spp. found in the Asahan River, North Sumatra, are omnivorous fish that tend to be herbivorous, with their primary food being phytoplankton and complementary foods in the form of Crustacea [15]. Furthermore, *Tor tambra* from the Batang Gadis River, North Sumatra, has a main diet of phytoplankton from the Chlorophyceae class and complementary foods in the form of aquatic insects [6]. However, there is no information about food and feeding habits in the Cibareno River. Therefore, the objective of this study was to examine the food and feeding habits of *Tor tambra* in the Cibareno River as basic information for conservation in relation to weir development on this river.

2 Material and methods

2.1 Time and location of research

Tor tambra sampling was conducted in May, June, July, and September 2022. Fish samples were taken in the Cibareno River, Sukabumi District, West Java, Indonesia using the

purposive sampling method with six sampling stations Figure 2. Purposive sampling is a method of sampling fish from a population using certain considerations [16]. The determination of station points is based on the location of Caringin Weir and the accessibility to the Cibareno River. Caringin Weir is located between station 3 and 4. Furthermore, *Tor tambra* samples were analyzed at the Macro Biology Laboratory, Department of Aquatic Resource Management, Faculty of Fisheries and Marine Science, IPB University, Bogor, West Java, Indonesia.

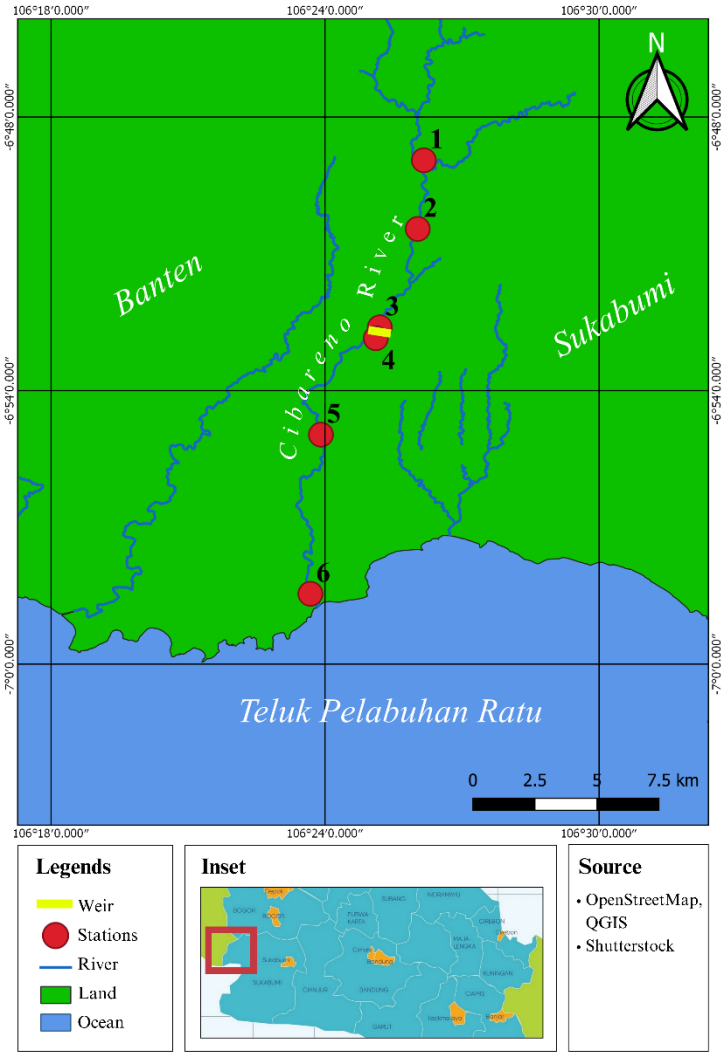

Fig. 1. Map of Cibareno River, West Java

2.2 Data collection

2.2.1 Water condition

The water condition of Cibareno River is known by measuring and observing several physical and chemical water quality parameters of Cibareno River. Physical parameters observed were

substrate type, water temperature, water conductivity, water brightness, and total dissolved solid (TDS). The chemical parameters observed were dissolved oxygen (DO), acidity (pH), ammonia, nitrite, nitrate, total phosphate, and mercury (Hg). The method and place of measurement of water quality parameters are presented in Table 1.

Table 1. Measurement of water quality parameters in Cibareno River, West Java, Indonesia

Parameters	Units	Methods	Location
Physical parameters			
Temperature	°C	Water quality meter	*In situ*
Conductivity	µS/cm	Water quality meter	*In situ*
Brightness	m	Secchi disk	*In situ*
TDS	mg/L	Gravimetry	Laboratory
Chemical parameters			
DO	mg/L	Water quality meter	*In situ*
pH	-	Water quality meter	*In situ*
Ammonia	mg/L	Spectrophotometry	Laboratory
Nitrite	mg/L	Spectrophotometry	Laboratory
Nitrate	mg/L	Spectrophotometry	Laboratory
Total Phosphate	mg/L	Spectrophotometry	Laboratory
Hg	mg/L	Spectrophotometry	Laboratory

2.2.2 Fish sampling

Fish sampling was conducted in the morning from 7 to 11 am using gillnet (mesh size 3/4, 1, 1.5, 2, 3, and 4 inches), cast net, bamboo traps, and Jarvis traps. Fish samples that have been obtained are then preserved using 10% formalin and put into plastic bags. Fish that had been obtained and preserved using formalin were then brought to the Macro Biology Laboratory, Department of Aquatic Resource Management, IPB University, Bogor, Indonesia, for analysis. Fish were put into distilled water to remove formalin from the fish. Furthermore, fish morphometrics were measured, such as fish length, fish weight, maxillary length, head height, and eye diameter. Length was measured by a ruler with an accuracy of 0.5 mm. Meanwhile, the weight of the fish was weighed using a digital scale with an accuracy of 0.05 g. After that, the fish were dissected and the digestive tract was taken. Fish food was analyzed using a combined method of frequency of occurrence and volumetric method, named the Index of Preponderance (IP) method [22]. The digestive tract of the fish was measured in length first and then the contents were removed by scraping. The contents of the digestive tract are then put into a measuring flask to measure the volume and then diluted with distilled water. Food in the form of micro-organisms found in the digestive tract was observed using a stereo microscope, while micro-organisms were taken using a drop pipette and placed on a glass plate to be observed under a compound microscope. Food identification was conducted using a census system. Food was then identified by types referring to [17] and measured in volume, then recorded for data analysis.

2.3 Data analysis

2.3.1 Length weight relationship

Length and weight are two basic components of biology in a fish species. According to [18], the length and weight relationship is mathematical modeling that will describe the growth pattern of fish for the estimation and management of fish stocks. Length and weight relationship analysis can also be used to measure the expected weight for fish length both individually and in groups to find out information related to fish fatness. Fish length and weight relationship can be calculated using the following general formula [19]:

$$W = aL^b \tag{1}$$

To obtain the constant values of a and b, the length and weight relationship of the weight and length formula is transformed into logarithms, so that a linear equation will be obtained:

$$log\ W = log\ a + b\ log\ L \tag{2}$$

W : Fish weight (g)
L : Total length of fish (mm)
a and b : Constant

The length-weight relationship can be seen from the constant value of b. If the constant value of b = 3 then the relationship is isometric (weight increase is proportional to length increase) and if b ≠ 3 it means it is allometric. If b > 3, it is positive allometric or weight gain is more dominant than length gain, while if b < 3, it is negative allometric or length gain is more dominant than weight gain [20].

2.3.2 Condition factor

Condition factor is the physiological condition of fish that is indirectly influenced by intrinsic and extrinsic factors to indicate the fatness of fish [18]. Calculation of condition factor can use the metric system based on the relationship between length and weight. If growth is isometric, it can be calculated using the following equation [19]:

$$K = \frac{10^5 W}{L^3} \tag{3}$$

K : Condition factor
W : Fish weight (g)
L : Fish length (mm)
a and b : Constants

2.3.3 Index of preponderance

The index of preponderance is an index used to determine the percentage of the largest amount of food in the stomach of fish [13]. This index is used to show the percentage proportion of the types of organisms present in the stomach of fish [21]. Index of Preponderance can be calculated using the following formula [22]:

$$Ii = \frac{V_i O_i}{\Sigma(V_i O_i)} \times 100 \tag{4}$$

I_i : Index of Preponderance
V_i : Percentage volume of one food type
O_i : Percentage of occurrence of one food type

Category:
IP > 40 = Main food
4<IP<40 = Supplementary food
<4 = Additional food

2.3.4 Niche breadth

Food niche breadth aims to determine the level of selectivity of fish size groups between similar species [23]. In addition, food niche area analysis can be done to determine the level of food selectivity and food competition by a group of fish. The niche breadth value shows the level of generality of fish in utilizing existing natural food. The higher value of food niche breadth in fish means the fish are more flexible to feed on food resources [24]. The niche breadth is calculated using the following formula [25]:

$$B = \frac{1}{\sum P_{ij}^2} \quad (5)$$

Description:
B : Niche breadth
P_{ij} : Proportion of i-th food in j-th food type.

By standardizing the value of the food niche area using the following formula:

$$B_a = \frac{B-1}{n-1} \quad (6)$$

Ba : Levin standardization index
B : Food niche breadth
n : Number of all types of food utilized

The value of Ba is closer to 1, meaning that the species exploits the available food types in the same proportion. The value of niche area (Ba) is classified into high (>0.6), medium (0.4-0.6), and low (<0.4) [26].

2.3.5 Relative gut length

Fish intestinal length can be used as an indicator in determining the type of fish diet [27]. Herbivorous fish have intestines whose length is equal to several times their body length, and can even reach five or more, while the intestine length of carnivorous fish is shorter than their total body length and the intestine length of omnivorous fish is only slightly longer than their total body length. The relative intestinal length value for carnivorous fish is < 1, omnivorous fish is 1-3, and for herbivorous fish the value is > 3 [28]. The relative gut length of fish can be determined using the following formula:

$$Relative\ Gut\ Lenght\ (\%) = \frac{GL}{BL} \times 100 \quad (7)$$

GL : Gut length (mm)
BL : Body length (mm)

2.3.6 Mouth size

Mouth size can describe the feeding habits of fish. Mouth size is one form of adaptation strategy for fish feeding habits that can be influenced by increasing age and body length. The following formula is used to determine the width of the mouth opening [29]:

$$M=\sqrt{2(UJ)} \tag{8}$$

M : Mouth size (mm)
UJ : Length of the upper jaw (mm)

2.3.7 Relative mouth size

Relative mouth size is the ratio between the width of the mouth opening and the height of the head. This parameter is used to determine the type of fish food. The relative mouth size is calculated using the following formula [30]:

$$RM = \frac{M}{H} \times 100 \tag{9}$$

RM : Relative mouth size (%)
M : Mouth size (mm)
H : Head height (mm)

2.3.7 Relative eye diameter

Relative eye diameter is the ratio of eye diameter to head height. Relative eye diameter can be used to determine whether fish forage during the day (diurnal) or at night (nocturnal). Relative eye diameter is calculated using the following equation [30]:

$$RE = \frac{E}{H} \times 100 \tag{10}$$

RE : Relative eye diameter (%)
E : Eye diameter (mm)
H : Head height (mm)

3 Result

3.1 Water quality of Cibareno river

Spatial measurements of Cibareno River water conditions at six stations were conducted to determine differences in Cibareno River water conditions along the river flow. The water conditions of the Cibareno River based on the stations are presented in Table 2.

Table 2. Water conditions based on stations in Cibareno River, West Java, Indonesia

Water quality parameters	Stations						Standard [31]
	1	2	3	4	5	6	
Physical Parameters							
Temperature (°C)	21.7 ± 0.29	22.6 ± 0.88	23.23 ± 0.36	22.74 ± 0.16	23.74 ± 0.42	24.28 ± 0.23	-
Brightness (m)	0.61 ± 0.25	0.46 ± 0.13	0.51 ± 0.16	0.35 ± 0.05	0.45 ± 0.25	0.41 ± 0.24	-
TDS (mg/l)	48.5 ± 11.5	48.5 ± 9.5	41.15 ± 10.85	38.15 ± 9.85	44 ± 16	59.85 ± 14.15	1000
Conductivity (µS/cm)	72.8 ± 4.03	73.7 ± 3.16	65.3 ± 2.53	59.89 ± 1.26	75.59 ± 7.39	96.48 ± 4.55	-
Chemical Parameters							
DO (mg/l)	8.3 ± 0.14	8.03 ± 0.35	8.1 ± 0.37	7.83 ± 0.8	8.25 ± 0.33	8.38 ± 0.6	6
pH	7.95 ± 0.2	7.68 ± 0.21	7.59 ± 0.16	7.64 ± 0.2	7.63 ± 0.19	7.79 ± 0.29	6-9
Ammonia (mg/l)	0.06 ± 0.01	0.06 ± 0.02	0.03 ± 0	0.04 ± 0.01	0.05 ± 0.01	0.04 ± 0	0.2
Nitrite (mg/l)	0.02 ± 0	0.01 ± 0	0.01 ± 0	0.01 ± 0	0.01 ± 0	0.01 ± 0	0.06
Nitrate (mg/l)	0.21 ± 0.1	0.21 ± 0.11	0.24 ± 0.11	0.31 ± 0.11	0.31 ± 0.09	0.26 ± 0.12	10
Total Phosphate (mg/l)	0.08 ± 0	0.08 ± 0.02	0.05 ± 0.01	0.1 ± 0.02	0.08 ± 0.02	0.1 ± 0.03	0.2
Hg (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002

Notes: TDS= Total Dissolved Solid, DO= Dissolved Oxygen

Cibareno River has good water conditions in terms of water quality. Water quality conditions based on physical and chemical parameters are suitable for the life of *Tor tambra* in general. The DO value in these waters is 7.83-8.38 mg/L. This value is by the good DO value for *Tor*, which is above 5 mg/L [32]. The pH value of Cibareno River water ranges from 7.63-7.95. According to Patil and Saxena [33], the ideal pH value for *Tor* generally ranges from 6.5-8.5. Ammonia, nitrite, and nitrate ions in Cibareno River water are in the range of 0.03-0.06 mg/L; 0.01-0.02 mg/L; and 0.21-0.31 mg/L, respectively. According to [34], ammonia values above 0.5 mg/L can cause disease in the gills. Furthermore, if the nitrite ion in the water is too high (>0.1), it can cause respiratory problems in fish because it can bind red blood cells into methaemoglobin. In contrast, nitrate ions are not directly toxic to fish, but if too high can cause eutrophication of waters. Water quality along the Cibareno River in Table 2 shows that all the parameters are by water quality standards and are suitable for *Tor tambra*. According to [35], the water quality that is suitable for the life of *Tor tambra* makes this species available in all sampling stations in this study.

3.2 Distribution of *Tor tambra*

The distribution of fish abundance indicates the presence or absence of *Tor tambra* in the Cibareno River. The distribution of fish presence is presented based on fish survey location

(station) and survey period (month). This is used to determine the amount of distribution of the number of fish at each station and each month.

The distribution of *Tor tambra* in the Cibareno River is spread across six sampling stations. *Tor tambra* were caught at the six stations, which have different numbers. The distribution of *Tor tambra* in the Cibareno River presented in Figure 2 shows that the total number of *Tor tambra* found at all stations is 61 individuals. The distribution of *Tor tambra* at each station point has a variety of numbers. The highest number of *Tor tambra* found was at Station 4, with 23 individuals, while the lowest number of *Tor tambra* found was at Station 2, with only one individual.

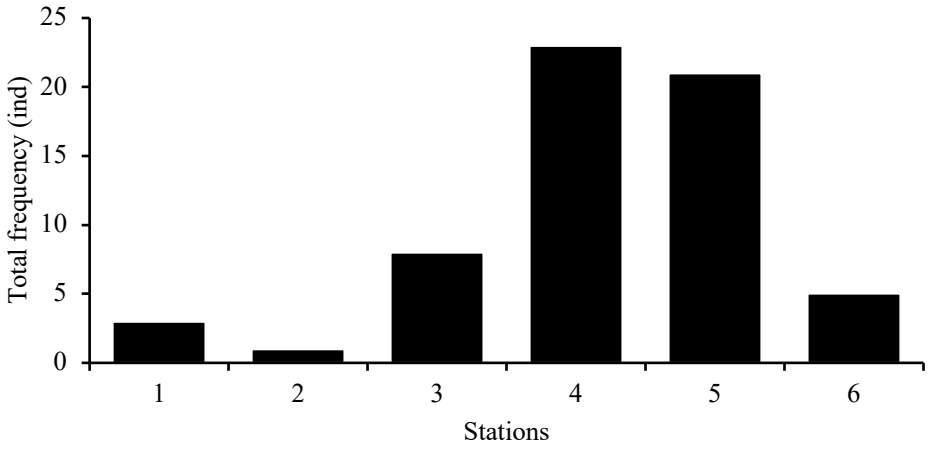

Fig. 2. Distribution of *Tor tambra* based on stations in the Cibareno River, West Java, Indonesia

The distribution of *Tor tambra* in the Cibareno River based on sampling time can show the temporal distribution of fish. *Tor tambra* caught in each month have different numbers. The distribution of fish abundance by sampling time is presented in Figure 3. The frequency distribution of *Tor tambra* based on sampling time shows that out of 61 fish, 26 were caught in September. Meanwhile, the least number of *Tor tambra* caught was in July, with 8 fish.

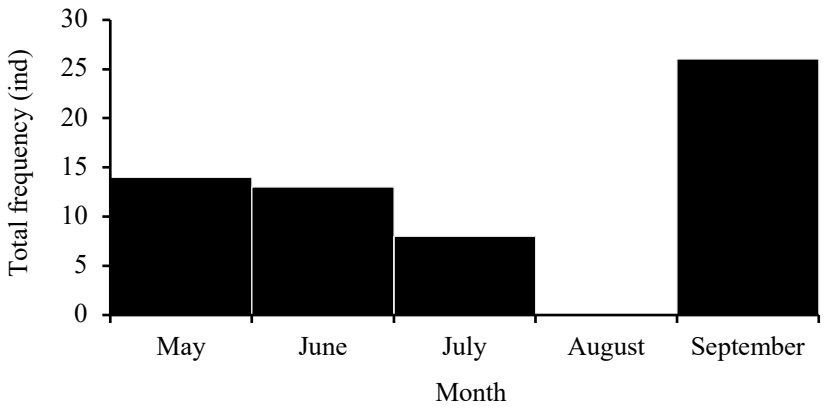

Fig. 3. Distribution of *Tor tambra* in Cibareno River, West Java, based on sampling time.

The spatial distribution of *Tor tambra* in the Cibareno River in Figure 2 shows that the distribution of the most fish is more downstream than upstream. Food availability factors can cause this. According to [36], food availability in the upstream is less than in the downstream. In addition, this condition can also be caused by the construction of the Caringin Weir between Station 3 and Station 4. According to [37], dam construction causes differences in diversity between the upstream and downstream parts of the river. Meanwhile, the temporal distribution of *Tor tambra* in the Cibareno River presented in Figure 3 shows that *Tor tambra* was mostly caught in September and the least in July. This is due to the different seasons in July and September. According to [38], September is the rainy season in West Java. *Tor* sp. will generally spawn in the rainy season, where river water flows fast [38]. Based on this, it can be concluded that *Tor tambra* spawns in September, so the number of fish is higher than the previous month. In addition, fish food sources in the rainy season are also more abundant than in the dry season [26]. Although *Tor tambra* was distributed throughout the study site, the individual fish caught had a diverse length distribution.

3.3 Length frequency distribution of *Tor tambra*

Tor tambra were caught in the Cibareno River and have various lengths. Therefore, fish were grouped based on length frequency distribution based on the interval classes of total fish length. The overall length frequency distribution of the *Tor tambra* is presented in Figure 4. The length frequency distribution presented in Figure 4 has seven length classes. The highest length of *Tor tambra* was in the 67-88 mm class interval, which reached 23 fish. Meanwhile, the least number of *Tor tambra* was found in the 177-198 mm class interval, with only one fish. This shows that the example of *Tor tambra* caught in the Cibareno River is dominated by small-sized fish.

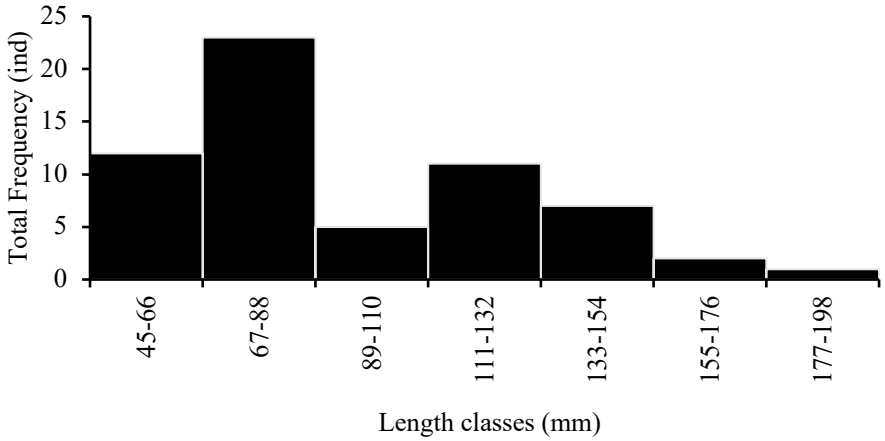

Fig. 4. Length distribution of *Tor tambra* caught in the Cibareno River, West Java, Indonesia

The length frequency distribution presented in Figure 4 shows that *Tor tambra* caught in the Cibareno River during the study had a length range of 45-198 mm which was dominated by small-sized fish at 67-88 mm. In previous research by [2], *Tor tambra* found in the Cibareno River has a length in the range of 106-164 mm. This indicates that the size of *Tor tambra* caught in Cibareno River was and is not much different. These results are in line with the study in the Nagan and Sikundo Rivers, West Aceh, which also caught dominantly small

and young *Tor tambra*. Furthermore, according to [39], *Tor tambroides* in the waters around the Muller Mountains, Central Kalimantan is also dominated by juvenile fish. However, this size is different from *Tor tambra* found in the Batang Gadis River which has a length of 92-390 mm [6]. This is thought to be due to overfishing activities in the Cibareno River, making it difficult to find large *Tor tambra*. According to [2], there are juvenile fishing activities by the surrounding community in the lower reaches of the Cibareno River. In addition to capture factors, habitat degradation such as river sedimentation can also affect fish populations in the Cibareno River, including *Tor tambra*. This sedimentation occurs due to logging around the river, sand mining by the surrounding community, and the conversion of forests into agricultural land [3]. Length frequency distribution can be used to determine fish growth when combined with the weight data.

3.4 Fish Growth Parameters

Observed growth parameters include length and weight relationships, condition factors, and fish growth patterns. *Tor tambra* caught at the study site had lengths and weights ranging from 45-196 mm and 1.05-92.6 g. Fish growth parameters are presented based on fish sampling time (month). This is done to determine how the fish grow each month. The growth parameters of *Tor tambra* are presented in Table 3 Fish growth parameters based on fish sampling time presented in Table 3 show that growth parameters in all months do not show significant differences. *Tor tambra* in Cibareno River during the study had an isometric growth pattern (b = 3). The condition factor of the *Tor tambra* in the Cibareno River in total amounted to 1.0056. The smallest condition factor was found in July (0.8630) and the largest in May (1.0919).

Table 3 Growth parameters of *Tor tambra* caught in Cibareno River, West Java, Indonesia

Month	Length-weight relationship	R^2	Condition factor	Growth pattern (t-test, α=0.05)
May	$W= 0.000019L^{2.9250}$	0.9931	1.0919	Isometric
June	$W= 0.000013L^{2.9857}$	0.9992	1.0367	Isometric
July	$W= 0.000003L^{3.2535}$	0.9655	0.8630	Isometric
September	$W= 0.000010L^{3.0466}$	0.9961	1.0331	Isometric
Total	$W= 0.000012L^{3.0010}$	0.9912	1.0056	Isometric

Fish growth presented in Table 3 shows that *Tor tambra* in the Cibareno River has an isometric growth pattern. Isometric fish growth pattern (b=3) indicates that *Tor tambra* has balanced length growth with weight growth. These results are different from those of the *Tor tambra* fish in the Nagan and Sikundo Rivers, West Aceh, which have negative allometric growth patterns with values of b = 2.34 and b = 2.84 [14]. According to [40], higher b values indicate appetite and environmental conditions are quite good for fish. In addition, the value of b can be influenced by the movement of fish, where fish living in fast-flowing waters cause the value of b to be smaller because fish are more active in swimming and allocate their energy for movement. The total condition factor shows that *Tor tambra* in the Cibareno River is 1.0056. This result is not much different from *Tor soro* in the Asahan River, North Sumatra, which has a condition factor of 1.0510-1.5847 [35]. According to [41], a condition factor of >1 indicates that the fish receives a fairly good food intake. Fish with a condition factor of 1-3 have a slightly fat body shape [19]. This is in line with [3] which stated that the large number of fish species in the Cibareno River may indicate that the river still has abundant food sources.

3.5 Food types of *Tor tambra*

Food items in the digestive tract of fish are grouped by several types of food groups, including aquatic insects, phytoplankton, nematodes, and plant seeds. The food types of *Tor tambra* are presented in Table 4.

Table 4. Diet of *Tor tambra* in Cibareno River, West Java, Indonesia

Group	Food type
Phytoplankton	Bacillariopyceae (*Navicula* sp., *Cymbella* sp., *Nitzschia* sp., *Fragilaria* sp., *Frustulia* sp., *Synedra* sp., *Achnanthes* sp., *Pinularia* sp., *Amphora* sp., *Melosira* sp., *Diatoma* sp., *Gyrosigma* sp., *Gomphonema* sp., *Cocconeis* sp., *Terpsinoe* sp., *Closterium* sp., *Cosmarium* sp.) Chloropyceae (*Ulothrix* sp., *Ankistrodesmus* sp., *Microspora* sp.) Cyanopyceae (*Stigonema* sp., *Dactylococcopsis* sp.)
Insect	Hymenoptera, Diptera, Ephemeroptera, Lepidoptera, Unidentified insect body fragments
Nematode	Nematode
Plant seed	Plant seed

The diet of *Tor tambra* in the Cibareno River in general can be seen in Figure 5 The Index of Preponderance of *Tor tambra* presented in Figure 5 shows that the food of *Tor tambra* is aquatic insects with a total of 53.37, followed by phytoplankton and nematodes at 28.96 and 17.12 respectively. While the smallest is plant seeds with total of 0.54. This shows that the main food of *Tor tambra* in the Cibareno River is insect larvae, while nematodes and phytoplankton are complementary foods. In addition, plant seed is an additional source of food.

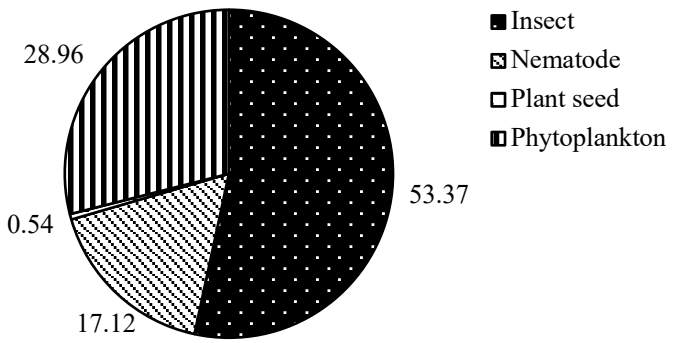

Fig. 5. Index of preponderance of *Tor tambra* in Cibareno River, West Java, Indonesia

Availability of food in the Cibareno River can be influenced by time or season. Therefore, the food of *Tor tambra* is grouped based on sampling time to determine the difference in their food each month. The food of *Tor tambra* based on sampling time is presented in Figure 6. It shows that the food of *Tor tambra* in Cibareno River includes insect larvae, phytoplankton, nematodes, and plant seeds. Food of *Tor tambra* in May and September was dominated by insects, June was dominated by phytoplankton, and July was dominated by nematodes.

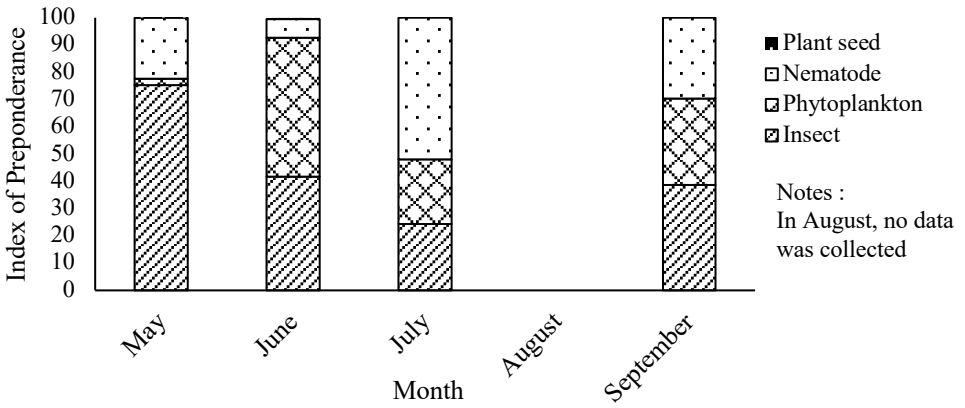

Fig. 6. Index of preponderance of *Tor tambra* in Cibareno River, West Java, based on sampling time

Tor tambra food in the Cibareno River depends on the availability of food in its environment. Fish food along the river's flow can vary. Therefore, their food was grouped by sampling stations to determine the differences in the food of *Tor tambra* along the river. Based on the sampling stations presented in Figure 7 it shows that the food of *Tor tambra* at all stations is dominated by insects, except at Station 1 and Station 6 which are dominated by phytoplankton. While at Station 2 only one fish was found, and its digestive tract was empty or not identified.

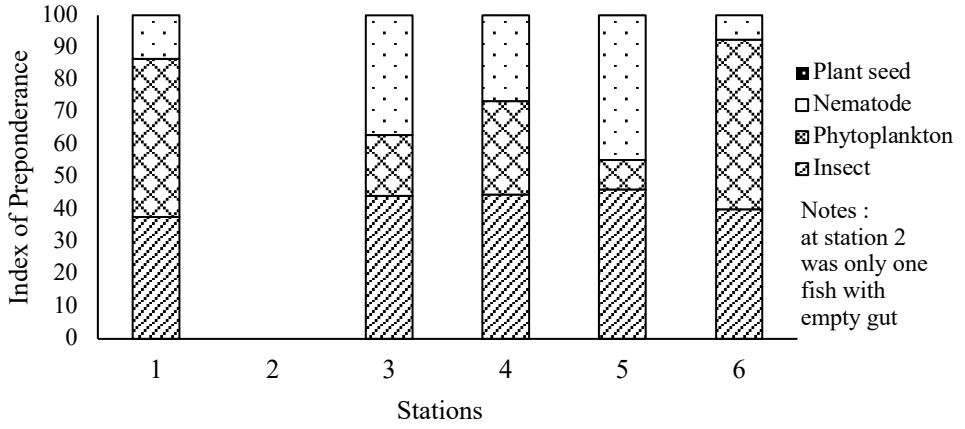

Fig. 7. Food of *Tor tambra* in Cibareno River, West Java, based on research stations

The food of *Tor tambra* presented in Table 4 shows that the fish food groups found are insects, phytoplankton, nematodes, and plant seeds. This is following [42] and [43] which stated that mahseer group is an omnivorous benthopelagic fish whose main food is insects and algae. Through the index of preponderance presented in Figure 5, it is known that the main food of *Tor tambra* in the Cibareno River is insect larvae, complementary food in the form of nematodes and phytoplankton, and additional food in the form of plant seeds. This result is slightly different from the *Tor tambra* fish found in the Batang Gadis River, North Sumatra, which has a main food of phytoplankton from the Chlorophyceae class and complementary foods in the form of aquatic insects [6]. This difference could be because the

Tor tambra caught in the Cibareno River were still small and young. According to [44], chocolate mahseer (*Neolissochilus hexagonolepis*) changes diet, where when the fish is young it is carni-omnivorous, while in adulthood, it becomes herbi-omnivorous. Furthermore, according to [14], young *Tor tambra* prefers earthworms but will switch to eating green algae after the fish reaches a larger size. Fish food in the form of insects is found more in May and September which is the rainy season. This is because the abundance of insects is more abundant in the rainy season [45]. Furthermore, the information on the feeding habits of this species can be used to determine the niche breadth of *Tor tambra* in the Cibareno River.

3.7 Niche breadth

The overall breadth of food niches for *Tor tambra* can be seen in Table 5. Food breadth niche of *Tor tambra* shows that the Ba value of *Tor tambra* as a whole is 0.5039. The value of the niche area is classified as medium. This indicates that the *Tor tambra* in the Cibareno River are not selective in finding food or do not have specific food preferences for certain types of food.

Table 5. Food niche area of *Tor tambra* during research in Cibareno River, West Java

B	Ba
2.5118	0.5039

Notes: B= Niche breadth, Ba= Levin standardization index

The niche breadth in Table 5 shows that *Tor tambra* in the Cibareno River has a food breadth niche of 0.5039. According to Novakowski [26], the value of breadth niche (Ba) of 0.4-0.6 is categorized as moderate. The higher breadth of fish food niches indicates that there are many types of food consumed by these fish, on the other hand, if the breadth of fish niches is getting smaller, it indicates that these fish are selective in choosing food [46]. The results of this study are in line with [47] that omnivorous fish such as tilapia have a niche area of 0.47 and 0.83, much greater than herbivorous fish such as *Amphilophus labiatus* which have a niche area of 0.007. This indicates that *Tor tambra* in the Cibareno River has a wide food niche and is not selective in choosing food. The known food and eating habits of fish can be further strengthened by using some characteristics related to their feeding habits such as relative eye diameter, relative mouth width, and relative gut length.

3.7 Characteristics of *Tor tambra* related to feeding habit

Some characteristics can be used as an indicator in determining the type of food and feeding habits of *Tor tambra*. Some of the parameters observed in this study were relative eye diameter, relative mouth width, and relative gut length. The results show that the average relative eye diameter was 34.47% and the average relative mouth width was 55.86%. While the average relative gut length was 117.83% Table 6.

Table 6. Morphometrics of *Tor tambra* in Cibareno River, West Java, Indonesia

Average of Length (mm)	Average of Weight (g)	Average of RE (%)	Average of RM (%)	Average of RGL (%)
95.0 ± 33.57	15.5 ± 17.6	34.47 ± 0.04	55.86 ± 6.54	117.83 ± 15.75

Notes: RE = relative eye diameter, RM = relative mouth width, RGL = relative gut length

The relative eye diameter of *Tor tambra* in Table 6 was 34.47%. This value is not much different from that of tilapia, which is 29-34% which feeds during the day (diurnal). These results follow research by [15] which stated that tor fish are diurnal and actively forage at 06.00 am until they finish digesting food at 05.00 pm. According to [48], nocturnal fish have eyes that are much larger for a given body mass than diurnal species. Large eye sizes can increase the amount of light transmitted and the brightness of retinal images, which will result in better scotopic vision. In addition, the larger diameter of fish eyes also makes it easier for fish to find food in fast-flowing waters [36]. The mouth opening width of the *Tor tambra* in Table 6 is 55.86%. This value is almost the same as opudi (*Telmatherina sarasinorum*), which is 55.59% [49]. This species is an omnivorous fish tending to be carnivorous. This value is much different from herbivorous fish such as bonylip barb (34.23%) and carnivorous fish such as eel (80.60%) [50]. The relative gut length of *Tor tambra* in the Cibareno River is 117.83%, which means that *Tor tambra* in Cibareno River has a gut length that is 1.18 times greater than its body length. According to [28], the relative gut length for carnivorous fish is <1, for omnivorous fish is 1-3, while for herbivorous fish is >3. Accordingly, *Tor tambra* in the Cibareno River can be categorized as an omnivorous fish that tends to be carnivorous. These results are in line with the study of [14] that *Tor tambra* fish in the Nagan and Sikundo Rivers, West Aceh have a digestive tract whose length is 1.25 times greater than their body length. In addition, *Sciaendores brunneus*, which has been confirmed as an omnivorous fish, has a relative gut length of 0.9 to 1.02 times its body length [51].

Tor tambra in the Cibareno River is an omnivorous fish that utilizes aquatic insects, phytoplankton, and nematodes as its food. *Tor tambra* will forage during the day at the bottom of the water. Therefore, benthic organisms, which are its main food, must always be available so that the vulture population is maintained. The construction of the Caringin Weir may negatively affect the habitat of fish in the Cibareno River, including *Tor tambra*. This is because the construction of the dam will limit the migration of *Tor tambra* and affect the macroinvertebrate population that feeds *Tor tambra* in the Cibareno River. According [52], the construction of the Rajghat Dam, in India adversely affects migratory fish such as mahseer and hilsha. Mahseer is the most prestigious fish in India, and its availability in nature is severely affected due to the construction of the dam, so this fish is now categorized as endangered. It used to be abundant in the Narmada River but has now been wiped out due to dams. In addition, the Tehri Dam in Bhagirathi is another example of the loss of mahseer due to dams. Besides disrupting fish migration, dams can also reduce macroinvertebrate richness. Different types of dams have different effects on macroinvertebrate assemblages. The larger the dam, the fewer macroinvertebrates will be present due to changes in substrate type [53]. In terms of management in the Cibareno River based on this study, numerous managerial suggestions have been proposed referring to [54] in mitigating the adverse effects of dams on *Tor tambra* populations. These include the implementation of environmental flows, whereby a minimum of 10% of the dam's water is released annually, the construction of fishways with suitable designs to facilitate fish migration, and the imposition of restrictions on fishing and sand mining activities in the river. Furthermore, ex-situ conservation measures may involve the artificial propagation of *Tor tambra* to replenish the declining fish population in the Cibareno River, which has been adversely affected by the presence of dams and fishing-related activities. The juvenile fish may be reintroduced into the river as a conservation measure or reared in artificial ponds to alleviate the strain on capture fisheries.

5 Conclusion

The main food of *Tor tambra* in the Cibareno River is aquatic insects, with nematodes and phytoplankton as complementary food, and additional food in the form of plant seeds. This

fish is a benthopelagic fish that feeds during the day (diurnal) with many food preferences and is not selective in choosing food.

Acknowledgement

The project funding of this study was fully supported by the Food and Agriculture Organization and Global Environment Facility project "Inland Fisheries Practices in Freshwater Ecosystems of High Conservation Value (IFish), FAO Project Symbol: GCP/INS/303/GFF, GEF ID: 5759". Therefore, we highly appreciate to FAO Indonesia (IFish) team for providing us the great opportunity and collaboration. Also, the authors gratefully acknowledge the Agency for Research and Human Resources Development, the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia (MMAF-RI) and Research Center for Conservation of Marine and Inland Water Resources, National Research and Innovation Agency (BRIN), Indonesia for their supports. We also would like to thank the assistance and information provided by local fishermen (Mr. Feri Vauzi and Mr. Ade), undergraduate students from Department of Aquatic Resources Management, IPB University (Astika Ambarwati, Putri Cahya Hardini, Helmia Almazayanur Affuroka Putri, Akhsan Faezya Poernama, and Pangestu Adyatma Ekandra), the laboratory technicians of Macro Biology Laboratory, Department of Aquatic Resources Management, IPB University (Mr. Aries Asriansyah and Mr. Reiza Maulana Aditriawan), and local government staffs during the fieldwork and laboratory analysis.

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