Food Habits and Ecological Niche of Silver Barp Fish (*Barbonymus gonionotus*) in Jatibarang Reservoir, Semarang

C Ain\(^*\), S Rudiyanti\(^1\), A Isroliyah\(^1\)

\(^1\)Department of Aquatic Resources, Faculty of Fisheries and Marine Sciences, Universitas Diponegoro
Prof. Soedarto, SH Street, Tembalang, Semarang, Jawa Tengah – 50275, Telp/Fax. +6224 7474698

Email: churunain@lecturer.undip.ac.id

Abstract. Research about biological characteristics of fish is important to support the conservation of fish resources. The fish population in the Jatibarang Reservoir includes Tilapia, Milkfish, Koan, Red Devil, and Silver Barp Fish (local name is tawes). The aims of this research was to study the abundance of plankton and determine the food habits of Silver Barp (*Barbonymus gonionotus*), such as Index of Preponderance (IP), proportion of food type (Pi) and ecological niche. It can be used as a management reference to maintain tawes, which is native to the waters of the Jatibarag Reservoir. This research was conducted by taking samples of Silver Barp using gillnet and hook fishing gear. Samples were taken in July and November 2020. The results showed that Chlorophyceae is the main food for tawes fish (IP value 52.34%). The phytoplankton in the waters of the Jatibarang Reservoir has an abundance of 4200 ind / L with the highest abundance is Chlorophyceae with value of 1780 ind / L (42.38%). Based on the results, Tawes chose food from the Cyanophyceae, Dinophyceae and Zygnematophyceae classes however Dictyochophyceae were not found in the digestive contents of the Tawes. The area of the Tawes niche (Bi) was 2,825, with the largest Pi originating from Chlorophyceae plankton while the smallest Pi is from the class Dictyochophyceae and Fragilariophyceae with a value of 0. The (Bi) index is to compare the area of the niche with other fish in a habitat, the higher this value means the wider the type of feed.

1. Introduction

Reservoir is an artificial water ecosystem created by damming the flow of river water around it. Jatibarang Reservoir has various functions, including flood control, water sources, tourism, and a place for freshwater fish conservation, therefore fishing activities using nets and marine cage activities are prohibited because they are considered to affect fish populations and damage the environment. The fish population in the Jatibarang Reservoir includes Tilapia, Milkfish, Koan, Red Devil Fish, and Tawes Fish. Tawes fish is a herbivorous fish native to Indonesian freshwater (Java and Sumatra) [1] [2][3]. Tawes or Silver Barp Fish is one of the Family from Cyprinidae (Minnows or carps) [4] that has a flat or slender body with a silvery body color, the height of the tawes fish is twice the standard length. The mouth tends to be pointed at the tip of the middle and is equipped with two small barbels. Tawes fish is part of the Cyprinidae family, where the Cyprinidae family has common features such as a single protrusion on the head or around the eyes, there is skin on the edge of the eye socket, the dorsal fin is parallel to the pelvic fins, and has a small tentacle around the mouth [5]. The original habitat of tawes fish is a river ecosystem with fast currents, its flat ease tawes fish to swim in waters with fast currents. Occurs at midwater to bottom depths in rivers, streams, floodplains, and occasionally in reservoirs. Seems to prefer standing water habitats instead of flowing waters. Inhabits the flooded forest during high water period [6]. The optimum temperature for the development of tawes fish ranges from 25-33°C. Tawes is easier to breed naturally in nature compared to breed in ponds. The main food of tawes fish is...
plankton and plant organisms so that tawes fish is included in one type of herbivorous fish that lives in reservoirs. The main food for adult tawes fish is water plants, while tawes fish larvae usually eat small algae and plankton [7].

The presence of introduced or immigrant fish in the reservoir can threaten the local fish population of these waters [8]. To maintain the ecological balance of the waters of the Jatibarang Reservoir, it is necessary to carry out optimal management of these ecosystem resources. The absence of research in the Jatibarang Reservoir regarding the availability of natural food and food habit of fish. An ecological niche describes how a species interacts with, and lives in habitat, included in this understanding how Tawes get and what is eaten. The objective of present study was to evaluate the food habit of Tawes which found in Jatibarang reservoir as basic for conservation and restocking program [9][10]. This study aims to determine the food habits of the tawes fish so that it can be used as a management reference so that the tawes fish population, which is native to the waters of the Jatibarang Reservoir, is maintained sustainably.

2. Material and Methods

2.1. Material
The tool used was a section kit used to dissect fish; 50 ml volume beaker glass as a container for the contents of the intestines that have been diluted; stirring rod as a homogenizing tool; dropper for extracting intestinal contents; Sedgwick rafter as a container for samples of intestinal contents and a microscope for observing samples. The materials used in the research include distilled water as a diluent lugol as a preservative for the contents of the fish intestines, was Tawes (Barbonymus gonionotus) taken from the Jatibarang Reservoir.

2.2. Method
This research was conducted by taking samples of tawes fish (Barbonymus gonionotus) in the waters of the Jatibarang Reservoir using Buttom Gillnet (mesh size 0.4) inch, Surface Gillnet (mesh size 0.3), and fishing gear (hook number 04) in order to catch this type of fish of all sizes. But what succeeded in getting tawes was fishing rods because the mesh size of the gillnet was bigger (> 0.2 cm) than the tawes that was caught with a range of body length (10-18.9 cm) and weight (14-86 gr). Tawes fish is small in size so that it can easily escape from gillnet nets. Sampling was conducted in July and November 2020 taken in morning and nightday. Samples were taken from 7 fishing points which were considered to represent these waters. The research location is presented in Figure 1.

Figure 1. Sampling point of Jatibarang Reservoir
The data used was plankton data contained in the digestion of the fish by dissecting fish samples and taking their intestines. The intestine that has been surgically preserved and then diluted with aquadest. The next step was to identify the contents of the stomach by placing the sample using a dropper into the Sedgwick Rafter. Then the plankton was observed under a microscope. The identification of plankton types uses the check list method, namely by matching the types of plankton found with the pictures in the identification book. Plankton identification books used include Fresh Water Biology [11][12]. The types of plankton that were present were then recorded, the number is counted according to the type. After the type of plankton present in the digestion of the fish can be identified, the data analysis of the Index of Preponderence and the area of the niche can be calculated.

2.3. **Analysis methods**

Data analysis carried out included:

2.3.1. **Analysis of plankton abundance.** The plankton identification method used the check list method compared to identification book by Edmonson (1959) entitled Fresh Water Biology. Calculation of the amount of plankton using the Sedgwick Rafter according to the APHA (2005) [13]

\[ N = n \times \frac{\text{Acg}}{\text{AA}} \times \frac{\text{Vs}}{\text{Vs}} \times \frac{1}{\text{As}} \]  

\[ \text{Information:} \]
- \( N \) : phytoplankton abundance (individual /L)
- \( n \) : number of individuals observed (individuals)
- \( \text{Acg} \) : Sedgewick Rafter Counting Cell (1000 mm\(^2\)) surface area
- \( \text{AA} \) : observation area (10 mm\(^2\))
- \( \text{Vt} \) : filtered volume (50 mL)
- \( \text{Vs} \) : sample volume of filtered water (10 L)
- \( \text{As} \) : volume of concentration in Sedgewick Rafter Counting Cell (1 mL)

2.3.2. **Analysis index of preponderence.** The index of preponderance data analysis [14] or the largest part of the index aims to determine what type of food eaten by fish and the percentage of types of food in fish digestion. The formula used was a modified result of Natarajan & Jhingran [15] which combines the frequency of occurrence method with the number method using the following formula:

\[ \text{IP} = \frac{\sum \frac{\text{Ni} \times \text{Oi}}{\text{Ni} \times \text{Oi}}}{} \times 100\% \]  

\[ \text{Information:} \]
- \( \text{IP} \) = Index of Preponderence
- \( \text{Ni} \) = Percentage of the amount of one kind of food
- \( \text{Oi} \) = Percentage frequency of occurrence of one type of food

Based on the IP value obtained, the order of fish food can be divided into three categories based on the Index of Preponderance (IP) percentage [14], namely:

- \( \text{IP} > 40\% \) : Main / staple food
- \( 4\% < \text{IP} < 40\% \) : Complementary foods
- \( \text{IP} < 4\% \) : Additional food

2.3.3. **Analysis of preference index.** The food selection index calculation was done by comparing the type of food in the fish stomach with the feed resources in the water.

\[ E = \frac{r_i - p_i}{r_i + p_i} \]  

\[ \text{Information:} \]
- \( E \) = Index of Preference
Information:
E = (Index of Selectivity)
ri = Percentage of natural food found in fish intestines
pi = percentage of natural food found in the water

The E (food selection) index ranges from +1 to -1. If the value was positive, there will be a selection of feed for the intended natural feed. If the E value was negative, there will be no selection of feed. The price of E = 0, means that there was no selection of fish from natural food in their intestines [16].

2.3.4. Analysis of Ecological Niche. The niche area is used to determine the selectivity of groups of fish species for food. The area of the niche is seen based on the food consumed by fish and calculated by the Levins index[17].

\[ B_i = \frac{1}{\sum P_i} \] ……………… (d)

Information:
Bj = area of food niche
Pi = Proportion of food type

There is no criterion for the value of the niche area, because fish that has a wide niche area value means that the fish is utilizing the available food in large quantities. Fish that have a narrow niche area value means that the fish is selective in choosing the food available in the water (specialist).

3. Results and Discussions
3.1. Location Description
Administratively, Jatibarang Reservoir is located in two sub-districts, Gunung Pati District which includes Jatirejo and Kandri Villages, and Mijen District which includes Jatibarang and Kedungpane Villages. The inlet of Jatibarang Reservoir comes from two water sources, namely the Kreo River as the main inlet of the reservoir and the inlet of the Kecebong River which only flows water during the rainy season. Some native fishes from there river, so for the next research, study scope should be in these area.

3.2. Number of Catches of Tawes in Jatibarang Reservoir
From the results of the completion, it is known that the catch of tawes fish in the morning is more. In the morning the abundance of plankton in the water is high and the water temperature is not hot so that the tawes fish are more active. This causes tawes fish to be easier to catch which can be influenced by fish eating habits and the availability of natural food [18]. As many as 18 Tawes fish caught in the Jatibarang Reservoir. The catch shows that tawes fish are easier to catch using fishing rods at night.

3.3. The Abundance of Plankton
The abundance of plankton in Jatibarang reservoir was 4200 ind / L. Based on the sampling results, 10 class of plankton were found including Bacillariophyceae, chlorophyceae Cyanophyceae, Dictyochophyceae, Euglenoidea, Mediophyceae, Zygmenatophyceae Coscinodiscophyceae, fragilariophyceae and Dinophyceae. The highest abundance was in the Chlorophyceae class with an abundance value of 1780 ind / L and a percentage of 42.18% (Table 1).

Chlorophyceae class is the dominant class in Jatibarang Reservoir waters. The most dominant genus of the Chlorophyceae class is Chlorella that a type of phytoplankton can live in sea water and fresh water. The wide distribution of Chlorella is due to the high adaptability of chlorella so that it can survive in a wide ecosystem. Chlorella has a high ability to adapt to the environment because it has thick and sturdy cell walls, besides that it also has high reproductive capabilities where each mature cell can release 2 to 16 autospores [19]. Chlorophyceae require waters with temperatures ranging from 30-35 °C and pH ranging from 7-8.5 for optimum growth, while Cyanophyceae require higher temperatures than
Chlorophyceae. Cyanophyceae can live well in waters with pH > 7. Data show that water quality parameter of jatibarang reservoir suitable for the dominant plankton (pH, temperatur).

### Table 1. The Abundance of Plankton in Jatibarang Reservoir

| No | Type of Plankton         | N (ind/L) | Percentage |
|----|--------------------------|-----------|------------|
| 1  | Bacillariophyceae        | 1540      | 36.49      |
| 2  | Chlorophyceae            | 1780      | 42.18      |
| 3  | Coscinodiscophyceae      | 40        | 0.95       |
| 4  | Cyanopyceae              | 280       | 6.64       |
| 5  | Dinophyceae              | 40        | 0.95       |
| 6  | Dictyochohyceae          | 60        | 1.42       |
| 7  | Euglenoidea              | 200       | 4.74       |
| 8  | fragilariophyceae        | 60        | 1.42       |
| 9  | Mediophyceae             | 100       | 2.37       |
| 10 | Zygnematoiphyceae        | 100       | 2.37       |
| 11 | Zooplankton              | 20        | 0.47       |
|    | Total                    | 4220      | 100        |

### 3.4. Index of Preponderance (IP)

IP calculations were carried out on the digestion of the tawes fish which was caught and then the contents were taken and observed under a microscope. The calculation of the tawes fish index of preponderance is presented in Table 2.

Based on Table 2, Chlorophyceae is the main food for Tawes fish where the IP value was 52.34%. The use of other natural food by Tawes Fish includes Bacillariophyceae, Cyanopyceae and Zygnematoiphyceae as complementary foods with IP values of 26.09, 6.07 and 8.10%. The additional food of Tawes Fish used from Cyanopyceae class 3.82%, from Dinophyceae class with IP tilapia 0.31%, while in Euglenoidea class, Fragilariophyceae, and Mediophyceae, IP value was 1.09%. The use of natural food by Tawes tends to prefer Cyanopyceae, Dinophyceae and Zygnematoiphyceae classes. This shows that although the abundance of a type of plankton is high, it is not certain that the food source is chosen by fish. The preference of fish for food is very relative because it is not that an abundant type of food in the waters can be used optimally by fish (Figure 2). Factors that can cause this to occur include the choice of the fish, uneven distribution of organisms as food for fish, availability of food, and the presence of physical and chemical factors in the waters that can affect water conditions [17].
Table 2. *Index of Preponderance* Tawes (*Barbonymus gonionotus*)

| No | Type of Plankton     | IP (%) |
|----|----------------------|--------|
| 1  | *Bacillariophyceae*  | 26.09  |
|    | Nitzschia            | 21.42  |
|    | Cyclotella           | 1.04   |
|    | Gyrosigma            | 0.21   |
|    | Synedra              | 3.09   |
|    | Navicula             | 0.00   |
|    | Rhizosolenia         | 0.10   |
|    | Cocconeis            | 0.03   |
|    | Netrium              | 0.10   |
|    | Diploneis            | 0.10   |
| 2  | *Chlorophyceae*      | 52.34  |
|    | Chlorella            | 52.34  |
|    | Pediastrum           | 0.00   |
|    | Scenedermus          | 0.00   |
| 3  | *Coscinodiscophyceae*| 3.82   |
|    | Skeletonema          | 0.00   |
|    | Hemidiscus           | 0.05   |
|    | Guinardia            | 3.76   |
| 4  | *Cyanophyceae*       | 6.07   |
|    | Microcystis          | 3.74   |
|    | Merismopedia         | 2.34   |
|    | Oscillatoria         | 0.00   |
| 5  | *Dinophyceae*        | 0.31   |
|    | Peridinium           | 0.31   |
| 6  | *Euglenoidea*        | 1.09   |
|    | Euglena              | 1.09   |
| 7  | *Fragilariophyceae*  | 1.09   |
|    | Fragilaria           | 1.09   |
| 8  | *Mediophyceae*       | 1.09   |
|    | Eucampia             | 1.09   |
| 9  | *Zygnematophyceae*   | 8.10   |
|    | Spirogyra            | 0.03   |
|    | Staurastrum          | 8.07   |
|    | **TOTAL**            | 100    |
3.5. Preference Index and Ecological Niche

The result of the preference index in tawes fish was presented in Table 3. The calculation of the niche area in fish is to determine how much fish use their food and determine the species selectivity in the group. The area of the niche can be determined by knowing the type of food eaten by the fish. The calculation of the area of the tawes fish niche is presented in Table 4.

| No | Type of Plankton | Tawes |
|----|------------------|-------|
| 1  | Bacillariophyceae | -1.52 |
| 2  | Chlorophyceae    | -0.98 |
| 3  | Coscinodiscophyceae | 0     |
| 4  | Cyanophyceae     | 0.66  |
| 5  | Dinophyceae      | 0.36  |
| 6  | Dictyochophyceae | 0     |
| 7  | Euglenoidea      | -0.34 |
| 8  | Fragilariophyceae| -1.00 |
| 9  | Mediophyceae     | -1.00 |
| 10 | Zyg nematophyceae| 0.25  |

Based on the results in Table 3, Tawes fish chose food from the Cyanophyceae, Dinophyceae and Zyg nematophyceae classes, while the Fragilariophyceae and Mediophyceae classes were not chosen at all by the tawes fish, and Dictyochophyceae were not found in the digestive contents of the tawes fish.
Table 4. Niche Breadth of Tawes

| No | Type of Plankton      | Tawes |
|----|-----------------------|-------|
| 1  | Bacillariophyceae     | 0.068 |
| 2  | Chlorophyceae         | 0.274 |
| 3  | Coscinodiscophyceae   | 0.001 |
| 4  | Cyanophyceae          | 0.004 |
| 5  | Dictyochohyceae       | 0     |
| 6  | Dinophyceae           | 9.70E-06 |
| 7  | Euglenoidea           | 1.19E-04 |
| 8  | Fragilariophyceae     | 0     |
| 9  | Mediophyceae          | 1.19E-04 |
| 10 | Zygmenatophyceae      | 6.56E-03 |

$\sum P_i^2 = 0.354$

Niche Breadth 2.825

Based on Table 4, it is known that the area of the tawes fish niche is 2.825 with the largest Pi originating from Chlorophyceae plankton while the smallest Pi is from the Dictyochohyceae and fragilariophyceae classes which have a value of 0.

The size of the food niche area value shows the general level of fish in utilizing existing natural feed. Fish that have a large niche area value are generalist fish species that make extensive use of food sources, while fish with narrow or small niche area values are specialist fish that choose their type of food. The selective nature of fish can be seen if the fish only uses several types of food with a high percentage. Fish that use a variety of food resources as food are a generalist type, so their niche area will increase even though the available resources are decreasing [20]. The study on availability and preference of food contents by the fish helps to find out the feeding habit of fish and accordingly fisheries management in the water body. In the present study, Chlorophyceae plankton was the dominant food content [21].

4. Conclusions

The conclusions obtained from this study are as follows:

1. The abundance of plankton in the waters of the Jatibarang Reservoir was 4220 ind / L. The types of plankton found in the waters of the Jatibarang Reservoir are the class Bacillariophyceae, Chlorophyceae Cyanophyceae, Dictyochohyceae, Euglenoidea, Mediophyceae, Zygmenatophyceae Coscinodiscophyceae, fragilariophyceae and Dinophyceae.

2. Based on the results of the Index of Preponderance value, it is known that the eating habits of Tawes fish are herbivores with the main food being phytoplankton. Tawes fish use Chlorophyceae class as the main food.

3. Based on the calculation of the niche area, it is known that the area of the tawes fish niche is 2.825. A wide niche area value means that the fish is utilizing the available food in large quantities.

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