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PRELIMINARY STUDY ON THE CONTENTS OF THE DIGESTIVE TRACT OF THE FISH *Sicyopus zosterophorus* (Bleeker, 1856) FROM THE BOHI RIVER, BANGGAI DISTRICT, CENTRAL SULAWESI

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ABSTRACT

Sicyopus zosterophorus (Gobiidae) has a habitat in clear and fast-flowing rivers. This fish species is found in several rivers in Banggai Regency, Central Sulawesi, one of which is the Bohi River. Studies on the type of food S. zosterophorus in the Bohi River have never been carried out. Therefore, it is necessary to conduct research that aims to determine the type of food *S. zosterophorus* in nature as important information for life history and feeding in controlled habitats. This research was carried out from December 2019 to January 2020. The fishing was done using a scoop net by snorkeling to get fish at the bottom of the river. The fish obtained were then preserved using 5% formalin and then taken to the laboratory for identification of digestive tract contents. Data on the composition and percentage of types of food in the digestive tract were processed using Microsoft Excel 2010 and analyzed descriptively. The results showed that the contents of the digestive tract of *S. zosterophorus* were dominated by insects (74%), crustaceans (7%), plants (5%), and phytoplankton (3%). The contents of the digestive tract were not identified as much as 11%. Based on this, *S. zosterophorus* in the Bohi River is categorized as stenophagic and is a carnivorous fish, especially insectivorous and phytobenthic eaters. This research can be used as a basis for providing natural food for *S. zosterophorus* in aquaculture.

Keywords: Goby fish, insectivorous, phytobenthic, stenophagic

INTRODUCTION

Gobiidae, especially amphidromous goby species, contribute greatly to the diversity of fish species in the Indo-Pacific and Caribbean with the highest levels of endemism (Watson, 1991, Radtke & Kinzie, 1996, Keith, 2002, 2003, Keith et al. 2002, 2005, Lim et al. 2002, Marquet et al. The diverse species means that the goby fish group has diverse morphological forms that cannot be separated from the food and habitat preferences of each species. The Sicydiinae subfamily has seven genera including *Akihito, Cotylopus*, *Lentipes, Sicyopterus, Sicyopus, Smilosicyopus,* and *Stipodon* which are differentiated based on the shape and type of teeth they have (Carpenter & Nim, 2001, Keith et al. 2015).

Sicyopus zosterophorus is a species of amphidromous goby whose postlarvae are often caught by fishermen when migrating to rivers (Nurjirana et al. 2019, 2020, 2022a, 2022b). Adult individuals in the river spawn, and then the embryos are carried by the river current and hatch in the river before reaching the waters. The larvae in the sea will undergo a planktonic phase for several months until they enter the post larval phase so that at a certain time the postlarvae will migrate again. towards rivers to grow and reproduce (McDowall 2007, Keith et al. 2008, Lord et al. 2010). The habitat of *S. zosterophorus* is the middle stream to upper stream area with a height of more than 400 m above sea level, characterized by rocky, fast-flowing habitat and rich in oxygen (Keith et al. 2015). *S. zosterophorus* was first discovered in Buleleng Regency, Bali, and described by Bleeker in 1856. This species is distributed from southern Japan (Yoshigou, 2014), China (Nip, 2010), Taiwan (Lin, 2007), the Philippines and Palau (Keith, 2015), Papua New Guinea (Allen, 1991), northern Australia (Ebner et al. 2011), Solomon Islands

(Polhemus et al. 2008), Fiji (Boseto, 2006), Vanuatu (Keith et al. 2010), and New Caledonia (Marquet et al, 2003). This species is also found on Sulawesi Island and can be found in all rivers in the middle-upper stream area which is an ideal habitat for this species (Miesen et al. 2016; Gani et al. 2019, 2020a, 2020b, 2021, Nurjirana et al., 2020).

Food in natural habitats is an important factor for organisms as a determinant of fish survival, growth, and reproduction (Annisa et al. 2018). Food factors can be used as indicators in determining habitat, life cycle (Guo et al. 2014), distribution area, and limits on individual growth, and can control fish populations (Persson & De Ross, 2006, Khoncara et al. 2018). The position and ecological relationships of an organism in certain waters can be determined from its food. The availability of food resources for aquatic organisms is influenced by biotic and abiotic factors, so information related to food aspects and food habits is important to study to see the ecological relationships of fish, such as predation, competition, and food chains (Effendie, 1979). The type of food can be determined by observing the contents of the fish's stomach (Guo et al. 2014, Gani et al. 2015, Annisa et al. 2018, Khoncara et al. 2018). Therefore, this study aims to determine the composition and percentage of food types from the stomach contents of *S. zosterophorus* fish obtained in the Bohi River, Central Sulawesi.

MATERIALS AND METHODS

This research was conducted from December 2019 to January 2020 in the Bohi River, Nambo Lempek Village, Nambo District, Banggai Regency, Central Sulawesi Province. The research sample used in this study was obtained from a collection curated by Gani et al. (2020b). The fish obtained were then placed in a bottle containing 5% formalin solution. The samples were then brought to the Test Laboratory of the Fish Quarantine Station, Quality Control and Safety of Luwuk Banggai Fishery Products to identify the contents of the digestive tract. The surgical technique was carried out based on Gani et al. (2015) by using a scalpel starting from behind the operculum in a circle to the anus so that the internal organs can be observed, especially the digestive tract (from the stomach to the anus).

Observation of the contents of the digestive tract of S. zosterophorus using an Olympus Stereo SZX7 microscope with a magnification of 0.8 to 5.6 times the object lens. Next, the observation results were documented using an Olympus LC30 camera attached to the microscope. Identification of stomach contents is based on the method of Kabata (1979) and Botes (2003). The results of identifying food types were recorded and tabulated in table form and then processed using Microsoft Excel. Calculating the type and amount of food uses the frequency of occurrence method by recording the presence of each organism contained in the fish's digestive system expressed in percent (Effendie, 1979). Percentage of each type of food, using the following formula:

$$FK = \frac{Ni}{I} x100\%$$

Where:
FK: Frequency of Occurrence
Ni: The total number of one species of organism
I: Total gut content

RESULTS AND DISCUSSION

Based on observations of the contents of the digestive tract of *S. zosterophorus,* it is known that the types of food consumed by this species in the Bohi River include shrimp, Chironomidae larvae (insect larvae), *Hymenoptera*, plant roots, algae, *Leptocylindricus danicus* (phytoplankton). Apart from that, several types of food were not identified (others) and sand was also found in the digestive tract of *S. zosterophorus* in the Bohi River (Figure 1).

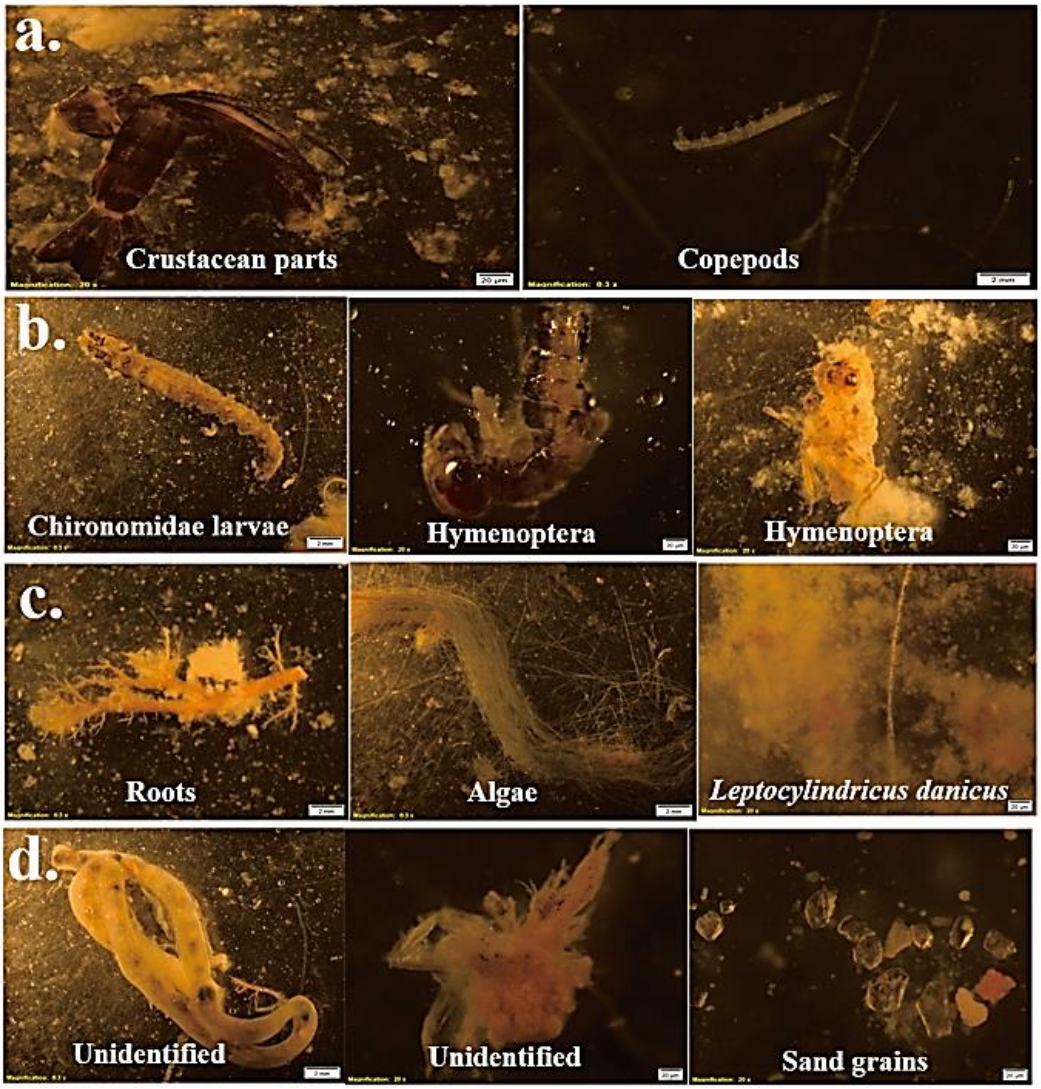

Figure 1. Types of food in *S. zosterophorus* fish in the Bohi River, a). Crustacea, b). Insects, c). Plants, d). Others.

The results of observing the types of food consumed by *S. zosterophorus* showed that there were different types of food (Table 1), so it was included in the Stenophagic category. This shows that *S. zosterophorus* is included in the category of carnivorous fish, which are specifically insectivores and phytobenthic eaters. Apart from that, the results of observations of the morphology of the *S. zosterophorus* fish show that the terminal mouth shape is a mouth shape that is located at the tip of the head and has conical teeth which resemble canine teeth, the characteristics of the teeth being that of a carnivorous fish group. The type of food most consumed by *S. zosterophorus* fish in the Bohi River is insects with a percentage of 74%. This is supported by observations that many insects were found around the Bohi River which is a source of food for these fish. The percentage of food contained in the digestive tract of *S. zosterophorus* fish consists of several food groups including insects (74%), crustaceans (7%), plants (5%), and phytoplankton (3%) (Figure 2).

Table 1. Food composition found in the digestive tract of *S. zosterophorus* from the Bohi River (n=30).

Food Items	Type Food Items	Composition (%)
1. Crustaceans		
Shrimp parts	Cephalothorax, Abdominal segment, Pereopoda, Pleopoda, Telson	4
Copepods	All parts of the body	3
2. Insects		
Chironomidae larvae	All parts of the body	47
Hymenoptera	All parts of the body	27
3. Plant materials		
Roots	Root pieces	2
Algae (filamentous algae)	Entire strands of algae	3
4. Phytoplankton		
Leptocylindricus danicus	Entire strands of algae	3
5. Unidentified	Piece	11

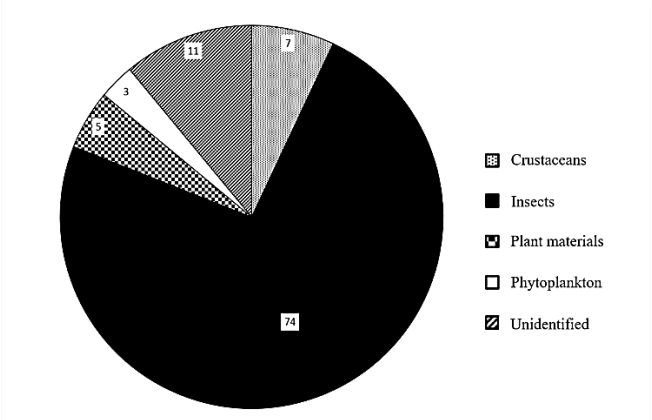

Figure 2. The percentage of food types contained in the stomach contents of *S. zosterophorus* from the Bohi River.

S. zosterophorus fish are known as benthic animals that tend to consume food at the bottom of the water, although sometimes this type is found occasionally swimming towards the water column. This is an indicator of the large number of insects consumed by *S. zosterophorus* fish, where Chironomidae and *Hymnoptera* larvae tend to be on the surface of the water. The results of research by Keith et al. (2015) stated that *S. zosterophorus* is a species of carnivorous fish that generally consumes small aquatic insects and crustaceans. The same results were also found in the benthic species *Economidichthys pygmaeus* in Lake Pamvotis, Greece which tends to consume insects (Gkenas et al. 2011). In addition, observations of the types of food in the *E. pygmaeus* species show that there are differences in the dominance of food types in each season, where many types of insects (Chironomidae larvae) are found in the digestive tract of *E. pygmaeus* when sampling is carried out in the summer, while more copepod types are found when winter (Kagalaou et al. 2006, Antonopoulos et al. 2008).

The introduction of types of insects, both water insects and land insects, in waters plays an important role as a food source for several types of fish when the availability of other types of food sources is lacking in the habitat where they live, which can influence their food habits. In one of the case studies of the *Awaous stamineus* species in the Wainiha River in Hawaii, it was found that there was a change in the food habits of this species from herbivores to omnivores when large insect populations were introduced to their habitat (Kido et al. 1993). Information on the type of food *A. stamineus* compared with samples collected at the Bishop Museum from 1938-1939 showed that algae dominated the amount of food consumed by 95.8% and the rest included the insect species *Pheidole megacephala* (Formicidae) 4.0%, *Calospectra* sp. (Chironomidae) 0.2%, and no water insects were

found, while the type of *A. stamineus* food obtained in 1993 was the type of water insect found in the digestive tract of *A. stamineus* which dominated 97.4%, even far exceeding the number of algae that previously served as the species' main food (Kido et al. 1993).

The type of food that is often found in the stomach of *S. zosterophorus* fish is generally only body parts (Figure 1), making it difficult to identify with certainty. Sjafei et al. (2004) explained that the remaining components of organisms that were often found in the stomach were thought to be due to the longtime interval between the time the fish were eaten and the time they were caught. Furthermore, Effendie (2002) stated that fish have a feeding periodicity, where the fish are actively taking food within 24 hours. The feeding time for each fish is different and depends on environmental conditions. Bad environmental conditions can change fish feeding times and can even cause food intake to stop.

CONCLUSION

The food composition in the digestive tract of *Sicyopus zosterophorus* from the Bohi River is dominated by insects as much as 74% consisting of Chironomidae larvae (47%) and Hymenoptera (27%) which shows that this fish is a species of carnivorous fish.

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