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Morphological characteristics of sex dimorphism in *Gobiopterus* sp. (Gobiiformes: Oxudercidae) from Ranu Grati Lake, Pasuruan District, East Java, Indonesia

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Abstract. *Anitasari S, Arfiati D, Susilo, Marhendra APW. 2024. Morphological characteristics of sex dimorphism in* Gobiopterus *sp. (Gobiiformes: Oxudercidae) from Ranu Grati Lake, Pasuruan District, East Java, Indonesia. Biodiversitas 25: 1214-1222.* Ranu Grati is a volcanic lake located in Pasuruan, East Java, Indonesia which has high ecological value as a habitat for a unique endemic fish found only in this lake, namely the Lempuk fish (*Gobiopterus* sp.)**.** The aim of this research is to determine the morphological characters based on sexual dimorphism of Lempuk fish. in Ranu Grati Lake. The result showed the body color of male and female Lempuk fish is transparent. Lempuk fish do not have sexual dichromatism or their sex cannot be distinguished based on their body color. Lempuk fish have vomer teeth and canine teeth. Types of male and female ctenoid scales have a comb-like shape. The position of the mouth of the Lempuk fish is located near the top or head of the fish but not precisely at the tip. There are variations in the superior subterminal mouth type between male and female fish, especially in terms of anatomical details and mouth structure. Based on meristic observations of the Lempuk fish, it can be explained that this fish has a fusiform body shape, this shows that gobies generally have a small fusiform body and also has pectoral fins, pelvic fins, dorsal fins, tail fins and anal fins. In this study, we found from histological observations of the Lempuk fish, mature oocytes and spermatids were found in one histological tissue sample at male fish with gonad maturity level II. This change from female to male occurs at the size of the fish with fish size of 21.21-30.58 ± 2.14mm. It indicates that is Lempuk fish is a species hermaphrodite protogyn.

Keywords: Gonadal histology, meristic, morphometric, Ranu Grati

INTRODUCTION

The biodiversity of fish species in Indonesia is very high and it is estimated that 8500 species live in Indonesian waters, which is 45% of the number of fish species in the world (Siskha et al. 2021). Of these, 1300 species occupy fresh waters (Kulsum and Nugrahapraja 2023). Syafei and Sudinno (2018) stated that Indonesia is listed as the country with the third largest megabiodiversity in the world, has 1.193 fish species, of which 120 are endemic species. According to Hubert et al. (2015) Indonesia has endemic fish and several types of local fish species that have different body characteristics. Indonesia's vast territory means that Indonesia has a variety of local fish. Local fish species refer to fish that many people like to use as food fish. However, information about the biodiversity of fish species in Indonesia is currently still minimal. According to Darwall and Freyhof (2016) low knowledge of the richness of fish species is an obstacle in their use. It was also explained that the characterization of native Indonesian fish really needs to be done immediately considering that knowledge about these native fish types is still relatively minimal. This situation is holding back the acceleration of utilization of fish biodiversity in Indonesia. Therefore, exploration of fish biodiversity must be an immediate priority considering the heavy pressure on habitat and ecosystem changes.

Ranu Grati is one of the lakes in Pasuruan District, Indonesia. Ranu Grati is located between 3 villages, namely Ranu Klindungan Village, Sumberdawesari Village and Gratitunon Village (Nugroho 2015). Ranu Grati is a volcanic lake located 16 km east of Pasuruan City, East Java Province. Ranu Grati is located in Ranu Klindungan Village, Grati Sub-district, Pasuruan District. The area is about 198 hectares, and is in a lowland area. Ranu Grati is at an altitude between 6-91 meters above sea level (Darmawan et al. 2019) One of the endemic fish in Ranu Grati is Lempuk fish, which are 2-3 cm in size. Lempuk fish has small size and as the first level consumer in the Ranu Grati Waters ecosystem. In August, there are not many Lempuk fish found because in the waters of Ranu Grati there is stirring in the middle of the lake so the fish die. The stirring releases sulfur because Ranu Grati is a volcanic lake (Anitasari et al. 2021). Lempuk fish has a wide distribution in various parts of the world, one of which is in China, namely there are types of fish *Gobiopterus lacustris* which belongs to the genus gobies which are small, transparent, native to fresh waters (Wang

et al. 2018). *Gobiopterus* sp. also found in Thailand (Nidsaraporn et al. 2017). Lempuk fish live in groups in the waters of Ranu Grati. According to Roesma et al. (2020) *Gobiopterus* sp. biogeographically, it is widely distributed in Sumatra, Java, the Philippines and Australia. In Sumatra, Lempuk fish is found in the waters of Lake Singkarak. According to Wang et al. (2018) which states that fish species *Gobiopterus* sp. is a species that has a small and transparent body that does not originate from the human migration process.

General Lempuk fish species is characterized by a transparent body with black or brown pigment. The morphological characters of *Gobiopterus* sp. include a head that tends to be short and wide with a round snout. It has relatively small and pointed teeth with a conical shape. Lempuk fish is a transparent fish and the inside of its body can be seen from the outside such as the kidneys, heart, swim bladder and other organs (Faqih et al. 2022). Apart from Java and West Papua, there are small and transparent fish species from the genus Gobiopterus such as the Lempuk fish in Lake Ranu Grati, Pasuruan District (Anitasari et al. 2021) also has a digestive tract that is short and straight. Lempuk fish reproduce naturally without human intervention, and in general the breeding cycle is every 4 months (Bramestian et al. 2016). Lempuk fish in Ranu Grati have characteristics that have not been studied much. The aim of this research is to determine the morphological characters based on sexual dimorphism of Lempuk fish in Ranu Grati Lake.

MATERIALS AND METHODS

Study area

This study was conducted from June to August 2023. Lempuk fish specimens were collected in Ranu Grati Pasuruan, East Java (Figure 1). In this study, samples were taken at three (3) stations (Table 1). Sampling locations were determined based on the distribution of the Lempuk fish population in the lake (Anitasari et al. 2021). The process of taking Lempuk fish samples using the installed Fish Aggregating Devices (FADs) net a 3x3 sq fish sampling using the simple random sampling method is carried out by selecting fish randomly from the existing population, where each fish has the same chance of being selected. In general, the conditions for taking Lempuk fish in the middle of the lake have an average depth of 75 m and a maximum of 134 m, have a mud substrate and have calm currents (Darmawan et al. 2019).

Materials and Methods should emphasize on the procedures and data analysis. For field study, it is better if study site is included (Figure 1).

Procedures

The sampling procedures are as follows: (i) The research activity begins with a site survey and preparation of research tools and materials. (ii) At each research station, traps were placed. Traps in each observation plot will be changed at each repetition, so that it is expected to represent the entire area of the observation plot. In addition to traps, samples of Lempuk fish is obtained from the catches of fishermen using FADs net a 3x3 sq, usually used by fishermen to catch fish. Measurement of physical-chemical factor temperature, and water pH of the environment in everystation; (iii) Observations and measurements of physical factors (iv) The specimen was put in a jar, labeled, and then transferred to the laboratory for identification purposes; (v) Specimen documentation was carried out utilizing a Nikon DX VR camera with an Nikon AF-S 18-55 mm lens and a Macro Pro Tama Digital PRO 0.45X HD WIDE LENS SDW-045 52 mm;

Table 1. The sampling stations

Stations	Geographical position	Number of specimens
Stations A	7°43’28.8”S 113°00’46.4”E	200 specimens
Stations B	7°43’30.0”S 113°00’30.2”E	200 specimens
Stations C	7°43’48.2”S 113°00’41.6”E	200 specimens

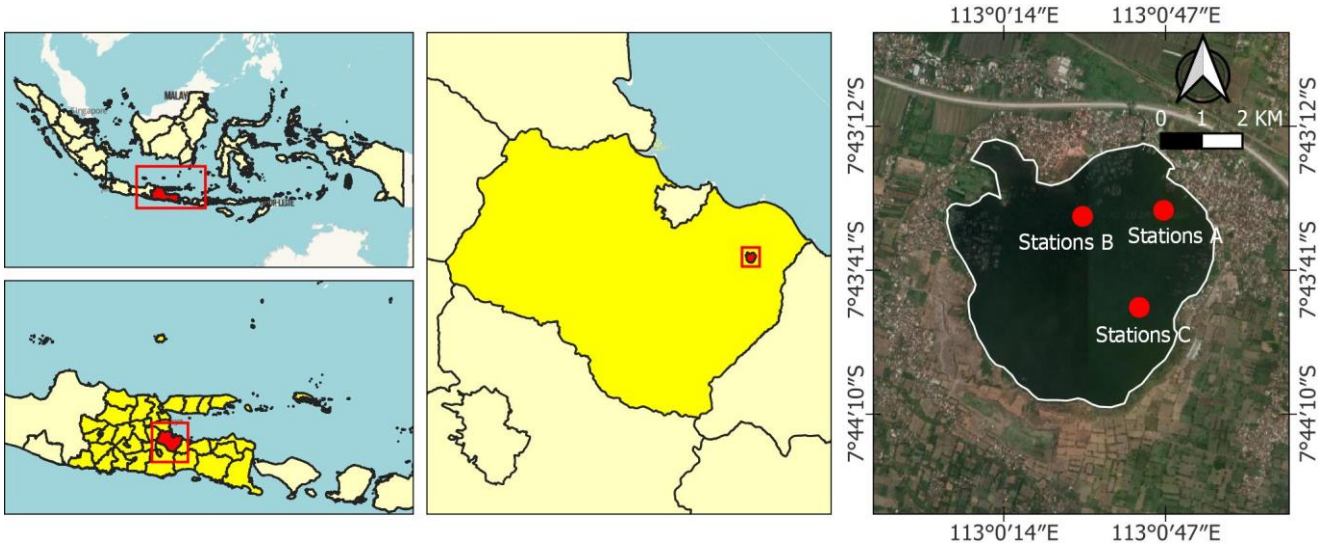


Figure 1. Location of sampling sites in Ranu Grati Lake, Pasuruan, East Java, Indonesia

(vi) Determination of morphometric characters at this stage refers to Baderan et al. (2023) is based on fish morphology. Morphometrics is the size of certain parts of the fish body structure (measuring methods). (vii) Determination of meristic characters in this research refers to González et al. (2016). Disparate the morphometric characters which emphasize the measurement of certain parts of the fish body, meristic characters are related to calculating the number of fish body parts (counting methods). The characters measured are total length, standard length, head length, caudal peduncle length, snout length, eye diameter, caudal peduncle depth, body depth, pectoral fin length, pelvic fin length, first longest height, spiny dorsal fin, first dorsal fin base length , length of base of second dorsal fin, length of base of anal fin, and weightaccording to Baderan et al. (2023). (viii) Surgery activities, preparations, observing anatomy and morphology were carried out at the laboratory of Fish Reproduction, Faculty of Fisheries and Marine Sciences, Universitas Brawijaya, Malang, Indonesia. In making fish histology, approval and guidance from the supervisor has been obtained. This observation and measurement step was referred to Maryam et al. (2015); Ghanbarifardi et al. (2018); Kaur et al. (2019); Mahadevan et al. (2019); Gonzalez-Martinez et al. (2020). Species identification was carried out by referring to (Jaafar et al. 2016). Specimen fixation, the organs that have been obtained are then fixed by immersing them in 10% formalin solution for 12-24 hours. Fixation aims to protect cells and tissue components from being damaged (ix) Gonad observations: Males and females were analyzed in the laboratory following Tamizhazhagan and Pugazhendy (2017) with the steps used to produce gonad histology, namely fixation, dehydration, clearing, embedding, and tissue observation. Observations to determine the level of gonad maturity are made by making histological preparations so that the level of gonad maturity can be known and determined with certainty in the Hydrobiology, Faculty of Fisheries and Marine Sciences, Universitas Brawijaya, Malang.

Data analysis

Morphometric and meristics data were analyzed using the Microsoft Excel program version 2021, and morphological observations were analyzed descriptively. The data used Total length, Standard length, Head length, Caudal peduncle length, Snout length, Eye diameter, Caudal peduncle depth, Body depth, Pectoral fin length, Pelvic fin length, height of the longest first spiny dorsal fin, first dorsal fin base length, second dorsal fin base length, anal fin base length based on Baderan et al. (2023). At the same time the gonad histology for both males and females was analyzed descriptively according to DoNascimento et al. (2017).

RESULTS AND DISCUSSION

Ecology condition in the Ranu Grati

Biological parameters of plankton water quality in the Ranu Grati area. There are 2 types, namely phytoplankton and zooplankton. Phytoplantons include Chlorophyta and Chrysophyta. Zooplankton in Ranu Grati consists of the phylum Protozoa, phylum Arthropoda, and phylum Rotifera. Physical and chemical water quality at the Ranu Grati location obtained average results: temperature 29-31 C, pH in the normal range of 7, dissolved oxygen 2.82-6.10 mg/L, brightness ranging from 56.25-80, 5 cm, carbon dioxide 5.9-13.9 mg/L, and total organic matter value 10.16-20.12 mg/L.

The morphology of Lempuk fish

Based on morphological observations of 600 specimens of Lempuk fish male and female fish can be distinguished based on their morphology or can be called sexual dimorphism. The differences in the morphology of male and female fish can be seen in Figure 2. This is in accordance with the statement of Dong et al. (2019), that gobiopterus fish can be differentiated by sex through their morphological characteristics. Observation of fish sexual dimorphism can be done by observing the shape of the caudal fin, body shape, and body abdominal shape. Male and female Lempuk fish have the same shape, body color, type of scales, number of fins, and type of teeth.

The body color of male and female Lempuk fish is transparent. The internal organs such as the heart, swim bladder, spine and blood vessels to be seen directly, Lempuk fish do not have sexual dichromatism or their sex cannot be distinguished based on body color. Male Lempuk fish have different morphometric characters from female Lempuk fish. Male fish have a larger body and a longer dorsal fin shape than female fish. Apart from that, in the anal fin, male fish are wider and elongated. The shape of the caudal fin of male Lempuk fish has a rounded and wider shape (Figure 2). The type of ctenoid scales male and female of Lempuk fish which can be seen in Figure 3 These scales have a comb-like shape, where on the back of the scales there are small serrations called *ctenii*. These scales are common in fish, especially in teleost. Ctenoid scales grow together from the top and bottom. The characteristics of the ctenoid scales are soft and transparent. This is caused by the composition of the scales which does not contain dentine or enamel and there is a reduction in the thickness of the scales which become thinner. The scales are embedded in the skin in small pockets in the dermis that are arranged like a tiled roof. These conditions reduce friction with water so that fish will be more agile and can accelerate the movement of fish (Muchlisin et al. 2017).

The position of a fish's mouth of Lempuk fish, which is located near the upper end or head of the fish but not precisely at the tip. This means that the fish's mouth is situated slightly below or beneath the tip of its nose or snout, but still close to the upper part of the fish's head. In Figure 4, there are variations in the subterminal superior mouth type between male and female fish, especially in terms of their anatomical details and mouth structures. These differences can include mouth size, lip shape, and the dental or chewing apparatus used for capturing and consuming food. Fish mouth shape Lempuk fish subterminal superior. In Lempuk fish, small and fine teeth are present, rather than pronounced canine teeth.

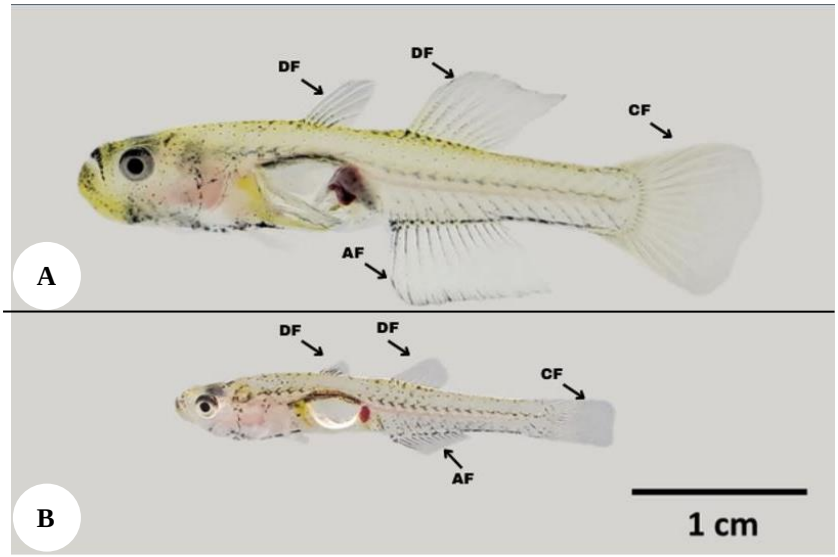


Figure 2. Male (A) and (B) female of Lempukfish spin in Ranu Grati. DF: Dorsal fin, AF: Anal fin, CF: Caudal fin

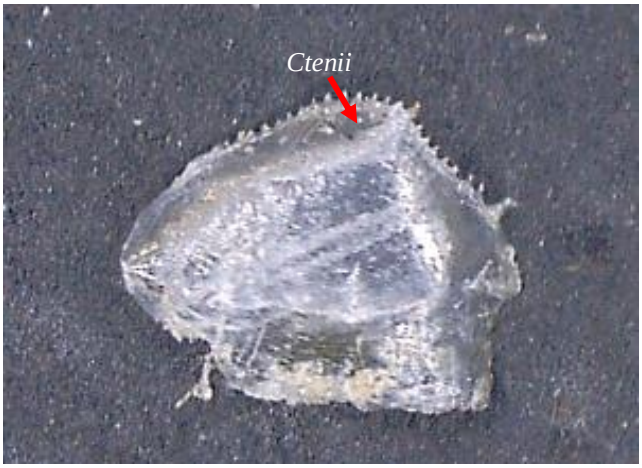
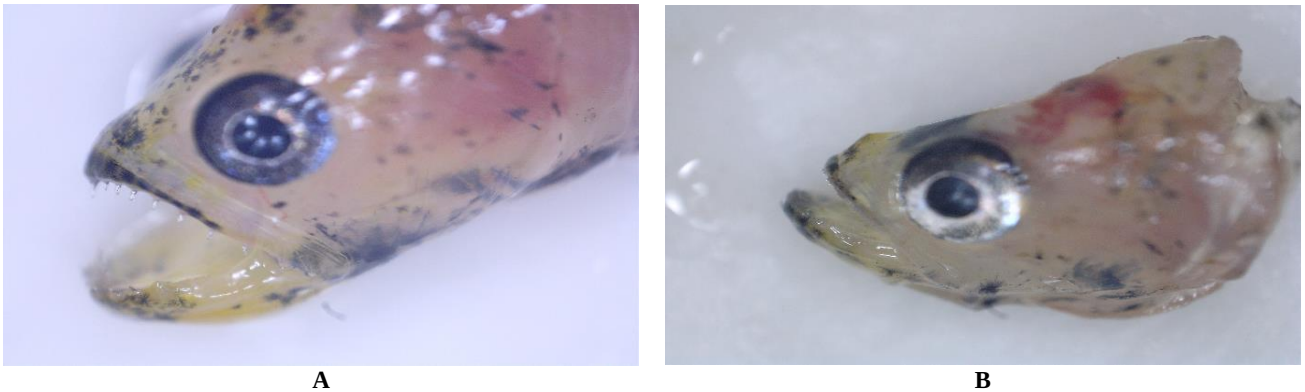


Figure 3. Scale of *Gobiopterus* sp. showing *ctenii*

The morphometric and meristic characters of Lempuk fish

Table 1 shows the morphological characters of Lempuk fish in the Ranu Grati, Indonesia. Table 1 shows the of morphometric characters of Lempuk fish in the Ranu Grati, Indonesia. The morphometric characteristics of Lempuk fish which were found in the Ranu Grati, Indonesia, along with the species classification, are presented in Table 1

Based on the meristic observations of the Lempuk fish it can be explained that this fish has a fusiform body shape, indicating that gobies generally have small, and inhabit the bottom of water. The body shape of the fish is related to its habitat and way of life. The mouth location is subterminal superior (Figure 5), with a truncate tail fin shape and a diphycercal tail type. The position of the pelvic (V) fin relative to the pectoral (P) fin is thoracic (the pelvic fin is located just below the pectoral fin). The dorsal (D) fin is of the double type, meaning the species has separate dorsal fins. The fish also has pectoral fins, pelvic fins, dorsal fins, caudal fins, and anal fins (see Figures 2, 3, and 4). The Lempuk fish (*Gobiopterus* sp.) has stenoid scales, which are small, thin, and lightweight fish scales. The Lempuk fish (*Gobiopterus* sp.) has teeth on both jaws, including vomer teeth and canine.



A **B**

Figure 4. The mouth of the male (A) and female (B) Lempuk fish is located at the anterior end of the head, facing forward

Table 1. The morphometric of Lempuk fish *Gobiopterus* sp. from Ranu Grati

Characters	Gonad Level Maturity							
	Female				Male			
	I	II	III	IV	I	II	III	IV
Total length	17.52-29.91 ± 2.49	18.73-36.41 ± 5.16	19.53-29.91 ± 2.63	20.56-34.58 ± 3.61	21.21-30.58 ± 2.14	22.55-28.8 ± 1.73	23.95-28.04 ± 1.53	23.99-30.32 ± 2.39
Standard length	14.54-25.51 ± 2.18	15.15-28.91 ± 4.10	16.95-24.93 ± 2.13	17.07-29.68 ± 3.03	14.24-24.76 ± 2.23	20.07-23.9 ± 1.11	20.65-24.71 ± 1.95	20.04-25.56 ± 2.03
Head length	2.18-6.96 ± 1.10	2.21-9.79 ± 1.69	2.23-6.37 ± 1.05	1.51-7.87 ± 1.25	2.75-8.54 ± 1.16	3.26-5.67 ± 0.79	4.25-5.28 ± 0.53	3.87-6.95 ± 1.14
Caudal peduncle length	1.36-6.92 ± 0.94	1.23-6.8 ± 1.29	2.21-5.33 ± 0.69	1.2-5.14 ± 0.94	1.7-7.79 ± 1.30	3.11-4.7 ± 0.55	3.92-5.48 ± 0.65	2.88-5.27 ± 0.92
Snout length	0.87-2.92 ± 0.49	0.86-3.3 ± 0.58	0.93-27.74 ± 4.55	0.93-3.49 ± 0.56	0.95-5.59 ± 0.87	0.84-2.54 ± 0.50	1.22-1.74 ± 0.22	1.2-2.52 ± 0.46
Eye diameter	0.61-3.21 ± 0.52	0.65-2.19 ± 0.44	0.48-2.27 ± 0.46	0.75-4.61 ± 0.87	0.83-2.94 ± 0.54	0.92-1.75 ± 0.25	1.02-1.4 ± 0.17	0.96-2.71 ± 0.61
Caudal peduncle depth	1.37-4.74 ± 0.54	1.28-4.69 ± 0.87	1.81-2.23 ± 0.52	1.42-4.37 ± 0.69	1.84-3.21 ± 0.36	1.96-3.39 ± 0.49	1.86-2.67 ± 0.34	1.88-4.32 ± 0.81
Body depth	1.39-6.99 ± 0.91	1.5-7.06 ± 1.32	1.61-6.62 ± 0.96	2.57-6.31 ± 0.87	2.01-5.85 ± 0.86	1.68-4.72 ± 0.86	3.9-4.98 ± 0.53	2.02-6.6 ± 1.61
Pectoral fin length	1.21-6.25 ± 1.19	1.2-6.23 ± 1.26	1.45-5.63 ± 1.17	1.1-6.62 ± 1.37	1.46-6.08 ± 1.03	2.42-4.68 ± 0.59	1.92-3.92 ± 0.96	1.58-5.18 ± 1.50
Pelvic fin length	0.6-3.36 ± 0.59	0.96-4 ± 0.72	1.09-2.97 ± 0.55	1.01-3.23 ± 0.56	1-3.77 ± 0.70	1.28-3.07 ± 0.71	1.26-2.25 ± 0.47	1.04-2.99 ± 0.67
Height of the longest first spiny dorsal fin	0.69-7.09 ± 0.80	0.66-4.27 ± 0.92	1.06-3.70 ± 0.68	1.11-3.78 ± 0.69	0.69-3.57 ± 0.68	1.48-4.12 ± 0.71	1.64-2.68 ± 0.45	1.54-3.18 ± 0.52
First dorsal fin base length	0.38-3.68 ± 0.66	0.56-3.39 ± 0.68	0.94-3.43 ± 0.60	0.35-3.94 ± 0.73	0.39-3.65 ± 0.68	0.41-3.92 ± 1.05	1.3-1.97 ± 0.30	0.73-2.37 ± 0.61
Second dorsal fin base length	1.47-4.96 ± 0.75	1.67-5.8 ± 1.06	1.87-4.86 ± 0.82	1.42-4.8 ± 0.87	1.54-5.12 ± 0.86	1.14-4.7 ± 0.99	2.51-2.95 ± 0.20	1.96-3.74 ± 0.71
Anal fin base length	1.75-5.6 ± 0.81	1.38-7.96 ± 1.578	1.4-5.57 ± 0.85	1.41-6.21 ± 1.02	2.42-5.74 ± 1.10	2.23-5.52 ± 1.10	3.07-4.51 ± 0.68	1.42-4.57 ± 1.08
Weight	0.02-0.53 ± 0.06	0.05-0.09 ± 0.17	0.067-0.19 ± 0.03	0.064-0.63 ± 0.10	0.049-0.21 ± 0.03	0.11-0.19 ± 0.02	0.11-0.19 ± 0.04	0.13-0.27 ± 0.05

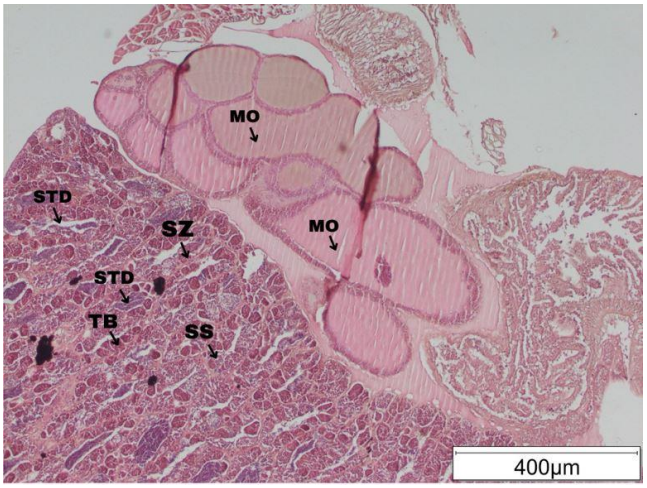


Figure 5. The Gonad histological observation of Lempuk fish Note: SG: Spermatogonium, STD: Spermatid, SS: Secondary spermatocyte, MO: Mature oocyte, TB: Tubulus.

Table 2. Sex ratio of Lempuk fish

Time period	Sex composition		Sex ratios
	Male	Female	
June	291	277	1.050541516
July	155	132	1.174242424
August	469	337	1.391691395

Histological observation of Lempuk fish gonads on sexual characteristic

From histological observations of the Lempuk fish, mature oocytes and spermatids were found in one histological tissue sample at Male fish with gonad maturity level I with fish size of 21.21-30.58±2.14 mm. Spermatids, on the other hand, are the early stage of sperm development that will later develop into mature sperm cells. The discovery of mature oocytes and spermatids in the histology of Gobiidae fish provides insights into the reproductive cycle and reproductive biology development of this species. It indicates that Lempuk fish in Ranu Grati is a species hermaphrodite protogyn

Sex ratio of Lempuk fish

The measurement of sex ratio indicates that the male Lempuk fish population is larger than the female Lempuk fish population (Table 2). At all observation stations, the female-to-male sex ratio is greater than one, indicating that there are consistently more male individuals than female individuals in the population. This suggests a skewed or imbalanced sex ratio with a predominance of males.

Discussion

The body shape of the Lempuk fish is fusiform, if the fish's body is cut crosswise, a body shape that resembles an ellipse, which can be seen in Figure 2. This is in accordance with Anitasari et al. (2021), the body shape of the gobiopterus is fusiform or resembles a torpedo. Radhi et al. (2018) stated that the fusiform body shape is characterized by a slender body shape, an elliptical body, a narrow tail, and is often referred to as a torpedo. This is following Sahami et al. (2020) that generally gobies have a small body and are fusiform, where their place of life is at the bottom of the waters. The shape of the fish's body will have a relationship with its habitat and way of life (Koniyo and Juliana 2018). The fusiform body shape tends to be elongated and allows fish to swim fast because it minimizes friction with water (Kilawati and Arfiati 2017). Asiah et al. (2018) stated that the emergence of meristic characters is based on genetic factors. The environment can cause a modification of the meristic character. Meristic characters compared between *Gobiopterus* sp., where *Gobiopterus chuno* and *Gobiopterus brachypterus* is the sum of dorsal fin rays 1 and 2 and anal fin rays. *Gobiopterus chuno* and *Gobiopterus brachypterus* have the same number of dorsal fin rays 1 as many as 5, while *Gobiopterus* sp. 4-5 pieces. The radius of the dorsal fin 2 of the three is different, namely in *Gobiopterus* sp. I.7-I.8; *Gobiopterus chuno* 8-9; and *Gobiopterus brachypterus* 8. The anal fin radii of the three fish also differ where *Gobiopterus* sp. has I.10-I.13; *Gobiopterus chuno* 10-11 pieces, and *Gobiopterus brachypterus* 11-12 pieces (Anitasari et al. 2021).

The collection of Lempuk fish specimens, characteristics of the first dorsal fin rays were observed first dorsal fin rays (D1) being 3-5, the second dorsal fin rays (D2) being 1.7-1.8, and 29 in the anal fin rays (A)1.10-1.13, with the body height being 4.5-5 times shorter than the standard length (SL/standard length). The mean standard length is 22 mm, and there is black pigment on the dorsal midline and vertical black pigments on the cheeks and at the preoperculum boundary. The number ventral fin rays is (V) 3-4. The pectoral fin radius of male and female fish is almost the same, (P) 10-18 for males, while for females (P) 10-15. The number of caudal fin rays in male and female fish is almost the same, in male fish (C) which are 8 hard rays, 2 soft hard rays, 10 soft rays up to12 hard rays, 4 soft hard rays, 19 soft rays. Meanwhile, female fish from caudal fin rays (C) which are 8 hard rays, 2 soft hard rays, 10 soft rays to 10 hard rays, 4 soft hard rays, 15 soft rays. The number of scales on the linea lateralis of male fish is 13-24, while on females it is 8-27.

Morphometric character measurements of Lempuk fish show differences between males and females. Male fish have larger body sizes compared to females. This can be seen in the range and average length, width, height, and body thickness of males, which have larger values than females. Therefore, to differentiate between female and male fish, morphometric character measurements can be carried out on Lempuk fish. This is in line with the statement (Leclercq et al. 2014), that morphometric characters can be used to differentiate the gender and species of fish, and it indicates that the different morphometric characters between females and males can be influenced by environmental conditions. This is because environmental conditions are related to the morphological and genetic structure of fish. These differences are caused by the fish's response to their habitat conditions. In terms of characters seen histologically, male Lempuk fish have

characteristics with spermatogonium and spermatid cells. Meanwhile, female Lempuk fish are indicated by the presence of egg cells in their gonads. Differences in morphometric characters will also influence the level of gonad maturity of Lempuk fish.

The change in sex of the Lempuk fish from female to male occurs at gonad maturity level I with a fish size of 21.21-30.58±2.14 mm. This indicates that the fish is a protogynous hermaphrodite. Protogyny was indicated in all four by the presence of tissue masses associated with the ovary, which, in protogynous congeners, develop into testis-associated structures during sex change. Gobiopterus exhibits considerable geographical, morphological and ecological diversity. The apparent prevalence of protogyny in this genus suggests that hermaphroditism is an ancestral, rather than a recently derived, condition (Maxfield and Cole 2019). Hermaphroditism has been reported for a small number of gobiid fishes, but the extent of this sexual pattern within the family is not known. Gonad structure was examined in one or more species from twenty-one gobiid genera. With the exception of *Gobiodon* and *Paragobiodon*, which exhibited similar gonadal structure, ovarian and testicular structure varied considerably among the hermaphroditic genera examined, both with regard to the configuration and to the degree of development of ovarian and testicular tissues, or testicular tissue precursors. Findings of this study indicate that hermaphroditic gonad structure will prove to be a useful trait in determining evolutionary relationships within the Gobiidae (Sunobe et al. 2017). The growth of male fish is known to be faster and bigger than female fish. According to Roque et al. (2022) this plays an important role in determining the extent of dimorphic characters that indicate gonad maturity. However, information about why males are larger than females still needs to be studied adequately. Therefore, it becomes very relevant when considering the fact that sexual dimorphism may be related to various measures and developments.

Protogyny hermaphroditism has been demonstrated in three species *of Gobiopterus* sp. Based on an examination of sexual patterns in histologi gonad, protogyny appears to be widespread in this genus. Female-to-male sex change was experimentally confirmed in the *Gobiopterus* sp. Hermaprodit protogyny is a condition where the gonad differentiation process proceeds from the female phase to the male phase (Setiawan et al. 2019). These fish begin their reproductive cycle as functional females and later change into functional males. The change in sex is influenced by size, age, and species. Gonad maturity level can be used as an indicator of the fish's reproductive status. It is not precisely known how the sex change occurs, but it is estimated to be related to the fact that males are larger than females. Protogynous hermaphrodite is a condition where the gonad differentiation process proceeds from the female phase to the male phase. This fish begins its reproductive cycle as a functioning female fish and then turns into a functioning male fish. This gender change is influenced by size, age and type. The level of gonad maturity can be used as an estimate of fish reproductive status. Protogynous hermaphroditism is a condition where the gonad differentiation process proceeds from the female phase to the male phase. This fish begins its reproductive cycle as a functioning female fish and then turns into a functioning male fish. This gender change is influenced by size, age and type. The level of gonad maturity can be used as an estimate of fish reproductive status. Protogynous hermaphroditism is a condition where the gonad differentiation process proceeds from the female phase to the male phase. This fish begins its reproductive cycle as a functioning female fish and then turns into a functioning male fish. This gender change is influenced by size, age and type. The level of gonad maturity can be used as an estimate of the reproductive status of fish. It is not yet known for certain the technical nature of sex change, but it is estimated from the size of male fish which is larger than female fish (Remya Mohan et al. 2018).

Based on the results of the sex comparison analysis on three different sampling occasions, it was found that the population of male Lempuk fish was greater than that of female Lempuk fish. One of the reproductive biology of fish is the sex ratio, size at gonad maturity, spawning season, fecundity and species condition factors. However, detailed biological information is also needed regarding the stock abundance, reproduction and growth of this species from any geographical area where its distribution is still insufficient to support sustainable exploitation (Ahamed et al. 2018). The sex ratio can be determined from the physical shape of the fish's body, namely the length and body of the fish (Sari 2017). Sex ratio is the ratio between male fish and female fish in a population (Pulungan 2015). The sex ratio of male Lempuk fish and female Lempuk fish at five different points is presented in Table 2.

The measurement of sex ratios indicates that the male Lempuk fish population is larger than the female Lempuk fish population. The difference in sex ratios is due to several factors such as climate, breeding season, and water quality in Ranu Grati. The male population of Lempuk fish (*Gobiopterus* sp.) is higher than the female population, likely influenced by the breeding season. August is suspected to be the spawning month for Lempuk fish, resulting in a higher male population during the research period.

The aim is to measure the sex ratio of the fish population. Observations began in June and it was discovered that the male to female sex ratio was 1:1.05, while in July, the male to female sex ratio was 1:1.17. The sex ratio between males and females in June and July is not much different and is close to the ideal sex ratio, namely 1:1. The ratio of male fish to female fish in a population, with ideal sex ratio conditions, namely a ratio of 1:1. Meanwhile, there was a significant difference in the sex ratio in August, namely 1:1.39. The comparison ratio of female and male fish in a population, with the ideal sex ratio being more females than malesone of the factors influencing sex change. In this study, sex change did not occur because the sex ratio was close to the ideal sex ratio. The sex change from female to to male in Lempuk fish fish would be very drastic so that sex ratio is imbalanced.

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