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Abstract
Climbing perch called Papuyu fish in South Kalimantan Indonesia caught in swamp waters, is a fish that is very popular with the community and has high economic value. Fish reproductive performance is very important to obtain information on the natural conditions of the reproductive status of climbing perch fish in the form of gonadal maturity level, and fecundity. This research aims to analyze the reproductive performance of climbing perch fish based on the level of gonadal maturity, gonadal maturity index and fecundity of climbing perch fish (*Anabas testudineus* Bloch). The method used in this study was descriptive quantitative. Starting from the preparation of tools and materials, the measurement of fish reproductive parameters including gonadal maturity level, gonadosomatic index and reproductive fecundity were observed morphologically and analyzed descriptively. The results of the study, reproductive performance, the maturity levels of the gonads ranged from TKG II, TKG III and TKG IV. The gonadosomatic index ranged from 0.995-11.147%. are within the range of IKG values of climbing perch fish. Fecundity in sample A ranged from 10,098-39,303 eggs with an average of 24,816 eggs and a gonad weight of 2.97g. Sample B ranged from 14,800-62,381 eggs with an average of 34,767 eggs with a gonad weight of 4.47g.
Keywords: Reproduction, Climbing perch, gonads, fecundity.
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1. Introduction

Reproduction is the ability of individuals to produce offspring as an effort to preserve their species or group. Reproduction is an important aspect in the management of an aquatic resource. The success of a fish species in its life cycle is determined by its ability to reproduce in a fluctuating environment in order to maintain its population (Musrin *et al.,* 2014). One way to obtain optimal fish hatchery results is to improve reproductive performance (Darwisito, 2008). Reproductive performance includes gonadosomatic index, egg diameter, fecundity, number of spawning fish, egg hatching rate, and larval survival (Darwasito *et al* 2015). According to Effendie (2002) the value of fecundity, and the diameter of the eggs produced can determine the level of gonadal maturity of the fish, this is because level of gonadal maturity greatly affects fecundity, egg diameter and the degree of fertilization of eggs from a spawning carried out, the higher the level of gonadal maturity of a parent fish, the higher the success rate of spawning is done.

Fecundity is the number of mature female eggs in the ovary before being released when the fish will spawn. Determination of fecundity is done by taking the ovaries of mature female fish. The amount of fecundity in each individual fish varies. (Sharif *et al* 2018). Several studies on fish reproduction have been carried out in different places and types of fish such as Harianti (2013) fecundity and egg diameter of snakehead fish in Lake Tempe, Herjayanto *et al* (2017) embryogenesis of Rainbow fish, Sharif *et al* (2018) reproductive biology of Gazza minuta fish, Prianto *et al* (2014) reproductive biology of climbing perch fish. Based on the description above, researchers conducted a study on the reproductive performance of climbing perch fish. This research is expected to contribute to the scientific concept of reproductive performance of climbing perch fish. The purpose of this study was to analyze the reproductive performance of climbing perch fish based on the level of gonadal maturity, Gonadosomatic index and fecundity of climbing perch fish *(Anabas testudineus* Bloch). From the results of this study it is expected to obtain scientific data on the reproductive performance of climbing perch fish based on the level of gonad maturity, Gonadosomatic index and fecundity of climbing perch fish.

2. Research Methods

Time and place

The research time has been carried out for 6 months consisting of preparation, maintenance, data processing and analysis, and reporting. located in the Wet Laboratory of the Faculty of Fisheries and Marine University of Lambung Mangkurat, Banjarbaru South Kalimantan Indonesia.

Research procedures

The research procedure was carried out observation of the reproductive performance of the climbing perch fish consisting of measurement of the level of gonadal maturity, Gonad somatic index and fecundity.

Observation of reproductive performance: Stunning fish surgery was carried out using clove oil at a dose of 1 ml per 5 liters of water before the surgery was carried out. The fish to be dissected must first be documented using a camera in the form of a photo. The unconscious fish is then dissected using surgical scissors starting from the anus and then moving towards the head. Climbing perch fish that have been dissected, then the gonad organs are harvested to observe the length and weight of the climbing perch fish, level of gonadal maturity, Gonad somatic index and egg fecundity calculations. Fish length and weight Measuring the length of climbing perch fish was done using a ruler in cm units. The length measured is the total length from the tip of the mouth to the tip of the tail. Climbing perch fish weight was weighed using a digital scale of 0.01 g.

Gonad Maturity Level: Determination of the gonadal maturity level is done by observing the gonads according to Effendie (1997) which can be seen in Table 1.

Table 1. Characteristics of the Gonad Maturity Level

Gonad Maturity Level	Female	Male
I	Ovaries are threadlike, long to the front of the body cavity. Smooth surface color. Larger ovary size	Testis are like threads, shorter (limited and visible ends in body cavity, clear color.
II	The coloration of the ovaries is darker yellowish, the eggs are not clearly visible to the eye.	Surface of the testes is larger. The coloration is white like milk. The shape is clearer than level I.
III	ovaries are yellow in color and morphologically the eggs begin to appear with the eyes.	The surface of the testes looks jagged, the color is whiter, the testes are more large, in preserved state easily broken
IV	The ovaries are getting bigger, the eggs are yellow in color, they are easy to separate. Oil grains are not visible, filling ½ to 2/3 of the abdominal cavity, intestines are pushed.	As in grade III and more clearly visible Testicles more solid
V	Ovary wrinkled, thick wall, ovary side present near release. Many eggs like at level II	Testes are the back of the back is deflated and near the release

Fecundity of fish eggs: To determine the fecundity of female climbing perch fish with TKG III, IV and V. gonads were taken out from sample fish and weighed with an accuracy scale of 0.001 gram to determine the total weight of the gonads. The eggs were then taken out and placed on a glass object to count the number of eggs with the help of an ocular microscope to make it clear. The data obtained from each parameter were analyzed descriptively.

Observation Parameters

Gonad Maturity level (GML)

Gonadal maturity levels were observed separately from morphological analysis with attention to color, shape, egg diameter and egg weight which refers to Effendi (1979), and references to the classification of gonad maturity (Effendi, 1992) Description of the GML stage was divided into 5 phases [6], namely immature (I), developing (II), ripening (III), ripe or fully mature (IV), and spent (V).

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Gonadosomatic index (GSI)

The Gonadosomatic index (GSI) was calculated by comparing the gonad weight (GW) with the fish body weight (W). GSI was calculated using Effendie (1997) formula as follows:

$$GSI = GW/W \times 100\%$$

Where:

GSI = Gondosomatic index (%) ; GW = Gonad weight (g); W = Fish body weight (g)

Fecundity

Fecundity is estimated as the number of eggs found in the ovaries of fish that have reached TKG III and IV. Total fecundity was calculated using the gonad weight sub-sampling method or called the gravimetric method. Fecundity of fish is determined using the gravimetric method using Effendie formula (1997):

$$F = G/Q \times N$$

Where:

F = Fecundity (total eggs); G = Total Weight of gonad (g)

Q = Weight of subsample (g); N = number of eggs in gonad subsample (eggs)

Data Analysis Data

The reproductive performance of the climbing perch fish broodstock were analyzed descriptively, the data is presented in the form of tables, graphs and figures.

3. Results And Discussion

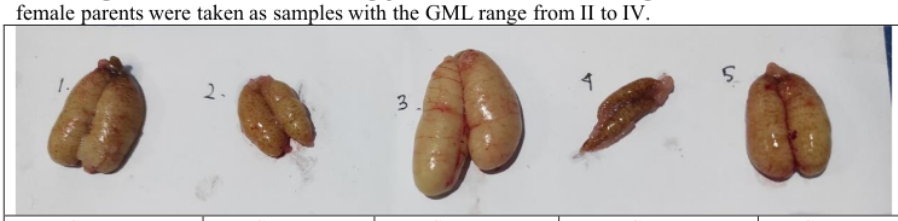
Gonad Maturity Level (GML)

The level of gonadal maturity was observed morphologically by taking into account the color, shape, egg diameter and egg weight which refers to Effendi (1979), and references to the classification of gonadal maturity (Effendie, 1992). GML research results in Table 2.

Table 2. Gonad Maturity Levels (GML)

Gonad	Samples	Gonad Color	Filling in the abdominal cavity	Reference (Effendie, 1997* and Hasnidar *et al* 2022**)
1	IV	Bright yellow	2/3 stomach	* GML IV, Development II/Almost ripe) ** The ovary is getting bigger, the yellow color is close to orange, and the egg grains are clearly visible. Estimated to fill 50-70% of the abdominal cavity)
2	III	yellow Brownish	½ abdomen	*GML III, Development I (Ovaries are yellow and morphologically the eggs begin to appear to the eye) **Ovaries have started to enlarge, yellow in color, egg grains are visible with clear but the eggs are still difficult to separate. Estimated to fill nearly 30% -50% of the abdominal cavity.
3	IV	Bright yellow	2/3 abdomen	GML IV, Development II/Almost ripe **Ovaries are bigger, yellow color closer to orange, egg grains clearly visible. Estimated to fill 50-70% of the abdominal cavity
4	II	Brown	1/3 abdomen	GML II, Dara develops (Ovary coloration is darker yellowish, eggs are not clearly visible to the eye) Ovaries are larger than ovaries GML I, pale yellow in color, egg grains already visible, it is estimated to fill 20-30% of the abdominal cavity.
5	IV	Bright yellow	2/3 abdomen	TKG IV, Development II/Almost ripe **Ovaries are getting bigger, yellow color is approaching orange, egg grains are clearly visible. It is estimated to fill 50-70% of the abdominal cavity

The gonads of the female climbing perch fish can be seen in Figure 1. The results of observations of 5 female parents were taken as samples with the GML range from II to IV.



GML IV	GML III	GML IV	GMLII	GML IV

Figure 1. Gonads of female Climbing perch fish

Gonads at GML II have a dark yellow color and only fill 1/3 of the abdominal cavity, brownish color at GML II, the eggs are still not clearly visible. The gonads at TKG III have a brownish yellow color, the yellow color is darker brown than GML IV, and the edges of the eggs appear still jagged or irregular, the eggs are still covered with fat inside the ovary so that the separation between eggs still has eggs sticky to each other, gonads fills /2 of the stomach According to Effendie (1992), GML III has brownish yellow ovaries, morphologically the eggs begin to be visible to the eye.

GML IV has a brighter yellow gonad color, the shape of the eggs is perfectly round and the color on the egg yolks is lighter yellow, GML IV eggs have a clear granular shape with a perfect shape and are very easy to separate from one another, this is because of the fat present in the climbing perch fish ovary has decreased. According to Effendi (1992), GML IV ovaries are getting bigger, the dark yellow eggs are easily separated. Oil grains are not visible, fill 1/2-2/3 of the abdominal cavity, intestines are pushed.

Gonadosomatic index (GSI)

The Gonadosomatic index (GSI) of female fish was calculated by comparing the gonad weight (GW) to the fish body weight (BW) multiplied by 100%. Gonadosomatic index data in Table 3 and Figure 2

Table 3. Gonadosomatic index (GSI) of female climbing perch Fish

Sample	Gonad Weight(g)	Fish Body Weight (g)	GSI (%)
1	2.97	46.25	6.422
2	1.79	29.90	5.987
3	4.47	40.10	11.147
4	0.43	43.21	0.995
5	1.67	45.32	3.685

Primary data (2022)

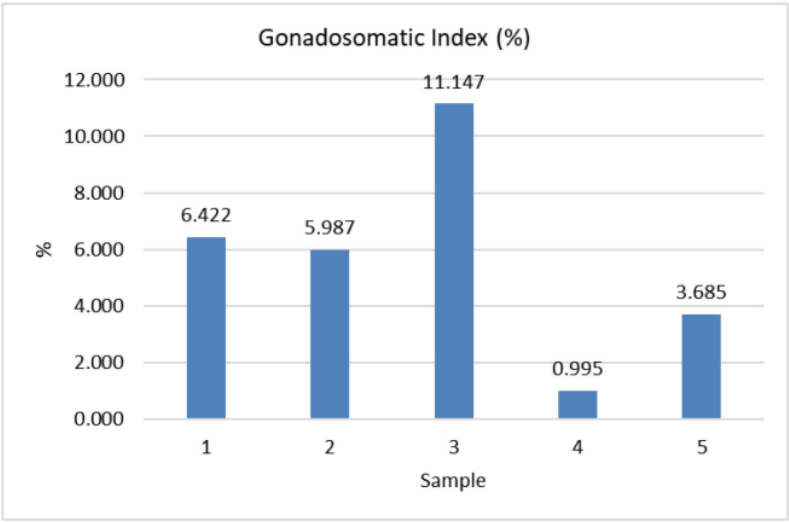


Figure 2. Graph of GSI of Climbing perch Fish

GSI is used as an indicator to determine the development of gonads in fish (Priyatha and Chitra, 2022). The calculation of the Gonadosomatic index from the research results ranged from 0.995-11.147%. The GSI results in this study were in the range of GSI values, compared to the results of Ernawati *et al.,* (2009) which were in the range of GSI values for female climbing perch fish, which tended to have a higher value than male climbing perch fish. The GSI value of the parrot fish ranged from 0.14-17.77%, with the range for males of 0.14-7.67%, and for females of 0.19-17.77%. In accordance with the statement Bagenal (1973) and Effendie (1979) less than 20%. Affandi and Tang (2000), stated that the addition of ovary weight in female fish is heavier than the increase in weight in male fish, which ranges from 10% - 15%. According to Zworykin (2012) the GSI of female climbing perch fish whose gonads were immature was from 1.10-16.41% and mature female parents ranged from 1.10 to 9.17%. The results of Jacob's research (2005) obtained GSI values ranging from 2.95-9.84% with the highest value being 14%. Affandi and Tang (2002) stated that the female gonadosomatic index was higher than that of the male, this was due to differences in the size of the male and female gonads. The GSI value increases with the development of the gonads until the fish spawn. The size of the GSI value is also influenced by the level of maturity of the gonads of the parent, this occurs because of an increase in vitellogenin which produces protein as a form of egg yolk. The results of research by Ernawati *et al* (2009) stated that the value of GSI from climbing perch fish will tend to increase as GML increases to GML IV and then decreases again to GMLV, this is due to a reduction in gonads in the spawning process.

A GSI value of less than 20% indicates that fish can spawn more than once a year (Bagenal and Braum, 1968 in Effendi, 2002). Based on the GSI value of the results of this study, because it is less than 20%, it cannot be confirmed that Papua New Guinea fish spawn more than once a year. According to Prianto *et al*., (2014) that climbing fish eggs do not mature simultaneously. It is suspected that the climbing perch fish spawns twice a year and is a partial spawner. However, several researchers such as Muhammad et al (2003), Jacob (2005), and (Anggra *et al* 2013) state that spawning of climbing perch fish occurs once a year during the rainy season. Rahmadi *et al* (2021) stated that the bioecological aspects of the climbing perch fish and concluded that the climbing perch fish are omnivorous, spawning more than once a year at the start of the rainy season. Much literature states that the spawning of climbing perch fish takes place only during the rainy season (during floods). The results of Jacob's research (2005) show that the spawning of climbing perch in India takes place in May-June. The difference in spawning seasons is thought to be due to differences in the hydrography of the locations. Weber (1974) in Prianto *et al* (2014), states that the spawning season for tropical fish is closely related to the hydrographic factors of an area. Female fish with GML III and IV were also found in July-October, a different matter because most of the literature stated that flood-exposed fish, including climbing perch, spawn at the beginning of the rainy season. This is reinforced by the results of Zworykin's research (2012) that climbing perch fish spawn at night and take place in the rainy season. The existence of this phenomenon is suspected because in that month the territory of Indonesia was affected by the negative Indian Ocean Dipole (IOD) which caused a dry season interspersed with rain so that this phenomenon is known as a wet dry season. This phenomenon causes the water level in Lubuk Lampam river in Sumatra to fluctuate and flood throughout the year so that this condition triggers the climbing fish to spawn. Based on the size distribution of egg diameter, the climbing perch fish reproductive pattern includes partial spawner, where the eggs are not released simultaneously (Prianto *et al*, 2014).

Fecundity

Fecundity is estimated as the number of eggs found in the ovaries of female broodfish that have reached GML III and IV. Total fecundity was calculated using the gonad weight sub-sampling method. The fecundity of the research results in Table 4.

Table 4. Fecundity data of female climbing perch fish

Sample	Replicate	Weight Gonad total (G)	Weight Gonad samples(Q)	Egg subsample (N)	Fecundity (eggs)
	1	2.97	0.03	397	39303
A	2	2.97	0.03	102	10098
	3	2.97	0.03	253	25047
Rerata		2.97	0.03	250.67	24816
	1	4.47	0.045	628	62381.333
B	2	4.47	0.045	149	14800.667
	3	4.47	0.045	273	27118
Rerata		4.47	0.045	350	34766.667

Fecundity in sample A ranged from 10,098 – 39,303 eggs with an average of 24,816 eggs, gonad weight 2.97 g. Sample B ranged from 14,800-62,381 eggs with an average of 34,767 eggs with a gonad weight of 4.47 g. The fecundity in this study showed that the greater the weight of the climbing perch fish, the larger the gonads.

Fecundity in this study was greater in number compared to research by Makmur, (2006) in Ernawati *et al* (2009), climbing perch fish with a range of body weights of 15-110 g and gonad weights of 2.42-15.96 g, had a number of eggs (fecundity) ranged from 4,882- 19,248 eggs. Priyatha and Chitra (2022) identified spawning peaks in July and August, fecundity ranging from 6,500–11,000 eggs. The fecundity value is in the range and tends to be higher with the broodstock used having a body weight of 40.10-46.25 g so that more eggs are produced, because according to Fahriny and Sharifuddin (2010), fecundity in one fish species can differ from one individual to another. According to Hasnidar (2022), the difference in fecundity produced by the climbing perch fish is thought to be related to the length and weight of the fish. The heavier and longer the fish, the tendency for fish fecundity to increase, and conversely the smaller the length and weight, the less fecundity. The results of this study are in accordance with the opinion of Hasnidar (2022), so that with greater fecundity it will provide more recruitment opportunities (Ernawati *et al*. 2009). According to Hasnidar (2022) In the reproductive process, most of the energy produced by metabolism is directed to the development of the gonads. If the energy is insufficient, it is suspected that it will affect the synthesis and release of gonadotropin hormones so that the reproductive process is hampered and even fish can delay their reproductive process. In addition, even though there is a reproductive process that begins with gonadal maturation, only a portion of the eggs in the mature gonads is reabsorbed.

5. Conclusion

Reproductive performance, the maturity levels of the gonads ranged from GML II, GML III and GML IV. The results of the calculation of the gonadosomatic index ranged from 0.995-11.147%. are within the range of GSI values of Climbing perch fish. Fecundity in sample A ranged from 10,098 – 39,303 eggs with an average of 24,816 eggs and a gonad weight of 2.97 g. Sample B ranged from 14,800-62,381 eggs with an average of 34,767 eggs with a gonad weight of 4.47g.

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