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Study on the Spawning of Hoven's carp Fish at BPBAT Sungai Gelam Through Broodstock, Fertilization, Hatching, and Embryonic Development Parameters

Kajian Pemijahan Ikan Hoven's carp fish di BPBAT Sungai Gelam Melalui Parameter Induk, Fertilisasi, Penetasan, dan Perkembangan Embrionik

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ABSTRACT

This study aims to determine the spawning techniques of *Leptobarbus hoevenii* fish at the Sungai Gelam Freshwater Aquaculture Center (BPBAT). Activities include maintaining prospective broodstock, selecting mature broodstock, injecting ovulation hormones, and the spawning process, *stripping*, egg handling, water quality monitoring to highlight its importance, and embryo development. Ovaprim hormone injections were administered to the female broodstock four times and once to the male broodstock to stimulate ovulation. The stripping process was carried out after ovulation and was followed by dry mixing of eggs and sperm before being spread into the hatching tank. The results showed a fertilization rate of 63,08% and a hatching rate of 9,73%, which were influenced by gamete quality and the physiological condition of the broodstock. Observations of embryogenesis showed developmental stages ranging from morula, blastula, gastrula, to organogenesis before the eggs hatch into larvae. Water quality parameters during the study were in the optimal range for spawning, namely pH 7,24–7,77, temperature 27–30,5°C, and DO 3,53–5,58 mg/L. The results of this study explain that the success of Hoven's carp fish seeding is highly dependent on the readiness of the broodstock, the application of artificial spawning techniques, and good water quality management.

Keywords: embryogenesis, fertilization, induced spawning, *Leptobarbus hoevenii*, water quality

ABSTRAK

Penelitian ini bertujuan mengetahui teknik pemijahan ikan jelawat (*Leptobarbus hoevenii*) yang dilakukan di Balai Perikanan Budidaya Air Tawar (BPBAT) Sungai Gelam. Kegiatan meliputi pemeliharaan calon induk, seleksi induk matang gonad, penyuntikan hormon ovulasi, proses *stripping*, penanganan telur, pengamatan kualitas air dan perkembangan embrio. Penyuntikan hormon ovaprim dilakukan pada induk betina sebanyak empat kali dan satu kali pada induk jantan untuk merangsang ovulasi. Proses stripping dilakukan setelah ovulasi dan diikuti pencampuran telur dan sperma secara kering sebelum ditebar ke dalam bak penetasan. Hasil penelitian menunjukkan tingkat pembuahan sebesar 63,08% dan derajat penetasan 9,73%, yang dipengaruhi oleh kualitas gamet dan kondisi fisiologis induk. Pengamatan embriogenesis menunjukkan tahapan perkembangan mulai dari morula, blastula, gastrula hingga organogenesis sebelum telur menetas menjadi larva. Parameter kualitas air selama penelitian berada pada kisaran optimal untuk pemijahan, yaitu pH 7,24–7,77, suhu 27–30,5°C, dan DO 3,53–5,58 mg/L. Hasil penelitian ini menjelaskan keberhasilan pembenihan ikan jelawat sangat bergantung pada kesiapan induk, penerapan teknik pemijahan buatan, serta pengelolaan kualitas air yang baik.

Kata Kunci: embriogenesis, fertilisasi, pemijahan buatan, *Leptobarbus hoevenii*, kualitas air

INTRODUCTION

The Hoven's carp Fish (*Leptobarbus hoevenii*) is a freshwater fish species endemic to Sumatra, Malaysia, and Thailand. It inhabits tributaries, upstream and downstream, and even estuaries with their forested banks (Sintia et al., 2020). This fish has high demand and economic value due to its delicious flavor and tender flesh (Iqbal et al., 2021).

In nature, *Leptobarbus hoevenii* spawn in the upper reaches of rivers during the rainy season, with their eggs or larvae carried by the current until they hatch downstream (Abidin, 2007). Community catching of fry is generally carried out in areas subject to seasonal flooding, which have high larval concentrations. However, increasing fishing pressure has the potential to reduce the wild broodstock population. Therefore, improving hatchery and artificial spawning techniques is crucial to reducing dependence on natural resources and maintaining the sustainability of *Leptobarbus hoevenii* fishery.

Besides seed supply issues, growth performance and environmental suitability are crucial factors in developing Hoven's carpfish cultivation. Several studies have shown that water quality influences the growth, survival, and success of Hoven's carpfish cultivation. For example, analysis of the water suitability of Lake Way Jepara showed that only some areas were classified as moderately suitable (S2), while other areas were less suitable due to limiting water depth and quality (Riyoma et al., 2020).

This indicates that successful cultivation, including seed production, requires controlled environmental conditions such as those available in government seed production units, including BPBAT Sungai Gelam. The Sungai Gelam Freshwater Aquaculture Center (BPBAT) is a hatchery institution that plays a crucial role in providing Hoven's carp fish fish fry in Jambi Province and the surrounding areas. The availability of potential broodstock, rearing technology, and efforts to improve reproductive management are key factors in increasing fry production. Various studies related to growth, egg nutrition, environmental requirements, and rearing techniques have become the basis for the development of more effective spawning methods (Harianto et al., 2025; Abbas et al., 2025; Andini 2023; Aryani, 2009; Bachry et al., 2021; Rimalia 2014). However, studies specifically describing Hoven's carp fish spawning techniques are still very limited. Therefore, this study aims to determine the spawning method of Hoven's carp fish fish at the Sungai Gelam Freshwater Aquaculture Center (BPBAT) as an effort to support increased fry production and the development of sustainable Hoven's carp fish cultivation.

RESEARCH METHOD

The research was conducted at the Freshwater Aquaculture Center (BPBAT) Sungai Gelam Muaro Jambi on July 8 - August 12, 2024.

The main materials used in the study included male and female Hoven's carp broodstock. Other materials included the hormone Ovaprim, distilled water, physiological solution (NaCl), and stabilizer. The tools used in the study included a fiber tank for storing the seeds/larvae, a 1 L measuring cup, a hand tally counter, a thermometer, a pH meter, a DO meter, a petri dish, and a microscope.

Research Procedures

The research procedure carried out began with the maintenance of broodstock of Hoven's carpfish, in floating net cages (KJA) measuring 4 x 4 x 1,5 m^2, where the maintenance was carried out separately between males and females by providing a divider in the KJA. The next procedure before the spawning process of Hoven's carpfish, namely the selection of broodstock in Hoven's carpfish. This selection was carried out to obtain broodstock Hoven's carpfish that have mature gonads and are ready to spawn. The criteria for broodstock that are mature gonads and ready to spawn include age and physical condition, namely female broodstock aged around 2-3 years with a weight of 2-3 kg/tail, while for male broodstock aged 1,5-3 years with a weight of 1,5-3 kg/tail.

The next step is the injection of ovulation hormones. Hormone injections into the fish's bodies are carried out to accelerate the ovulation process and artificial spawning (induced breeding). Ovaprim hormone injections were carried out in one injection to the male parent at a dose of 0,5% and to the female parent at a dose of 0,7%. The stripping process was carried out after the female parent experienced ovulation. The ovulation period for the Hoven's carpfish is 4-12 hours. The first check was carried out 4

hours after the last injection. The procedure continued with the handling and hatching of eggs and observation of embryo development. Parameters observed in this study included water quality (pH, temperature, and Dissolved Oxygen (DO).

Data analysis

1. Fertilization rate

The degree of fertilization in fish can be influenced by various factors such as gamete quality, environmental conditions, and spawning techniques, all of which contribute to reproductive success (Hunter & Olham, 1980). The percentage of fertilization degree can be calculated using the formula below:

$$FR\ \% = \frac{Number\ of\ fertilizable\ eggs}{Number\ of\ sample\ eggs}\ x\ 100\%$$

2. Hatching rate

Hatching rate is a parameter used to determine the degree of egg hatching. The degree of hatching is determined by several factors, including the percentage of fertilization, environmental factors, and pests and diseases. The fertilization factor is largely determined by how many eggs can be fertilized by sperm; the more eggs fertilized by sperm, the higher the hatchability, and conversely, the fewer eggs fertilized by sperm, the lower the hatchability. Water with low dissolved oxygen and pH will also affect egg hatchability. Poor water quality can inhibit embryo growth and result in eggs not hatching (Simbolon et al., 2015). The hatching rate can be calculated using the formula below:

$$HR = \frac{Number\ of\ eggs\ hatched}{Number\ of\ fertilized\ eggs}\ x\ 100\%$$

This study uses descriptive analysis. Data is presented in the form of figures and tables.

RESULTS AND DISCUSSION

Maintenance of Parent Hoven's carp Fish

The broodstock of the Hoven's carp fish are reared in floating net cages (KJA) measuring 4 x 4 x 1,5 m², with an average weight of 2-3 kg for females and 1,8-2 kg for males. Male and female broodstock are kept separate by providing a divider within the KJA. This is to prevent illegal spawning, which could affect the quality of the broodstock.

The Hoven's carp fish are fed twice daily, in the morning and afternoon at 8:00 AM and 2:00 PM WIB. They are fed commercial pellets with a protein content of around 45%. The feed is given at a rate of 3% of the fish's total weight per day. In addition to pellets, the Hoven's carp fish are also fed cassava leaves once a week.

Selection of Hoven's carp Fish Broodstock

This selection process is carried out to obtain gonad-mature broodstock ready for spawning. The selection process begins with fasting the broodstock for one day to reduce stress, facilitating stripping, or sorting, of eggs and sperm collection.

Broodstock selection is carried out in the morning to reduce stress levels in the broodstock. The criteria for gonad maturity and spawning readiness are shown in Table 1. According to Rimalia (2014), fertilization occurs when spermatozoa meet eggs. The success of this process is largely determined by the quality of the eggs and sperm, as well as the sperm's ability to move spontaneously and quickly to reach and penetrate the micropyle of the egg.

Ovulation hormone injection

The first step before spawning is preparing the tank. The tank used to house the female broodstock is a 2 x 1 x 0,5 m³ vibration tank with a water level of 30 cm. The male broodstock is housed in a 2 x 1 x 1 m³ concrete tank with a water level of 70 cm, equipped with aeration and a cover.

Artificial spawning (induced breeding) is performed by injecting the hormone ovaprim to stimulate and accelerate gonad maturation. The female broodstock is injected four times at 12:00, 18:00, 24:00, and 06:00 WIB (Western Indonesian Time) with doses of 10, 25, 25, and 50%. The male broodstock is injected once at a dose of 0,5%, simultaneously with the second injection of the female broodstock at 18:00 WIB.

The broodstock to be spawned are first weighed to determine the hormone dosage to be administered. The broodstock to be injected are first placed in a plastic bag to minimize the risk of them jumping or struggling. The injection is performed behind the dorsal fin (intramuscularly), precisely in the softest and thickest area of the back, allowing for a deep injection and reducing the risk of ovaprim leaking through the injection site. The injection is performed at a specific angle on the syringe.

After injection, the syringe is slowly withdrawn while gently pressing the injection site to ensure no hormone is released.

Table 1. Characteristics of Mature Female and Male Broodstock

Female Parent	Male Parent
1. Genital papillae are enlarged/rounded and red. 2. The lower pectoral fin rays and operculum feel smoother to the touch. 3. Short dorsal fin 4. Bigger and fatter body shape	1. The stomach tapers towards the genitals and when massaged, white sperm fluid will come out. 2. Genital papillae are tapered and red in color. 3. The lower pectoral fin rays and operculum feel rougher to the touch. The dorsal fin is longer. 4. Smaller and slimmer body shape

Source: Data Processing

Ovulation and striping

The stripping process is carried out after the female broodstock experiences ovulation. The ovulation period for the Hoven's carp fish is 4-12 hours. The first check is carried out 4 hours after the last injection, and if ovulation still hasn't occurred, checks are carried out 2 hours later, and so on. The ovulated female broodstock is anesthetized with a stabilizer solution. The fish is placed on a wet towel to facilitate the stripping process. The fish's abdomen and urogenital area are dried with tissue to prevent the eggs from mixing with water. The fish is stripped from the abdomen towards the urogenital area. After the eggs are obtained, the male broodstock is stripped to obtain sperm cells. Stripping the male broodstock is carried out in the same way as for the female broodstock. Sperm cells are collected using a syringe previously added with 1 ml of physiological solution (NaCl). Sperm cells can be stored in a coolbox and can last for 4-6 hours.

The eggs are then mixed with sperm and stirred using a chicken feather in a figure-eight motion. Stirring with the feather is done gently to protect the eggs. Afterward, the eggs are added to mineral water and stirred again, then the water is discarded and replaced with plain water. This step aims to wash and help the eggs expand. The washing process is repeated eight times, and the eggs must be continuously stirred throughout. Once completed, the fertilized eggs are released into the hatching tank. The fertilization rate can be seen in Table 2.

Table 2. Fertilization Rate

Number of Sample Eggs	Number of Fertilized Eggs	Number of Unfertilized Eggs	FR%
2,018	1,273	745	63.08%

Source: Data Processing

Fertilization rate data shows that 1,273 eggs were fertilized, with a fertilization rate of 63.08%. Andini (2023) reported a fertilization rate of 78.93%. Fertilized Hoven's carp fish eggs hatch within 18-24 hours.

Egg Handling and Hatching

The egg hatching process is carried out in a round fiber tank with a diameter of 80-90 cm with a maximum volume of 500 liters. The hatching tank is filled with water and aerated. The water is filled three days before spawning to neutralize the pH and increase the dissolved oxygen levels in the water. Fertilized eggs are spread into the hatching tank at a volume of 2,000 ml per tank. Water changes are carried out 24 hours after spreading the eggs, amounting to 80% to maintain water quality. The hatching rate can be seen in Table 3.

Based on Table 3, it is known that a total of 1,273 fertilized eggs with a percentage (hatching rate) of 9.73%. This result is lower when compared to Andini's (2023) study, which obtained a percentage of 73.81%. Eggs that do not hatch can be caused by differences in fertility levels in each Hoven's carp fish broodstock, such as the condition of the female broodstock

itself, which can affect the number of eggs that hatch, and is directly related to the quality of the eggs produced by the female broodstock (Prabowo et al., 2016).

Larvae are harvested after the eggs hatch. This is done to determine the number of eggs that hatch and the number of larvae produced. Larvae are harvested by reducing the water level in the hatching tank by about 70-80%, then harvesting the larvae using a fine-mesh scoop.

The larvae in the scoop were then measured using a measuring spoon to estimate the number of larvae produced. Before determining the amount with the measuring spoon, a sample of one-day-old larvae was first taken from one measuring spoon. This sample was used as a benchmark for the number of larvae produced.

Table 3. Hatching Rate

∑ Total number of fertilized eggs	∑ Total Eggs Hatched	*Hatching rate (%)*
1,273	1,149	9.73%

Source: Data Processing

Observation and Development of Embryos

Embryogenesis begins with the process of cell division and differentiation of the embryo, which occurs in the early stages of life. The embryonic process begins with the union of the egg and sperm. The zygote emerges after fertilization and undergoes division, during the embryonic developmental stages, including the morula, blastula, gastrula, differentiation, and organogenesis. Embryogenesis in the Hoven's carp fish exhibits complex developmental stages, from fertilization to the larval stage, with significant morphological changes (Fitriani, 2021).

Observations of embryogenesis in Hoven's carp fish eggs were conducted using a microscope. The observations show the embryogenesis process of Hoven's carp fish eggs, starting from the morula, blastula, gastrula, and organogenesis stages, until the eggs finally hatch into larvae. The results of the observations of Hoven's carp fish embryogenesis are shown in Table 4.

In the Hoven's carp fish, the formation of internal organs such as the heart and liver can be observed starting from the early larval stage, indicating rapid and coordinated development (Rahmawati & Prabowo, 2020). Observations of Hoven's carp fish embryogenesis clearly map the main stages, such as morulation, blastulation, and gastrulation, over specific time periods (Wijayanti & Santoso, 2022). Embryogenesis in Hoven's carp fish indicates that the formation of external structures such as fins and scales occurs relatively quickly after fertilization (Kurniawati, 2023).

Water Quality

Water quality measurement in larval rearing ponds, KJA, male incubation tanks, female incubation tanks, and larval egg hatching vibration tanks is one of the important factors in the Hoven's carp fish spawning process. The water quality parameters measured include pH, temperature, and DO. The results of water quality measurements are presented in Table 5.

pH measurements showed results ranging from 7.26 to 7.48. These results align with those of Inawati et al. (2022), who stated that a good pH value for fish farming is 6-7. The results of measurements of the water temperature of the Hoven's carp fish spawning fish ranged between 27-30.5°C. Inawati et al., (2022) reported that the results of measurements of the temperature of the Hoven's carp fish maintenance media had a value of 26.75°C, this result is in accordance with the research of Suryatno (2009) which explained that the good water media temperature for fish growth ranges between 25-30°C.

Dissolved oxygen levels in Hoven's carp fish spawning ponds ranged from 3,53 to 5.58 mg/L. This result is lower than the research by Inawati et al. (2022), which reported dissolved oxygen levels ranging from 5 to 5.6 mg/L. The high dissolved oxygen content in the water is due to the strong aeration system, which facilitates oxygen entry into the water.

Good water quality is a prerequisite for successful cultivation and achieving an optimal and controlled culture environment. The optimum conditions for each parameter are pH ranging from 6.5 to 7.5, DO ranging from 3.59 to 9.65 mg/L-1, temperature

ranging from 18 to 28°C, and ammonia <0.02 ppm (Sonavel et al., 2020).

Table 4. Results of Observations Embryogenesis of the Hoven's carp Fish *(Leptobarbus hoevennii)*

No	Picture	Stadium	Description
1.		Morula	Blastula is the morula cells dividing to form a cavity filled with water, which is the process of the morula developing into a blastula.
2.		Blastula	Where it still forms a cavity
3.		Grastula	The egg nucleus phase has appeared and has surrounded 2/3 of the yolk and the embryo will form.
4.		Organogenesis/ Embryo	In this phase, organogenesis is still taking place, the formation of a body organ.
5.		Organogenesis/ Embryo	In this phase, organogenesis is still taking place, the formation of a body organ.
6.		Hatch	At this stage, the eggs have undergone changes where the larvae's tail moves.

7.		Larva newly hatched	it is said to have hatched because the larvae started moving

Source: Data Processing

Table 5. Quality of Spawning Water for Hoven's carp Fish

Parameter	Measurement place					Optimal range	Reference
	KJA	Male Reservoir	Female Retention Tank	Egg fiber tub	Larva fiber tank		
Temperature (°C)	27	30.5	28	27.1	27	27-29	Arifin et al., 2014
pH	7.26	7.65	7.77	7.24	748	7.08-7.28	Rusliadi et al., 2015; Harianto et al., 2023
DO (mg/L)	3.53	4.45	3.55	5.96	5.58	4.89-5.32	Rusliadi et al., 2015; Harianto et al., 2023

Source: Data Processing

Poor water quality can cause stress and mortality in fish larvae, so parameters such as pH, temperature, and dissolved oxygen must be monitored regularly to maintain larval health (Hoffman et al., 2019). Fluctuations in water temperature can affect the growth rate and metabolism of fish larvae, ultimately affecting larval survival. Optimal water quality for fish larvae includes sufficiently high levels of dissolved oxygen and control of contaminants such as ammonia and nitrite (Jones 2021).

CONCLUSION

The success of Hoven's carp fish spawning in the Sungai Gelam BPBAT is determined by the quality of the broodstock, proper hormone injection techniques, and controlled environmental management. The fertilization rate reached 63.08%, but the hatching rate was still low at 9.73%, which was influenced by egg quality, the physiological condition of the broodstock, and environmental factors. Embryo development can be clearly observed from the morula stage to hatching, indicating that the embryogenesis process is normal under appropriate maintenance conditions. Overall, Hoven's carp fish spawning can be successful if the quality of the broodstock, reproductive techniques, and water quality parameters are maintained within the optimal range.

RECOMMENDATIONS

Further research is needed to explore varying hormone dosages and improving egg and sperm handling techniques to increase fertilization and hatching rates. It's also important to monitor more water quality parameters, such as ammonia and nitrite, to better maintain hatching conditions. Furthermore, improving feed quality and pre-spawning broodstock care can help produce better gametes and increase spawning success.

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