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The Effect of Functional Male Broodstock Sex Ratio on Fertilization and Hatching Rate of Climbing Perch (*Anabas testudineus* Bloch)

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ABSTRACT

One approach to optimizing the effectiveness of functional male broodstock is by using different sex ratios during the spawning of climbing perch. This study aimed to analyze the effect of sex ratio on the fertilization and hatching rate of climbing perch. The main research was conducted at the Freshwater Aquaculture Research Center, Mandiangin, South Kalimantan. A Completely Randomized Design with 4 treatments and 3 replicates was employed. The research parameters were fertilization and hatching rate of the eggs. The effect of sex ratio on fertilization and hatching rate showed that the highest fertility rate was 94.40% in Treatment C (1:3 ratio), and the best hatching rate was 99.44% in Treatment B (1:2 ratio).

Keywords: *Climbing Perch, Sex Ratio, Fertility, Hatching Rate*

INTRODUCTION

The development of climbing perch aquaculture has been incorporated into the freshwater fish development strategy in South Kalimantan Province. Trials for the cultivation of climbing perch, both at the seedling and grow-out stages, are continuously being conducted by various institutions, including universities—specifically researchers from the Faculty of Fisheries and Marine Sciences, Lambung Mangkurat University—provincial and district fisheries departments in South Kalimantan, as well as the Freshwater Aquaculture Center (BPBAT) Mandiangin, South Kalimantan. The results obtained are quite promising, indicating that the technology for the seedling and grow-out stages of climbing perch can now be considered proven technology (Ansyari et al., 2021).

The development of climbing perch in controlled environments is currently hindered by several factors such as seed quality, genetics, behavior, and reproduction (Slamat, 2012). A common phenomenon observed in the cultivation of climbing perch is the significant size difference between male and female individuals, leading to a higher proportion of fish below market size (Bunasir et al., 2014). In addition to genetic factors, this size difference is suspected to be caused by sexual dimorphism in growth, with female climbing perch growing faster than males. Therefore, systematic research is required to validate this.

Due to the significant growth difference between male and female climbing perch, the development of monosex female cultivation techniques for climbing perch presents a highly promising opportunity (Hidayat, 2016).

The limited number of functional male broodstock of climbing perch obtained from progeny tests significantly affects the breeding system of climbing perch, which typically requires more male than female broodstock. Given this condition, one approach to optimizing the use of functional male broodstock is by employing different sex ratios during the spawning of climbing perch.

Several studies on varying sex ratios during spawning have been conducted. For example, in rabbitfish (Siganus guttatus), the best sex ratio was found to be 2 males to 1 female (2:1), resulting in a hatching rate of 61%. In Rasbora (Rasbora argyrotaenia), the optimal sex ratio was 3 males to 1 female (3:1) with a fertilization rate of 98%, while a 1:1 ratio yielded a fertilization rate of 71% (Burmansyah, 2013).

Frid et al. (2018), an appropriate sex ratio will optimize the fertilization process because the number of eggs can be effectively fertilized by the sperm cells. This is due to the balance between the number of eggs and sperm under the correct sex ratio conditions. This study aims to analyze the effect of different sex ratios on the fertilization and hatching rate of climbing perch.

MATERIALS & METHODS

The main research was conducted at the Freshwater Aquaculture Center, Mandiangin, South Kalimantan. A Completely Randomized Design with 4 treatments and 3 replicates was employed:

1. Treatment A: Climbing perch spawning with a sex ratio of 1:1 (functional male: female).
2. Treatment B: Climbing perch spawning with a sex ratio of 2:1 (functional male: female).
3. Treatment C: Climbing perch spawning with a sex ratio of 3:1 (functional male: female).
4. Treatment D: Climbing perch spawning with a sex ratio of 4:1 (functional male: female).

Data Analysis

Fertilization

Fertilization is the process of uniting the ovum (egg cell) with spermatozoa, where this process is the initial stage of embryo formation, or in other words fertilization is the percentage of fertilized eggs. Prasetya et al. (2015) stated that the formula for the percentage of fertilized eggs (fertilization) according to Winarsih (1996) is:

$$\text{Percentage of fertilized eggs} = \frac{\sum Tf}{\sum Tt} \times 100\%$$

Description:
Tf = number of fertilized eggs
Tt = Total number of eggs

Hatching Rate

According to Putri et al. (2013), the percentage of egg hatching is the number of fertilized eggs using the following formula:

$$\text{Egg hatching percentage} = \frac{\sum Th}{\sum Tf} \times 100\%$$

Description:
Th = Number of eggs hatched
Tf = Number of fertilized eggs

RESULT

Fertilization

"Fertilization is the process of the union of ovum (egg cells) with spermatozoa, which represents the initial stage of embryo formation; in other words, fertilization is the percentage of eggs that are fertilized. To determine the number of fertilized and unfertilized eggs, this study used a sample of 1 gram of climbing perch per sample,

resulting in the table shown below

Table 1. Fertility level of spawned climbing perch

Treatment	Test (%)			Amount (%)	Average (%)	St.Deviasi
	I	II	III			
A	83,88	80,73	75,56	240,17	78,150	±3,430
B	97,10	88,62	95,75	281,47	93,823	±4,556
C	96, 96	93,60	95,20	188,80	94,400	±1,131
D	94,27	93,44	89,58	277,29	92,430	±2,503

The results of the Shapiro-Wilk normality test for the fertility rate of climbing perch showed p-values for Treatment A (0.734), Treatment B (0.284), Treatment C (0.948), and Treatment D (0.318), all of which are greater than 0.05, indicating that the data is normally distributed. The results of the homogeneity test on the fertility rate of climbing perch showed a p-value Based on Mean of 0.275, which is greater than 0.05, indicating that the data variance is homogeneous (homogeneity test fulfilled).

The results of the Analysis of Variance (ANOVA) on fertility showed a p-value of 0.002, which is less than 0.05, indicating a significant effect. The graph showing the fertility rate of climbing perch can be seen in Figure 1.

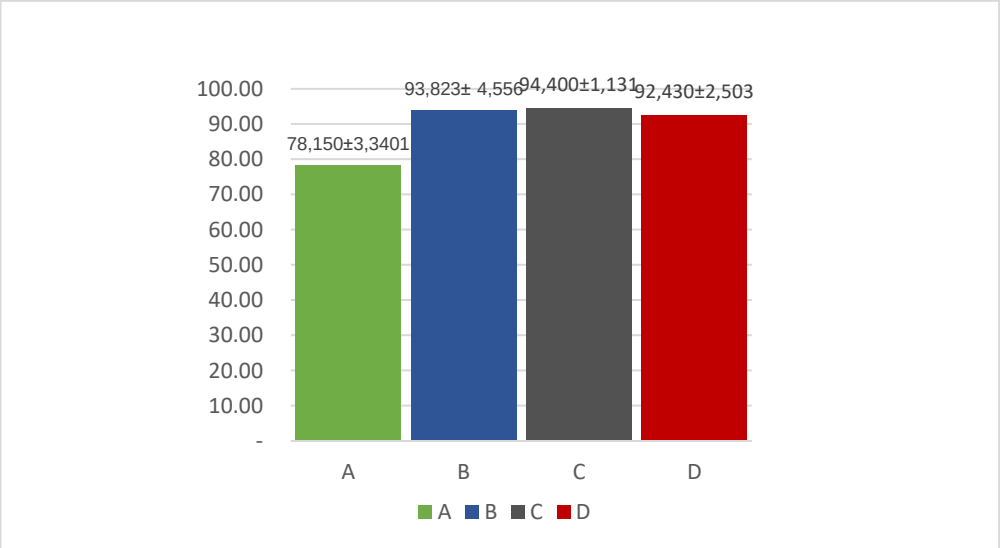

Figure 1. Fertility graph of climbing perch

Based on the data in Figure 1, there are differences in the fertility of climbing perch among the treatments. The average fertilization rate ranges from 78.150% to 94.40%. Fertility rates for Treatment C were 94.40%, Treatment B was 92.823%, and Treatment D was 92.430%, while Treatment A had the lowest fertility rate at 78.150%.

The Analysis of Variance (ANOVA) results for the fertility of climbing perch indicate a significant effect of the sex ratio on fertilization. The highest fertility rate was observed in Treatment C (1:3 ratio) at 94.40%, followed by Treatment B (1:2 ratio) at 92.823%, and Treatment D (1:4 ratio) at 92.430%. The lowest fertility rate was in Treatment A (1:1 ratio) at 78.150%.

According to Slamat (2012), the hatching rate in studies with a 1:1 sex ratio ranges between 40-85%. Subagja et al. (2003) identified factors affecting fertilization percentage, including egg quality, sperm quality, and sex ratio.

An optimal sex ratio ensures effective fertilization because it allows the number of eggs to be adequately fertilized by the sperm. This balance between the number of eggs and sperm is crucial. The study results suggest

that a single male broodstock can effectively fertilize the eggs of a female broodstock with uniform body weight. Fertilized eggs were observed to be clear and transparent.

Hatching Rate

The hatching rate is used to determine the proportion of eggs that develop into larvae. Eggs are considered to have hatched when they exhibit tail movement and overall body movement. The hatching rate calculation includes both normally hatched eggs and abnormally hatched eggs (defective), as presented in the following table:

Table 2. Hatchability of climbing perch (HR)

Treatment	Test (%)			Amount (%)	Average (%)	St.Deviasi
	I	II	III			
A	97,38	94,35	97,41	289,14	96,380	±1,758
B	99,62	99,92	98,78	298,32	99,44	±0,591
C	93,34	98,41	99,22	290,97	96,99	±3,187
D	94,30	93,25	94, 74	187,55	93,78	±0,742

The results of the Shapiro-Wilk normality test for the hatching rate of climbing perch showed p-values of 0.878 for Treatment A, 0.637 for Treatment B, 0.726 for Treatment C, and 0.537 for Treatment D, all greater than 0.05, indicating that the data is normally distributed. The results of the homogeneity test for the hatching rate of climbing perch showed a p-value Based on Mean of 0.367, which is greater than 0.05, indicating that the data variance is homogeneous (homogeneity test fulfilled).

The Analysis of Variance (ANOVA) results indicated a p-value of 0.002, which is less than 0.05, showing a significant effect. The Tukey HSD test results can be interpreted based on the p-values: if the p-value is less than 0.05, the treatments are significantly different from each other. According to the subset table, Treatment D and A are in subset 1, Treatment A and C are in subset 2, and Treatment C and B are in subset 3. Treatments within the same subset are not significantly different from each other, while those in different subsets are significantly different.

Thus, it can be concluded that Treatment D is not significantly different from Treatment A but is significantly different from Treatments C and B. Treatment A is not significantly different from Treatments D and C but is significantly different from Treatment B. Treatment C is not significantly different from Treatments A and B but is significantly different from Treatment D. Treatment B is not significantly different from Treatment C but is significantly different from Treatments D and A. The graph of the hatching rate of climbing perch is shown in Figure 2.

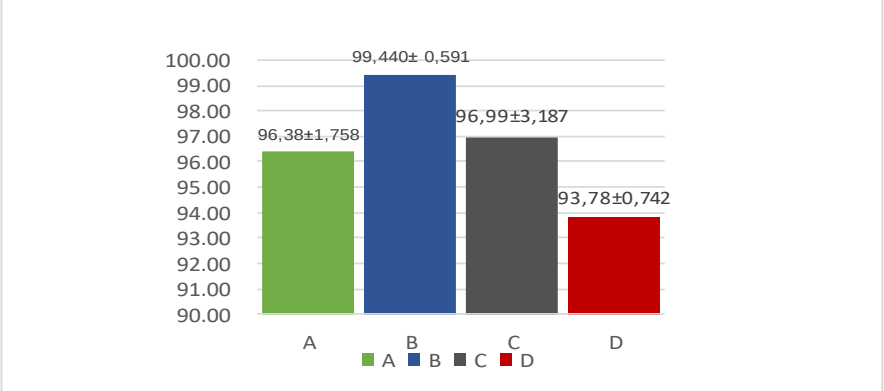

Figure 2. Graph of hatching power of climbing perch

Based on the data in Figure 2, there are differences in the hatching rate (HR) of

climbing perch among the treatments. The average hatching rate ranges from 93.78% to 99.44%. The highest hatching rate was observed in Treatment B at 99.44%, followed by Treatment C at 96.99%, Treatment A at 96.38%, and the lowest in Treatment D at 93.78%.

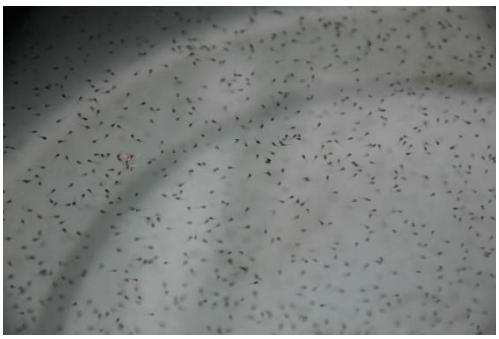

Figure 3. Climbing perch larvae

The hatching percentage reflects the ability of fertilized eggs to hatch. Analysis of variance (ANOVA) for the hatching rate of climbing perch indicates a significant effect. The average hatching rate ranges from 93.78% to 99.44%. The highest hatching rate was observed in Treatment B (1:2 ratio) at 99.44%, followed by Treatment C (1:3 ratio) at 96.99%, Treatment A (1:1 ratio) at 96.38%, and the lowest in Treatment D (1:4 ratio) at 93.78%.

This variation is likely due to differences in the balanced ratio of males to females, the body weight of male and female broodstock, sperm quality, and egg maturity. The 2:1 sex ratio in Treatment B may have allowed more eggs to be fertilized by sperm from the semen produced by two male broodstock. According to Slamat (2012), the fertilization percentage is highly influenced by the quality and quantity of sperm, which are affected by factors such as nutrition, season, temperature, frequency of male usage, and heredity. The amount of sperm released from a male fish also depends on its age, size, and frequency of ejaculation. Additionally, Zairin et al. (2005) stated that fertilization levels are influenced by egg maturity, related to the vitellogenesis process before ovulation.

Burmansyah (2013) reported hatching percentages ranging from 89.38% to 91.57%. The high hatching rates were likely influenced by factors such as temperature, yolk volume, and hormones. Lower temperatures result in slower hatching times, while temperatures within an optimal range accelerate the hatching process.

CONCLUSION

The effect of sex ratio on fertilization and hatching rate of climbing perch shows that the highest fertility rate is 94.40%, observed in Treatment C (1:3 ratio), while the best hatching rate is 99.44%, found in Treatment B (1:2 ratio).

Declaration by Authors

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REFERENCES

1. Ansyari. P, Slamat, N. A. Fauzana. 2021 Teknologi pembenihan ikan papuyu (*Anabas testudineus* Bloch) semi buatan untuk kelompok pembudidaya ikan “setia kawan” desa beringin kalimantan Selatan. AQUANA Jurnal Pengabdian kepada Masyarakat. 2 (1): 21–231.
2. Bunasir, Mudjiutami E, Ilmi A, Webby, Haryadi A, Riva’i A, Tulus, Hidayat R, Wahyutomo, Susanti W, Sihananto BS, Suprapto DF, Syafrudin, Helmiansyah, Widodo P. 2014. Domestikasi dan budidaya ikan papuyu. Jakarta: Direktorat Jenderal Perikanan Budidaya Kementerian Kelautan dan Perikanan.
3. Burmansyah, Muslim, & Fitriani, M. 2013. Pemijahan ikan betok (*Anabas testudineus*) semi alami dengan seks ratio berbeda. Jurnal Akuakultur Rawa Indonesia, 1, 23-33.
4. Frid A., Infa Minggawati. 2018. Pemijahan dan Kelangsungan Hidup Ikan Betok (*Anabas testudineus*) dengan Rasio Indukan yang Berbeda. Jurnal Ilmu Hewani Tropika Vol 7. No. 2. Desember 2018. ISSN : 2301-7783 Laman : unkripjournal.com
5. Hidayat R, Odang Carman, Alimuddin. 2016. Perbedaan pertumbuhan ikan papuyu

(*Anabas testudineus)* jantan dan betina. Jurnal Akuakultur Indonesia 15 (1), 8–14.
6. Prasetya J., Muslim, Fitriani M. 2015. Pemijahan Ikan Betok (*Anabas testudineus* Bloch) yang Dirangsang Ekstrak Hipofisa Ikan Betok dengan Rasio Berat Ikan Donor dan Resipien Berbeda. Jurnal Akuakultur Rawa Indonesia. 3(2) : 36-47. ISSN : 2303-2960.
7. Putri D.A., Fitrani M. 2013. Persentase penetasan telur ikan betok. Jurnal Akuakultur Rawa Indonesia, 1 (2): 184 – 191.
8. Slamat. 2012. Kajian bioekologi pendukung konservasi ikan betok (*Anabas testudineus* Bloch) di rawa Monoton Kabupaten Hulu Sungai Utara, Kalimantan Selatan. Disertasi pada Program Pascasarjana Fakultas Pertanian Universitas Brawijaya. Malang.
9. Subagja.J dan Rydhy Gustiano. 2010. Uji keturunan jantan hasil pengalihan kelamin pada ikan nilem (*Osteochilus hasselti* C.V) . Balai Riset Perikanan Budidaya Air Tawar.
10. Zairin, Jr., K.R. Sari., dan M. Raswin. 2005. Pemijahan ikan tawes dengan sistem imbas memijahkan ikan mas sebagai pemicu. Jurusan Budidaya Perairan Fakultas Perikanan dan Ilmu Kelautan Institut Pertanian Bogor. Bogor. Jurnal Akuakultur Indonesia 4 (2) : 103-108

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