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## Study of Reproductive Aspects of Fish Cyprinidae Family and Poeciliidae Family in Lake Batur Waters Area, Bali

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**Abstract.** This study aims to determine the reproductive characteristics of the Cyprinidae and Poeciliidae families in Lake Batur, including gonad maturity stage, gonadosomatic index, and sex ratio. Sampling was carried out from November to December 2021. This study uses descriptive and quantitative methods, with purposive sampling at three station points. The fishing gear used is a gill net with sizes of 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 inches. Determination of the gonad maturity stage of the gonads is determined morphologically, which includes observations on the color, shape, and size of the gonads. The gonad maturity stage III and IV was analyzed with the gonadosomatic index and sex ratio. The fish samples total 147 individuals: 54 from the Cyprinidae family and 93 from the Poeciliidae family. Cyprinidae family fish samples are *Barbodes binotatus* and *Barbonimus gonionotus*. Poeciliidae family fish samples are *Xiphophorus hellerii* and *Poecilia reticulata*. gonad maturity stage of the cyprinidae family in *Barbodes binotatus* obtained I-IV and *Barbonimus gonionotus* fish obtained all stages I-V, while the poeciliidae family *Xiphophorus hellerii* at all stages IV and *Poecilia reticulata* only found I-IV, the average of gonadosomatic index of female cyprinidae and poeciliidae is higher than males, and spawning time occurs in November and December (rainy season). The sex ratio of the Cyprinidae family in *Barbodes binotatus* is unbalanced, while in the Poeciliidae family, the sex ratio of *Xiphophorus hellerii* is balanced.

**Keywords:** Cyprinidae family; Lake Batur; Reproductive aspects; Poeciliidae family

### I. INTRODUCTION

Lake Batur is a natural lake, the largest surface water source of the four lakes in the province of Bali. The Lake Batur area is administratively part of the Kintamani District, Bangli Regency, Bali Province [1]. Lake Batur itself is one of 15 national priority lakes [2]. The Lake Batur area has long been used for vegetable farming, tourism, aquaculture using the Floating Net Cage System, and fisheries by local fishermen [1].

The fish community in Lake Batur is dominated by cichlids, followed by cyprinids and poeciliids [3]. According to research by Parawangsa et al. (2022), the cyprinid fish found in Lake Batur is the nyalian fish (*Barbodes binotatus*). This type of fish is used for consumption and as an ornamental; tawes fish

(*Barbonimus gonionotus*) was also found at the same location. This fish is usually consumed [4]. Fish in Lake Batur, which can be classified as ornamental fish, include *Poecilia reticulata* and *Xiphophorus hellerii* [3]. These fish belong to the Poeciliidae family. Several studies have been conducted on fish of the families Cyprinidae and Poeciliidae, namely the reproductive biology of swordtail fish (*Poecilia reticulata*) and *Barbodes binotatus*. Research on the reproductive biology of fish from the families Poeciliidae and Cyprinidae in Lake Batur remains limited. Based on this, a study is needed to examine the reproductive characteristics of fish from the families Cyprinidae and Poeciliidae. Studies on reproductive aspects are needed to provide material and data for controlling fish populations in nature [7]. This study aims to determine the reproductive characteristics of the fish families Cyprinidae and Poeciliidae observed in Lake

Batur, including gonad maturity stage, gonadosomatic index, and sex ratio.

## II. METHODS

### A. Research Locations

This research was conducted in the waters of Lake Batur, Kintamani District, Bangli Regency, Bali Province. Data collection was carried out in November and December 2021.

### B. Methods of Data Collection

The research methods used are descriptive and quantitative. Fish from the families Cyprinidae and Poeciliidae were purposively sampled at 3 sampling points in Lake Batur, Bali. Sampling was carried out every month with an interval of 3 weeks, once for 2 months. The research used experimental gill nets and traps. Gill nets with mesh sizes of 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 inches, with a length of 300 m and a height of 2 m. The gill nets were set at 16.00 WITA and removed the next day at 07.00 WITA. Fish samples were taken alternately from stations 1, 2, and 3. The caught fish were separated by station, then the fish samples were preserved in 10% formalin and stored in a *coolbox*. Fish sample measurements were weighed on a scale with an accuracy of 0.01 grams.

### C. Data Analysis

The gonad maturity stage is the stage of gonad development, from before to spawning [8]. Gonad maturity is assessed morphologically in both male and female fish by observing color, shape, and size.

The gonadosomatic index is measured by comparing the gonad weight with the weight of the fish [9]

$$GSI = \frac{Bg}{Bi} \times 100$$

Information: GSI: Gonadosomatic index, Bg: Gonad weight (g), Bi: Fish weight (g).

The sex ratio is calculated by comparing the numbers of male and female fish [10].

$$NK = \frac{J}{B}$$

Information: NK: sex ratio, M: number of male fish, F: number of female fish.

Knowing the balance of fish sex using the chi-square test with the equation formula according to [11].

$$X^2 = \sum \frac{(oi+ei)^2}{ei}$$

Description:  $X^2$ : Chi-squared value,  $oi$ : Frequency of observed male and female fish,  $ei$ : Frequency of male and female fish in balanced condition.

## III. RESULTS AND DISCUSSION

Fish samples from the Cyprinidae and Poeciliidae families in Lake Batur in November and December 2021 totaled 147 individuals, consisting of 54 individuals from the Cyprinidae family and 93 individuals from the Poeciliidae family (Figure 1).

The gonad maturity stage of the spotted barb fish (*Barbodes binotatus*) in Lake Tamblingan, Bali, found fish at stages I to IV [11]. This is consistent with research conducted at Lake Batur on spotted barb (*Barbodes binotatus*) at stages I-IV. The gonad maturity stages of silver barb fish (*Barbonymus gonionotus*) in Lake Batur were determined as stages I-V, based on research on the gonad maturity stages of tawes (*Barbonymus gonionotus*) in the Jombang Brantas River [12].

Research on green swordtail fish (*Xiphophorus hellerii*) in Lake Tamblingan from January to June found gonad maturity stages II-V; no stage I was observed [5]. In this study, from November to December, swordtail fish (*Xiphophorus hellerii*) were obtained from gonad maturity stages I-V. It is possible that the differences in stage in the fish obtained were due to different sampling times. The guppy fish (*Poecilia reticulata*) in this study were only at stages I-IV. In the study in the Riau Reservoir, only stages II-IV fish were found; no early stage (I) was found, allegedly because the fish samples caught were larger than the size at which gonads mature for the first time [6].

The average highest gonadosomatic index (GSI) of the four species occurred in quite varied months. The spawning time for fish of the families Cyprinidae and Poeciliidae in Lake Batur occurs in November and December (the rainy season) (Table 1-3). Spotted barb fish when the peak of spawning in Lake Tamblingan occurs in March or during the rainy season [11]. Research on silver barb species indicates that they can spawn year-round, with spawning peaks at certain times, and that spawning occurs during the rainy season [12]. This is also in accordance with research from [13], which states that the spawning season for motan fish (*Thynnichthys thynnoides*) belonging to the cyprinidae family is during the rainy season.

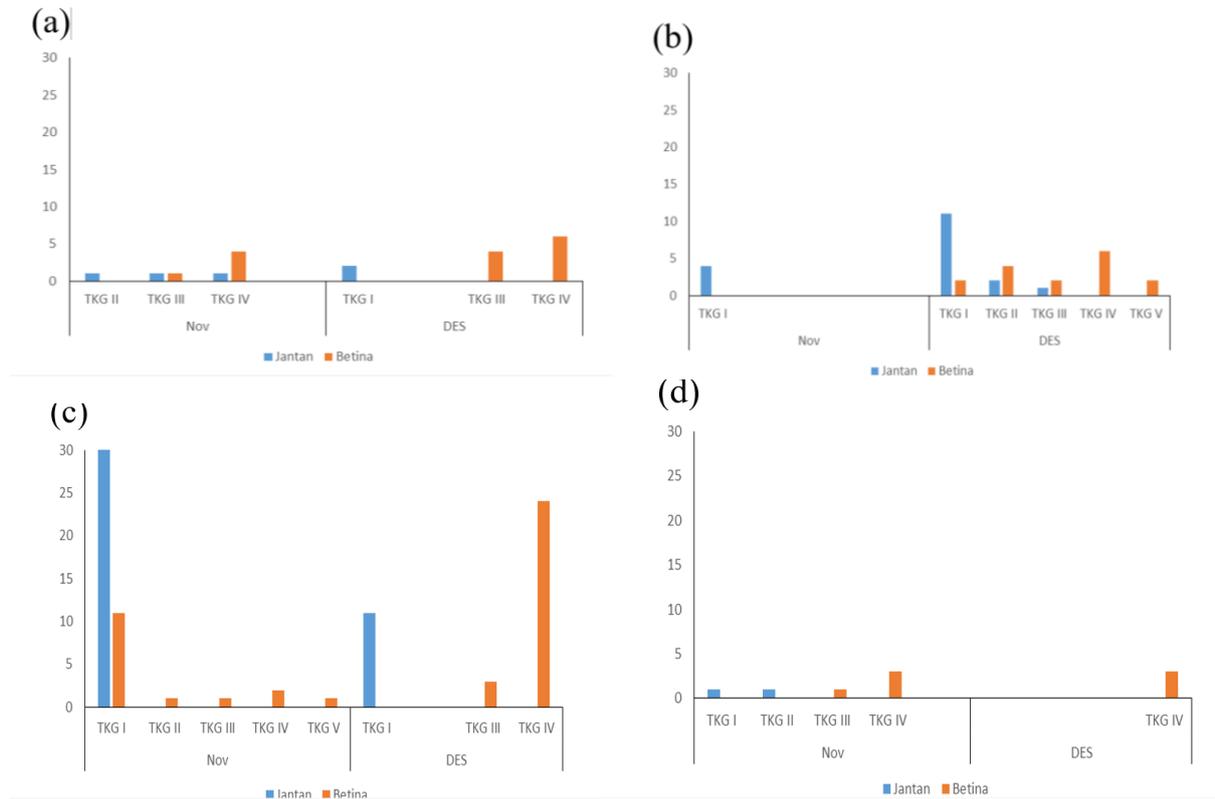


Figure 1. Number of Catches Based on Location of the Cyprinidae Families (a) Spotted barb (*Barbodes binotatus*), (b) Tawes Fish (*Barbonymus gonionotus*), and Poeciliidae Families (c) Green swordtail (*Xiphophorus hellerii*); (d) Guppy (*Poecilia reticulata*) in Lake Batur waters.

Green swordtail fish are at the peak of spawning in Lake Tamblingan in February or during the rainy season [5]. In the species *P. Velivera*, which is also included in the family Poeciliidae, it reproduces continuously throughout the year, with two spawning peaks: March-May and August-December. The rainy season shows a strong correlation with the spawning of tropical fish, due to increased water mass in rivers and lakes [14].

The sex ratio of the Cyprinidae family in the spotted barb fish (*Barbodes binotatus*) shows that the sex ratio is

in an unbalanced state. The sex ratio of the nyalian fish (*Barbodes binotatus*) in the Pelus River, Banyumas, is unbalanced [15]. In the family Poeciliidae, the sex ratio of swordtail fish (*Xiphophorus hellerii*) is in a balanced state; this is the same as the sex ratio of swordtail fish (*Xiphophorus hellerii*) in Lake Beratan in a balanced state [5]. The sex ratio of fish can be influenced by several factors, including mortality, lifespan, activity, movement, distribution, food availability, population density, food chain balance, and spawning time [8].

TABLE 1.  
 RANGE AND MEAN IKG VALUES OF THE CYPRINIDAE FAMILY FISH IN LAKE BATUR  
 IN NOVEMBER AND DECEMBER 2021.

Species	Bulan	Jumlah (n)	Ikan Jantan		Jumlah (n)	Ikan Betina	
			Kisaran	Rerata		Kisaran	Rerata
Ikan Nyalian ( <i>B. binotatus</i> )	Nov	3	2.17-3.59	<b>3.04</b>	5	11.27-20.89	10.24
	Des	2	2.26-2,38	2.32	10	3,47-15,37	<b>10,63</b>
	<b>Total</b>	<b>5</b>		2.68	<b>15</b>		10.24
Ikan Tawes ( <i>B. gonionotus</i> )	Nov	4	0.29-1.97	1.14	-	-	-
	Des	14	0.43-10.45	<b>1.78</b>	16	00.01-16.97	<b>7.11</b>
	<b>Total</b>	<b>18</b>		1.46	<b>16</b>		3.56

TABLE 2.  
 RANGE AND MEAN IKG VALUES OF THE POECILIIDAE FAMILY FISH IN LAKE BATUR  
 IN NOVEMBER AND DECEMBER 2021.

Spesies	Bulan	Jumlah (n)	Ikan Jantan		Jumlah (n)	Ikan Betina	
			Kisaran	Rerata		Kisaran	Rerata
Ekor Pedang ( <i>X.hellerii</i> )	Nov	30	0.40-2.50	1.62	15	0.43-11.06	2.91
	Des	11	0.36-6.67	<b>1.80</b>	28	1.57-22.50	<b>11.21</b>
	<b>Total</b>	<b>41</b>		<b>1.71</b>	<b>43</b>		<b>7.06</b>
Seribu ( <i>P. reticulata</i> )	Nov	2	8.00-7.69	<b>7.85</b>	4	10.00-21.11	<b>16.37</b>
	Des	-	-	-	3	6.62-10.91	<b>11.37</b>
	<b>Total</b>	<b>2</b>		<b>3.93</b>	<b>7</b>		<b>13.87</b>

TABLE 3.  
 SEX RATIO OF THE CYPRINIDAE AND POECILIIDAE FAMILIES IN LAKE BATUR  
 IN NOVEMBER AND DECEMBER 2021.

Famili	Spesies	Bulan	Jumlah (ekor)		
			Jantan	Betina	NK
Cyprinidae	Nyalian ( <i>B. binotatus</i> )	Nov	3	5	0.60
		Des	2	10	0.20
		<b>Total</b>	<b>5</b>	<b>15</b>	<b>0.33</b>
Peciliidae	Ekor Pedang ( <i>X. hellerii</i> )	Nov	30	15	2.00
		Des	11	28	0.39
		<b>Total</b>	<b>41</b>	<b>43</b>	<b>0.95</b>

#### IV. CONCLUSION

The conclusions that can be drawn based on the research that has been done are as follows:

1. *Barbodes binotatus* gonad maturity stage fish were obtained from I-IV, *Barbonimus gonionotus* fish were obtained from all stages I-V. Gonad maturity stage of fish from the Poeciliidae family, *Xiphoporus hellerii*, at all I-V stages, *Poecilia reticulata* fish were only found at I-IV.
2. The gonadosomatic index of both cyprinidae and poeciliidae families in general in November – December, the females are larger than the males, the spawning time for fish from the cyprinidae and poeciliidae families for each species in Lake Batur occurs in November and December (rainy season).
3. The sex ratio in the Cyprinidae family for the gnats (*Barbodes binotatus*) shows an unbalanced sex ratio, while in the Poeciliidae family, the swordtail fish (*Xiphoporus hellerii*) sex ratio is in a balanced state. While 1 species from each family was not analyzed because the female or male sex was not found.

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