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Biological reproduction aspects of jaguar guapote (*Parachromis managuensis*) in Penjalin reservoir Brebes-Central Java, Indonesia

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Key words: Jaguar guapote, *Parachromis managuensis*, Biological reproduction aspects.

Abstract

Jaguar Guapote (*Parachromis managuensis*) is an introduction fish in the Penjalin Reservoir, whose population is constantly increasing. It even tends to cause a loss of native species in that reservoir. The anticipation of the increase in this fish population can be conducted by control effort comprehensively. This study aimed to assess the biological reproduction aspects and stock control in the future. Biological reproduction aspects examined including the growth pattern, fecundity, gonadal somatic index, diameter of eggs and length at first maturity. Analysis of stock control involving a determination of optimal size to capture the populations of the mature gonad. Jaguar Guapote that was caught had a size of 9-20.8cm with a weight of 5-130gr, the growth pattern was positive allometric with the fecundity of 1190-18240eggs/female and diameter of eggs from 0.38 to 1.63mm. Jaguar Guapote classified as partial spawner. Length at first maturity in female and male was 13.14cm and 14.14cm, respectively.

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Introduction

Penjalin reservoir has a function for irrigation purposes. This reservoir has an area of 125ha, normal depth of 12m, the water volume of 9.5million m3 with dike length of 850m located at 365m asl (Rukayah & Wibowo, 2011). The fish found in Penjalin reservoir including native fish and introduction fish. Native fish in reservoir Penjalin more dominated by Cyprinidae families, such as *Puntius orphoides, Barbonymus gonionotus, Rasbora argyrotaenia*, and *Puntius binotatus* (Rukayah & Wibowo, 2011). While introduction fish in Penjalin Reservoir such us Marble goby (*Oxyeleotris marmorata*), Tilapia (*Oreochromis niloticus*), and Jaguar Guapote (*Parachromis managuensis*) (Hedianto *et al*., 2013). The most abundant fish in Penjalin reservoirs based on Hedianto *et al*. research (2013) is Jaguar Guapote, as many as 129 fish, or 64.5% of the catch. Jaguar Guapote that has been caught had a maximum length of 55cm with a weight of 1580g (Rosana *et al*., 2006). Jaguar Guapote is original fish from Central America and introduced to many countries as ornamental fish. It is very popular among Aquaris.

Jaguar Guapote is known as predators that consume small fish and very aggressive. These fish exist because of unintentional introductions with the characteristics of high tolerance to temperature (25°-36°C) and pH (range 7-8.7) (Rosana *et al*., 2006). Jaguar Guapote is mostly found in waters that have many aquatic plants, because Jaguar Guapote prefers to lay their eggs on aquatic plants or in crack rocks (Agasen *et al*., 2006).

The existence of Jaguar Guapote in Penjalin Reservoir is considered decreasing fish diversity in Penjalin Reservoir. The decreasing of species diversity, extinction of endemic species, malfunction the food web and ecosystem changes in water are caused by the introduction of exotic species on the water (Ellender and Weyl, 2014). The absence of research on the biological reproduction aspect of Jaguar Guapote in Penjalin reservoir is one of the aims this study. Beside that, oobservation of biological reproduction aspects can be used as basic information for controlling the population of Jaguar Guapote in Penjalin Reservoir.

Material and methods

Sampling site

This study was conducted in Penjalin Reservoir, Brebes, Central Java, Indonesia for three months from March to June 2015. Sample collection was conducted at 4 sites representing the state of Penjalin Reservoir. Fig. 1 showed part of the sampling location. Stations 1 and 2 representing inlet section, station 3 representing central part and the station 4 representing an outlet. Fishing was performed using gill nets with different mesh sizes such us 2.54, 3.81, 5:08, and 6:35 inch Measurement of the length and weight of fish was performed directly, whereas observation of biological reproduction aspects was performed in the laboratory.

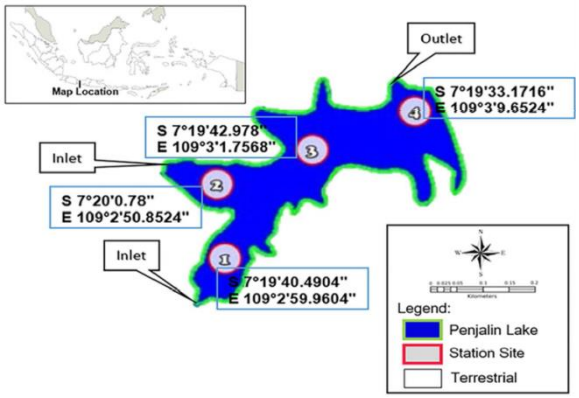

Fig. 1. Sample collection sites in Penjalin Reservoir, Brebes, Indonesia. Source: Google Maps (2015).

Sampling methods

Fishing was performed using gill nets with different mesh sizes. Nets are set up at night, then lifted up in the morning. Caught fishes were separated based on mesh size and station. Subsequently, the measurement of fish weight, total length, and record the fish number were done. Furthermore, fishes were identified based on Kottelat *et al*. (1993) and biological reproduction aspects of fishes were performed in the laboratory.

Biological aspects

Biological aspects: Growth patterns

Analysis of Length and weigh tgrowth aimed to determine the growth patterns of fish in the water. The formula was used to find the relationship between the length and weight is as follows (Effendie, 1997).

$$W = {}_aL^b$$

Where,

W = fish weight (g)

L = fish length (mm)

a and b = constants

Biological aspects: Determination of Gonadosomatic Index

Gonad maturity level was observed visually following the standard gonadal maturity scale (five-stage maturity scale for partial spawners) which referring to Holden and Raitt (1974). Then GSI (Gonadosomatic Index) analysis was determined using the ratio of gonad weight to body weight, with following the formula (Effendie, 1997; Howaida *et al*., 1998):

$$GSI=GW/BW \times 100$$

Where,

GSI = gonad somatic Index (%)

GW = Weight of gonad (g)

BW = Body weight (g)

Biological aspects: Fecundity Determination

The procedure of fecundity determination was conducted using a combination method of gravimetric and volumetric. Gonad maturation level III and IV gonadal female fish that have been previously preserved with formalin 5%, dried and then weighed the total weight. Thereafter, 3 parts were taken randomly from one gonad to be observed, and then weighed. Gonad example was counted its egg number then looked for the whole egg number using the formula as follow (Effendie, 1997):

$$X: x = G: Q$$

Where,

G = Total weight of gonad (g)

Q = Total weight of gonad sample (g)

X = Total eggs of gonad (eggs/female)

x = Total eggs of gonad sample (eggs/female)

Biological aspects: The length at first maturity

The Length at first maturity of Jaguar Guapote reached the maturity gonad (Lm) was calculated following Spearman-Karber method in Udupa (1986). The assumption used is gonad maturity level III (ripening) is also considered as the mature fish, it is considered that way because the number of Jaguar Guapote with GSI IV condition (mature gonads) are limited. The range of fish length reached mature gonad was obtained from antilog value m (M) at 95% confidence interval:

$$M = \text{antilog}\,[m \pm 1.96\sqrt{X^2(p_i(1-P_i)/n_i-1)}$$

$$m = (X_k+X/2) - (X.\sum P_i)$$

Where,

m = fish log length at first mature gonad

M = antilog of m

X k = log of fish size which 100% of fish samples are ripe

X = calculation of log of class median length

pi = proportion of mature fish in all groups-I, where pi = ri / ni

ri = number of mature gonad fish in the long grade-i

ni = fish number in the long grade-i

Result and discussion

Composition of caught fish during the research

The fishes were caught during the study were about 461 fishes, which consisted of six species and dominated by fish introductions. Jaguar Guapote (*Parachromis managuensis*) was the most caught fish, which was about 217 fishes and then followed by Tilapia (*Oreochromis niloticus*), Betutu (*Oxyeleotris marmorata*), Local catfish (*Clarias batrachus L.*), Local Tilapia (*Oreochromis mossambicus*), and Blue Gourami (*Trichogaster trichopterus Pall.*). The dominance of the caught fish during this study is similar to the previous reported in Penjalin Reservoir in 2013 which is Jaguar Guapote (Hedianto *et al*., 2013). However, this fish was not found in Penjalin Reservoir in 1999 (Rukayah & Wibowo, 2011).

Fish composition in Penjalin Reservoir continued to decline, especially for native species. The research that was conducted in 2011 in Penjalin Reservoir dominated by native species as many as 15 species (*Barbonymus gonionotus, Osteochilus vittatus, Trichogaster trichopterus, Puntius orphoides, Puntius binotatus, Mastacembelus erythrataenia, Barbichtys laevis, Rasbora argyrotaenia, Oshpronemus gourami, Anabas testudineus, Mystus*

nemurus, Cyclocheilichthys enoplos, Anguilla bicolor, Mystus micracanthus, Monoptherus albus), while for introduction fish had a total of 12 species (*Oreochromis mossambicus, Oxyeleotris marmorata, Clarias batrachus, Oreochromis niloticus, Hypostomus plecostomus, Osteochilus kappenii, Ctenopharyngodon idella, Cyprinus carpio, Colosoma macropomum, Lebistes reticulatus, Clarias lerachanthus, Puntius brevis*). Two years later, the other research was conducted in Penjalin Reservoir and those species that were found in the previous year was no longer found in 2013 and it only showed 6 species dominated by fish introductions. It is similar to the study in 2015 study showed 6 species and is dominated by introduction fish (Table 1). The changes in fish composition can be caused by several environmental changes such our water pollution, a formation of embankments or dams, loss of vegetation, and interactions between species (Abekura *et al.*, 2004). According to Bernauer and Jansen (2006), the changes in species composition and relative abundance indicate the presence of native species lost caused by introduction species and relatively quick succession between the old and new species.

Table 1. Composition of caught fish in Penjalin Reservoir.

No	Species	Number of fish				Total
		ST 1	ST 2	ST 3	ST 4	
1	Marble goby (*Oxyeleotris marmorata*)[a]	15	21	21	20	77
2	Catfish (*Clarias batrachus L.*)[a]	3	1	1	0	5
3	Jaguar guapote (*Parachromis managuensis*)[a]	53	65	53	46	217
4	Tilapia (*Oreochromis niloticus*)[a]	40	47	51	22	160
5	Local tilapia (*Oreochromis mossambicu*)[a]	1	0	0	0	1
6	Blue gourami (*Trichogaster trichopterus Pall.*)[b]	0	1	0	0	1
	Total	112	135	126	88	461

[a]introduction species [b]native spesies

Biological reproduction aspect of Jaguar Guapote

The growth pattern can be predicted by looking at the value of 'b' from the length and weight relationship. The length and weight relationship almost follow the cubic law, which is Jaguar Guapote weight as the cube of its length (Effendie, 1997). Jaguar Guapote that was caught during the study was about 212 fish. The total length of Jaguar Guapote obtained during the study ranged from 9-20.8cm with a weight of 5-130g.

Fig. 2 showed that Jaguar guapote had a positive allometric growth pattern, which is the weight gain faster than the length. The value of b can be affected by several factors such as season, habitat, gonad maturity, gender, natural food, abdominal fullness, health, preservation techniques and yearly differences and environmental conditions. The relationship of length and weight showing the relative growth which means it can be changed according to the time (Sulistiono *et al.*, 2001).

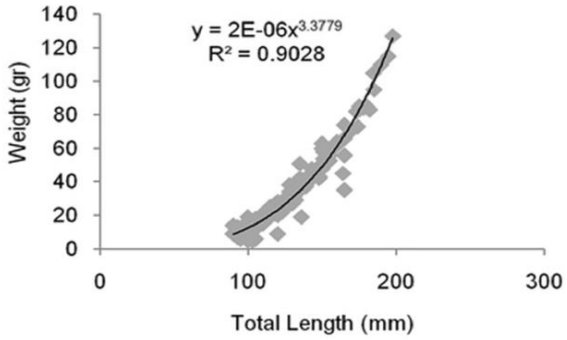

Fig. 2. Growth pattern of Jaguar Guapote.

Reproduction aspects of each fish are different depends on the environmental conditions and other factors (Sulistiyarto, 2012). Gonad Maturity Index (GMI) of females and males Jaguar Guapote have the highest distribution in GMI 1 or immature gonad phase. The distribution of total length size had a range from 13.2 to 15cm in males and females when they have entered the age of GMI III and IV. Overall, a number of male fish reached mature gonad is more than the females, but the difference was not very significant. The number of male fish mature gonads (GMI III and IV) was about 28 fishes and the female fish mature gonad (GMI III and IV) was about 21 fishes. The more detail data was presented in Table 2.

Gonadosomatix Index (GSI) of female Jaguar Guapote had a range from 0.89 to 1.00% on a minimum length of 14.2cm and optimum length of 22.5cm.

Based on the class length of male and female fish, they were ready to spawn at the size of 13.2cm or GML IV. GSI and percentage of mature gonad fish number (ready to spawn) can be used to determine the spawning season (Arocha & Barrios, 2009). In addition, GSI indicates gonadal development and maturation of fish (Agasen *et al.*, 2006).

Table 2. Reproduction of males and females Jaguar Guapote.

Species	Gonado maturity (Ind) ♂				♀				Gonadosomatic Index (%)	Fecundity (egg/ female)
	I	II	III	IV	I	II	III	IV		
Parachromis managuensis	73	6	16	12	84	1	10	11	0.89-1.00	1190-18240

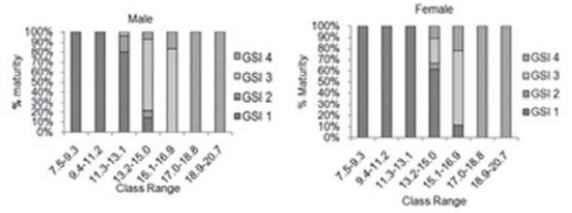

Fig. 3. Gonad Maturity Level of males and females Jaguar Guapote.

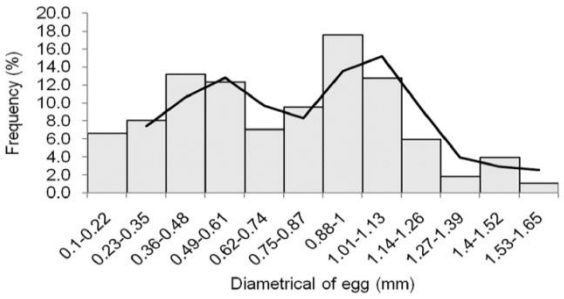

Fig. 4. Distribution of egg diameter of Jaguar Guapote.

Egg diameter of Jaguar Guapote at GML III had a range from 0.38 to 0.85mm, while GML IV had a range from 0.80 to 1.63 (Fig. 4). The overview about spawning type of this fish can be known through the analysis of distribution frequency of egg size diameter. Egg diameter distribution of Jaguar Guapote formed two peaks deployment, therefore, the spawning pattern of Jaguar Guapote is a partial spawner, which is fish can spawn multiple times in one spawning season or reproductive pattern is piecemeal in releasing eggs (Effendie, 1997). This is similar to spawning pattern of Jaguar Guapote in Taal Lake, Philippines which spawning two times in a year with the climax in December and July (Agasen *et al.*, 2006).

First size of mature gonad

Female Jaguar Guapote was the biggest number for mature gonads which was about 38% on the size of 15.1-16.9cm. The first size of mature gonads of female Jaguar Guapote was 14.18cm while the Male was 13.18 cm. The percentage of male fish mature gonads most to the size of 13.2-15.0 cm which was approximately 39% (Table 3). The first size of the mature gonad is required in determining the optimum mesh size (Ozyurt *et al.*, 2011).

Table 3. Length at first maturity of males and females Jaguar Guapote.

SKB (cm)	SKA (cm)	Gonad maturity of female (%)	Gonad maturity of male (%)	Length at first maturity of female	Length at first maturity of male
7.5	9.3	0	0		
9.4	11.2	0	0		
11.3	13.1	0	3.57		
13.2	15.0	28.57	39.28	14.18	13.18
15.1	16.9	38.09	21.42		
17.0	18.8	19.04	25		
18.9	20.7	14.28	10.71		

SKB = Lower class range , SKA = High class range

The research of Agasen *et al.* (2006) reported that males Jaguar Guapote had the mature gonads faster than the females. Jaguar Guapote had a high fecundity of 1190-18240grains/fish with an average of 6804eggs/fish on the length of 14.3-22.5cm and a weight of 35-228gr.

Conclusion

Biological reproduction aspects of Jaguar Guapote are required as basic information for the management of fish resources in Penjalin Reservoir. Fish composition found in Penjalin Reservoir showed a decrease in the number of native species annually.

Recommendation(s)

The existence of Jaguar Guapote abundantly feared to be invasive in Penjalin Reservoir. According to that fact, it is necessary to do a further study as an effort of sustainable management of fish resources. The study can use stock assessment prediction on each cohort. It can be used as a management effort to optimize catch on the size class of mature to reduce Jaguar Guapote recruitment in Penjalin Reservoir.

References

Abekura K, Michio H, Yasuhiro T. 2004. Changes in the fish community after the invasion and during control of alien fish populations in Mizoro-ga-ike, Kyoto City. Global Environmental Research **8(2),** 145-154.

Agasen EV, Julian PC, Mauria RR, Nenita SK. 2006. Biological investigation of Jaguar Guapote *Parachromis managuensis* (Gunther) in Taal Lake, Philippines. Journal of Environmental Science and Management **9(2),** 20-30.

Arocha F, Barrios A. 2009. Sex ratios, spawning seasonality, sexual maturity, and fecundity of white marlin (*Tetrapturus albidus*) from the Western Central Atlantic. Fisheries Research **95,** 98-111.

Bernauer D, Jansen W. 2006. Recent invasions of alien macroinvertebrates and loss of native species in the upper Rhine River, Germany. Aquatic Invasions **1(2),** 55-71.

Effendie MI. 1997. Fisheries Biology. Yogyakarta, INA: Yayasan Pustaka Nusantara 163 p.

Ellender BR, Weyl OLF. 2014. A review of current knowledge, risk and ecological impacts associated with non-native freshwater fish introductions in South Africa. Aquatic Invasions **9(2),** 117-132.

Hedianto DA, Kunto P, Andri W. 2013. The interaction of natural feed utilization by the fish community in Penjalin Reservoir. Central Java. BAWAL **5(1),** 33-40.

Holden MJ, Raitt DFS. 1974. Manual of fisheries science part 2 - methods of resource investigation and their application. http://www.fao .org/docrep/003 /F0752E /F0752E00.HTML.

Howaida RG, Hanlon TH, Mahmoud HH, Eletreby SG. 1998. Maturation, fecundity, seasonality and reproduction of two commercially valuable cuttlefish, *Sephia pharaonis* and *S. dollfusi* in Suez Canal. Journal of Fisheries Research **36(23),** 99-115.

Kottelat M, Anthony JW, Sri NK, Soetikno W. 1993. Freshwater Fishes of Western Indonesia and Sulawesi. Jakarta, Indonesia: Kantor Menteri KLH & Periplus Edition Hong Kong 221 p.

Ozyurt CE, Volkan BK, Sinan M, Erhan A. 2011. Spawning, maturity length and size selectivity for Pikeperch (*Sander lucioperca*) in Seyhan Dam Lake. Journal of Animal and Veterinary Advances **10(4),** 545-551.

Rosana MR, Agasen EV, Villanueva LS, Clemente JP, Nenita JR, Kawit S, Josephine T, Vega D. 2006. Status and economic impact of *Parachromis managuensis* in Taal Lake, Philippine. Journal of Environmental Science and Management **9(2),** 1-19.

Rukayah S, Wibowo DN. 2010. The composition of indigenous and introduction fish species Penjalin Reservoir, Brebes (Reference: Conservation & Fish cultivation). Proceeding Seminar Nasional Hari Lingkungan Hidup 39-48.

Sulistiono, Muhamad A, Aziz KA. 2001. Thegrowth of Belanak fish (*Mugil dussumieri*) in Ujung Pangkah River, East Java. Jurnal lktiologi Indonesia **1(2),** 39-47.

Sulistiyarto B. 2012. Relationship of length-weight, factor of conditions and food composition of Saluang (*Rasbora argyrotaenia* Blkr) in Dataran Banjir Rungan river, Central Kalimantan. Jurnal Ilmu Hewan Tropika **1(2),** 62-66.

Udupa KS. 1986. Statistical method of estimating the size of first mature in fishes. Fishbyte **4(2),** 8-10.