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Research Article

Morphometric characteristic and condition factor of Snakeskin gourami (*Trichogaster pectoralis*) from Sungai Batang Swamp, Indonesia

AHMADI

Faculty of Marine and Fisheries, Lambung Mangkurat University, Indonesia.
**Email:* ahmadi@unlam.ac.id

Abstract: The Snakeskin gourami (*Trichogaster pectoralis*) from Sungai Batang swamp, Indonesia has high commercial value and high pressure on population due to fishing, while the fish growth condition is poorly studied. A total of 848 fish ranging 75-200mm (119.14±18.43mm) (TL) and 5-132g (29.76±14.76g) were sampled to estimate its length-weight relationship and condition factors. Local fishermen mostly collected them using horizontal gill-net and also electrofishing device. Based on the results, the Snakeskin gourami grow allometrically (b=2.7748-2.8971), indicating that fish becomes slender as the length increases. Total length and weight of female were significantly higher than those of male (P<0.001). More than 21% of total catch was in 105-114 mm TL, and more than 34% existed 15-24g weight classes. No difference was observed in the percentage of catch number between male and female, as well as in condition factor (K) (P>0.05). The mean K values for male and female were 1.64±0.24 and 1.66±0.21, respectively, indicating that fish in the swamp is in good condition.

Keywords: Allometric, Condition factor, Sungai Batang, Weight-length.

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Introduction

Trichogaster pectoralis Regan 1910, commonly known as Siamese gourami or Snakeskin gourami, is one of economically important freshwater fish species due to a great taste and flavor, high price and availability throughout the year. The fish is either sold alive or in salted form, while the Dwarf gourami, *T. lalius* is traded as ornamental fish (Awasthi et al. 2015). In Indonesia and Malaysia, it is locally called "Sepat Siam" (Fig. 1) while in Thailand it is known as "pla-salid". Paepke (2009) gives its native range as southern Viet Nam, Lao PDR, Thailand, the Malay Peninsula, and Myanmar. This species has been introduced widely to other countries e.g., Indonesia, the Philippines, Southern China (Hong Kong), Sri Lanka and elsewhere. This species can be found in marshlands, swamps and peatlands, and occasionally in running waters as well as in impounded and man-made water bodies, but it does not tolerate polluted waters (Vidthayanon 2012). It is adapted to low oxygenated waters, being able to breathe air because of having labyrinth organ (Tate et al. 2017). It is also more tolerant to high salinities up to 23 psu (Arenas & Acero 1992). As a root grazer, it can be used to control *Eichhornia crassipes* population (Ismail et al. 2018). This species is successfully cultured in paddy field (Ali 1990; Vromant et al. 2001) in the earthen pond (Boonsom 1984), fish farm (Yoonpundh & Little 1997; Tansatit et al. 2014) and blue tank system (Ninwichian et al. 2018). At the same time, culture strategies for Snakeskin gourami are also being developed (Chesoh et al. 1995; Baishya et al. 2012; Lee et al. 2016; Jintasataporn & Chumkam 2017; Ninwichian et al. 2018), as well as conservation measures for this species (Wijeyaratne & Perera 2000; Morioka 2018). Nevertheless, the use of potassium

Fig.1. Snakeskin gourami sampled from Sungai Batang swamp

and electricity, indiscriminate fishing, pollution, infrastructure development and wetland clearance impact the species (Vidthayanon 2012; Hossain et al. 2015).

Several works on biological and physiological characteristics of *T. pectoralis* have been reported. Amornsakun et al. (2004) stated that Siamese gourami has high fecundity and fertilized eggs diameter similar to Climbing perch but smaller than Red-tail catfish. Hails & Abdullah (1982) observed oocyte distribution in thee selected ovaries concluding *T. pectoralis* was a total spawner, although a batch of ripe oocytes may be released over an extended period of time. Ninwichian et al. (2018) reported *T. pectoralis* reared in blue tanks has a significantly higher final body weight and lower average feed conversion ratio than the those reared in black tanks. Chesoh et al. (1995) suggested that it is suitable to nurse Snakeskin gourami fingerling from 1-2 inches in cement tanks with the stocking density of 100 fish/m^2. Tan et al. (1980) found evidence for polymorphism in the liver esterase of "Sepat Siam" that could be useful for genetic markers. Snakeskin gourami is also susceptible to virus or parasites infection (Paperna et al. 1987; Tansatit et al. 2014).

Length-weight data (LWR) on fishes are useful for a variety of purposes. They can be considered typical average weights of species for each of the given lengths. LWR is the most common approach for analyzing growth of fishes (Kalita et al. 2016; Jumawan & Seronay 2017), as well as understanding survival, maturity and reproduction (Satrawaha & Pilasamorn 2009; Paswan et al. 2012) of various species from different geographical regions. It is also useful in local and interregional, morphological and life historical comparisons in species and populations (Rahim et al. 2009; Khan et al. 2012). Ghorbani et al. (2012) stated that the fish length is the best indicator of production efficiency, while Lawson (2011) reported that fecundity may increase with increased body size in fish. Studies on LWR of threatened and commercially important fish species are highly significant for management and conservation purposes (Khan et al. 2011).

Fishing activity for Snakeskin gourami in Sungai Batang swamp is open throughout the year regardless of seasonal periods, which is done by both villagers using various fishing gears. Although prohibited by the law, electrofishing is still used for collecting them. Since, baseline information on the fish growth and exploitation rates is not available. Therefore, we carried out the field survey by collecting Snakeskin gourami from local fishermen to investigate its length-weight relationship and condition factor for better fisheries management and conservation of *T. pectoralis*.

Materials and Methods

Study site: The research was carried out in Sungai Batang swamp, Martapura of South Kalimantan Province (03°22'S, 114°49'E). The village consists mostly of wetland area with water level fluctuation between 0.5-2m. The wetland is regulated mainly by the rainfall resulting in two contrasts environmental conditions. During rainy season (October-April), the wetland is entirely flooded by water and the fishes are difficult to be caught. Inversely, during the dry season (May-September) the wetland is covered by very dense vegetation and the fish are concentrated on the sludge holes or backwater and allow. This regular changing from water environment to high plant biomass is an important factor in regulating high production of freshwater fishes in the wetland.

Data collection and Statistical analysis: A total of 848 individuals of Snakeskin gourami comprising 405 males and 443 females were obtained from local

Table 1. Total length, weight and condition factor of male and female of Snakeskin gourami taken from Sungai Batang swamp

Sex	N	Total length (mm)			Weight (g)			a	b	R^2	r	GP	K
		Min	Max	Mean ± SD	Min	Max	Mean ± SD						Mean ± SD
M	405	75	170	120.48±18.49	5	80	30.37±14.14	0.00005	2.7748	0.8970	0.9471	A-	1.64±0.24
F	443	80	200	117.91±18.31	8	132	29.05±15.12	0.00003	2.8971	0.9339	0.9664	A-	1.66±0.21
Both	848	75	200	119.14±18.43	5	132	29.76±14.76	0.00004	2.8366	0.9164	0.9573	A-	1.65±0.23

N=Number of fish samples, SD=standard deviation, a=constant, b=exponent, R^2=coefficient of determination, r=coefficient of correlation, GP=Growth pattern and K=condition factor.

fishermen during April 2017 and February 2018. Fish samples were collected using *Lalangit* (horizontal gill-net) and also electrofishing. A total of 50-100 units of *Lalangit* were deployed around the swamp with the vegetated habitats (e.g. *Hydrilla verticillata*, *Eichornia crassipes*, *Ipomea aquatic*), starting from 8 am till 4 pm. After soaking, the gear was retrieved every 30 minutes and applied again with the same procedure. The size of *Lalangit* in the present study is typically smaller than that used in Bangkau swamp of Hulu Sungai Selatan District (Irhamsyah et al. 2017). Electrofishing is usually conducted at the nighttime with the help of a lamp.

Sexes of the collected Snakeskin gourami were identified, and their total length (TL), body depth (BDD) and weight (W) were measured. Total length was taken from the tip of the snout to the extended tip of the caudal fin. Body depth was measured from the dorsal fin origin vertically to the ventral midline of the body. The total length and body depth were measured with a ruler to the nearest mm, while body weight was determined with a digital balance to an accuracy of 0.01g (Dretec KS-233, Japan). The size distribution of fish was set at 15mm and 10g. The length-weight relationship can be expressed in either the allometric form (Froese 2006) as $W= aL^b$; or in the linear form (Garcia 2010) as Log W=Log a+b Log L; where W is the total weight (g), L is the total length (mm), *a* is the constant showing the initial growth index and *b* is the slope showing growth coefficient. The *b* exponent with a value between 2.5 and 3.5 is used to describe typical growth dimensions of relative wellbeing of fish population (Bagenal 1978). If fish retains the same shape, it grows isometrically (b=3), when weight increases more than length (b>3), it shows positive allometric pattern and if length increases more than weight (b<3), it indicates negative allometric growth pattern (Senguttuvan & Shivakumar 2012). The coefficient of determination (R^2) and the coefficient of correlation (r) of morphological variables between male and female were also computed. The data used for length-weight relationship were also utilized for calculating Fulton's condition factor of male and female by mean of formula pf $K=100(W/L^3)$ (Pauly 1983); where K is the Fulton's condition factor, L is total length (cm) and W is weight (g). The factor of 100 is used to bring K close to a value of one. The K value is used in assessing the health condition of fish of different sex and in different seasons. In addition, the Mann-Whitney test was employed to verify if there are no differences between sexes for lengths and weights and for the condition factor. All tests were analysed at the 95% significance level. SPSS for windows version 16.0 statistical software was used for all data analysis.

Results

All estimated length-weight relationships and condition factor of Snakeskin gourami are presented in Table 1. A total of 848 individuals of Snakeskin gourami consisted of 405 males and 443 females were analyzed. The male size was ranged from 75 to 170 mm (120.48±18.49mm) total length and 5 to 80g (30.37±14.14g) weight; while the female was ranged from 80 to 200mm (117.91±18.31mm) total length and 8 to 132g (29.05±15.12g) weight. The pooled size was ranged from 75 to 200 mm (119.14±18.43

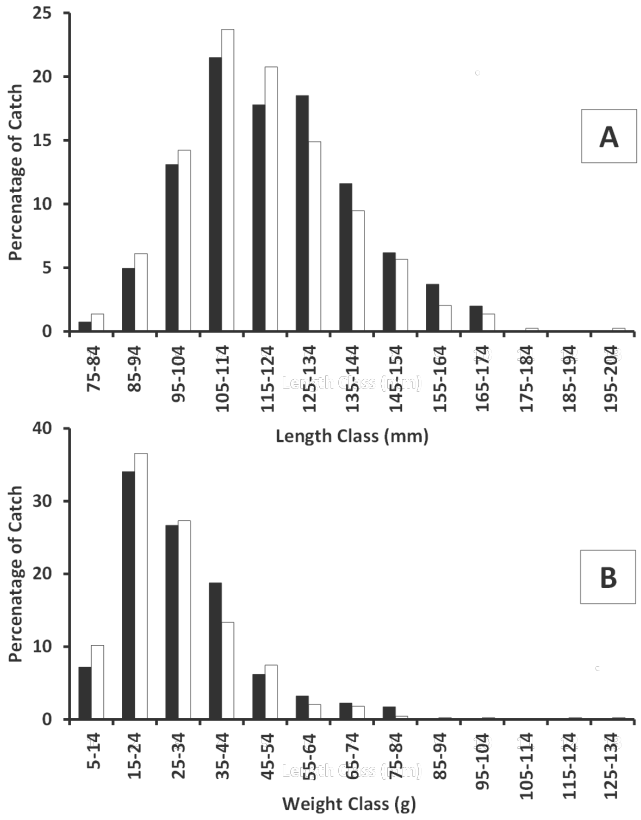

Fig.2. Total length and weight sizes distribution of male and female. More than 21% of total catch was 105-114 mm TL (A), and 34% between 15-24 g weight classes (B).

mm) total length and 5 to 132g (29.76±14.76g) weight (Fig. 2).

The length-weight relationship of male and female was found significantly difference (Fig. 3), while the *b*-values implied that the body shape displays a negative allometric growth pattern (*b*<3), which means that the length increases more than weight. The estimated *b*-values in the LWR equations were 2.7748 for male and 2.8971 for female, with the coefficient of determination (R^2) values ranged from 0.8970 to 0.9339, indicating that more or less 90% of variability of the weight is explained by the length. The index of correlation (r) of male and female were 0.9471 and 0.9664, found to be higher than 0.5, showing the length-weight relationship is positively correlated. Regardless the sex, the pooled *b*-value obtained was 2.8366 with R^2=0.9164 confirming fish grew allometrically.

The Mann-Whitney test showed that male had the

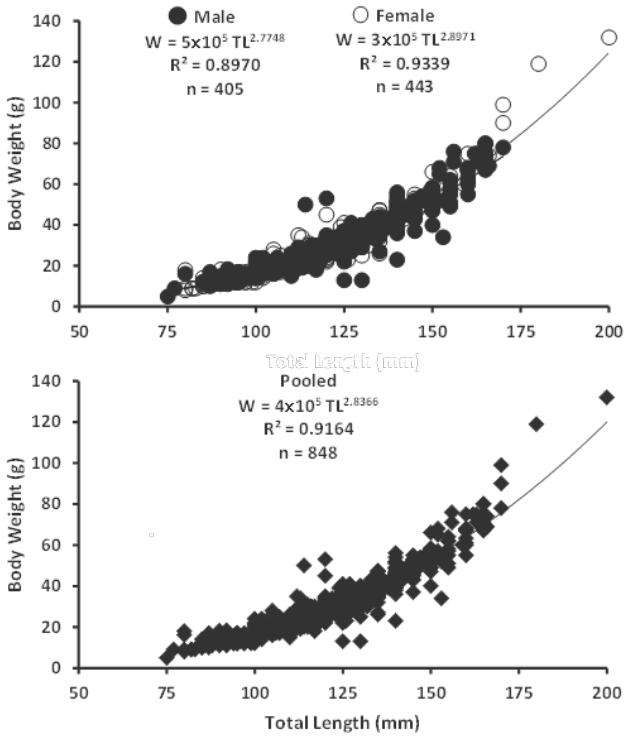

Fig.3. The relative growth curves for Snakeskin gourami from Sungai Batang swamp, displaying a negative alometric growth pattern (the *b*-value values were <3).

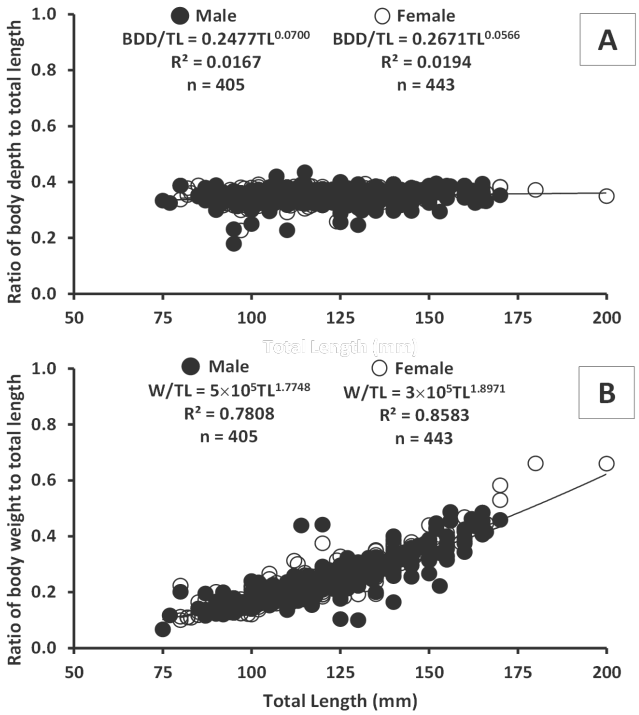

Fig.4. The ratio of body depth to total length (A) and the ratio of body weight to total length (B) were found not significant differences between male and female (*P*>0.05).

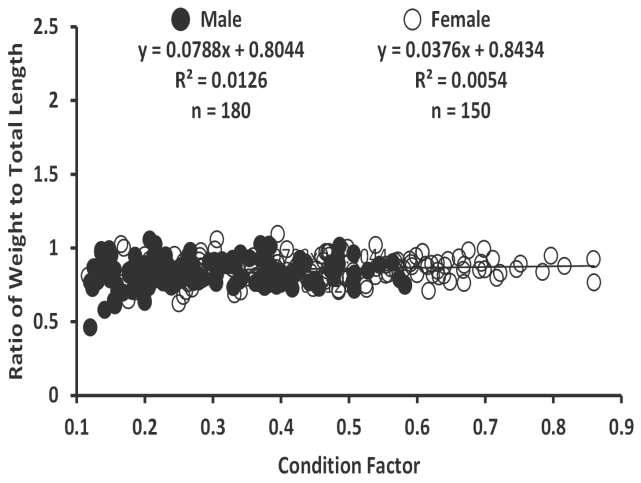

Fig.5. The relationship between ratio of body weight to total length and condition factor of Snakeskin gourami. No significant difference in condition factors of male and female was observed *(P*>0.05).

average total length greater as compared to female (*P*<0.05), but no significant difference was observed in the average weight between them (*P*>0.05). Further analysis revealed that there were no significant differences in the ratio of body depth to total length (BDD/TL), as well as the ratio of weight to total length (W/TL) between male and female (*P*>0.05) as shown in Figure 4. Figure 5 shows no difference in condition factor (K) between male and female (*P*>0.05). The mean K values obtained for male, female and pooled were 1.64±0.24, 1.66±0.21 and 1.65±0.23, respectively (see Table 1).

Discussion

The length-weight relationship and its parameters (*a* and *b*) have a wide application in fish biology and fisheries management. In fish, the weight is considered to be a function of length (Weatherley & Gill 1987), while the fish length, according to Ghorbani et al. (2012), is the best indicator of production efficiency. In the genus *Trichogaster*, a negative allometric growth pattern in the present study was documented in *T. pectoralis* from Agusan Marsh, the Philippines (Jumawan & Seronay 2017), *T. fasciata* and *T. sota* from Jorhat District of Assam, India (Paswan et al. 2012), *T. fasciata* from Nitai Beel, India (Kalita et al. 2016), *T. leerii* from Toh Daeng peatswamp, Thailand (Kaewsritong et al. 2009), *T. leerii* from Gomti River, India (Awasthi et al. 2015), and *T. trichopterus* from Martapura, Indonesia (Aminah & Ahmadi 2018). According to Vicentin et al. (2012), fish with *b*-value less than 3 consumed more of its energy in axial growth rather than weight. Our finding was contrary to *T. pectoralis* from Thai Rivers, Thailand (Sidthimunka 1973). *Trichogaster pectoralis* and *T. trichopterus* from Agusan Marsh, the Philippines (Talde et al. 2008; Jumawan & Seronay 2017), and *T. lalius* from Nitai Beel, India (Kalita et al. 2016) in which exhibited a positive allometric growth. Considering the value of the *b* coefficient and its significant differences for male and female in the future, one should think about examining the differences in the condition coefficient separately, dividing the fish not only in terms of sex but also in terms of size (sexual maturity), because with the increase in length, differences in the coefficient of fitness between the sexes vary. Variation in *b*-value may also be attributed to life stages and environmental factors such as food and space (Kleanthids et al. 1999; Khan et al. 2012; Vicentin et al. 2012). Snakeskin gourami grow allometrically in the current study may also be attributable to impact of seasonal hydro-climatic change in which dry season came earlier than usual. The effect of climate change on catchability of fish is described by Dematawewa et al. (2008) and Gu et al. (2015).

The maximum total length of *T. pectoralis* recorded in the present study as 200 mm, larger in Boralasgamuwa reservoir, Sri Langka i.e. 168mm (Wijeyaratne & Perera 2000), in Lake Taliwang, Indonesia: 168mm (Tampubolon & Rahardjo 2011), or *T. pectoralis* in Martapura, Indonesia (110mm) (Aminah & Ahmadi 2018), but it was lower than size of *T. pectoralis* in Thailand (220mm) (Sidthimunka 1973) or *T. pectoralis* in Agusan Marsh, the Philippines (250mm) (Talde et al. 2008). In this study, the ratio of body weight to total length of *T. pectoralis* (0.660) was lower than that of *T. pectoralis* (0.833) sampled from Agusan Marsh,

Table 2. Length-weight relationships and factor conditions of the genus *Trichogaster* from different geographical areas.

Species	N	Ratio of W/TL	a	b	R^2	GP	Average K	Location	Country	References
T. pectoralis	848	0.660	0.00004	2.8366	0.9164	A-	1.65	Sungai Batang swamp	Indonesia	Present study
T. pectoralis	350	0.864	-2.0120	3.182	-	A+	15.61	Thai Rivers	Thailand	Sidthimunka 1973
T. pectoralis	107	-	0.0072	3.238	0.9663	A+	4.92	Agusan Marsh	Philippines	Talde et al. 2008
T. pectoralis	27	0.833	0.0170	2.904	0.9550	A-	-	Agusan Marsh	Philippines	Jumawan & Seronay 2017
T. trichopterus	246	0.187	0.0290	3.046	0.9660	A+	-	Agusan Marsh	Philippines	Jumawan & Seronay 2017
T. trichopterus	26	0.144	0.0002	2.404	0.7027	A-	1.88	Martapura	Indonesia	Aminah & Ahmadi 2018
T. sota	114	0.047	-2.523	1.042	0.6810	A-	24.47	Jorhat district of Assam,	India	Paswan et al. 2012
T. fasciata	128	0.109	-9.795	2.424	0.6990	A-	19.18	Jorhat district of Assam,	India	Paswan et al. 2012
T. fasciata	83	0.085	-1.390	2.580	0.7761	A-	1.02	Nitai Beel	India	Kalita et al. 2016
T. lalius	85	0.099	-1.830	3.140	0.9194	A+	0.99	Nitai Beel	India	Kalita et al. 2016
T. leerii	421	-	0.0216	2.880	0.9456	A-	3.70	Gomti River	India	Awasthi et al. 2015
T. leerii	199	0.081	0.0268	2.5880	0.8941	A-	-	Toh Daeng peatswamp	Thailand	Kaewsritong et al. 2009

W=weight (g), TL=total length (mm), A-=negative allometric, A+=positive allometric and K=condition factor.

the Philippines (Jumawan & Seronay 2017), but it was higher than other species of the genus *Trichopterus*, such as *T. trichopterus, T. fasciata, T. lalius*, *T. sota* and *T. leerii* (Aminah & Ahmadi 2018; Kalita et al. 2016; Paswan et al. 2012; Kaewsritong et al. 2009) (Table 2). Dealing with the total length and weight size distribution of *T. pectoralis*, no statistical difference was observed in the percentage of catch number between male and female.

The K values for *T. pectoralis* in the current study was in agreement with other species of the genus *Trichogaster* from different geographical areas (Table 2). The present K value was found to be higher than that reported by Nash et al. (2006) for *T. pectoralis*. Variation in the value of the K may be attributed to biological interaction involving intraspecific competition for food and space (Arimoro & Meye 2007) between species, including sex, maturity, stomach contents and food availability (Saikia et al. 2012; Widodo et al. 2013). The K gives information when comparing two populations living in certain feeding, density, climate, and other conditions; when determining the period of gonad maturation; and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source (Weatherley 1972). In addition, information on condition factor of fish is required for aquaculture management particularly to better understand of specific condition and healthy of fish being cultured

Snakeskin gourami are caught using different gears (Wijeyaratne & Perera 2000; Khairul et al. 2009; Tampubolon & Rahardjo 2011; Petsut et al. 2013; Jumawan & Seronay 2017; Aminah & Ahmadi 2018). All these studies outlined have reported only the length-weight relationships collected using various gears without considering the detailed composition of fish lengths by each typical gear. Therefore, it is necessary to use different fishing gears to determine the composition of fish lengths that will be analyzed and compare the results of work with other work done on the species, particularly on the basis of catch selectivity and typical growth dimensions of relative well-being of fish population. In the investigated area of the current study, Snakeskin gourami has experienced a high pressure due to fishing. Local fishermen use horizontal gillnet (*Lalangit*) and electrofishing and this is on-going throughout the year. *Lalangit* is created by considering the behavior of fish itself where they often emerge to breathe air at the surface waters. The

size of *Lalangit* used here was smaller than the size of *Lalangit* operated in Bangkau swamp, Indonesia (Irhamsyah et al. 2017). The acquisition of fish from fishermen is associated with fishing selectivity and the preferences of the fishermen themselves. Often, larger individuals do not reach scientists because of their market value. The use of *Lalangit* is much better than electrofishing in term of gear selectivity because it only captures the larger fish, but the catch is usually no longer survived due to being gilled on the net. It would be worth to investigate the catching efficiency of *Lalangit* associated with underwater lamps of different color and light intensities to promote a responsible fishing method (Ahmadi 2012; Ahmadi & Rizani 2013; Ahmadi et al. 2018).

It is a great challenge for Fisheries Services of Banjar District to improve the quality of inland fishery statistic data for some species of commercial importance including Snakeskin gourami fishery, and our finding provides the first reference on the length-weight relationship and condition factor of this species. Such information could be useful for biologist or researcher to assess the biomass of fish captured and to take conservation measures for them since catch tends to decline.

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مقاله پژوهشی

بررسی صفات ریختی و شاخص وضعیت گورامی پوست ماری (*Trichogaster pectoralis*) در تالاب سونگای باتانگ اندوزی

احمدی

دانشکده دریایی و شیلاتی، دانشگاه لامبورگ منگ‌کورات، اندونزی.

چکیده: گورامی پوست ماری (*Trichogaster pectoralis*) از تالاب سونگای باتانگ اندوزی دارای ارزش اقتصادی بوده که به دلیل صید، جمعیت متحمل فشار زیاد شده است، با این وجود وضعیت رشد این گونه خیلی کم مورد مطالعه قرار گرفته است. تعداد ۸۴۸ قطعه از این گونه با دامنه طول کل ۱۰۰-۷۵ میلی‌متر (۱۸/۴۳±۱۱۹/۱۴ میلی‌متر) و ۱۳۲-۵ گرم (۱۴/۷۶±۲۹/۷۶ گرم) برای برآورد طول-وزن مورد استفاده قرار گرفتند. نمونه‌ها توسط صیادان محلی با استفاده از تور گوشگیر و الکتروشکر جمع‌آوری شدند. گونه گورامی پوست ماری دارای الگوی رشد آلومتریک (۲/۸۹۷۱-۲/۷۷۴۸) بودند که نشان دهنده باریک و لاغر شدن ماهی با افزایش طول می‌باشد. طول و وزن کل جنس ماده اختلاف معنی‌داری با جنس نر داشتند ($P<۰/۰۰۱$). بیشتر از ۲۱ درصد از کل صید طول کل بین ۱۰۵ تا ۱۱۴ میلی‌متر و بیشتر از ۳۴ درصد دامنه وزنی بین ۱۵ تا ۲۴ گرم داشتند. تفاوت آماری معنی‌داری در درصد تعداد صید بین جنس نر و ماده و همچنین در مقدار شاخص وضعیت (K) گونه مورد مطالعه مشاهده نشد. مقادیر شاخص وضعیت برای جنس نر و ماده به ترتیب ۰/۲۴±۱/۶۴ و ۰/۲۱±۱/۶۶ به‌دست آمد که نشان‌دهنده شرایط مناسب باتلاق برای این گونه است.

کلمات‌کلیدی: آلومتریک، شاخص وضعیت، گورامی پوست ماری، سونگای باتانگ، طول-وزن.