Length-weight relationships of five ornamental fish species harvested from a tributary of Bira Cot River, Indonesia

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Length-weight relationships of five ornamental fish species harvested from a tributary of Bira Cot River, Indonesia

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Abstract. Aceh Besar, Indonesia has a big potency on fisheries resource, including small fish that have potential as ornamental fish, such as Zebrafish, Checker barb, Rasbora, and Hasselt's Loach. To date, information on the growth pattern of this species was not available. Hence, the objective of the present study was to examine the growth pattern of five ornamental fish species namely; *Danio albolineatus*, *Puntius oligolepis*, *P. binotatus*, *Rasbora sumatrana* and *Lepidocephalichthys hasselti*. The fish sample was collected from Bira Cot River, Aceh Besar District from February to July 2020. In Bira Cot, Aceh Besar District, Indonesia. The study showed that the a and b values of regression parameters ranged between 0.0025-0.0097 and 3.043-3.545, respectively. The growth pattern of *P. oligolepis*, *D. albolineatus* and *L. hasselti* had a positive allometric growth pattern, while *P. binotatus* and *R. sumatrana* showed an isometric growth pattern. Based on the condition factors parameter indicated that the condition of the waters of the sampling location is still in good condition and supports the life of fish.

1. Introduction

Information on length-weight relationships (LWRs) is an important aspect in fish biology study [1]. The length-weight analysis is useful for estimating the average weight of fish based on the length of fish samples [2]. LWRs is also important for fisheries and fish biology studies to provide information on growth patterns [1, 3], physiology [4], gonadal development [5], the health of fish populations or individuals [6-8], also provides information when comparing two populations [9-11]. Besides that, the study of LWRs is also crucial for fish conservation and management [12, 13].

Ricker [14] stated the relationship between length and weight as $W = aL^b$. The *a* value can interpret body shape for example, when the *a* value is 0.001, it indicates the body shape of the fish eel-like, 0.008 elongated, 0.013 fusiform, and 0.018l short and deep [12]. Furthermore, the value of *b* is used to predict the growth pattern of fish, when $b = 3$, shows an isometric growth pattern where fish length and weight increase proportionally [15] and there is no change in body shape [16]. When the $b > 3$, is a positive allometric where the bodyweight of the fish increases faster than the length and makes the fish fatter

[16] while an allometric negative (b < 3) indicates that the length of the fish increases faster than body weight so that the fish becomes slimmer.

Aceh Besar district is located in the Aceh Province, Indonesia. This region has a big potency in fisheries resources, for example, Dekar et al. [17] reported 44 species of freshwater fish in the Aceh Besar and Banda Aceh City waters, and 25 species of coral fishes in Lhoknga and Lhok Mata Ie Beaches [18].

Presently, at least 28 species of fish from Aceh waters have been examined for their length-weight relations and condition factors. These species including seven species of freshwater fish, namely; Barbonymus gonionotus [6], Oreochromis niloticus [19], Oxyeleotris marmorata [20], Poropuntius tawarensis [8], Puntius brevis [21], Rasbora tawarensis [8], and Tor tambra [5]; 16 species marine fish, namely; Alepes djadaba [22], Aurigequula fasciata [7], Auxis thazard [22], Decapterus macrosoma [23], Decapterus russelli [22], Epinephelus bleekeri [24], Epinephelus fuscoguttatus [24], Euthynnus affinis [25], Leiognathus fasciatus [26], Lutjanus russellii [7], Plectropomus laevis [24], Plectropomus leopardus [24], Sardinella fimbriata [25], Selar crumenophthalmus [27], Selaroides leptolepis [22] and Siganus canaliculatus [7]; and five species of peripheral fish, namely; Ambasis koopsii [26], Anguilla bicolor bicolor [28], Liza macrolepis [29], Moolgarda engeli [29] and Mugil cephalus [19]. However, no report on the LWRs of ornamental fish from Aceh waters was available. Therefore, the aim of this study was to analyze the LWR of five ornamental fish species from a tributary in Bira Cot, Aceh Besar. This study provided valuable information for biologists and conservationists to manage and conserve fisheries resources, especially ornamental fish.

2. Material and Methods

2.1 Location and Sampling Procedure

A field sampling was conducted at Bira Cot River (05° 29.895' N and 095° 27.939' E), Aceh Besar District, Indonesia from February to July 2020. The sampling sites were determined purposively based on information from local fishermen. The sampled fish were transported to the laboratory. In the laboratory, the fish was weighed for body weight (g) and measured for standard length and total length (cm).

2.2 Length-weight relationship analysis

The Linear Allometric Model was utilized to estimate the growth pattern of the fish as proposed by De-Robertis dan William [30] as follow: $W=e^{0.56}(aL^b)$, where W is total body weight (g), L is the total length (mm), *a* is the regression intercept of the model, *b* is the regression coefficient, e is the variance of residual of the LAM model, 0.56 is a correction factor. Furthermore, fish status (native, endemic or introduced) is confirmed from the Fishbase database [31].

2.3 Data analysis

The data were analyzed descriptively by comparing the results with the relevant reports and direct field observation during the sampling.

3. Results and Discussions

A total of 348 individual offish samples were successfully sampled during the survey comprises of 85 samples of *P. oligolepis* with standard length (SL) from 1.16 to 2.39 cm, 23 samples of *P. binotatus* (SL: 1.50-5.14 cm), 142 samples of *D. albolineatus* (SL: 1.35-1.80 cm), 92 samples of *R. sumatrana* (SL: 1.42-6.28 cm) and 6 samples of *L. hasselti* (SL: 2.49-2.81 cm) were calculated for length-weight relationships. All of these species are native in Aceh Province, Indonesia.

The *D. albolineatus* has represented the predominant of the ornamental fish caught during study, followed by *R. sumatrana, P. oligolepis, P. binotatus* and *L. hasselti.* The low representation of *P. binotatus* and *L. hasselti* during the study period may due to the degradation of environmental conditions and predation [32].

According to Froese [12], the growth coefficient value *b* normally lies between 2.5 and 3.5 and this value of all five species in the present study was within the expected range as well as within the 95% confidence limit of bayesian LWR prediction value in Fishbase. The results of the length-weight relationship showed that *Puntius binotatus and Rasbora sumatrana* have an isometric growth pattern. This indicated that the increases of body weight and total length are balanced, while *Puntius oligolepis, Danio albolineatus* and *Lepidocephalichthys hasselti* showed a positive growth pattern where the weight gain occurs faster than the total length [33].

The *b* values ranged from 3.043 to 3.545, where the highest *b* value was found in *L. hasselti* followed by *D. albolineatus* (3.362), *P. oligolepis* (3.162), *R. sumatrana*. (3.056) and *P. binotatus* (Table 1). Froese [12] stated that the body shape of the fish is represented by the *a* value, where when the value is 0.001, it shows the body shape of the fish eel-like, 0.008 elongated, 0.013 fusiform, and 0.018l short and deep. Based on the results showed that the value was ranged from 0.0025 to 0.0097, it describes the body shape of the three species (*D. albolineatus*, *R. sumatrana*, *L. hasselti*) are eel-like body shape, while *P. oligolepis* and *P. binotatus* has elongated body shape.

The results showed *b* value of *L. hasselti* was significantly higher than other species (Table 1). The *b* values are dependent on diet, sex, sampling sites, season, environmental, stomach fullness and gonadal maturity [34, 35], food availability [35], biological and environmental condition, geographical [12, 36], and also fish behavior [35] According to Datta et al. [37] the coefficient of determination (r^2) values narrated the proper fitness of the model for growth and fish with ideal growth always shows r^2 value between 0.9 and < 1. The r^2 value for the present study indicates good health status for all ornamental fish species except *L. hasselti* even this species that have a higher *b* value.

Table 1. Descriptive statistics and length-weight parameters for five ornamental fish species in the Bira Cot River, Indonesia, February to July 2020.

Species	n	SL (cm)		TL (cm)		BW (g)		*a*	*b*	Growth coefficient		r^2	Status
		Min	Max	Min	Max	Min	Max			95% CL *a*	95% CL *b*		
Puntius oligolepis	85	1.16	2.39	1.48	3.16	0.02	0.39	0.0084	3.162	0.00482-0.02174	2.84-3.8	0.953	native
Puntius binotatus	23	1.50	5.14	1.95	6.57	0.06	3.39	0.0097	3.043	0.00508-0.02720	2.84-3.18	0.983	native
Danio albolineatus	142	1.35	1.80	3.39	4.29	0.03	0.84	0.0047	3.362	0.00273-0.01268	2.84-3.22	0.969	native
Rasbora sumatrana	92	1.42	6.28	1.75	8.09	0.04	2.61	0.0067	3.056	0.00251-0.01000	2.82-3.16	0.987	native
Lepidocephalichthys hasselti	6	2.49	2.81	3.08	3.35	0.10	0.25	0.0025	3.545	0.00252-0.01200	2.86-3.22	0.547	native

4. Conclusion

Based on the results of this study can be concluded that the growth pattern of *P. oligolepis, D. albolineatus* and *L. hasselti* had had a positive allometric growth pattern, while *P. binotatus* and *R. sumatrana* displayed an isometric growth pattern, and therefore, it was assumed that the waters are still in good condition for five ornamental fish species.

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