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Length-weight relationship and condition factor of an endemic *Lagusia micracanthus* Bleeker, 1860 in Rivers of the Maros Watershed

[Hubungan panjang bobot ikan endemik, *Lagusia micracanthus* Bleeker, 1860 pada Sungai-Sungai di Daerah Aliran Sungai Maros]

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Abstract

Lagusia micracanthus is one of endemic freshwater fish in Sulawesi. It also has been locally consumed. The purpose of this research was to analyze length-weight relationship and condition factors of *L. micracanthus* in rivers of the Maros Watershed, South Sulawesi Province . The study was conducted in three rivers, namely Pattunuang River, Bantimurung River and Pucak River. The sampling was conducted monthly from May 2018 to April 2019. Fish samples were collected by an electric shocker (12 V and 9 A). A total of 1850 individual fishes with samples ranging from 31.58-127.79 mm in total length and 0.76-31.07 g in weight. The length-weight relationship was $W = 0.00009L^{2.6241}$ ($r = 0.95$) in Pattunuang River, $W = 0.0001L^{2.5237}$ ($r = 0.94$) in Bantimurung River, and $W = 0.0001L^{2.4953}$ ($r = 0.92$) in Pucak River. The slope (b) values of *L. micracanthus* obtained a negative allometric growth pattern ($b < 3$). The relative condition factors of *L. micracanthus* was fluctuated from 0.86 to 1.43 in Pattunuang River, 0.65 to 1.45 in Bantimurung River, and 0.55 to 1.26 in Pucak River. The condition factor increased towards the peak of the spawning season and decreased after the spawning period. The condition factor increased with the increasing of gonad maturity stage up to stage IV and decreased after spawned or stage V.

Keywords: Length-weight relationship, condition factor, endemic fish, *Lagusia micracanthus*, Maros Watershed

Abstrak

Lagusia micracanthus merupakan salah satu ikan endemik air tawar Sulawesi.Ikan ini telah lama dimanfaatkan masyarakat lokal sebagai ikan konsumsi. Penelitian ini bertujuan menganalisis hubungan panjang-bobot dan faktor kondisi *L. micracanthus* di sungai-sungai pada Daerah Aliran Sungai Maros, Provinsi Sulawesi Selatan. Penelitian dilakukan di tiga Sungai yaitu Sungai Pattunuang, Sungai Bantimurung dan Sungai Pucak. Pengambilan ikan contoh dilakukan setiap bulan dari Mei 2018 hingga April 2019. Penangkapan ikan contoh menggunakan alat tangkap *electric shocker* (12 V & 9 A). Total ikan yang tertangkap sebanyak 1850 ekor dengan panjang berkisar 31,58-127,79 mm dan bobot 0,76-31,07 g. Hasil penelitian menunjukkan, hubungan panjang bobot *L. micracanthus* di Sungai Pattunuang adalah $W = 0{,}00009L^{2{,}6241}$ ($r = 0{,}95$), Sungai Bantimurung $W = 0{,}0001L^{2{,}5237}$ ($r = 0{,}94$) dan Sungai Pucak $W = 0{,}0001L^{2{,}4953}$ ($r = 0{,}92$). Berdasarkan nilai b yang diperoleh *L. micracanthus* tergolong ke dalam tipe pertumbuhan allometrik negatif ($b < 3$). Nilai faktor kondisi ikan pirik berfluktuasi. Di Sungai Pattunuang nilai faktor kondisi berkisar antara 0,55-1,26, di Sungai Bantimurung berkisar 0,65-1,45 dan di Sungai Pucak berkisar 0,55-1,26. Faktor kondisi meningkat menjelang puncak musim pemijahan dan menurun setelah masa pemijahan. Faktor kondisi meningkat seiring peningkatan tingkat kematangan gonad sampai pada TKG IV dan menurun setelah ikan berpijah atau pada TKG V.

Kata penting: Hubungan panjang bobot, faktor kondisi, ikan endemik, Lagusia micracanthus, DAS Maros

Introduction

Sulawesi, the largest island in the Indonesian biodiversity hotspot region Wallacea (Stelbrink *et al.* 2012; Miesen *et al* 2015). Sulawesi Island is a habitat for endemic ichthyofauna which cannot be found anywhere in the world (Hadiaty 2018). Based on its geological history, Sulawesi Island in the past was never united with any land, in contrast to Sumatra, Jawa, Bali, and Kalimantan Islands which were once united with mainland Asia (the Sunda Shelf), as well as Papua and the Australian mainland (Sahul Shelf) (Shekelle & Leksono 2004). Currently, the number of endemic fish species identified in Sulawesi keeps increasing due to new species discovered by researchers. A total endemic fish in Sulawesi is 23 species (Whitten *et al.* 1987), 52 species (Kottelat *et al.* 1993), 56 species (Parenti 2011), and currently there are 68 species from seven families and belong to four orders (Hadiaty 2018). *Lagusia micracanthus* is known as endemic fish of Sulawesi.

Lagusia micracanthus is one of the endemic freshwater fishes which distributed locally in South Sulawesi rivers (Vari & Hadiaty 2012; Hadiaty 2018). *L. micracanthus* is unique endemic fish species because it is the only endemic fish of Sulawesi from genus *Lagusia* and Family Terapotindae. The high intensity of fishing for consumption has led to a decline the population of *L. micracanthus* in its habitat (Nur & Dahlan 2015). Apart from being a species that is consumed, *L. micracanthus* are considered as ornamental fish because of their interesting body and color patterns.

The study of length-weight relationship (LWR) and condition factor (K) are an important parameter in fisheries management (Jisr *et al.* 2018; Olivera *et al.* 2020). The length-weight relationship can describe an important aspect of the fish life cycle (Froese 2006), namely the growth pattern of a fish species (Jisr *et al.* 2018), and variations growth (Bobori *et al.* 2010). A LWR study for a fish species can provides important insights into the ecology of the species (Froese 2006). Condition factors can be interpreted as an index that interacts between biotic and abiotic factors on the physiological condition of fish (Faradonbeh *et al.* 2015) and is a number that indicates fitness habitat (Jisr *et al.* 2018). From a nutritional point of view, the conditions factor in fat accommodation and gonad development (Le Cren 1951). This factor is calculated from LWR, with the intention of describing the "condition" of each fish (Froese 2006).

The information about the length-weight relationship of *L. micracanthus* is still limited. LWR of this species has only been reported by Nur (2015), but it was limited to only two locations and does not cover all seasons. This study aims to analyze LWR and condition factor of *L. micracanthus* in Maros Watershed rivers. The results are expected to be useful in strategic and sustainable management of *L. micracanthus* endemic fish in South Sulawesi.

Material and methods

Study sites

Fish sampling was conducted monthly from May 2018 to April 2019. Fish sampling was carried out at six locations, which consisted of three rivers in the Maros Watershed, i.e. Pattunuang River, Bantimurung River and Pucak River (Figure 1).

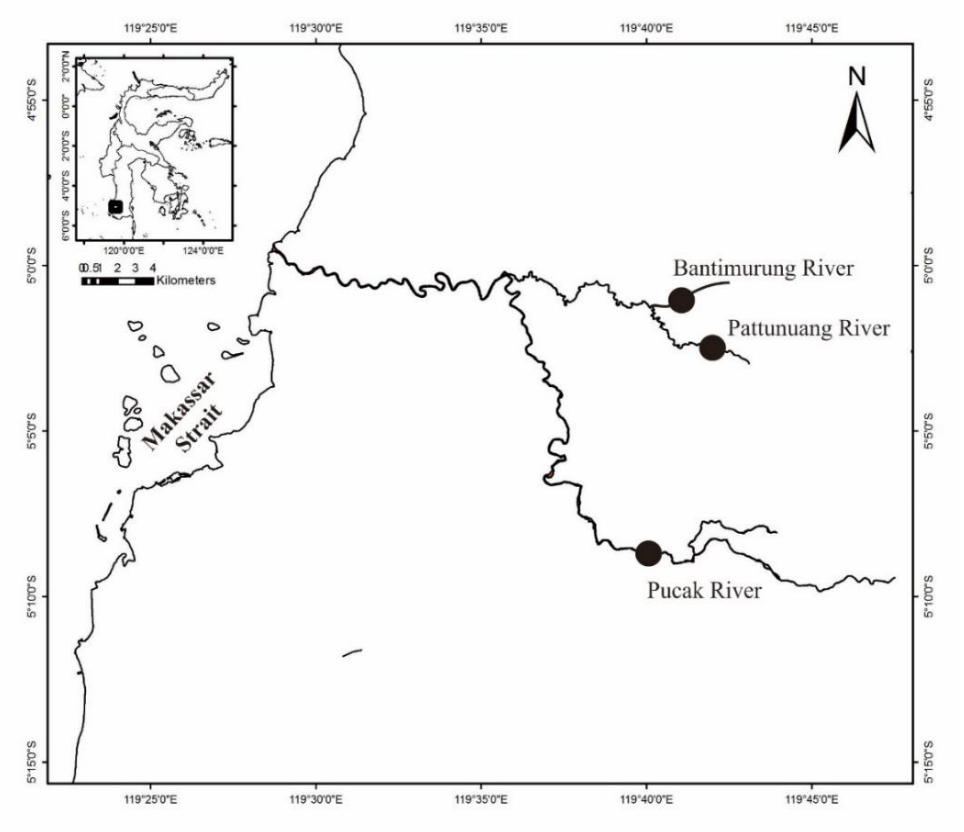

Figure 1 Map of sampling sites in rivers the Maros Watershed.

Sampling collection

Sampling was carried out using an electric shocker (12 V & 9 A). Electric shocker unit was operated in a zig-zag manner, against the current and operated for 200 m, for 30 minutes. The caught fish were preserved in a 10% formalin solution. The samples were labeled based on the location, station and collection dates. After 24 hours, the fish specimens were rinsed with running water and transferred into 70% alcohol containers and then were analyzed. The fish were measured for total length (TL) using a digital caliper of 0.01 mm accuracy and weighed using a digital scale of 0.001 g. The fish samples were dissected for sex identification and gonad maturity stages. Gender identification was performed by observing the reproductive organs of fish, such as the testes (male) and ovary (female). The observation of gonad maturity stages was carried out morphologically ac-cording to Nur (2015).

Data Analysis

Length-weight relationship and condition factors were analyzed based on the sampling location, gender and sampling period. Length-weight relationship was estimated from the equation (Le Cren, 1951):

$$W = aL^b$$

Where: W = weight of fish (g), L = total length of fish (mm), a = Intercept, b = Slope.

The t-test ($p < 0.05$) whether the value of b were remarkably 3 or not. If the value of b = 3 means that the fish has an isometric growth

pattern, on the contrary if $b \neq 3$ means the growth pattern is allometric. To determine the differences in b value between gender and location, covariance analysis was performed using SPSS software Ver. 16.0.

Condition factor calculated using the equation (Le Cren 1951):

$$K = \frac{W}{W^*}$$

where: K= condition factor, W= weight of fish (g), W*= calculated weight derived from length-weight relationship

Result

A total of 1850 individual fish ranging from 31.58-127.79 mm in length and 0.76-31.07 g in weight. The highest number of samples was obtained consisting of 891 individuals (513 males and 378 females) in Pattunuang River and the lowest was 423 (217 males and 206 females) in Bantimurung River. The statistical description of LRW of *L. micracanthus* for all sampling stations in this study is presented in Table 2.

The results of the t- test on the value of b, obtained the value of t count > t table, so that the pirik fish in Pattunuang River, Bantimurung River, and Pucak River belong to the negative allometric growth pattern (b <3). The results of covariance analysis showed no significant differences ($P<0.05$) for b value between male and female fish in Pattunuang River, Bantimurung River, and Pucak River with values of 0.172, 0.122 and 0.098 respectively.

The value of the condition factor based on the sampling time (Table 2) at all research locations varied. Overall, the highest average value of condition factors *L. micracanthus* was obtained at Bantimurung, Pattunuang, and Pucak stations. Based on sex at each sampling period, a higher condition factor was found in female fish than male ones. Furthermore, the condition factor value based on the gonad maturity stages can be seen in Figure 2.

Table 1 Statistical description of length-weight relationship *Lagusia micracanthus* in rivers in the Maros Watershed, April 2018 - May 2019

Location	Sex	n	Length (mm)	Weight (g)	a	b	r	Growth type
Pattunuang River	M	513	37.70-106.55	0.96-22.31	0.00001	2.5167	0.94	*NA*
	F	378	39.85-121.07	1.01-31.07	0.00005	2.7533	0.96	*NA*
	C	891	37.70-121.07	0.96-31.07	0.00009	2.6241	0.95	*NA*
Bantimurung River	M	217	31.58-127.79	0.76-26.13	0.00010	2.5190	0.96	*NA*
	F	206	35.19-119.40	1.32-25.33	0.00010	2.5225	0.93	*NA*
	C	423	31.58-127.79	0.76-26.13	0.00010	2.5237	0.94	*NA*
Pucak River	M	263	37.59-95.80	1.45-12.67	0.00009	2.0530	0.90	*NA*
	F	273	46.90-111.40	1.65-21.81	0.00008	2.6281	0.92	*NA*
	C	536	37.59-111.40	1.09-21.81	0.00010	2.4953	0.92	*NA*

Descriptions: n : total individual, M : male, F : female, C : combination a :intercept, b :slope, r : correlation coefficient, NA : *Negative allometric*

Table 2 Condition factor of *Lagusia micracanthus* in the Maros Watershed from April 2018 - May 2019

Period	Pattunuang River				Bantimurung River				Pucak River			
	n	M	F	C	n	M	F	C	n	M	F	
May-18	64	0.94	0.96	0.95	31	1.01	1.04	1.03	26	1.00	1.03	1
Jun	104	1.11	1.12	1.13	28	0.87	0.95	0.89	52	0.56	0.67	0
Jul	67	1.09	1.10	1.11	44	1.40	1.47	1.45	45	0.74	0.84	0
Aug	48	1.09	1.13	1.21	42	0.92	0.99	0.93	72	1.00	1.02	1
Sep	84	1.18	1.19	1.18	44	1.82	1.98	1.95	55	0.89	0.92	1
Oct	101	1.40	1.42	1.43	28	1.06	1.19	1.16	39	1.23	1.22	1
Nov	67	0.86	0.87	0.86	49	0.62	0.76	0.65	47	0.95	1.12	1
Dec	86	1.03	1.05	1.04	25	0.89	0.92	0.91	48	0.99	1.05	1
Jan-19	78	0.99	1.09	1.00	16	1.00	1.07	1.06	43	0,91	1.01	1
Feb	60	1.09	1.10	1.09	29	1.01	1.05	1.03	34	0.10	1.10	1
Mar	69	0.98	0.99	0.93	39	1.09	1.00	1.11	44	1.03	1.13	1
Apr	63	0.98	1.01	1.00	47	0.90	0.92	0.89	23	1.00	1.04	1
Total	891	1.06	1.12	1.01	423	1,34	1,36	1.31	536	1.04	1.08	1

Descriptions: n : total individual, M : male, F : female, C : combination

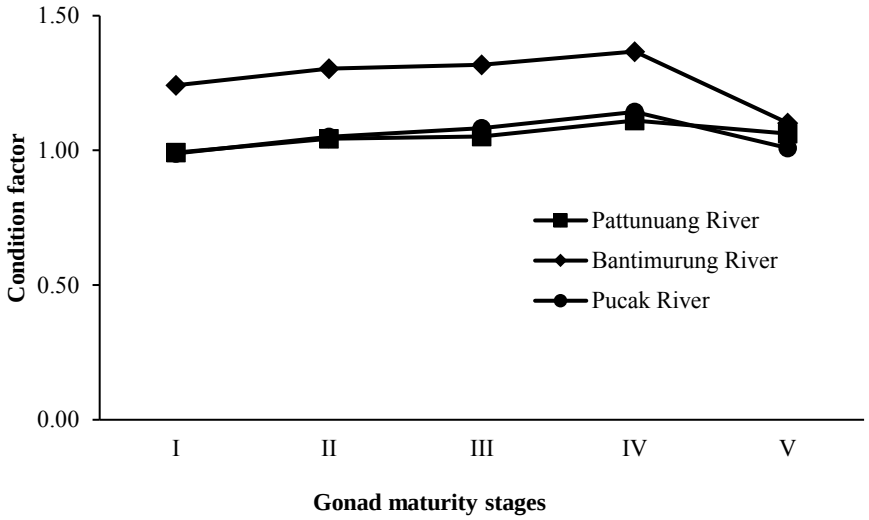

Figure 2 Condition factor of *Lagusia micracanthus* based on the gonad maturity stages in the Maros Watershed.

Discussion

Length-weight relationship of pirik fish showed that b values were different among the pirik population in three rivers of the Maros Watershed. The different was caused by the habitat variability conditions between Pattunuang River, Bantimurung River, and Pucak River. According to Zubia *et al.* (2014) the value of b can vary between different populations, even of the same species. The diversity of exponential values (b) can be caused by various factors, namely differences in age, gonad development, sex, season, season, habitat type, health, food availability, and gastric fullness (Bagenal and Tesch 1978; Wootton 1992; Froese 2006; Milosevic & Talevski 2006; Zaher *et al.* 2015).

In the present study, length-weight relationship of *Lagusia micracanthus* was negative allometric. The negative allometric growth pattern was also obtained by *L. micracanthus* in

the Sanrego River (Nur 2015). Different pattern of growth were actually found in the same location, namely Pattunuang River, however, at a different time, the *L. micracanthus* in the river had isometric growth (Nur 2015). The difference in growth types at different times could be caused by differences in environmental conditions and biology of *L. micracanthus* at that time. Some researchers suggest that fish growth pattern in each habitat may different because of environmental and biological factors, such as temperature, food (quantity, quality and size), gonad development and sex (Froese 2006; Hossain *et al.* 2012; Kimmerer *et al.* 2005; Moeslen & Daka 2017), anthropogenic factors namely over exploitation (Famoofo & Abdul 2020) and pollution (Azmat *et al.* 2007).

The value of the condition factor in each month at all study locations, during one year was fluctuated. The condition factor in female fish was higer than male ones. Variation in fish conditions in each habitat maybe caused by several factors such as gender, age, gonad maturity stages (Gupta & Tripati 2017) water quality parameters and food availability (Fagbuaro *et al.* 2019). differences in season (Sarkar *et al*. 2013; Parida *et al*. 2013), and hydrological cycles (Tribuzy-Netoa *et al.* 2018).

The value of the condition factor at all sampling locations, at the beginning of the spawning season (July), increased until it reached the peak of spawning season (September to October) then decreased in November or after the spawning period (Nur 2020). This phenomenon was related to the development of gonads during spawning time (Lizama & Ambrósio 2002), where energy was mostly used for reproduction so that the condition factor increased at the peak of spawning and decreased thereafter. According to Rahardjo and Simanjuntak (2008), this could happen because the largest part of the food consumed was used for the development of reproductive cells, the process of reproductive cell formation reached its peak at stage IV or in other words the largest gonad size had been achieved, thereby increasing body weight. as a whole, then the condition factor value decreases after the fish have finished spawning or in the stage V.

Conclusion

The growth pattern of *L. micracanthus* in the Maros Watershed was negative allometric. The condition factor increased towards the peak of the spawning season and decreased after the spawning period.

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