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Morphometric Characteristic of *Macrobrachium* sp. from Barito River, Indonesia

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Abstract: *The present study provides the first scientific information on the length-weight relationship for Macrobrachium sp. from Barito River, Indonesia. A total of 336 specimens consisted of 161 males (48%) and 175 females (52%) with the sex ratio of 0.92:1 were analysed. This species were collected by using light traps with various intensities and trap designs. The statistical analysis confirmed that males showed positive allometric growth (b=3.210), while females displayed negative allometric growth (b=2.734).Males had total length (TL), carapace length (CL) and chelae length (ChL) longer than females. The CL/TL, ChL/TL and CL/ChL of males were considerably higher than that of females (P<0.001). Males were also significantly heavier than females. The estimated mean weight ranged from 0.454 to 10.015 g corresponding to the mean total length ranged from 27.38 to 81.64 mm. The condition factor values ranged from 1.00 to 2.19, indicating shrimp living in Barito River are in better condition. From fishing point of view, Macrobrachium sp. showed positively responded to all light traps tested. For future application, the use of LED light trap is strongly recommended.*

Keywords: *Allometric, Barito River, condition factor, light trap, Macrobrachium sp.*

1. INTRODUCTION

In all parts of the world, many active and passive gears are being used to collect shrimps from their habitats such as baited traps [1], trawl nets [2],[3], cast nets[4], trammel nets[5], gillnet [6], lift net [7], Electro fishing [8], sex-pheromone-baited traps [9], tangle nets [10], fyke-nets [11],and light traps [12].The length-weight relationships of the shrimp had been widely studied in many countries, for example *Acetesjaponicus* in Malaysia [3],*P. notialis* in Nigeria [4], *Penaeusmonodon* in Sri Lanka[13], *P. semisulcatus*, *Litopenaeusvannamei* and *Macrobrachiumrosenbergii* in India [14-16], *M.olfersi* in Brazil [17], *M. vollenhovenii*in Nigeria [18], *M. lamarrei* in Bangladesh [19], *M. felici-nium* and *Atyagabonensis*in Nigeria [20], *Pandalus borealis* in West Greenland [21], *Penaeusindicus* in Mozambique [22], *Astacusleptodactylus* in Turkey [23], *Farfantepena- euspaulensis* in Brazil [24], *Procambarusclarkii* in China[25]

It is generally accepted that the length-weight relationships are useful for estimating growth rates, age structure and other aspect of shrimp population dynamics [26]. Knowledge of length-weight relationship will also help in establishing mathematical relationship between the two variables which enables conversion of one variable to other to describe growth in the wild [27], differentiating sexes [28], calculating the standing stock biomass [29], analyzing ontogenetic changes [30] or determining condition factor in prawns [31].

The length-weight regressions have been frequently used to estimate weight from length because direct weight measurements can be time-consuming in the field [32, 33].Information on the length-weight relationship will assist the manager in selecting suitable species or varieties of faster growth rate for culture and estimating the duration of the culture period for producing marketable size of the shrimp [13], as well as make light of local authority in formulating a policy for better fisheries management.

Barito **River is the most important river in** South Kalimantan Province served as transportation, floating market, recreation and fisheries activities. A great attention has been devoted by local researchers to describe the characteristic habitats and fish species [34, 35], the abundance and diversity of plankton types[36], as well as fishing activities [12,37] in this river. Among crustaceans, *Macrobrachium* sp. belongs to family Palaemonidae was abundantly found in Barito River (12]. It can be distinguished clearly from other shrimp species in term of its arms, which are longer than its body lengths. To understand the biological aspect and its implication for fisheries management, we analysed data on the length-weight relationship of *Macrobrachium* sp. sampled from a series of trapping experiment with lights. The fact that there was no scientifically published information on the length-weight relationship of this species, so far

2. MATERIALS AND METHODS

2.1. Study Site

Trapping experiments with underwater lamps for *Macrobrachium* sp. were carried out in Barito river, South Kalimantan(Figure 1),located on03°19'S114°34'E and03°20'S114°36'E determined by the GPS 60 (Garmin Co. Ltd., Taiwan). The experimental conditions encompassed highly turbid water (total suspended solids ranged from 182 to 567 mgl^{-1}), slow flowing, blocked water, and rarely vegetated habitat with water depths from 2 to 4 m. The water transparency varied from 45 to 55 cm measured with Secchi-disk reading at noon. The surface water temperatures were daily recorded ranging from 27 to 29 °C throughout the sampling periods.

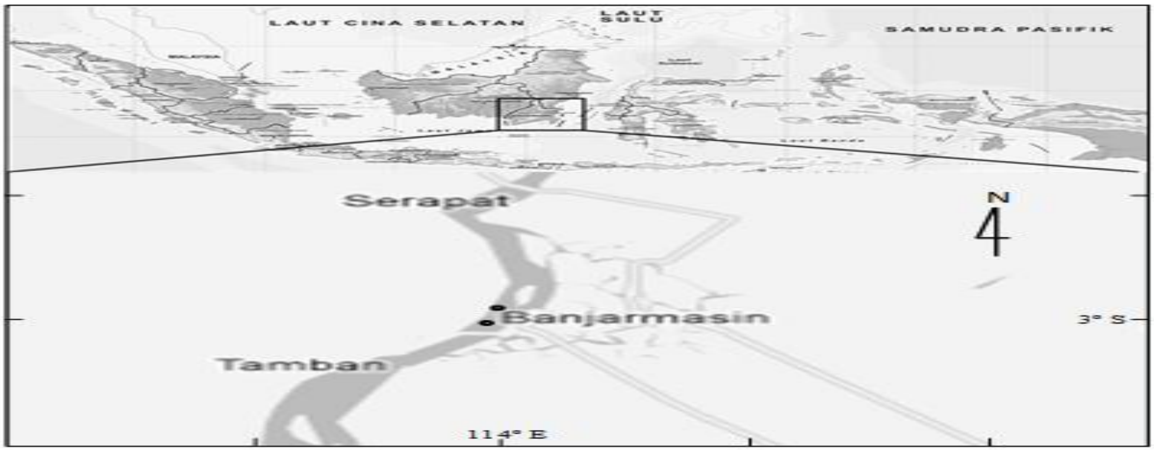

Figure1. *The map showing trapping sites in Banjarmasin, South Kalimantan.*

2.2. Experimental Design

Experiment 1: Collapsible trap fishing with different light intensities of incandescent lamps. The four collapsible box-shaped traps were fabricated with iron rod frame (80×60×28 cm), covered with polyethylene netting and had two 58 cm slit all-web entrances at the ends (Kagotoku Shiroyama Kenmousha, Ise,Japan). Each of the four traps had one incandescent lamp. The lamp types used were (i) Japanese squid fishing tackles (Yo-zuri Co. Ltd. Japan) consisting of SIL-1 (10×3 cm; 0.45 W) and SIL-2 (16×3 cm; 0.9 W) powered by 1.5 and 3.0 V dry-cell batteries respectively, and (ii) acrylic box-shaped lamps consisting of DIM and LIGHT, of which a 4.5 W lamp was placed inside a waterproof acrylic box (14× 8× 15 cm) generated by 6 V dry-cell batteries. For DIM, the walls of the box were lined with a white-paper. Light intensities of each lamp were 215 lx (SIL-1), 398 lx (SIL-2), 1010 lx (DIM) and 2050 lx (LIGHT) determined with an illuminometer (IM-2D, Topcon, Ltd. Tokyo).

Experiment 2: Collapsible trap fishing with different coloured incandescent or LED lamps. Five collapsible box-shaped traps were modified in their funnel entrances by replacing the two slit all-web entrances at the ends with two open slackness nylon monofilaments 23mm mesh size. Additional net bag was placed at the bottom of the trap to prevent juveniles dropped. Each of the five traps was assigned with one colour of LED Torpedo flashers (24 × 5 cm, Yuli Co. Ltd. China) or one colour of incandescent lamps YL/YS-1 (22 × 5 cm, Yuli Co. Ltd. China), containing blue, green, yellow, red and extra white.

Experiment 3: Wire-square trap fishing with different coloured LED lamps. Five wire-square traps were made of iron-wire frame (25×25×22 cm) and covered with black 3/5 inch hexagonal mesh wire (16 gauge PVC-coated wire). The trap had four entry funnels located on each side with a5 cm inside ring entrance. A trap door on top (23×24 cm) was used to release the catches. Each of the five traps was assigned with one colour of LEDs (blue, green, yellow, red and extra white) placed inside the squid lamp case (SIL-2) powered by 3 V dry-cell batteries (0.06 W).Light intensity of LEDs was set at equal quanta intensities by placing a grey fibreglass window screen (Dio Chemicals, Ltd., Tokyo) inside of the lamp to standardize the lights used.

Experiment 4: The acrylic-square trap fishing with different coloured LED lamps designed for sampling juvenile species. Five acrylic-square traps were constructed with 3-mm acrylic plates and had 8 entrance slits with 1 cm wide opening on each side. The acrylic plates were attached vertically with two sheets of PVC (24 × 24 cm) top-down and reinforced with four iron rods (25 cm long) on each corner. The trap was equipped with two floats at the surface, four wire-stairways (23 × 23 cm) attached to lower part of PVC sheet on each side and a collection wire-jar at the bottom (18 × 18 × 7 cm). A lamp was placed downright in the middle of trap. Each of the five traps was assigned with one colour of LEDs following the same procedure in Experiment 1.

Experiment 5: Various traps fishing with the white LED and incandescent lamps. **Four traps with different sizes and shapes** were investigated. These traps were: (1) PVC box-shaped trap: PVC rod frame (67 × 53 × 20 cm) covered with black 150 mm hexagonal mesh wire (16 gauge PVC-coated wires); ten entry funnels are located on each side of the trap with a 5.2 cm inside ring entrance; (2) Wire fish trap: heart-shaped, 45 cm high and 40 cm wide, with 1.2 cm square mesh wire and 2.5 cm wide opening of entrance slit; (3) Bamboo fish trap: heart-shaped, 42 cm high and 30 cm wide with horizontal gap 1.5 cm and 2.5 cm wide opening of entrance slit; and (4) Minnow nets: cylindrical-shaped, 60 cm long by 30 cm wide, covered with 1.3 cm polyethylene netting and 7 cm inside the ring entrance. Each of the four traps was associated with 0.06 W white LED or 1.5 W incandescent squid fishing lamp (SIL-2; Experiment 1).

The light traps with constant light pattern were deployed randomly at the bottom of the riverbank and illumination began 1 h before sunset and retrieved the next morning. The lighted traps were spaced about 2.5 m apart to minimize any significant light contamination between traps. Such trap arrangement was considered sufficient for the existing turbidity conditions and illumination intensities. The trials consisted of 113-trap hauls/lamp type using 1-night soaking time, which varied from 14-16 h. The typical traps and lamps used during trapping experiments in Barito River can be seen in Figure 2.During the research, the catches were counted, identified and measured for carapace length (CL), chelae length (ChL), total length (TL) and weight (W) according to the type of light traps used. Carapace length was measured from the anterior tip of the rostrum to the posterior edge of the carapace; chelae length was from the base of the first pair of walking legs to the anterior tip the pincers; and the total length was from the tip of the rostrum to the tip of the telsonto the nearest mm, keeping the abdomen fully stretched. Digital balance with precision of 0.01 g (Dretec KS-233, Japan) was used to record body wet weight of this species.

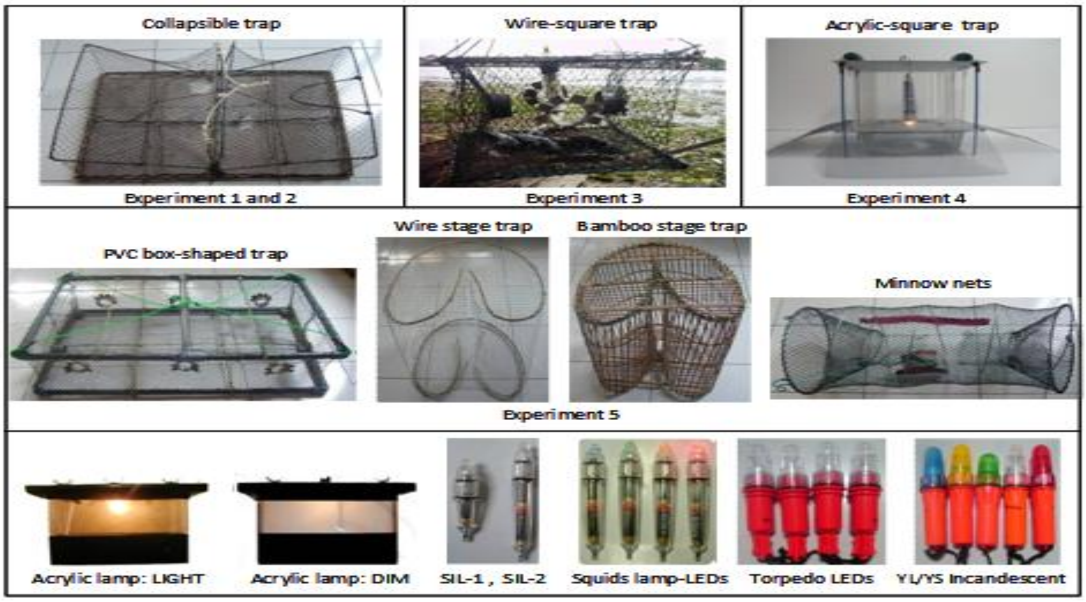

Figure2. *Typical traps and lamps used during trapping experiments in Barito River.*

2.3. Statistical Analysis

The length-weight relationship of *Macrobrachium*sp. Was expressed in the allometric form

$$W = {}_{a}L^{b} \quad (1)$$

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 [38]. The *b* values were calculated to find out whether the *Macrobrachium* sp. was growing allometrically or isometrically. The exponent *b* values of length-weight relationship of males and females were compared to the hypothetical value of 3. When the *b* value is greater than 3 indicating positive allometric, less than 3 is negative allometric, and equal to 3 is isometric[15]. Positive allometic means that weight increases more than length. Negative allometric means that length increases more than weight. Isometric means that length and weight are growing at the same rate. Frota et al. [39] reported that the parameter *b* of the length-weight relationship equation, also known as allometry coefficient that has an important biological meaning, indicating the rate of weight gain relative to growth in length. The proper fit of the growth model is given by the coefficient of determination (R^2). The coefficient of correlation (r) between variables is computed by the square regression. The class interval for each 10 mm total length was computed for *Macrobrachium* sp. without regard to the sex. The data used for length weight relationship were also utilized for calculatingthe Fulton's condition factor of male and female *Macrobrachium* sp.by mean of formula [40]:

$$K = 100W/L^3 \quad (2)$$

Where L = total length (cm) and W = 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 compare the body parts of males and females or which catch differed between incandescent and LED light traps. Kruskal-Wallis test was used to investigate if there were significant differences in the total catches of the four or five lighted traps as well as in condition factor among class intervals. All tests were analysed at the 0.05 level of significance. SPSS for windows version 16 statistical software was used for all data analysis.

3. Results

The trials with the collapsible box-shaped traps containing incandescent lamps with different light intensities in Experiment 1 showed that there were no significant differences in the total number of catches among the four traps (P >0.05). In this trial, the LIGHT and DIM traps collected the same number of *Macrobrachium*sp. (13). The mean total length and weight of catches were 68.97 ± 15.34 mm and 5.94 ± 2.78 g (mean ± SD) respectively.

The five collapsible box-shaped traps fishing with different coloured incandescent or LED lampsin Experiment 2 revealed that the colour of lights had strong effects on the number of *Macrobrachium*sp. LED light traps were more effective in catching *Macrobrachium*sp.(total 138) than incandescent light traps (total 51) (P <0.05). The mean total length and weight of catches for incandescent light traps were 46 ± 15.02 mm and 1.55 ± 1.46 g, while those for LED light traps were 51.96 ± 11.72 mm and 1.83 ± 1.71 g respectively. From the length measurement, the males' chelae were 1.5 times longer than its total length and 1.3 times longer than females of the same body size. Furthermore, sex ratio of male to female *Macrobrachium*sp. was 1.0 :2.3. A total of 48 egg-bearing females were also collected during the whole sampling period.

In Experiment 3, a total of 62 specimens *Macrobrachium*sp. were caught by the five wire-square traps with different coloured LED lamps. There were no significant differences in the total number of catches among the five traps (P >0.05). The mean total length and weight of the catches obtained were 68 ± 10.81 mm and 4.97 ± 1.96 g respectively.

The trials with the five acrylic-square traps containing different coloured LED lamps in the Experiment 4 displayed that the traps were less success in catching juvenile's *Macrobrachium*sp. The only three juveniles were caught by the blue and yellow light traps. The acrylic entrance slits apart from the trap body because of loss of adhesiveness when soaked and from water pressure, thus allowed the animals to escape from the traps. The mean total length and weight of the catches were 47 ± 14.53 mm and 2.27 ± 2.37 g respectively.

The performance of PVC box-shaped trap, wire fish trap, bamboo fish trap, and minnow nets associated with incandescent lamp(SIL-2) or white LED was examined in Experiment 5.There were no significant differences in the total catch among the four traps (P >0.05).Overall, the minnow nets were the most effective in catching *Macrobrachium*sp. Among the other traps (total 14 for incandescent light trap and 11 for LED light trap). The mean total length and weight of catches for incandescent light traps were 64.58 ± 13.37 mm and 3.58 mm ± 2.28 g, while those for white LED light traps were 65.04 ± 13.54 mm and 3.57 ± 2.62 g respectively. The detailed data on the number of catches on each experiment are presented in Table 1.

Table1. *Total number of Macrobrachium sp.caught by lighted traps during sampling periods.*

Exp. 1	Collapsible trap fishing with different light intensities of incandescent lamps					
	SIL-1	SIL-2	DIM	LIGHT	Total	
	10	3	13	13	39	
Exp. 2	Collapsible trap fishing with different coloured LED lamps					
	Blue	Green	Yellow	Red	White	Total
	31	31	22	26	28	138
	Collapsible trap fishing with different coloured incandescent lamps					
	Blue	Green	Yellow	Red	White	Total
	5	13	23	6	4	51
Exp. 3	Wire-square trap fishing with different coloured LED lamps					
	Blue	Green	Yellow	Red	White	Total
	10	15	15	12	10	62
Exp. 4	The acrylic-square trap fishing with different coloured LED lamps for sampling juvenile species					
	Blue	Green	Yellow	Red	White	Total
	1	0	2	0	0	3
Exp. 5	Various traps fishing with the white LED lamps					
	Box-shaped trap	Wire fish trap	Bamboo fish trap	Minnow nets	Total	
	1	5	0	11	17	
	Various traps fishing with incandescent lamps					
	Box-shaped trap	Wire fish trap	Bamboo fish trap	Minnow nets	Total	
	6	6	0	14	26	

A total of 336 individuals of *Macrobrachium*sp. Comprising 161 males (48%) and 175 females (52%) withthe sex ratio of 0.92:1.00were analysed (Table 2). There was no significant difference between the sexes (P >0.05). The sizes of male ranged from 28 to 85 (66.2 ± 14.17 mm) TL and from 0.3 to 10 (4.7 ± 2.61 g) weight. The sizes of female ranged from 24 to 82(49.7±11.68 mm) TL and from 0.3 to 8(1.6 ± 1.32 g) weight (Table 1). Total length, carapace length and chelae length of male were considerably longer than that of female (P <0.001).Therefore, the values of CL/TL and ChL/TL ratios of male were significantly higher than the values of female (P <0.001). Male had chelae about 1.3 times longer than female of the same size. The values of observed length and corresponding weights of *Macrobrachium*sp.are plotted in Figure3. The regression plots of the transformed data on the relationship of CL/TL, ChL/TL, CL/ChL and weight for both sexes indicated a linear relationship between the two variables. The R^2values of these relationships were varied from 0.0322 to 0.3419 and the respective equations given for each relationship were displayed in the curves.

Table2. *Descriptive statistic and estimated parameters of length and weight relationship of Macrobrachiumsp. Sampled from Barito River. TL = total length, CL = carapace length, ChL = chelae length, W = weight, a = constant, b = exponent, r = coefficient of correlation, and K = condition factor*

Sex	N	Sizes		Mean ± SD				b	a	r	K
		Max (mm)	Min (mm)	TL (mm)	CL (mm)	ChL (mm)	W (g)				
Male	161	85	28	66.2±14.17	22.9±7.30	123.0±21.83	4.7±2.61	3.210	$6x10^{-6}$	0.975	1.39
Female	175	82	24	49.7±11.68	19.5±5.32	77.6±11.87	1.6±1.32	2.734	$3x10^{-5}$	0.937	1.14

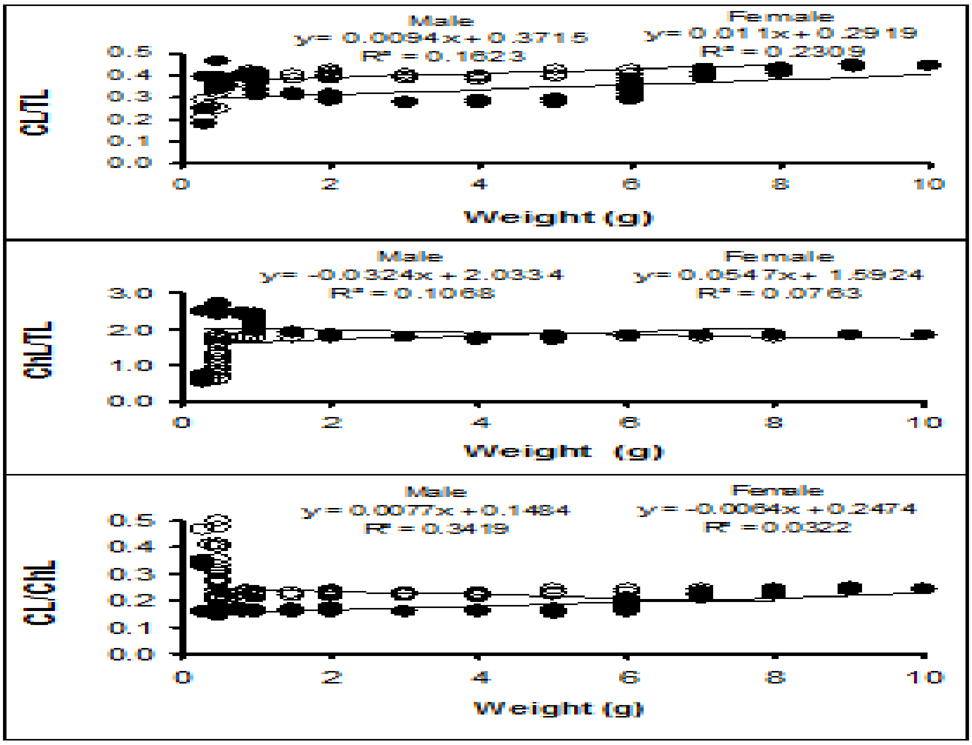

Figure3. *Comparative morphometric (CL/TL, ChL/TL, CL/ChL and weight) between male and femaleof Macrobrachiumsp. showing that male(○) was outcompete as compared to female(●) in all ratio values (P < 0.001). The CL/TL seemed to increase proportionally with weight increment, while the ChL/TL or CL/ChL tended to be relatively constant with weight increasing was observed.*

Figure 4 clearly demonstrates that male had a positive allometric growth (*b*= 3.210), while female had a negative allometric growth (*b* = 2.734).The length-weight relationships of crayfish male and female were expressed as: $W = 6\times10^{-6}TL^{3.210}$ (R^2 = 0.950) and $W = 3\times10^{-5} TL^{2.734}$ (R^2 = 0.879) respectively. The index of regression (r) obtained showing that for every mm of length, weight increases by 0.975 g in males, and by 0.937g in females. These values are being closed to 1, indicating that there was a strong relationship between length and weight. Further analysis done by plotting the average total length and average weight data into the size class, the *b* values obtained (3.268-6.195) were significantly higher than critical isometric value of 3 (P <0.001), indicating *Macrobrachium*sp. had positive allometric growth type(Table 3). Dealing with the mean weight by sex, male was significantly heavier than the female (P <0.001).The observed average weight ranged from 0.454 to 8.500 g, while the calculated average weight ranged from 0.454 to 10.015 g corresponding to the average total length was from 27.38 to 81.64 mm. Changing in weight was apparently begin at size class of 40-49 mm TL and so on. The observed values of condition factor (K)by the sex were ranged from 1.14 to 1.39 (see Table 2), while the calculated K values obtained ranging from 1.00 to 2.19 regardless the sex (Table 3).The mean K value of male was significantly higher than that of female (P <0.001).The condition factor of *Macrobrachium*sp. was statistically significant increase corresponding to length classes (P <0.001).

Table3. *Class interval and the estimated parameters of length-weight relationship of Macrobrachiumsp. taken from Barito River.TL = total length, W = weight, a = constant, b = exponent, r = coefficient of correlation, K = condition factor*

Class Interval	Average TL (mm)	n	Average W (g)	Log L	Log W	b	a	r	Calculated W (g)	K
20-29	27.38	13	0.454	1.4375	-0.3431	3.268	$6x10^{-6}$	0.87	0.454	2.19
30-39	34.92	26	0.500	1.5431	-0.3010	0.000	$5x10^{-1}$	N/A	0.500	1.23
40-49	44.27	66	0.879	1.6461	-0.0561	3.806	$5x10^{-7}$	0.80	0.936	1.00
50-59	54.23	70	1.757	1.7342	0.2448	4.274	$7x10^{-8}$	0.73	1.835	1.09
60-69	65.03	60	3.250	1.8131	0.5119	6.195	$2x10^{-11}$	0.93	3.532	1.15
70-79	73.90	79	6.127	1.8686	0.7872	3.699	$7x10^{-7}$	0.94	5.764	1.51
80-89	81.64	22	8.500	1.9119	0.9294	3.412	$3x10^{-6}$	0.94	10.015	1.56

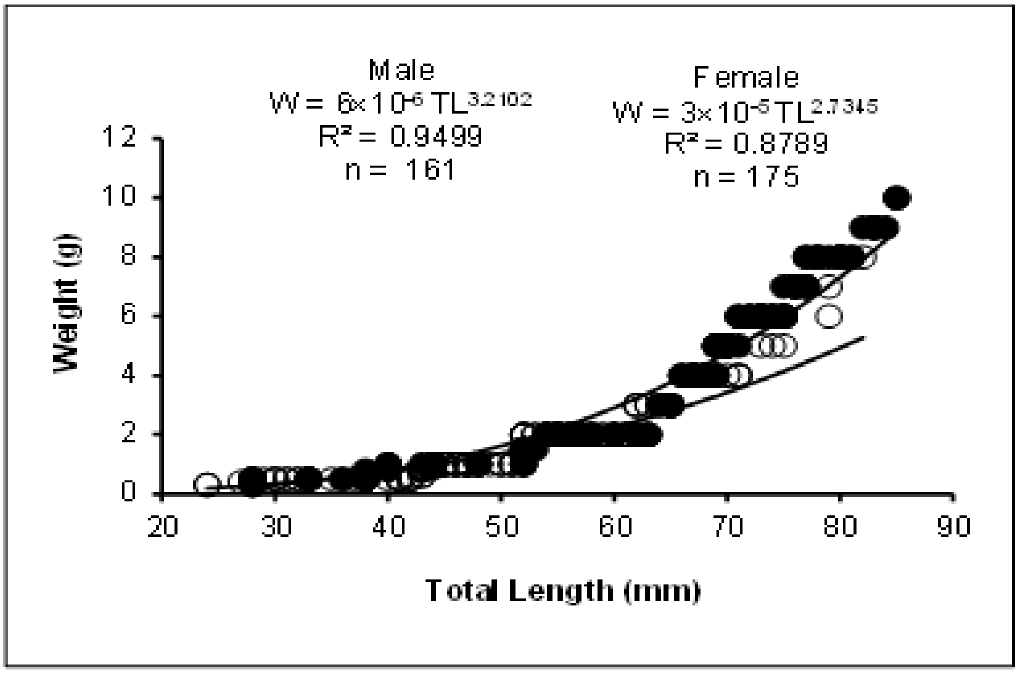

Figure4. *The length-weight relationships of males and females Macrobrachiumsp. sampled from Barito River. Male (●) showed a positive allometric growth (b= 3.2102), while female (○) exhibited a negative allometric growth (b= 2.7345).*

4. DISCUSSION

This study describes in which different folding shrimp traps equipped with lamps of different light intensities and colour were used in order to test their effect on catchment success what is an interesting premise for research. It is well-known that weight measurements of shrimps often comprise an essential part of biological studies; however, the instruments and time required to accurately measure weight are often not amenable to field research condition. Length, on the other hand, is very easily measured accurately in the field using only a ruler. Consequently, biologists have developed length-weight relations which allow them to estimate weight using length measurement.

For comparison, the size range of *Macrobrachium*sp. 24-85 mm collected from the Barito River was also similar to *M. hainanense* in Chinese streams [41], *M. Lamarrei* in Nepal freshwater ponds and rivers [42] and *M. nipponense* in Japanese aquacultures [43]. The body shape of *Macrobrachium* sp.maledis plays a positive allometric growth pattern. The similar observations were also documented for *Astacusleptodactylus* in Turkey [11], *M.rosenbergii* and *Litopenaeusvannamei* in India [15-16], *M.vollenhovenii* in Nigeria [18], *Procambarusclarkii* in China and Morocco [25,44], and *Austropotamobiustorrentium*in Austria [45],but inconsistent with *Acetesjaponicus* and *A. indicus* in Malaysia [3],*M.lamarrei* in Bangladesh [19], *Atyagabonensis*, *M.felicinium* and *Penaeusnotialis* in Nigeria [4, 20], *Metapenaeusmonoceros* in India [46], *Procambarusfallax* in Florida [47], and *P. monodon* in Sri Lanka and India[13,48].

A negative allometric growth condition for female in the present study was also reported for *Acetesindicus* and *A. serrulatus* in Malaysia [3], *Penaeusnotialis* in Nigeria[4], *A. leptodactylus* in Turkey [23], and *P. monodon*in India[48].Negative allometric growth shown by female *Macrobrachium*sp. Could be due to individuals stay in spawning period by indication of egg-bearing females was often found in the traps. In many cases, egg-bearing females are usually less active during the breeding season and are not responded to the baited trap[49]. They become more active after releasing the young and preparing for matting [50]. In the present study, the egg-bearing females can be allured into a lighted trap. It was also clear from our previous work with *P. clarkii*in Japan [51].Based on these findings; we can say that *Macrobrachium*sp. is multi chromatic species because it shows pronounced photopositive to all colours tested.

*Macrobrachium*sp. Morphologically resembles with species *M. australiense* from Australia River [52]. To differentiate between two species, cheliped traits were considered as they show a high level of developmental variation [53]. Figure 5 clearly shows that the male's chelae of

*Macrobrachium*sp.(112 mm) was twice longer than that of *M. australiense* (51 mm)at the same body size (72 mm). Such ratio of ChL/TL in *Macrobrachium*sp.(1.56) may be the highest ratio across the entire genus *Macrobrachium*.It is commonly accepted that the weight-length relationships are not constant over the entire year and vary according to factors such as food availability, feeding rate, gonad development and spawning period [54],[3], temperature [55], salinity [56], inherited body shape[57]and fecundity [58].In the current study, the *b*values were generally in good agreement with the results obtained from other geographical areas (Table 4).The *b* values also suggested that Barito River has a better ecological condition for the species thus supports higher biomass in the aquatic food web. Recording of individual length and weight data of *Macrobrachium*sp.should be continued to provide more detailed statistical analysis on possible differences in the length-weight relationship between the various developmental stages and survey areas along Barito River. To the best knowledge of the author, this study presents the first reference on the weight-length relationships of *Macrobrachium*sp. from Barito River.

Table4. *Comparative parameters of length and weight relationship of Macrobrachiumsp from Barito River and other shrimp species from different geographical areas.*

Species	Sex	a	b	R^2	Equation	Growth Type	Country	Citations
*Macrobrachium*sp.	M	0.000	3.210	0.975	$W= 6\times10^{-6}L^{3.210}$	A+	Indonesia	Present study
	F	0.000	2.734	0.937	$W= 3\times10^{-5}L^{2.734}$	A-	Indonesia	Present study
M. lamarrei	P	0.000	2.924	0.970	$W = 0.000L^{2.924}$	A-	Bangladesh	Ara et al. 2014
M. felicinium	P	0.002	3.003	0.998	$W = 0.002L^{3.003}$	I	Nigeria	OkayiandIorkya a 2004
M. vollenhovenii	M	0.000	3.483	0.993	$W = 0.000L^{3.483}$	A+	Nigeria	NwosuandWolfi 2006
	F	0.000	3.329	0.990	$W = 0.000L^{3.329}$	A+	Nigeria	NwosuandWolfi 2006
Penaeusnotialis	M	0.539	0.619	0.302	$W = 0.539L^{0.619}$	A-	Nigeria	Lawal-Are andAkinjogunla 2012
	F	0.397	0.817	0.394	$W = 0.397L^{0.817}$	A-	Nigeria	Lawal-Are andAkinjogunla 2012
M. rosenbergii	M	0.088	3.389	0.949	$W = 0.088L^{3.389}$	A+	India	Lalrinsanga et al. 2012
	F	0.073	3.550	0.948	$W = 0.073L^{3.550}$	A+	India	Lalrinsanga et al. 2012
Metapenaeusmonoceros	M	0.009	2.920	0.907	$W=0.009L^{2.920}$	A-	India	Dineshbabu 2006
	F	0.003	3.290	0.972	$W = 0.003L^{3.290}$	A+	India	Dineshbabu 2006
Litopenaeusvannamei	M	0.000	3.260	0.999	$W= .0007L^{3.260}$	A+	India	Gautam et al. 2014
	F	0.000	3.654	0.998	$W= .0004L^{3.654}$	A+	India	Gautam et al. 2014
Penaeus monodon	M	0.077	2.409	0.778	$W = 0.077L^{2.409}$	A-	India	Uddin et al. 2016
	F	0.091	2.388	0.847	$W = 0.091L^{2.388}$	A-	India	Uddin et al. 2016
Penaeus monodon	M	0.006	3.016	0.958	$W= 0.006L^{3.016}$	I	Sri Langka	Piratheepa et al. 2013
	F	0.005	3.075	0.963	$W= 0.005L^{3.075}$	I	Sri Langka	Piratheepa et al. 2013
Acetes japonicas	M	0.002	3.153	0.659	$W=0.002L^{3.153}$	I	Malaysia	Wong et al. 2015
	F	0.017	2.432	0.798	$W= 0.017L^{2.432}$	A-	Malaysia	Wong et al. 2015
Acetesindicus	M	0.010	2.694	0.907	$W = 0.010L^{2.694}$	A-	Malaysia	Wong et al. 2015
	F	0.008	2.778	0.917	$W = 0.008L^{2.778}$	A-	Malaysia	Wong et al. 2015

Astacusleptodactylus	M	0.000	3.293	0.939	$W = 7\times10^{-6}L^{3.293}$	A+	Turkey	Deniz et al. 2010
	F	0.000	3.022	0.939	$W = 2\times10^{-5}L^{3.022}$	I	Turkey	Deniz et al. 2010
Astacusleptodactylus	M	0000	3.016	0.973	$W= 8\times10^{-6}L^{3.302}$	I	Turkey	Aydin et al. 2015
	F	0.000	3.011	0.972	$W= 3\times10^{-5}L^{3.011}$	I	Turkey	Aydin et al. 2015
Austropotamobiustorrentium	M	0.000	3.379	0.994	$W= 8\times10^{-6}L^{3.379}$	A+	Austria	Streissl and Hödl 2002
	F	0.000	3.136	0.990	$W= 2\times10^{-5}L^{3.136}$	A+	Austria	Streissl and Hödl 2002
Procambarusfallax	M	0.188	3.060	0.924	$W = 0.188L^{3.060}$	I	Florida USA	Klasssen et al. 2014
	F	0.193	3.070	0.971	$W = 0.193L^{3.070}$	I	Florida USA	Klasssen et al. 2014
Procambarusalleni	M	0.229	2.84	0.873	$W =0.229L^{2.84}$	A-	Florida USA	Klasssen et al. 2014
	F	0.209	2.82	0.929	$W =0.209L^{2.82}$	A-	Florida USA	Klasssen et al. 2014
Procambarusclarkii	M	0.014	3.63	0.955	$W=0.014L^{3.63}$	A+	China	Wang et al. 2011
	F	0.020	3.35	0.935	$W=0.020L^{3.35}$	A+	China	Wang et al. 2011

a = constant, b = exponent, R^2 = coefficient of determination, A+ = positive allometric, A- = negative allometric, I = isometric

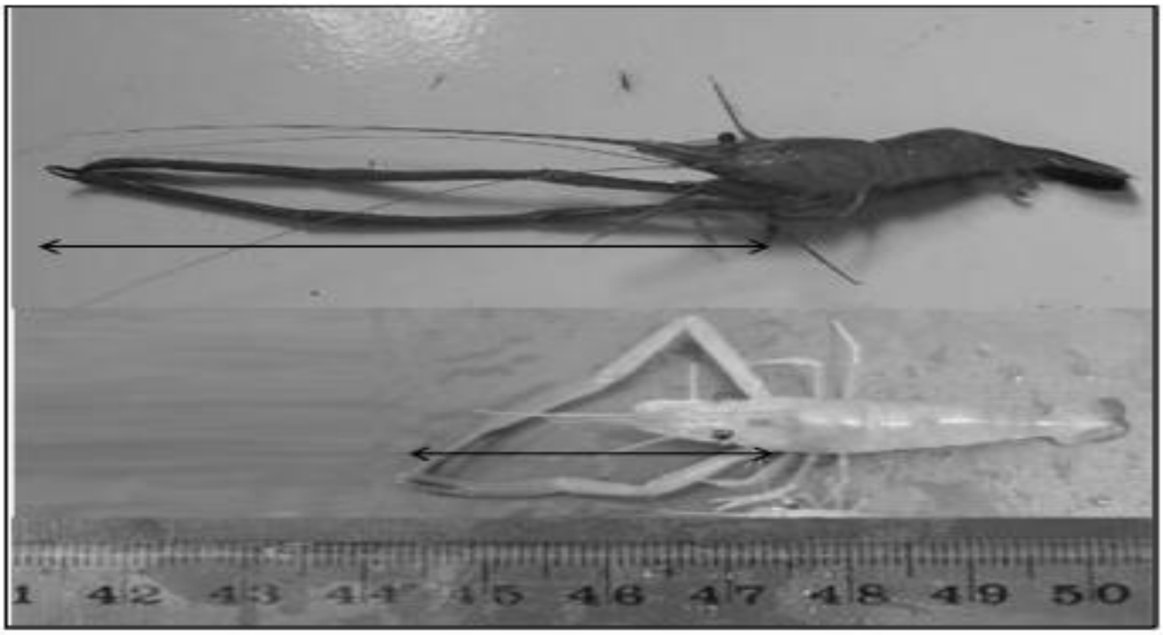

Figure5. *The photograph shows the individuals of Macrobraciumsp. from Barito River (Top) and Macrobraciumaustralience from Australia River (Bottom) of the same body size (72 mm TL).*

In the present study, the K value obtained (1.14 - 1.39)was greater than 1,according to Le-Cren[59]; this species was in better condition, suggesting that result of this study is valid.For comparison, theKvalues here were slightly higher than the K values for *Atyagabonensis* (1.014) from river [20],*M. rosenbergii* (1.09) at rice fields [60]or *P. monodon* (0.727) under pond cultured[61], but it was lower than the K value for *A. leptodactylus* from Kılıçkaya Reservoir[62].Variation in the value of the mean K may be attributed to biological interaction involving intra specific competition for food and space [63] and the difference in aggressive behavior [64] between shrimps.

5. CONCLUSION

Positive allometric growth trends in catches of *Macrobrachium*sp. Revealed that Barito River is still good condition for the growth of shrimp. Dealing with the mean weight by sex, male was significantly heavier than that of female.The *b* values were generally in good agreement with the results obtained from other geographical areas. From light fishing perspective, *Macrobrachium*sp. Shows positively responded to all light traps tested. For future application, it is strongly recommended to use LED lights, because they are more energy efficient, more colours available and more durable.

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REFERENCES

[1] Mejia-Ortiz, L.M., Alvarez, F., Roman, R., Viccon-Pale, J.A. (2001).Fecundity and Distribution of freshwater praws of the genus Macrobrachium in the Huitzilapan River, Veacruz, Mexico. Crustaceana, 74(1): 69-77.

[2] Ruas, V.M., Rodrigues, M.A., Dumont, L.F.C., D'Incao, F. (2014).Habitat selection of the pink shrimp *Farfantepenaeuspaulensis* and the blue crab *Callinectessapidus* in an estuary in southern Brazil: influence of salinity and submerged seagrass meadows. Nauplius, 22(2): 113-125. http://dx.doi.org/10.1590/S0104-64972014000200005

[3] Wong, B.Y., Ong, H.K.A., Khoo, G. (2015).Length-Weight Relationships of *Acetes* spp. sampled along the West Coast of Peninsular Malaysia. Sains Malaysiana, 44(3): 379-386.

[4] Lawal-Are, A.O., Akinjogunla, V.F. (2012). *Penaeusnotialis* (Pink Shrimps): Length-weight relationships and condition factor in Lagos Lagoon, South West, Nigeria. Science Technology, 2(3): 32-40.

[5] Boutson, A., Mahasawasde, C., Mahasawasde, S., Tunkijjanukij, S.,Preecha, A. (2007). Possibility to modify shrimp trammel net to reduce discard species. Kasetsart Journal (Natural Science),41: 149-156.

[6] Pravin, Ravindran.(2011).Catch efficiency of gillnets in shrimp filtration farms at Vypeen Island, Kerala, South India. Indian Journal of Fisheries, 58(2): 153-157.

[7] Puspito, G., Thenu, I.M., Julian, D., Tallo, I. (2015).Utilization of light-emitting diode lamp on lift net fishery. AACL Bioflux, 8(2): 159-167

[8] Alonso, F. (2001). Efficiency of electrofishing as a sampling method for freshwater crayfish populations in small creeks. Limnetica,20(1): 59-72.

[9] Stebbing, P.D., Watson, G.J., Bentley, M.G., Fraser, D., Jennings, R., Rushton, S.P., Sibley, P.J. (2004).Evaluation of the capacity of pheromones for control of invasive non-native crayfish. English Nat Res Rep No. 578, Peterborough, UK.

[10] Ahmadi, Satoshi, I., Sho, S. (2015). Trapping Survey for the Red Frog Crabs (*Raninaranina*) using the baited tangle nets and pots in Offshore Tanegashima, Japan – International Journal of Innovative Studies in Aquatic Biology and Fisheries, 1(1): 30-37.

[11] Deniz, T., Harlıoglu, M.M., Deval, M.C. (2010).A study on the morphometric characteristics of *Astacusleptodactylus* inhabiting the Thrace region of Turkey. Knowledge and Management of Aquatic Ecosystems, 397: 05.https://doi.org/10.1051/kmae/2010021

[12] Ahmadi. (2012). An Introduction of Light Traps for sampling freshwater Shrimp and fish in the Barito River, South Kalimantan. Journal of Fisheries and Aquatic Sciences, 7(2): 173-182.https://doi.org/10.3923/jfas.2012.173.182

[13] Piratheepa, S., Edrisinghe, U., Chitravadivelu, K. (2013).Investigation on Length-Weight Relationship of *Penaeus monodon* (Fabricius, 1798) in Kakkaithevu coastal waters in the Northern part of Sri Lanka.Tropical Agricultural Research, 25(1): 133-140.

[14] Maheswarudu, G., Radhakrishnan, E.V., Arputharaj, M.R., Mohan, S. (2011). Growth Performance of the Green Tiger Prawn *Penaeussemisulcatus* De Haan in cages in the Gulf of Mannar off Mandapam, Southeast Coast of India. Asian Fisheries Science, 24: 100-114.

[15] Lalrinsanga, P.L., Pillai, B.R., Patra, G., Mohanty, S., Naik, N.K., Sahu, S. (2012).Length weight relationship and condition factor of giant freshwater prawn *Macrobrachiumrosenbergii* (De Man, 1879) based on developmental stages, culture stages and sex. Turkish Journal of Fisheries and Aquatic Sciences, 12: 917-924.

[16] Gautam, K, Nazar, A.R., Anand, E., Ganesh, Mahendran, S.,Mahadevan, G. (2014).Study of length and weight relationship of *Litopenaeusvannamei* (Boone, 1931) from East Coast of India.International Journal of Science Inventions Today, 3(4): 365-376.

[17] Mossolin, E.C., Bueno, S.L.S. (2003).Relative growth of the second pereiopod in *Macrobrachiumolfersi* (Wiegmann, 1836) Decapoda, Palaemonidae). Crustaceana, 76: 363-376.

[18] Nwosu, F.M., Wolfi, M. (2006). Population Dynamics of the Giant African River Prawn *Macrobrachiumvollenhovenii*Herklots 1857 (Crustacea, Palaemonidae) in the Cross River Estuary, Nigeria.West Africa Journal of Applied Ecology, 9: 1-14.

[19] Ara, M.G., Nobi, M.N., Ahmed, Z.F., Fatema, M.K. (2014). Length-weight relationship and growth pattern inference of a small indigenous freshwater prawn, *Macrobrachiumlamarrei* (H. Milne-Edwards, 1837) in Bangladesh. Research in Agriculture, Livestock and Fisheries, 1(1): 137-145. http://dx.doi.org/10.3329/ralf.v1i1.22377

[20] Okayi, G., Iorkyaa, A. (2004).Length-weight relationship and condition of freshwater shrimps *Atyagabonensis* and *Macrobrachiumfelicinium* from the Mu river, Makurdi, Nigeria.Animal Research International, 1(3): 153-154.

[21] Wieland, K. (2002). A new length-weight Relationship for Northern Shrimp (Pandalus borealis) off West Greenland (NAFO Subareas 0+1).Scientific Council Meeting, November 2002. NAFO SCR Doc.02/144 Serial No. N4773. p. 1-4.

[22] Franco, AR., Ferreira, J.G., Nobre, A.M. (2006).Development of a growth model for penaeid shrimp.Aquaculture,259: 268-277. https://doi.org/10.1016/j.aquaculture.2006.05.051

[23] Aydin, H., Harlioglu, M.M.,Deniz, T. (2015). An investigation on the population parameters of freshwater crayfish (*Astacusleptodactylus*Esch., 1823) in Lake İznik (Bursa).Turkish Journal of Zoology,39: 660-668. https://doi.org/10.3906/zoo-1406-6.

[24] Peixoto, S., Soares, R., Wasielesky, W., Cavalli, R.O., Jensen, L. (2004).Morphometric relationship of weight and length of cultured *Farfantepenaeuspaulensis* during nursery, grow out, and broodstock production phases. Aquaculture, 241: 291-299.

[25] Wang, Q., Yang, J.X., Zhou, G.Q., Zhu, Y.A., Shan, H. (2011).Length–weight and chelae length-width relationships of the crayfish *Procambarusclarkii* under culture conditions. Journal of Freshwater Ecology, 26(2): 287-294. https://doi.org/10.1080/02705060.2011.56438

[26] Tsoumani, M., Liasko, R., Moutsaki, P., Kagalou, I., Leonardos, I. (2006).Length-weight relationship of an invasive cyprinid fish (*Carassiusgibelio*) from 12 Greek lakes in relation to their trophic states.Journal of Applied Ichthyology, 22: 281-284.

[27] Mayavu, P., Rajasegar, M., Ajmalkhan, S. (2005).Length-weight relationship of loose-shell affected *Penaeus monodon* (Fabricius, 1798) in grow-out system. Indian Journal of Fisheries, 52(2): 233-234.

[28] Yang, Z., Chen, Y.F. (2003).Length–weight relationship of obscure puffer (*Takifugu obscurus*) during spawning migration in the Yangtze River, China. Freshwater Ecology, 18: 349-352. https://doi.org/ 10.1080/02705060.2003.9663969

[29] Froese, R. (1998).Length–weight relationships for 18 less-studied fish species. Journal of Applied Ichthyology, 14: 117-118.

[30] Safran, P. (1992).Theoretical analysis of the weight–length relationship in fish juveniles. Marine Biology, 112: 545-551.

[31] Enin, U.I. (1994).Length–weight parameters and condition factor of two West African prawns. Review of Hydrobiology Tropic. 27: 121-127

[32] Chu, K.H., Chen, Q.C., Huang, L.M., Wong, C.K. (1995). Morphometric analysis of commercially important penaeid shrimps from the Zhejiang estuary, China. Fisheries Research, 23: 83-93.

[33] Sivashanthini, K. (2008).Length-Weight Relationships and Condition of Gerreids (Pisces: Gerreidae) from the Parangipettai Waters (SE coast of India).Asian Fisheries Science, 21(4): 405-419.

[34] Prasetyo, D., Asyari, Sudrajat, A. (2005).Inventory of fish species and habitat characteristics of Barito River waters, South Kalimantan and Central Kalimantan. Research Center for Fisheries Management and Fish Resource Conservation. Proceeding of Indonesian Inland Fishery Forum, p. 339-346. (Indonesian with English in Abstract).

[35] Asyari.(2006). Characteristic of habitat and fish species at some fishery sanctuaries in the stream of Barito River, South Kalimantan. Indonesian Journal of Fisheries and Aquatic Science,13: 155-163. (Indonesian with English in Abstract)

[36] Rahman, A. (2008). Study on abundance and diversity of typical planktons at estuary river of Kelayan. Al 'Ulum,36: 1-6. (Indonesian with English in Abstract).

[37] Rosadi, E., Yuli, E., Setyohadi, D., Bintoro, G. (2016). Native Species in Barito Upstream at South Kalimantan, Indonesia: sex ratio and length-weight relationship of SeluangBatang Fish (*Rasboraarg yrotaenia* Blkr, 1850).Journal of Wetlands Environment Management, 4(2): 84-90. http:// dx.doi.org/ 10.20527/jwem.v4i2.55

[38] Bagenal, T. (1978). Methods for assessment of fish production in freshwaters. 3rd ed. Oxford: Blackwell Scientific Publication. Oxford, London, pp. 365

[39] Frota, L.O., Costa, P.A.S., Braga, A.C.(2004).Length-weight relationship of marine fishes from the central Brazilian coast. NAGA, the World Fish Center Quarterly,27(1): 20-26

[40] Gayanilo, F.C., Pauly, D. (1997). FAO-ICLARM Stock Assessment Tools (FiSAT). FAO Computerised Information Series (fisheries) No. 8, Rome, 262 p.

[41] Mantel, S.K., Dudgeon, D. (2004).Growth and production of a tropical predatory shrimp, *Macrobrachiumhainanense* (Palaemonidae) in two Hong Kong streams. Freshwater Biology, 49: 1320-1336.

[42] Sharma, A., Subba, B.R. (2005).General biology of freshwater prawn *Macrobrachiumlamarrei* (H. Milne-Edwards) of Biratnagar, Nepal. Our Nature, 3: 31-41.

[43] New, M.B. (2005).Freshwater prawn farming: global status, recent research and a glance at the future. Aquaculture Research, 36: 210-230.

[44] El Qoraychy, I., Fekhaoui, M., El Abidi, A., Yahyaoui, A.(2015).Biometry and demography of *Procambarusclarkii* in Rharb Region, Morocco. AACL Bioflux, 8(5): 751-760.

[45] Streissl, F., Hödl, W. (2002).Growth, morphometrics, size at maturity, sexual dimorphism and condition index of *Austropotamobiustorrentium* Schrank. Hydrobiology, 477: 201-208.

[46] Dineshbabu, A.P. (2006). Length-weight relationship and growth of the speckled shrimp *Metapenaeus monoceros* (Fabricius) off Saurashtra. Journal of Marine Biology Association of India, 48(2): 180-184

[47] Klassen, J.A., Gawlik, D.E., Botson, B.A. (2014).Length-weight and length-length relationships for common fish and crayfish species in the Everglades, Florida, USA.Journal of Applied Ichthyology, 30: 564-566.

[48] Uddin, S.K.N., Ghosh, S., Maity, J. (2016). Length weight relationship and condition factor of *Penaeus monodon* (Fabricius, 1798) from Digha coast, West Bengal, India. International Journal of Fisheries and Aquatic Studies. 4(3): 168-172.

[49] Holdich, D.M.(2002).Biology of freshwater crayfish. Blackwell Science, Oxford,pp. 702.

[50] Faller, M., Maguire, I. Klobucar, G. (2006).Annual activity of the noble crayfish (*Astacusasutacus*) in the Orljava River (Croatia).Bulletin Français de la Pêcheet de la Pisciculture, 383: 23-40.https://doi.org/ 10.1051/kmae:2006003

[51] Ahmadi, Kawamura, G.,Archdale, M.V. (2008). Mechanism of phototaxis in American crayfish *Procambarusclarkii* (Girard) following different methods of trapping. Journal of Fisheries andAquatic Sciences, 3(6): 340-352.https://doi.org/10.3923/jfas.2008.340.352

[52] Dimmock, A., Williamson, I., Mather, P.B. (2004). The influence of environment on the morphology of *Macrobrachiumaustraliense* (Decapoda, Palaemonidae).Aquaculture International,12: 435-456.

[53] Short, J.W. (2000).Systematics and biogeography of *Australian macrobrachium* (Crustacea: Decapoda, Palaemonidae) – with descriptions of other new freshwater Decapoda. Doctor of Philosophy Thesis, University of Queensland, Australia.

[54] Amin, S.M.N., Arshad, A., Siraj, S.S.,Japar, S.B. (2010).Reproductive seasonality and maturation of the sergestid shrimp, *Acetesjaponicus* (Decapoda: Sergestidae) in coastal waters of Malacca, Peninsular Malaysia. African Journal ofBiotechnology,9(45): 7747-7752.

[55] Lopez-Martinez, J., Arreguín-Sánchez, F., Hernandez-Vaz-quez, S., García-Juárez, A.R., Valenzuela-Quiñonez, W. (2003).Inter-annual variation of growth of the brown shrimp *Farfantepenaeuscaliforniensis* and its relation to temperature. Fisheries Research, 61: 95-105.

[56] Lemos, D., Phan, V.N., Alvarez, G. (2001).Growth, oxygen consumption, ammonia- excretion, biochemical composition and energy content of *Farfantepenaeuspaulensis* Pérez-Farfante (Crustacean, Decapoda, and Penaeidae) early post-larvae in different salinities.Journal of Experimental Marine Biology and Ecology, 261: 55-74.

[57] Yousuf, F., Khurshid, S. (2008).Length-weight relationship and relative conditions factor for the halfbeak *Hamirampus* far Forsskal, 1775 from the Karachi coast.University Journal of Zoology, Rajashahi University, 27: 103-104.

[58] Lawson, E. (2011).Length-weight relationships and fecundity estimates in mudskipper, *Periophthal muspapilio* (Bloch and Schneider 1801) from the mangrove swamps of Lagos lagoon, Nigeria. Journal of Fisheries and Aquatic Sciences, 6(3): 264-271. https://doi.org/10.3923/jfas.2011.264.271

[59] Le-Cren, E.D. (1951).The Length-Weight Relationship and Seasonal Cycle in Gonad-Weight and Condition in the Perch (*Percafluviatilis*). Journal of Animal Ecology, 20: 201-219

[60] Kunda, M., Dewan, S., Uddin, M.J., Karim, M., Kabir, Uddin, M.S. (2008).Short Communication: length-weight relationship, condition factor and relative condition factor of *Macrobrachiumrosenbergii* in rice fields. Asian Fisheries Science, 21: 451-456.

[61] Gopalakrishnan, A., Rajkumar, M., Rahman, M.M., Sun, J., Antony, P.J., Venmathimaran, B.A., Trilles J.P. (2014).Length-weight relationship and condition factor of wild, grow-out and 'loose-shell affected' giant tiger shrimp, *Penaeus monodon* (Fabricius, 1798). (Decapoda: Penaeidae).Journal of Applied Ichthyology, 30: 251-253. https://doi.org/ 10.1111/jai.12269.

[62] Dirican, S. (2018). Predata on Some Morphometric Characters and Condition Factors of Crayfish, Astacusleptodactylus (Eschscholtz, 1823) from Kılıçkaya Reservoir, Sivas, Turkey. International Journal of Innovative Studies in Aquatic Biology and Fisheries, 4(1): 20 -25. http://dx.doi.org/10.20431/ 2454-7670.0401004

[63] Arimoro, F,O., Meye, J.A. (2007).Some aspects of the biology of *Macrobrachium dux* (Lenz, 1910) (Crustacea: Decapoda: Natantia) in river Orogodo, Niger delta, Nigeria. ActaBiologicaColombiana, 12(1): 111-122.

[64] Deekae, S.N.,Abowei, J.F.N. (2010). *Macrobrachiummacrobrachion* (Herklots, 1851) length-weight relationship and Fulton's condition factor in Luubara creek, Ogoni land, Niger delta, Nigeria. International Journal of Animaland Veterinary Advances, 2(4): 155-162.

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