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Morphometric relations in the grey eel catfish *Plotosus canius* in the coastal waters of Port Dickson, Peninsular Malaysia

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Abstract

Samples of grey eel catfish *Plotosus canius were* collected from the coastal waters of Port Dickson, Malaysia from January to December, 2012. A total of 341 specimens (172 males and 169 females) were used to estimate the length-weight relationship parameters. Mean population size of females were 0.72 cm taller than the males, however difference was not significant (t-test, $P > 0.05$). The overall relationship equations between total length (TL) and body weight (BW) were established for males as Log TW = 2.71 Log TL – 1.85 ($R^2 = 0.95$) and for females as Log TW = 2.88 Log TL – 2.10 ($R^2 = 0.95$). The estimated relative growth co-efficient (b) values were 2.71 for males and 2.88 for females. It is revealed that growth pattern of the species showed negative allometry. In both males and females, relationship between TL and SL gave highest regression coefficient (0.99). While relationship between TL and EL gave lowest regression coefficient in both males and females (0.87 and 0.81 respectively). The findings from this study contributed first information on morphometric relations of the fish from Malaysian coastal waters and could be useful for sustainable management options of *P. canius* in Malaysia.

Key words

Grey eel catfish, Length-length relationships, Morphometric relations, *Plotosus canius*

Introduction

Plotosus canius, the grey-eel catfish (family Plotosidae) is a commercially important fish, marketed mostly fresh on the coastal areas of Peninsular Malaysia. It is locally familiar as "Sembilang" or "Semilang" (Ambak *et al*., 2010). Although the status of fish has not been assessed in Malaysia, landing of the fish has been declining in recent times. Although, the status of *P. canius* has not been evaluated in the IUCN red list (IUCN, 2013), It has been reported among the fishes that are facing extinction in the near future in India and Bangladesh (IUCN Bangladesh, 2000; Mijkherjee *et al*, 2002).

Length-weight relationship (LWR) and length-length relationship (LLR) are important tools used in growth estimation, population characterization and determination of age in fishery biology. It also provides useful information about the condition and robustness of fish in its environment. With the given length of fish, a mathematical correlation between length and weight can be used to estimate its weight and often LWR is a useful tool for the management and conservation of fish species in its environment. The condition factor is an important tool which serves as an indicator of the well-being of fish in its habitat. It greatly helps in understanding the life cycle of any fish species and is vital in the development of adequate management strategies of any fish species (Imam *et al*., 2010; Sarkar *et al*., 2013).

Information is readily available for a number of fish species on LWR (Bautista-Romero *et al*., 2012; Dutta *et al*., 2012; Mazlan *et al*., 2012; Achakzai *et al*., 2013) and LLR (Azadi and Rahman, 2008; Elamin *et al*., 2011; Arshad *et al*., 2012; Pervaiz *et al*., 2012), to mention but a few. However to date, references on basic biology aspects of *P. canius* in both national and international literature is scarce. Information on LWR of this important commercial fish is very scarce. Even in the "Fish Base" , this has not been reported, hence, need for

more research on this subject. The present work was carried out to examine morphometric relations of grey eel catfish, *P. canius* in the coastal waters of Port Dickson, Peninsular Malaysia with the aim of conservation and management of this fish.

Materials and Methods

Sampling was conducted in the coastal waters of Kampung Telok (Kg. Telok), Port Dickson, Peninsular Malaysia. Fish samples of different size classes were randomly collected monthly (January to December, 2012) during full moon from local fishermen. All the fish samples were immediately placed in ice chest and transported to the laboratory for detailed analyses.

All body measurements were made by a digital vernier caliper (Mitutoyo absolute CD-12″CP) to the nearest 0.01mm except for total length (TL) and standard length (SL), which were measured to the nearest 0.1 cm using a measuring board. Weights were determined to the nearest 1.0 g using a digital top loading electronic balance (Simon TH-5000). For determining the length-length relationships, variables which were taken into consideration were as follows : total length (TL), standard length (SL), head length (HL), eye length (EL), eye diameter (ED), snout length (SNL), post orbital length (POL), inter orbital length (IOL), head width (HW), pre-dorsal distance (PDD), pre-anal distance (PAD), pre-ventral distance (PVD), pre-pectoral distance (PPD), body depth at anus (BDA) and mouth gape (MG) (Table 1). Internal examination of fish gonads was employed for identification of various sexes.

To establish population structure, length-frequency data were analyzed. Equation $W = aL^b$, where W= wet weight in g, L= total length in cm, a = constant and b = relative growth coefficient, was used to estimate LWRs. Logarithmic transformation of the formula ($W = aL^b$) into Log W = Log a + b Log TL was done, while each value of a (constant) and b (slope of the line) was determined empirically employing common statistics. Relationship between TL and various body lengths (SL, HL, EL, ED, SNL, POL, IOL, HW, PDD, PVD, PAD, PPD, BDA and MG) were also examined and regression coefficients (R^2) were determined for different sexes separately. The formula y = a + bx was used to work out the various relationships; where x = independent variable and y = dependent variable. All analyses were done using Excel 2010, MINITAB 16 and SPSS 20 statistics software.

Results and Discussion

The annual size frequency distribution is depicted in Fig. 1. A total number of 341 specimens of *P. canius* were

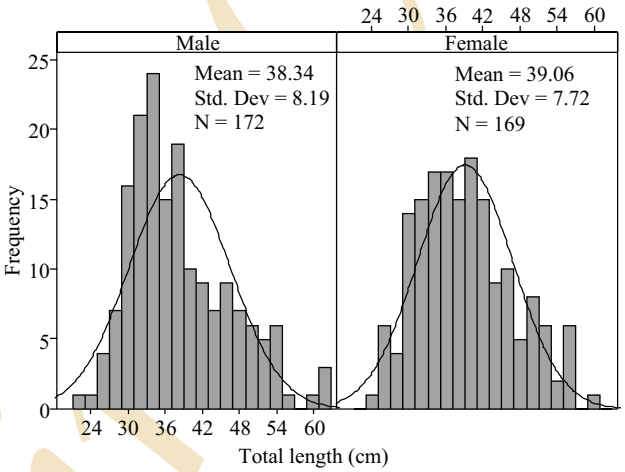

Fig. 1 : Annual size frequency distribution of male and female grey eel catfish *P. canius* in the coastal waters of Port Dickson during January to December, 2012

Table 1 : Body measurements of grey eel catfish *P. canius* used in the study of length-length and their descriptions

Body measurements	Descriptions
Standard length (SL)	Length the tip of the fish snout to the base of the tail fin.
Total length (TL)	Length from the tip of the snout to the tip of the tail fin.
Head length (HL)	Length from the tip of the snout of the posterior bony extremity of the operculum.
Eye length (EL)	Length between upper and lower walls of the bony orbit.
Eye diameter (ED)	Length between the anterior and posterior walls of the bony orbit.
Snout length (SNL)	Length from the tip of the snout to the anterior margin of the orbit.
post orbital length (POL)	Length from the tip of the snout to the anterior margin of the orbit.
Inter orbital length (IOL)	Length between the upper rims of each orbit.
Head width (HW)	Length between the margins at the widest area of the head between the opercula on either side.
Pre dorsal distance (PDD)	Length from the tip of the snout to the structural base of the first dorsal fin ray.
Pre anal distance (PAD)	Length between the tip of the snout and the insertion of the first ray of the anal fin.
Pre ventral distance (PVD)	Length between the tip of the snout and the insertion of the first ray of the ventral fin.
Pre pectoral distance (PPD)	Length between the tip of the snout and the insertion of the first ray of the pectoral fin.
Body depth at anus (BDA)	Vertical distance between the body margins through the posterior boarder of the anal opening.
Mouth gape (MG)	Length between the angles of the mouth.

Table 2 : Length-weight relationship parameters of grey eel catfish *P. canius* in the coastal waters of Port Dickson, Malaysia

Sex	N	TL range	Regression equation	a	b	95% CI of b	R^2	Growth type
M	172	22.80 - 62.90	Log TW = 2.71 Log TL - 1.85	0.01	2.71	2.57 - 2.85	0.95	Allometric (-)
F	169	24.60 - 60.00	Log TW = 2.88 Log TL - 2.10	0.01	2.88	2.78 - 2.98	0.95	Allometric (-)

Note: M, male; F, female; N, number of individuals; TL, Range minimum and maximum total length (cm); TW, total weight; a, intercept; b, slope; CI, coefficient of interval, R^2, coefficient of determination

Table 3 : Summary of the descriptive statistics of the various body measurements of males and females of grey eel catfish *P. canius* in the coastal waters of Port Dickson, Malaysia

Body length (mm)	Male		Female	
	Min – Max	Mean ± SD	Min – Max	Mean ± SD
Total length	228.00 – 629.00	382.20 ± 82.45	246.00 – 600.00	388.70 ± 79.26
Standard length	217.00 – 596.00	359.16 ± 79.16	230.00 – 571.00	365.04 ± 76.22
Head length	45.38 – 128.55	74.32 ± 17.58	44.69 – 116.56	74.67 ± 16.07
Eye length	3.15 – 8.23	5.62 ± 0.95	3.47 – 7.94	5.73 ± 0.79
Eye diameter	3.99 – 9.39	6.56 ± 1.08	4.62 – 8.94	6.70 ± 0.95
Snout length	15.77 – 55.83	28.71 ± 7.88	17.82 – 70.9	28.84 ± 7.30
Post orbital distance	21.21 – 64.89	36.02 ± 9.04	22.58 – 57.26	35.75 ± 7.48
Inter orbital length	13.13 – 47.68	24.67 ± 6.81	14.15 – 40.83	24.84 ± 5.63
Head width	30.15 – 91.95	51.07 ± 12.55	32.02 – 79.16	51.48 ± 10.67
Pre-dorsal distance	52.91 – 147.75	85.70 ± 20.54	54.65 – 134.26	86.99 ± 18.64
Pre-ventral distance	81.94 – 213.88	130.32 ± 28.93	85.43 – 208.38	134.87 ± 28.94
Pre-anal distance	93.33 – 252.62	154.92 ± 33.67	100.76 – 247.6	160.03 ± 33.65
Pre-pectoral distance	40.23 – 128.8	70.36 ± 16.90	39.95 – 113.95	71.02 ± 15.61
Body depth at anus	25.47 – 67.18	40.92 ± 8.90	25.92 – 67.55	43.01 ± 8.93
Mouth gape	25.93 – 120.31	56.19 ± 18.66	28.62 – 98.71	53.95 ± 14.03

collected for this investigation. Among them, 172 (50.4%) were males, while 169 (49.6%) were females. In males, minimum total length was 22.80 cm, while maximum was 62.90 cm. In females, minimum and maximum total lengths were 24.60 cm and 60.00 cm respectively. The average total length for males was 38.34 (±8.19) cm and that of females was 39.06 (±7.72) cm. The average total length of females was 0.72 cm taller than that of the males; however, difference was statistically non-significant (t-test, $p > 0.05$). This was further confirmed by Kolmogorov-Smirnov test ($d_{max} = 1.41$, $p > 0.01$). Furthermore, analysis of the length frequency data of smaller individuals ($\leq$ 30.00 cm) revealed that the average total length for males and females were 27.80±1.88 and 27.66±1.64 cm respectively. Difference in total length among smaller males and females ($\leq$ 30.00 cm) was statistically non-significant ($p > 0.05$). The results suggested that no sexual size dimorphism was noted in *P. canius* from the coastal waters of Port Dickson. No information regarding sexual size dimorphism in *P. canius* has been reported from Malaysia or elsewhere; however sexual size dimorphism was reported in *S. eupterus* and *S. clarias* (shinkafi and Daneji, 2011; Shinkfi *et al*., 2002).

The parameters of total length-body weight relationships of *P. canius* for males and females are presented in Table 2. Regression between total length and body weight of *P. canius* were plotted, while linear chart was obtained by plotting the values of log total length against their log calculated weight. The results indicated positive relationship in both males and females (Figs. 2 and 3). The estimated b values in the present study was 2.71 for males and 2.88 for females. These values lie within the expected range of 2.50 to 3.50 reported for most the aquatic animals (Ecoutin *et al*., 2005; Froese and Pauly, 2011; Garcia, 2010). These suggested a negative allometric growth in males and females. It is generally considered that b values for most fishes in aquatic ecosystems may differ among species and could be affected by factors that were not accounted in the present study; like quality and quantity of food, sex ratio, physiological condition, gonadal development (Amin *et al*., 2005).

Total length was plotted against various body lengths so as to examine the extent of association between total length and different lengths. The descriptive statistics for males and females *P. canius* are presented in Table 3. Relationship between total length and various body lengths are summarized in Table 4. Regression coefficient (R^2) for total length compared against various lengths revealed positive

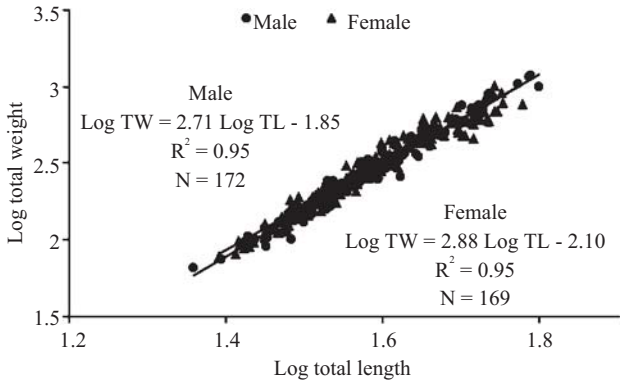

Fig. 2 : Length-weight relationship of grey eel catfish *P. canius* (logarithmic scale) from the coastal waters of Port Dickson, Malaysia

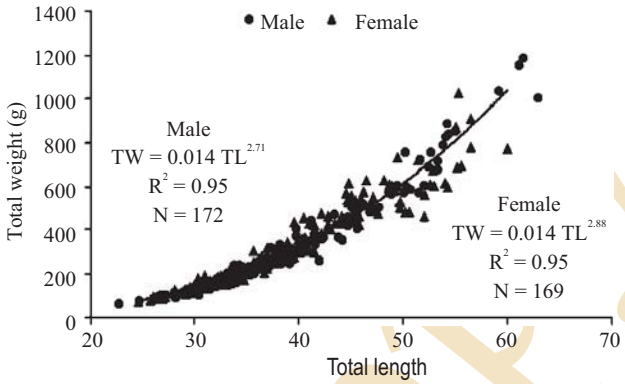

Fig. 3 : Length-weight relationship of grey eel catfish *P. canius* (arithmetic scale) from the coastal waters of Port Dickson, Malaysia

Table 4 : Summary of regression analysis of the various morphometric characters of grey eel catfish *P. canius* in the coastal waters of Port Dickson, Malaysia

Relationship	Sex	Regression equation	a value ± SE	b value ± SE	R^2 value
TL vs SL	M	SL = 0.96TL - 7.24	-7.24 ± 1.04	0.96 ± 0.00	0.99**
	F	SL = 0.97TL - 8.40	-8.39 ± 1.04	0.96 ± 0.00	0.99**
TL vs HL	M	HL = 0.21 TL – 5.92	-5.92 ± 1.11	0.21 ± 0.00	0.99**
	F	HL = 0.19 TL – 2.15	-2.15 ± 1.39	0.19 ± 0.00	0.98**
TL vs EL	M	EL = 0.01 TL + 1.81	1.81 ± 0.17	0.01 ± 0.00	0.87**
	F	EL = 0.01 TL + 2.61	2.61 ± 0.18	0.01 ± 0.00	0.81**
TL vs ED	M	ED = 0.01 TL + 2.08	2.08 ± 0.17	0.01 ± 0.00	0.89**
	F	ED = 0.01 TL + 2.68	2.68 ± 0.19	0.01 ± 0.00	0.86**
TL vs SNL	M	SNL = 0.09 TL – 7.01	-7.01 ± 0.60	0.09 ± 0.00	0.98**
	F	SNL = 0.08 TL – 2.28	-2.28±1.40	0.08 ± 0.00	0.87**
TL vs POL	M	POL = 0.11 TL – 4.97	-4.97 ± 0.68	0.11 ± 0.00	0.98**
	F	POL = 0.09 TL + 0.18	0.18 ± 0.71	0.09 ± 0.00	0.97**
TL vs IOL	M	IOL = 0.08 TL – 5.97	-5.97 ± 0.59	0.08 ± 0.00	0.97**
	F	IOL = 0.07 TL – 1.78	-1.78 ± 0.58	0.07 ± 0.00	0.96**
TL vs HW	M	HW = 0.15 TL – 5.50	-5.50 ± 1.07	0.15 ± 0.00	0.97**
	F	HW = 0.13 TL + 0.97	0.97 ± 1.08	0.13 ± 0.00	0.97**
TL vs PDD	M	PDD = 0.25 TL – 8.36	-8.36 ± 1.15	0.25 ± 0.00	0.99**
	F	PDD = 0.23 TL – 2.63	-2.63 ± 1.43	0.23 ± 0.00	0.98**
TL vs PVD	M	PVD = 0.35 TL – 2.09	-2.09 ± 1.66	0.35 ± 0.00	0.99**
	F	PVD = 0.36 TL – 4.63	-4.63 ± 2.10	0.36 ± 0.00	0.98**
TL vs PAD	M	PAD = 0.39 TL + 5.33	5.33 ± 3.49	0.39 ± 0.00	0.96**
	F	PAD = 0.41 TL – 0.48	-0.48 ± 3.04	0.41 ± 0.01	0.97**
TL vs PPD	M	PPD = 0.19 TL – 5.79	-5.79 ± 1.43	0.19 ± 0.00	0.97**
	F	PPD = 0.19 TL – 2.57	-2.57 ± 1.67	0.19 ± 0.00	0.96**
TL vs BDA	M	BDA = 0.10 TL + 1.13	1.13 ± 0.86	0.10 ± 0.00	0.96**
	F	BDA = 0.11 TL + 2.17	2.17 ± 1.24	0.11 ± 0.00	0.93**
TL vs MG	M	MG = 0.22 TL + 27.48	27.48 ± 1.71	0.22 ± 0.00	0.97**
	F	MG = 0.17 TL + 11.89	11.89 ± 1.57	0.17 ± 0.00	0.96**

— Male, F- Female, ** Significant relationship ($p < 0.01$)

and significant relationship ($p < 0.01$), which ranged from 0.87 to 0.99 in males and 0.81 to 0.99 in females. In both males and females, relationship between total length and standard length gave highest regression coefficient (0.99). While relationship between total length and eye length gave lowest regression coefficient in both males and females (0.87 and 0.81 respectively). This implied that total length increased with increase in body length in both males and females . Even though, relationship related to eye length and eye diameter indicated lower values of regression coefficients (R^2), relationships were still significant in both males and females. Highest growth rate was of standard

length; 0.96 mm in both males and females. This is suggesting that apart from total length, standard length is the fastest growing part of the body in both sexes of *P. canius*. The next growing parts were pre-anal distance and pre-ventral distance in both males and females. The growth rates in PAD were 0.35 mm in males and 0.41 mm in females. Whereas in pre-ventral distance it were 0.35 mm and 0.36 mm in males and females respectively. Eye length and dye diameter were the slowest growing part with growth rates of 0.01 mm in both males and females. In general, the results also indicate that in both males and females *P. canius,* there were similar values of growth rate in terms of various lengths examined; however there were slight differences. From the findings, it is evident that gape size gradually increased with increase in body size of *P. canius*. The growth rates were 0.22 and 0.17 mm in males and females respectively. This implied that *P. canius* may exploit large prey items up to 40-50% of their own body size. Gape size is a valuable indicator of maximum prey size ingested and is closely related to maximum prey sizes. Variations in gape size has been attributed to difference in the types of preys, as well as, prey sizes eaten by predatory fishes, and the range of prey sizes increased with increase in the size of gape (Scharf *et al*., 2000). The findings are consistent with those of Elamin *et al*. (2011) who reported high correlation between total length and other measurements taken on the body of *P. pessuliferus* and *P. areolatus*. Furthermore, the results is in agreement with that of Azadi and Rahman (2008), where significant correlation was found between total length and other morphometric characters in *Gudusia chapra* and *Gonialosa manmina*.

In conclusion, the results indicated no sexual size dimorphism between males and females. Both the sexes exhibited negative allometric growth. Furthermore, there was significant and positive relationship between total length and the various body lengths. Study of such relationships could help in taxonomic studies of the fish. Moreover, the information will be very important for any fisheries management and conservation endeavor for *P. canius* fisheries resources.

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