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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF A LARGE PREDATORY CATFISH, *WALLAGO ATTU* (SCHNEIDER, 1801) FROM THE RIVERS OF CENTRAL KERALA, INDIA

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Abstract: Length-weight relationship and condition factor of a large predatory catfish, *Wallago attu* from three small westward-flowing rivers of Peninsular India revealed *b* values in the ranges of 2.7 to 3.5 and condition factor (*K*) lower than unity with significant differences in these values across populations.

Key words: Asian Sheat Catfish, conservation, Pampa River, Siluridae

INTRODUCTION

The Asian silurid catfish, *Wallago attu* (Schneider, 1801) also known as the 'Asian sheat catfish' or the 'freshwater shark' is one of the twenty megafishes on Earth (Stone, 2007), and a high-value species targeted in rivers and their associated flood plains, lakes and reservoirs across south and south east Asia (Poulsen *et al*., 2004; Montana, 2011; Renjithkumar *et al*., 2011). Although overfishing is known to have resulted in large-scale population declines (Patra *et al*., 2005; Montana, 2011) and the species is currently assessed as 'Near Threatened' in the IUCN Red List (Ng, 2010), exploitation, continues unabated with thousands of kilograms of *W. attu* caught from many rivers in which they occur (Renjithkumar *et al*., 2011).

The confluent rivers of Lake Vembanad (i.e. Pampa, Achankovil, Manimala, Meenachil and Muvattupuzha) in Central Kerala support significant fisheries of commercially important fin-fishes and shell fishes including *Horabagrus brachysoma, Labeo dussumieri, Channa diplogramma, W. attu* and *Macrobrachium rosenbergii* (Kurup, 1998; Harikrishnan and Kurup, 2001; Raghavan *et al*., 2016; Benzgier *et al*., 2011; Renjithkumar *et al*., 2011). For example, the average annual exploited fishery of the Pampa River was estimated close to 400 tons with two species, *L. dussumieri* and *W. attu* contributing to 30% of the catches (Renjithkumar *et al*., 2011). However, except for *H. brachysoma* (see Raghavan *et al*., 2016 for a review) and *L. dussumieri* (Kurup, 1997; 1998), none of the other commercially important species including *W. attu* have been the focus of any organized studies pertaining to age, growth, population status and/or dynamics. As a first step towards understanding the demographic aspects and need for management of species of conservation-concern, we determined the length-weight relationship and condition factor of *W. attu* from three rivers in this region viz. Pampa, Achankovil and Manimala.

MATERIALS AND METHODS

Samples for our study originated from six important landing centres, Edathua, Parumala, Prayikkara, Payippad, Changanassery and Tiruvalla, located on the banks of three major rivers draining into the Vembanad Lake (Table 1; Fig. 1). Study was carried out during two phases (January to May 2013 and October to December 2015) when each of the landing centre was visited on random days (twice a month),

Table 1. Details of landing centres, associated river basin, number of samples and duration of sampling

Landing Center	River Basin	Number of records	Year
Tiruvalla	Manimala	47	2015
Changanassery	Pampa	91	2015
Edathua	Pampa	59	2013
Prayikkara	Achenkovil	142	2013, 2015
Parumala	Pampa	92	2013, 2015
Payippad	Pampa	45	2013

and total length (TL) (in centimetres) and total weight (TW) (in grams) measures of exploited *W. attu* in the market catches recorded. A total of 476 individuals were measured during the course of the study, while no specimens were collected or sacrificed.

The length-weight relationship was determined using the equation $W = aL^b$ (Pauly, 1984) and logarithmically transformed into log W = log a + b log L where W is the weight of the fish (in gram) and L is the total length of the fish (in centimetre). The parameters a (proportionality constant) and b (exponent) of the LWR were estimated by least square regression (Zar, 1999). Goodness of fit was determined using the coefficient of determination (r^2). The null hypothesis that b = 3 or isometric growth was tested using two tailed t test as described by Zar (1999). Fulton's Condition factor (K) was determined using the formula $K = 100\ W/L^3$ following Tesch (1971). Following suggestions provided by Bolger and Connolly (1989), Kruskal–Wallis one-way analysis of variance was performed to test whether the mean K was significantly different between populations. Post-Hoc analysis using Mann–Whitney U test with Bonferroni correction to reduce family wise error rate was performed to check whether K differed between different pairs of populations. Statistical analysis was performed in PAST 3.11 (Hammer *et al*., 2001).

RESULTS AND DISCUSSION

Range of total length and total weight of *W. attu*, along with the analysis of LWR and test of isometry are provided in Table 2 and the scatter of log-log plot of LWR is provided in Appendix 1. Although *W. attu* is known to grow to > 200 cm TL

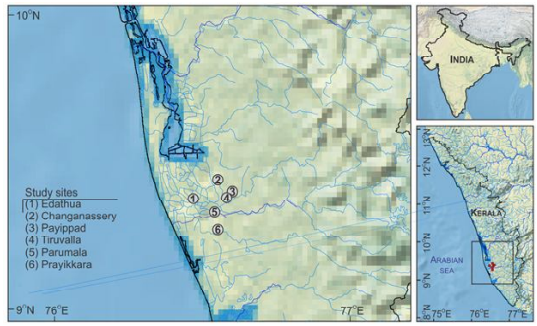


Fig. 1. Study sites in the confluent rivers of Vembanad Lake, central Kerala, India

(Pethiyagoda, 1991; Menon, 1999), our surveys could only record individuals with a maximum length of 120 cm TL (Table 2) with a mean value of 56.2 cm TL (sd = 13.6). Nevertheless, such large sizes (maximum TL of 120 cm) are uncommon for exploited *W. attu* in other parts of the Indian subcontinent (for e.g. a max TL of 78 cm in the Ganges and 50.2 cm in the Indus; see Sani *et al*., 2010; Yousaf *et al*., 2009) as well as in the Mekong (80 cms; Poulsen et al. 2004). The large size ranges (27–120 cms) of *W. attu* that occur in the fishery correspond to individuals in the 0+, 1+ and 2+ classes (see Goswami and Devaraj, 1992).

The b value for the six populations ranged from 2.7 to 3.5, and for the pooled data was 3.3 (Table 2). For three populations, viz. Changanassery, Prayikkara and Payippad, the b value for the LWR was not significantly different from the expected cubic value by isometry. For Tiruvalla and Parumala, the b value was significantly higher, while the b value for Edathua was significantly lower than the cubic value (Fig. 2). Although this apparent variation in the LWR of *W. attu* is difficult to understand, similar variations have been observed previously. For example, both Yousaf *et al*. (2009) and Achakzai *et al*. (2013) reported significantly higher values of b than the expected cubic value from isometry for both males and females as well as combined data of *W. attu* populations from the Indus River and the Manchar Lake in Pakistan. However, Sani *et al*., (2010) observed that the value of b was significantly <3.0 for *W. attu* populations in the Gomti tributary of Ganga River. Although, Goswami and Devraj (1992) also recorded b < 3.0, they did not provide

Table 2. Range of total length and weight, regression analysis for length-weight relationship and test for isometry. P values in bold are significant

Location	Total length (cm)		Weight (g)		LWR regression analysis				Test for isometry	
	Minimum	Maximum	Minimum	Maximum	a	b	Se (b)	R^2	t	P
Tiruvalla	34	120	200	8000	0.002	3.2486	0.0762	0.9758	3.2622	**0.0021**
Changanassery	27	75	100	2800	0.004	3.0574	0.0897	0.9288	0.6397	0.524
Edathua	35	113	425	6800	0.0258	2.6647	0.0769	0.9547	4.3593	**<0.0001**
Prayikkara	31	96	150	4000	0.003	3.1517	0.0737	0.9289	2.0571	0.0415*
Parumala	29	94	100	4300	0.0006	3.5335	0.0776	0.9584	6.8733	**<0.0001**
Payippad	41	83	450	3900	0.0108	2.8784	0.0699	0.9753	1.7405	0.0888
Pooled	27	120	100	8000	0.002	3.255	0.0383	0.9386	6.6661	**<0.0001**

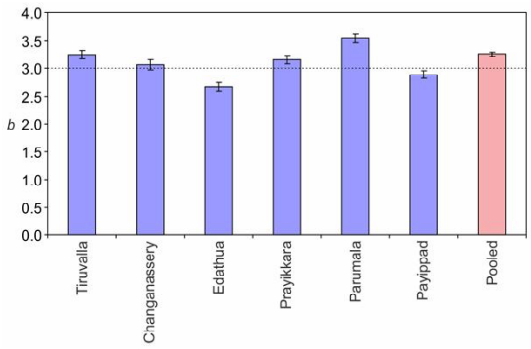


Fig. 2. LWR *b* values for different landing centers and pooled data. Error bars represent standard errors of the estimate. Dashed line is expected value of 3 based on isometric growth pattern

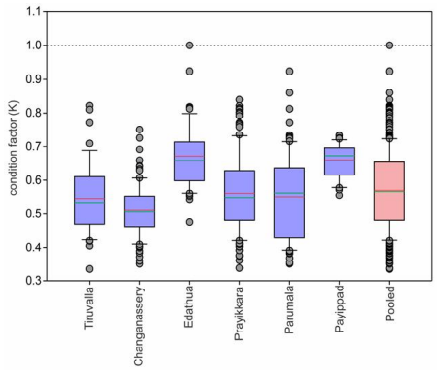
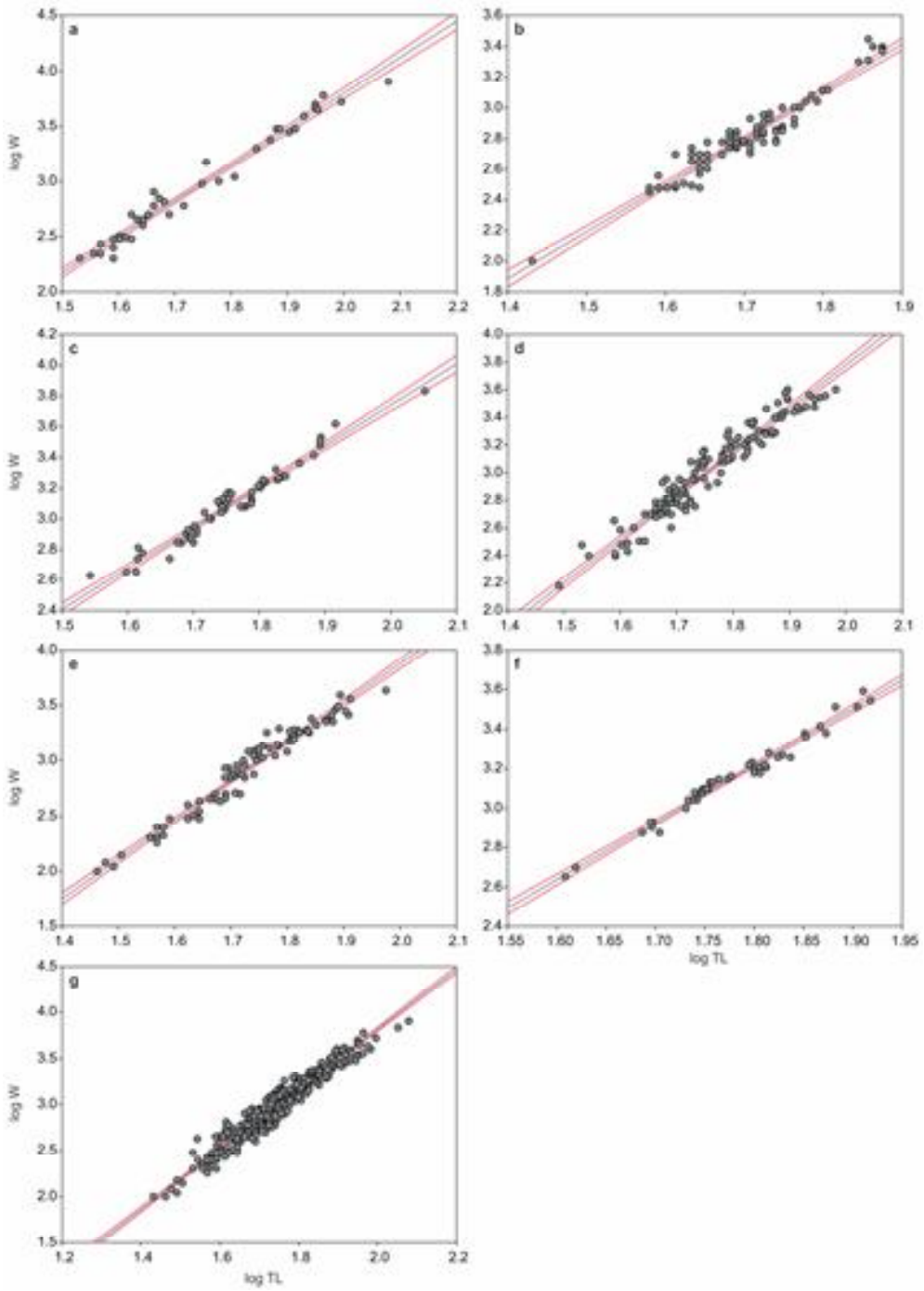


Fig. 3. Distribution of condition factor (*K*) for different landing centers and pooled data. Red line represents mean and green line represents median. Dashed line is expected value of 1 indicating good conditioning

Table 3. Comparison of condition factor *K* across pairs of populations. Mann-Whitney U is provided below the diagonal and associated P values are above the diagonal. P values in bold are significant after Bonferroni correction

	Tiruvalla	Changanassery	Edathua	Prayikkara	Parumala	Payippad
Tiruvalla		0.1168	<0.0001	0.4557	0.8169	<0.0001
Changanassery	1789		<0.0001	0.0015	0.0353	<0.0001
Edathua	490	444		<0.0001	<0.0001	0.9372
Prayikkara	3094	4868	1878		0.5826	<0.0001
Parumala	2110	3432	1238	6254		<0.0001
Payippad	344	261	1315	1396	889	



Appendix 1. Scatter plot of data. (a) Tiruvalla, (b) Changanassery, (c) Edathua, (D) Prayikkara, (E) Parumala, (F) Payippad and (G) pooled data from all landing centers

the standard error of the estimate making it difficult to predict whether the value was significantly different from '3' or not.

A number of reasons have been suggested to influence the LWR *b* value of fish including the species under study such as gender, age, season, ontogenic changes, fish feeding, number of specimen examined, length ranges of the specimen caught, anthropogenic stressors and variation in gonad weight during various stages of sexual maturity (Türkmen *et al*., 2001; Moutopoulos and Stergiou 2002; Peck *et al*., 2005; Froese, 2006; Kharat *et al*., 2008; Winfield *et al*., 2012). Although we could not identify the factors responsible for the large variations in the *b* values of six different populations, we have followed the recommendations given by Froese (2006) wherever possible.

Condition factor (*K*) is a useful measure to understand the health of the fish as well as monitor feeding intensity, age, and growth rates (Oni *et al*., 1983). The condition factor (*K*) for all the populations of *W. attu* was lower than unity (Fig. 3), while for the pooled data the mean *K* value was 0.57 (sd = 0.12). There was a significant difference in *K* values across the six populations (ANOVA, $F_{5,470}$ = 25.2, P < 0.0001). Comparison of the *K* values between pairs of populations (Table 3) indicate two groups, i.e. the first group with Tiruvalla, Changanassery, Prayikkara and Parumala populations had no significant difference in *K* values, except for a marginal significance after Bonferroni correction between Changanassery and Prayikkara populations; while the second group of Edathua and Payippad populations had no significant difference in *K* values. However, there was a significant difference between the first and the second group, with the first group having significantly lower *K* value than the second. The reason for this difference is yet to be identified, and is beyond the scope of this study.

The *K* value is known to be strongly influenced by both biotic and abiotic conditions, and can therefore be used as an indicator of the aquatic ecosystem health (Anene, 2005), with a value of unity for condition factor indicating that the fishes are in good health, while a lower values denoting the probable poor health quality and stress (Simon *et al*., 2013). The fact that the *K* <1 indicates that although *W. attu* grows in length, there is no proportionate increase in weight, which is expected of a long elongated fish. The poor condition factor recorded for *W. attu* in the confluent rivers of Vembanad Lake during the present study, may also be as a result of on-going environmental degradation including large scale pollution and sand mining (Padmalal *et al*., 2008; Renjithkumar *et al*., 2011).

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REFERENCES

Anene, A. 2005. Condition factor of four Cichlid species of a man-made lake in Imo State, Southeastern Nigeria. *Turkish Journal of Fisheries and Aquatic Sciences*, 5: 43–47.

Achakzai, W.M., Baloch, W.A., Saddozai S. and Memon, N.. 2013. Length weight relationships (LWRs) of *Wallago attu* (Bloch and Schneider) from Manchar Lake Jamshoro, Sindh, Pakistan. *Journal of Applied Ichthyology*, 29 (5): 1172–1172.

Benziger A., Philip, S., Raghavan, R., Ali, A., Sukumaran, M., Tharian, J., Dahanukar, N., Baby, F., Peter, R., Radhakrishnan, K.V., Remadevi, K., Haniffa, M.A., Britz, R., and Antunes, A. 2011. Unravelling a 146 years old taxonomic puzzle: validation of malabar snakehead, species status and its relevance for channid systematics and evolution. *PLoS ONE*, 6(6): e21272.

Bolger, T. and Connolly, P.L. 1989. The selection of suitable indices for the measurement and analysis of fish condition. *Journal of Fish Biology*, 34(2): 171-182.

Froese, R. 2006. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22: 241–253.

Goswami, P.K. and Devaraj, M. 1992. Breeding, age and growth of the freshwater shark *Wallago attu* (Bloch and Schneider) from the Dhir Beel of the Brahmaputra basin, Assam, India. *Journal of the Indian Fisheries Association*, 22: 13–20.

Hammer, Ø., Harper, D.A.T. and Ryan, P.D. 2001. PAST: paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4(1): 1–9.

Harikrishnan, M and Kurup, B.M. 2001. Fishery of *Macrobrachium rosenbergii* (De Man) in the Vembanad Lake and confluent rivers. *Indian Journal of Fisheries*, 48 (2): 189–198.

Kharat, S.S., Khillare, Y.K. and Dahanukar, N. 2008. Allometric scaling in growth and reproduction of a freshwater loach *Nemacheilus morreh* (Sykes, 1839). *Electronic Journal of Ichthyology*, 4: 8–17.

Kurup, B.M. 1998. Population dynamics of an indigenous carp (*Labeo dussumieri*) of the River Pampa, Kerala (India). *Fishery Technology*, 35(2): 114–119.

Kurup, B.M. 1997. Age and growth of *Labeo dussumieri* Val. (Pisces, Cyprinidae) from the River Pamba. *Indian Journal of Fisheries*, 44(2): 155–163.

Menon, A.G.K. 1999. Check List - Fresh Water Fishes of India. Occasional Paper No. 175. Records of the Zoological Survey of India, Kolkata, 366pp.

Montana, C.G., Choudhary, S. K., Dey, S. and Winemiller, K.O. 2011. Compositional trends of fisheries in the River Ganges, India. *Fisheries Management and Ecology*, 18: 282–29.

Moutopoulos, D.K. and Stergiou, K.I. 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). Journal of Applied Ichthyology 18: 200–203;

Ng, H.H. 2010. *Wallago attu*. In: The IUCN Red List of Threatened Species 2010: e.T166468A6215731. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T166468A6215731.en. Downloaded on 05 May 2016

Oni, S.K., Olayemi, J.Y. and Adegboye, J.D. 1983. Comparative physiology of three ecologically distinct freshwater fishes, *Alestes nurse* Ruppell, *Synodontis schall* Bloch and *S. schneider* and *Tilapia zilli* Gervais. *Journal of Fish Biology*, 22: 105–109.

Padmalal, D., Maya, K., Sreebha, S. and Sreeja, R. 2008. Environmental effects of river sand mining: a case from the river catchments of Vembanad Lake, southwest coast of India. *Environmental Geology*, 54: 879–889.

Patra, M.K., Acharjee, S.K. and Chakraborty, S.K. 2005. Conservation categories of siluroid fishes in North-East Sundarbans, India. Biodiversity and Conservation, 14(8): 1863–1876.

Pauly, D. 1984. Fish Population Dynamics in Tropical Waters: A Manual for Use with Programmable Calculators. ICLARM. Manila, Philippines, 325 pp.

Peck, M.A., Clemmesen, C. and Herrmann, J.P. 2005. Ontogenic changes in the allometric scaling of the mass and length relationship in *Sprattus sprattus*. *Journal of Fish Biology*, 66: 882–887.

Pethiyagoda, R. 1991. Freshwater fishes of Sri Lanka. The Wildlife Heritage Trust of Sri Lanka, Colombo. 362 p.

Poulsen, A.F., Hortle, K.G., Valbo-Jorgensen, J., Chan, S., Chhuon, C.K., Viravong, S., Bouakhamvongsa, K., Suntornratana, U., Yoorong, N., Nguyen,T.T. and Tran, B.Q. 2004. Distribution and Ecology of Some Important Riverine Fish Species of the Mekong River Basin. *MRC Technical Paper No*. 10. ISSN: 1683-1489.

Raghavan, R., Philip, S., Ali, A., Katwate, U. and Dahanukar, N. 2016. Fishery, Biology, Aquaculture and Conservation of the Asian Sun Catfish. *Reviews in Fish Biology and Fisheries*, 26(2): 169-180.

Renjithkumar, C.R., Harikrishnan, M. & Kurup, B.M.. 2011. Exploited fishery resources of the Pampa River, Kerala, India. *Indian Journal of Fisheries*, 58(3): 13-22.

Sani, R., Gupta, B.K., Sarkar, U.K., Pandey, A., Dubey, V.K. and Lakra, W.S. 2010. Length–weight relationships of 14 Indian freshwater fish species from the Betwa (Yamuna River tributary) and Gomti (Ganga River tributary) rivers. *Journal of Applied Ichthyology*, 26 (3): 456–459.

Simon, K.D., Mazlan, A.G. and Cob, Z.C. 2013. Condition factors of two archerfish species from Johor coastal waters, Malaysia. *Sains Malaysiana*, 42(8): 1115–1119.

Stone, R. 2007. Last of the Leviathans. *Science*, 316: 1684–1688.

Tesch, F.W. 1971. Age and growth, pp. 98–130. In: Ricker, W.E. (ed.). *Methods for Assessment of Fish Production in Fresh Waters*. Blackwell Scientific Publications, Oxford.

Türkmen, M., Erdoan, O., Hallolu, H. and Yildirim, A. 2001. Age, growth and reproduction of *Acanthalburnus microlepis*, Filippi, 1863 from the Yagan Region of the Aras River, Turkey. *Turkish Journal of Zoology*, 25: 127–133.

Winfield, I.J., Adams, C.E, Armstrong, J.D, Gardiner, R., Kirika, A., Montgomery, J., Spears, B.M., Stewart, D.C., Thorpe, J.E. and Wilson, W. 2012. Changes in the fish community of Loch Leven: untangling anthropogenic pressures. *Hydrobiologia*, 681(1): 73–84.

Yousaf, M., Salam, A. & Naeem, M. 2009. Length–weight relationships of *Wallago attu* and *Sperata sarwari* from the Indus River, southern Punjab, Pakistan. *Journal of Applied Ichthyology*, 25 (5): 614–615.

Zar, J. H. 1984. *Biostatistical Analysis*. Prentice Hall, New Jersey. 718p.