Note

Length-weight relationship and condition factor of *Gudusia chapra* (Hamilton, 1822) from Panchet Reservoir, Jharkhand, India

SUMAN KUMARI[1], K. M. SANDHYA[2], GUNJAN KARNATAK[1], LIANTHUAMLUAIA[1], U. K. SARKAR[1], D. PANDA[3] AND P. MISHAL[1]

[1]*ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata -700 120, West Bengal, India*
[2]*ICAR-Central Institute of Fisheries Technology, Kochi - 682 029, Kerala, India*
[3]*ICAR-Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar - 751 002, Odisha, India*
e-mail: sumankumari.icar11@gmail.com

ABSTRACT

This study provides length-weight relationship and condition factor (K) of Indian river shad *Gudusia chapra* (Hamilton, 1822) collected from Panchet Reservoir, Jharkhand, India during October 2014 to September 2015 using gillnets and drag nets. About 342 specimens (153 male and 189 female) of length range 4.7 to 15.1cm were collected. Length-weight relationship for male and female were calculated separately. The difference between the sexes was insignificant (independent t-test, p>0.05). The pooled length-weight regression equation was estimated as log W = -1.863+2.855 log L (r²=0.983) which indicated negative allometric growth. The value of condition factor (Kn value) was observed to be nearer to or greater than one in both sexes, indicative of the general wellbeing of the fish in the Panchet Reservoir. This is the first report on length-weight relationship parameters of *G. chapra* from an Indian reservoir.

Keywords: Allometric growth, Condition factor, *Gudusia chapra,* Length-weight relationship, Panchet Reservoir

Introduction

Reservoir fisheries contributes significantly to fish production from Inland open waters (Lianthuamluaia *et al*., 2019) and caters to nutritional and livelihood security of rural populace in India (Sarkar *et al*., 2017). Length-weight relationships are important and fundamental components of fisheries management tools (Jobling, 2002; Froese, 2006; Kumari *et al.*, 2018). These can be used to assess the well-being of individuals and to determine possible differences between separate unit stocks of the same species in an ecosystem (King, 2007; Zolkhiflee *et al*., 2017). The condition factor (Kn) or ponderal index of a fish is widely used to compare the 'condition', 'fatness' or well being of fish (Ahmed *et al.,* 2007). Fulton's condition factor (K) is the most significant biological parameter that provides information on growth, sexual maturity, the degree of food source availability, age and sex of species (Okgerman, 2005).

The Indian river shad, *Gudusia chapra* (Hamilton, 1822) of family Clupeidae and order Clupeiformes, grows very well in the low land, slow flowing rivers as well as stagnant waters. *G. chapra* is a commercially important clupeid resource of India and Bangladesh (Vinci *et al*., 2005, Ahmed *et al*., 2007) and also reported from Pakistan and Nepal (Froese and Pauly, 2015). According to Jhingran (1972) and Jhingran and Verma (1973), the species was abundant during seventies in Ganga river system. Fish composition structure, length-weight relationships of selected species and diversity of planktivorous fish of Panchet Reservoir was reported by Sandhya *et al.* (2017; 2019). Most of the studies have been conducted in rivers and wetlands on abundance but there is no previous report on LWRs of this species from an Indian reservoir (Froese and Pauly, 2015).

Fish samples were collected from Panchet (23°68'88" N; 86°75'69" E), a large tropical reservoir (Area: 12181 ha) in Damodar basin, situated in Dhanbad District of Jharkhand and Purulia District of West Bengal, India (DVC, 2010). Fish specimens were collected using gillnets and drag nets during October 2014 to September 2015 on monthly basis. Fishes were identified following Hamilton (1822) and for each sample, total length was measured with 0.1cm accuracy and weighed to the nearest 0.01g. The LWR of pooled data (male and female) was calculated as $W = aL^b$, where *W* is total weight (g), *L* is total length (cm) (from the tip of the snout to the tip of caudal fin), *a* is constant proportionality (intercept value) and *b* is allometry coefficient (slope). The log-log plots of length and weight of male, female and pooled data were prepared before regression analysis and outliers were removed following the recommendations of Froese (2006). Fulton's condition factor (K) was calculated following

the equation: K = $100W/L^3$ for both male and female in different length group of fishes.

A total of 342 (female - 189 and male - 153) specimens of *G. chapra* were studied. Sample size, length range, length-weight regression parameters, coefficient of determination (r^2) are given in Table 1.

The calculated values of a and b were 0.0158, 2.734 for male and 0.0114, 2.918 for female respectively (Table 1). No significant difference was observed in regression coefficient values (α=0.05) of males and females. Therefore, a pooled regression equation was calculated (Fig. 1). The calculated 'b' value for combined data was comparable with the value obtained by Vinci *et al.* (2005). Conversely, Quddus (1993) reported values of regression coefficient b = 3.40 in *G. chapra* from a lake in Bangladesh, probably due to different habitat characteristics. Narejo *et al*. (2006) reported lower b values for *G. chapra* from fish ponds. The estimate for b values obtained in the present work is in confirmity with those of earlier researchers, *e.g.* Vinci *et al.* (2005), Sani *et al.* (2010) and Ahamed *et al.* (2014) from wetlands and rivers (Table 2).

The condition factor (K) for males and females of different length group were determined. The K values ranged from 0.7113 - 1.479 with mean K = 1.0285 for males while, it ranged from 0.7759-1.3558 with mean K=1.0016 for females. The Kn (mean K) value corresponding to different length groups is depicted in Fig. 2. There were inflexions on the curve showing Kn of *G. chapra* against the length of 5.5 to 6.5 cm and 13.5 to 14.5 cm for females and 7 to 8 cm and 10 to 11cm for males (Fig. 2). The present study also corroborated with the study of the different species of freshwater ecosystem (Hossain *et al.*, 2009, 2010: Ahamed *et al.*, 2014). In contrast to present finding, Mondal and Kaviraj (2010) observed single peak for both sexes (male and female) in floodplain wetlands of West Bengal.

G. chapra was observed in the catches throughout the year in the reservoir. The availability of different size groups throughout the year indicates its continuous recruitment round the year. The estimated 'b' value reported for the species was around 3 from the rivers and reservoirs but much lower in fish ponds indicating growth of the species is not isometric in pond, which may be attributed to habitat variability. The basic information reported in the present study will be helpful in conservation and management of natural stock of this species in reservoirs of eastern India.

Table 1. Descriptive statistics and estimated parameters of LWRs for *G. chapra* of Panchet Reservoir

Sex	n	Total length (cm)		a	b	95% CL of b	SE(b)	r^2
		Min	Max					
Female	189	4.9	15.1	0.0114	2.91	2.867-2.969	0.0355	0.985
Male	153	4.7	11.6	0.0158	2.73	2.634-2.835	0.0680	0.950
Pooled	342	4.7	15.1	0.13002	2.85	2.815-2.898	0.045	0.983

n - Sample size; a and b - Parameters of LWRs, CL - confidence limit; r^2 - Coefficient of determination
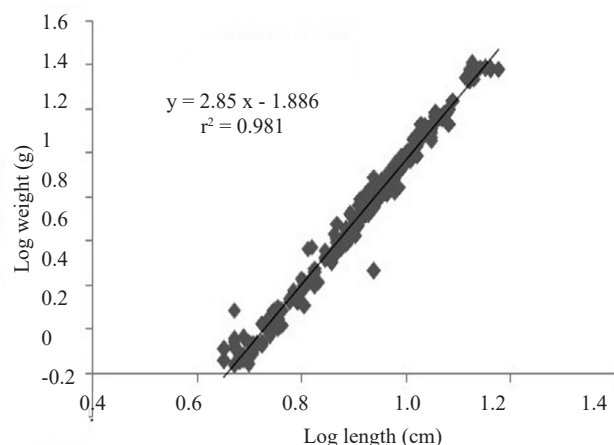

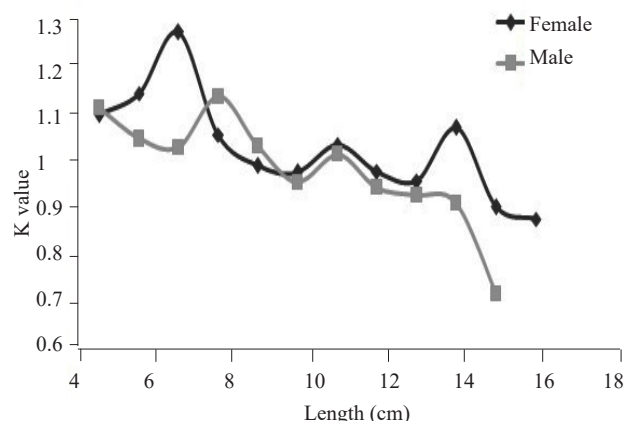Fig. 1. Length-weight relationship of *G. Chapra* (sexes pooled)

Fig. 2. Mean condition factor (K) of *G. chapra* in different length groups

Table 2. Comparison of length-weight relationship of *G. chapra* from different aquatic systems

Sample size	Sex	Intercept (a)	Slope (b)	Correlation coefficient (r^2)	Aquatic system	Location	Authors
30	Combined	0.0079	2.98	0.950	Betwa and Gomti rivers,	Uttar Pradesh, India	Sani *et al*. (2010)
200	Combined	_	2.85	0.918	Floodplain wetland	West Bengal	Vinci *et al*. (2005)
138	Combined	_	2.11	0.342	Fishponds	Sindh, Pakistan	Narejo *et al*. (2006)
1091	Male	0.0236	2.92	0.980	Brahmaputra River	North-eastern	Ahamed *et al.* (2014)
941	Female	0.0289	2.83	0.989		Bangladesh	

Acknowledgements

References

Ahmed F., Ahmed Z. F., and Hossain Y. and Ohtomi J. 2014. Population biology of the Indian river shad *Gudusia chapra* (Clupeidae) in the old Brahmaputra River, North-eastern Bangladesh. *Sains Malays.,* 43(11): 1645-1655.

Ahmed Z. F., Smith C., Ahamed, F. and Hossain, Y. 2007. Growth and reproduction of the Indian river shad, *Gudusia chapra* (Clupeidae). *Folia Zool.,* 56(4): 429-439.

Beyer J. E. 1987. On length-weight relationships, part-1: Computing the mean weight of the fish in a given length class. *Fishbyte,* 5(1): 11-13.

DVC 2010. *Dams and barrages*. Damodar Valley Corporation. https://www.dvc.gov.in/dvcwebsite-new1/water-management-overview (Accessed 6 June 2010)

Froese, R. 2006. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. *J. Appl. Ichthyol.*, 22: 241–253. https://doi.org/10.1111/j.1439-0426.2006.00805.x

Froese R. and Pauly D. 2015. *FishBase. World Wide Web Electronic Publication*. www.fishbase.org version (2/2015) (Accessed 29 May 2015).

Hamilton, F. 1822. *An account of the fishes found in the river Ganges and its branches*. Archibald Constable and Co., Edinburgh and Hurst, Robinson and Co., London, UK, 405 pp., Pls. 1-39. https://doi.org/10.5962/bhl.title.6897.

Hossain, M. Y., Ahmed, Z. F., Islam, A. B. M. S., Jasmine, S. and Ohtomi, J. 2010. Gonadosomatic index-based size at first sexual maturity and fecundity indices of the Indian river shad *Gudusia chapra* (Clupeidae) in the Ganges River (N-W Bangladesh). *J. Appl. Ichthyol.*, 26: 550-553. https://doi.org/10.1111/j.1439-0426.2010.01454.x.

Hossain, M. Y., Jasmine, S., Ibrahim, A. H. M., Ahmed, Z. F., Rahman, M. M. and Ohtomi, J. 2009. Length-weight and length-length relationships of 10 small fish species from the Ganges, Bangladesh. *J. Appl. Ichthyol.,* 25: 117-119. https://doi.org/10.1111/j.1439-0426.2008.01168.x.

Jhingran A. G. 1972. Diet composition of *Gudusia chapra* from Ganga River System. *Proc. Indian Natl. Sci. Acad.,* 38 (1-2): 94-105.

Jhingran A. G., Verma D. N. 1973. Sexual maturity and spawning of *Gudusia chapra* (Ham) in the Ganges river system. *Proc. Indian Natl. Sci. Acad.*, 42: 207-224.

Jobling, M. 2002. Environmental factors and rates of development and growth. In: Hart, P. J. B and Reynolds, J. D. (Eds.), *Handbook of fish biology and fisheries*, vol. 1. Blackwell Publishing, Oxford, UK, p. 107-109.

King, M. 2007. *Fisheries biology, assessment and management*. 2nd edn. Blackwell Science Publishing, Oxford, UK, p. 189-194.

Kumari, S., Hassan, M. A., Lianthuamluaia, L., Sandhya, K. M., Mishal, P., Kumar, V., Sarkar, U. K., Jaiswar A. K., Deshmukhe, G. and Shenoy, L. 2017. Influence of environmental factors on rotifer abundance and biomass in a shallow, tropical oxbow lake, West Bengal, *The Bioscan,* 11(2): 129-135.

Kumari, S., Sarkar, U. K., Sandhya, K. M., Lianthuamluaia, L., Panda, D., Chakraborty S. K., Karnatak, G., Kumar, V. and Mishal, P. 2018. Studies on the growth and mortality of Indian River shad, *Gudusia chapra* (Hamilton, 1822) from Panchet Reservoir, India. *Environ. Sci. Poll. Res.*, 25(33): 33768-33772. doi: 10.1007/s11356-018-3232-3. Epub 2018 Oct 1.

LeCren E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Ecol.*, 20:201-219. DOI: 10.2307/1540

Lianthuamluaia, L., Mishal, P., Panda, D., Sarkar, U. K., Kumar, V., Sandhya, K. M., Karnatak, G., Kumari, S., Bera, A. K., Das, S. and Yusuf Ali, Y. 2019. Understanding spatial and temporal patterns of fish diversity and assemblage structure *vis-a-vis* environmental parameters in a tropical Indian reservoir. *Environ. Sci. Poll. Res*.,26(9): 9089-9098. doi: 10.1007/s11356-019-04305-z.

Manorama, M. and Ramanujan, S. N. 2014. Condition factor and relative condition factor of an ornamental fish, *Puntius shalynius* Yazdani and Talukdar in Meghalaya, India. *Int. J. Fish. Aquat. Stud.*, 4(2): 77-81.

Mondal, D. K. and Kaviraj A. 2010. Feeding and reproductive biology of Indian shad *Gudusia chapra* in two floodplain lakes of India. *Electronic J. Biol.,* 6(4): 98-102.

Okgerman, H. 2005. Seasonal variation of the length-weight and condition factor of rudd (*Scardinius erythrophthalmus* L.) in Spanca Lake. *Int. J. Zool. Res.,* 1: 6-10. DOI**:**10.3923/ijzr.2005.6.10.

Quddus, M. M. A. 1993. Observation on some aspects of biology of *Gudusia chapra* (Hamilton-Buchanan, 1822) in a lake. *Bangladesh. J. Sci. Ind. Res.,* 11 (1): 83-88.

Sandhya, K. M., Lianthuamluaia, L., Karnatak, G., Sarkar, U. K., Kumari, S., Mishal, P., Panda, D., Chakraborty S. K., Kumar, V., Panda, D., Ali, Y. and Naskar, B. K. 2019. Fish assemblage structure and spatial gradients of diversity in a large tropical reservoir, Panchet in the Ganges basin, India, *Environ. Sci. Poll. Res*., 26(2): 1-10. DOI: 10.1007/s11356-019-05314-8.

Sandhya, K. M., Sarkar, U. K., Karnatak, G., Lianthuamluaia, L., Kumar, V., Kumari, S., Panda, D., Mishal, P. and Ali, Y. 2017. Length-weight relationships of two small indigenous cyprinid fishes, *Osteobrama cotio* (Hamilton, 1822) and *Salmophasia phulo* (Hamilton, 1822) from Panchet reservoir, Damodar River (tributary of River Ganga), India. *J. Appl. Ichthyol.*, 33(3): 635–636. DOI: 10.1111/jai.13328.

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. *J. Appl. Ichthyol.,* 26: 456-459.

Vinci, G. K., Suresh, V. R. and Bandyopadhyaya, M. K. 2005. Biology of *Gudusia chapra* (Hamilton-Buchanan) from a floodplain wetland in West Bengal. *Indian J. Fish.,* 52(1): 73-79.

Zolkhiflee, N., Zain, K. M., Hossain, M. Y. and Yahya, K. 2017. Length-weight relationship and relative condition factor of *Liza subviridis* (Valenciennes, 1836) in Pinang River Estuary, Balik Pulau, Penang, Malaysia, *Indian J. Fish.,* 64(3): 106-109. DOI: 10.21077/ijf.2017.64.3.59178-15.