



## RESEARCH NOTE

# Length–weight relationships of four small indigenous freshwater fishes from the subtropical Ganga River, India

Absar Alam<sup>1</sup> | Dharm Nath Jha<sup>1</sup> | Sushil Kumar Verma<sup>1</sup> | Hari Om Verma<sup>1</sup> | Sandeep Kumar Mishra<sup>1</sup> | Shyamal Chandra Sukla Das<sup>1</sup> | Jeetendra Kumar<sup>1</sup> | Venkatesh RamaRao Thakur<sup>1</sup> | Monika Gupta<sup>1</sup> | Basanta Kumar Das<sup>2</sup>

<sup>1</sup>Regional Centre, ICAR-Central Inland Fisheries Research Institute, Allahabad, Uttar Pradesh, India

<sup>2</sup>ICAR-Central Inland Fisheries Research Institute, Barrackpore, West Bengal, India

**Correspondence**

Absar Alam, ICAR-Central Inland Fisheries Research Institute, Regional Centre, 24 Panna Lal Road, Allahabad, Uttar Pradesh, 211002 India.  
Email: Absar.Alam@icar.gov.in

**Funding information**

Ministry of Water Resources, River Development & Ganga Rejuvenation (Govt. of India); Ministry of Water Resources

**Abstract**

Basic information on length–weight relationships for a number of small indigenous tropical freshwater fish species is still sparse or not available on the FishBase. The present study reports the weight–length relationships of four species from the Ganga River in India. A total of 795 fresh fish specimens of *Pethia gelius*, *Corica soborna*, *Parambassis baculis* and *Aborichthys elongatus* were collected from four different locations along stretches of the Ganga River from June 2017 to August 2018. The  $r^2$  and  $b$  values for the four fish species ranged from 0.949 to 0.998 and 2.55 to 2.849, respectively. Length–weight relationships for *P. gelius*, *P. baculis* and *A. elongatus* represent the first information from the Ganga River. A new record for the maximum size of *C. soborna* was documented as 8.54 cm TL and 4.25 g.

**KEYWORDS**

allometric growth, coefficient of determination, linear regression

## 1 | INTRODUCTION

The Ganga River is one of the largest rivers in the world, draining a basin of over a million  $\text{m}^2$ . The river contains a copious biological wealth characterized by its rich ichthyofaunal diversity (Menon, 1974; Sarkar et al., 2012). Rather than the high fish diversity in the Ganga River, there are no factual data on length–weight relationships for some fish species. The length–weight relationship (LWR) has significant applications in regard to fisheries management and fish biology. The relationship facilitates the growth studies, calculation of condition indices, estimation of length from known weight, estimation of weight at age, evaluation of life-history traits, and comparisons of the morphological characters between and among the populations inhabiting a variety of habitats and/or region (Abdul & Famofo, 2020; Alam et al., 2019; Froese, 2006; Froese et al., 2011; Goncalves et al., 1997). It is also fundamental to population dynamics studies and for assessment of fish stocks (Binohlan & Pauly, 1998; Froese, 2006; Petrakis & Stergiou, 1995). Latest information on the LWRs from Indian water systems was provided by Panda et al. (2016), Baitha et al. (2017), Borah et al. (2017), Karna

et al. (2017) and Verma et al. (2018). *Pethia gelius* Hamilton, 1822 (Cyprinidae), *Corica soborna* Hamilton, 1822 (Clupeidae), *Parambassis baculis* Hamilton, 1822 (Ambassidae) and *Aborichthys elongatus* Hora, 1921 (Nemacheilidae) are the native fish species of ornamental value in the Ganga River, being reported by Hamilton (1822), Talwar and Jhingran (1991) and Menon (1999) in the Ganga River. Recent studies on the fish diversity of the Ganga River reported only *P. baculis* (Sarkar et al., 2012), suggesting that these are the rare species in the Ganga River. Information on LWRs of the commercially important fish species is widely available, whereas that on those of the rare fishes are least investigated. Information on the LWRs of *P. gelius*, *P. baculis* and *A. elongatus* from the Ganga River is not available. Accordingly, the present study focuses on filling this information gap and also reporting a new maximum size record for *C. soborna*.

## 2 | MATERIALS AND METHODS

Fish samples of *Pethia gelius*, *Aborichthys elongatus*, *Parambassis baculis* and *Corica soborna* were collected from the Ganga River at

TABLE 1 Estimated parameters from length–weight relationship of fishes collected from the Ganga River from June 2017 to August 2018

Species	Location	n	Total length (cm)		Total weight (g)		Regression parameters				Student's t test			
			Min	Max	Min	Max	a	95% CI of a	b	95% CI of b	SE (b)	r <sup>2</sup>	t-stat (b)	p-value
<i>Pethia gelius</i>	Bijnor	215	2.29	4.06	0.18	0.74	0.0216	0.0198–0.0235	2.558	2.483–2.632	0.044	0.955	55.368	2.0087E–128**
<i>Corica soborna</i>	Prayagraj	109	2.06	<b>8.54</b>	0.04	4.25	0.0113	0.0102–0.0126	2.842	2.777–2.907	0.032	0.985	40.240	1.93364E–66**
<i>Parambassis baculis</i>	Farrukhabad	181	2.41	4.51	0.27	1.46	0.0255	0.0250–0.0260	2.669	2.652–2.685	0.008	0.998	831.143	0**
<i>Aborichthys elongatus</i>	Narora	290	2.91	4.69	0.18	0.78	0.0093	0.0083–0.0103	2.849	2.773–2.925	0.038	0.949	17.4574	5.23083E–47**

Abbreviations: n, sample size; Min, minimum; Max, maximum; a, intercept; b, slope of linear regression; CIs, confidence intervals; SE, standard error of slope; b, r<sup>2</sup>, coefficient of determination; t-stat (b), t statistics of b; p-value, probability level.

Note: Values in bold, new TL max; Species in bold, new LWR information.

\*\*p < .001.

Bijnor (29°22'49"N 78°02'43"E), Narora (28°12'13"N 78°23'19"E), Farrukhabad (27°24'30"N 79°37'32"E) and Prayagraj (25°30'14"N 81°51'30"E), respectively, using gill nets (8–17 mm mesh size) and cast nets (5–15 mm mesh size) from June 2017 to August 2018. The collected fresh specimens were separated on the basis of species and identified using standard literature references (Jayaram, 2006; Talwar & Jhingran, 1991). The total length (TL) of each fish was noted to the nearest 0.1 mm using a vernier calliper, and the total weight was recorded to the nearest 0.01 g on an analytical balance. The length and weight data were log-transformed, and a scatter diagram was plotted. A trend line was subsequently added to the diagram, and the extreme values identified as outliers were removed. LWR parameters were assessed with the following linear regression equation (Froese, 2006):

$$W = aL^b \tag{1}$$

where L = total length (cm) and W = total weight (g). The regression parameters b and a were calculated using the regression equation from the log-transformed weight and length data (ln W = ln a + b ln L). The 95% confidence intervals (CIs) and statistical significance for the parameters b, a and R<sup>2</sup> were also calculated. The test for isometric growth (b = 3) was examined by employing the formula of Pauly (1984), as follows:

$$t = \left( \frac{sd \ln L}{sd \ln W} \right) * \left( \frac{|b - 3|}{\sqrt{(1 - r^2)}} \right) * (\sqrt{n} - 2) \tag{2}$$

where n = sample size; sd ln L and sd ln W are the standard deviations in total body weight and total length; b = regression coefficient; and r<sup>2</sup> = coefficient of determination.

### 3 | RESULTS

The sample size, ranges of weight and length and weight–length parameters of the four species are presented in Table 1. The maximum length in the present study was found to be 4.06 cm TL, 8.54 cm TL, 4.51 cm TL and 4.69 cm TL for *P. gelius*, *C. soborna*, *P. baculis* and *A. elongatus*, respectively. The maximum length records available in FishBase for four species of *P. gelius*, *P. baculis* and *A. elongatus* *C. soborna* are 5.1 cm TL, 5.0 cm SL, 7.4 cm SL and 5.3 cm TL (Froese & Pauly, 2020), respectively. All LWRs were found to be significant (p < .001), with R<sup>2</sup> values ranging between 0.949 and 0.998. The b values of an unsexed population of *P. gelius*, *C. soborna*, *P. baculis* and *A. elongatus* were 2.558, 2.842, 2.669 and 2.849, respectively. The calculated t values for b were found to be highly significant at the 5% level of significance (p < .001), indicating allometric growth pattern in all these species.

### 4 | DISCUSSION

The exponent values of all the studied species were found to lie within the suggested value of 2.5 and 3.5 (Froese, 2006). Kaushik

et al. (2019) reported the parameter  $b$  for *P. gelius* and *P. baculis* as 3.924 and 3.347, respectively, from the Ranganadi River in Assam, while the Simsang and Kynshi rivers in Meghalaya indicated positive allometric growth. Kamal (1982) described a positive allometric growth pattern ( $b = 3.2724$ ) in the Buxar stretch of the Ganga River (India), while Hossain and Afroze (1991) and Hossain et al. (2008) reported an isometric growth pattern ( $b \sim 3.0$ ) for *C. soborna* in the Mathabhanga River (Bangladesh). All four species examined in the present study, however, exhibited a negative allometric growth pattern. The  $b$  parameter observed for *C. soborna* in the present study was similar to the value reported by Hossain et al. (2017) for the Mathabhanga River (Bangladesh). In addition, the confidence limits of  $b$  and  $a$  for all the fish species in the present study were found to be within the proposed Bayesian confidence limits (Froese, 2006). The growth coefficient ( $b$ ) for *A. elongatus*, not reported earlier in FishBase, was calculated as 2.849 (Froese & Pauly, 2020). The values of allometric coefficient can be less, greater or equal to three (Froese, 2006). Values of  $b \neq 3$  indicate an allometric growth pattern. All four species in the present study exhibited  $b < 3$  values, implying a negative allometric growth pattern. The negative allometric growth means that, for a unit increase in body weight through time, there was a proportionally greater increase in the cube of its body length, meaning the fishes become more slender with increased length. Theoretically, if  $b$  is less than 3, as in the present study, the fitness should decrease as they grow into adults. In fact, the maximum TL reported for *C. soborna* (8.54 cm) in the present study establishes a new zenith. The results of the present study will provide baseline information for the conservation and management, and as the basis for further studies of these four small indigenous fish species in the Ganga River, India.

## ACKNOWLEDGEMENT

The authors are grateful to the Ministry of Water Resources, River Development and Ganga Rejuvenation (Government of India), New Delhi, for financial support from the National Mission for Clean Ganga (NMCG).

## CONFLICT OF INTEREST

The author declares that there is no conflict of interest among the authors that could be perceived as prejudicing the fairness of the present study reported.

## ORCID

Absar Alam  <https://orcid.org/0000-0003-2786-5082>

Dharm Nath Jha  <https://orcid.org/0000-0003-4495-9363>

Hari Om Verma  <https://orcid.org/0000-0002-4789-7527>

Jeetendra Kumar  <https://orcid.org/0000-0003-1319-2788>

Basanta Kumar Das  <https://orcid.org/0000-0003-4172-1296>

## REFERENCES

Abdul, W. O., & Famofo, O. O. (2020). Biometry, condition factors and length-weight relationships of sixteen fish species in Iwopin

- fresh-water ecotype of Lekki Lagoon, Ogun State, Southwest Nigeria. *Heliyon*, 6, e02957. <https://doi.org/10.1016/j.heliyon.2019.e02957>
- Alam, A., Chadha, N. K., Chakraborty, S. K., Joshi, K. D., Kumar, T., Das, S. C. S., Roy, S. D., Rizvi, A. F., Sawant, P. B., & Kumar, J. (2019). Studies on the growth and mortality of invasive *Oreochromis niloticus* (Linnaeus, 1758) in sub-tropical river Yamuna, part of Gangetic River system, India. *Aquatic Ecosystem and Health Management*, 22(4), 473–480. <https://doi.org/10.1080/14634988.2019.1690926>
- Baitha, R., Sinha, A., Koushlesh, S. K., Chanu, T. N., Kumari, K., Gogoi, P., Ramteke, M. H., Borah, S., & Das, B. K. (2017). Length-weight relationship of ten indigenous freshwater fish species from Gandak River, Bihar, India. *Journal of Applied Ichthyology*, 34, 233–236. <https://doi.org/10.1111/jai.13555>
- Binohlan, C., & Pauly, D. (1998). The length-weight table. In R. Froese, & D. Pauly (Eds.), *FishBase 1998: Concepts, design and data sources* (pp. 121–123). ICLARM.
- Borah, S., Bhattacharjya, B. K., Saud, B. J., Yadav, A. K., Debnath, D., Yengkokpam, S., Das, P., Sharma, N., Singh, N. S., & Sarma, K. K. (2017). Length-weight relationship of six indigenous fish species from Deepor beel, A Ramsar site in Assam, India. *Journal of Applied Ichthyology*, 33(3), 655–657. <https://doi.org/10.1111/jai.13348>
- Froese, R. (2006). Cube law, condition factor and weight-length relationships: History, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22, 241–253. <https://doi.org/10.1111/j.1439-0426.2006.00805.x>
- Froese, R., & Pauly, D. (2020). World Wide Web electronic publication. <https://www.fishbase.org>
- Froese, R., Tsikliras, A. C., & Stergiou, K. I. (2011). Editorial note on weight-length relations of fishes. *Acta Ichthyologica Et Piscatoria*, 41(4), 261–263. <https://doi.org/10.3750/AIP2011.41.4.01>
- Goncalves, J. M. S., Bentes, L., Lino, P. G., Ribeiro, J., Canario, A. V. M., & Erzini, K. (1997). Weight-length relationships for selected fish species of the small-scale demersal fisheries of the south and south-west coast of Portugal. *Fisheries Research*, 30, 253–256. [https://doi.org/10.1016/S0165-7836\(96\)00569-3](https://doi.org/10.1016/S0165-7836(96)00569-3)
- Hossain, M. A., & Afroze, S. (1991). Small fishes as a resource in rural Bangladesh. *Fishbyte*, 9(2), 16–18.
- Hossain, M. Y., Hossen, M. A., Nawar, F., Khatun, D., Parmanik, M. N. U., Parvin, M. F., & Yahya, K. (2017). New maximum size records and length-weight relationships for two species, *Corica soborna* (Hamilton, 1822) and *Mystus bleekeri* (Day, 1877), from the Ganges River (NW Bangladesh). *Journal of Applied Ichthyology*, 33, 661–662. <https://doi.org/10.1111/jai.13342>
- Hossain, M. Y., Leunda, P. M., Ohtomi, J., Ahmed, Z. F., Oscoz, J., & Miranda, R. (2008). Biological aspects of the Ganges River sprat *Corica soborna* (Clupeidae) in the Mathabhanga River (SW Bangladesh). *Cybius*, 32(3), 241–246.
- Jayaram, K. C. (2006). *The freshwater fishes of the Indian region*, 2nd ed. Narendra Publication House.
- Kamal, M. Y. (1982). The length-weight relationship and K factor in *Corica bihariensis* Kamal & Ahsan and *Corica soborna* (Hamilton) from the River Ganga. *Journal of the Inland Fisheries Society of India*, 14, 102–107.
- Karna, S. K., Mukherjee, M., Suresh, V. R., Manna, R. K., Manas, H. M., & Raman, R. K. (2017). Length-weight and length-length relationship of *Strongylura strongylura* (van Hasselt, 1823) and *Hyporhamphus limbatus* (Valenciennes, 1847) from Chilika lake, India. *Journal of Applied Ichthyology*, 33, 640–641. <https://doi.org/10.1111/jai.13334>
- Kaushik, G., Synnah, K., Tariang, K.-U., Narayana, R. S., & Bordoloi, S. (2019). Length-weight relationships of four indigenous fish species collected in Assam and Meghalaya, India. *Lakes & Reservoirs: Research & Management*, 24, 299–301. <https://doi.org/10.1111/lre.12279>

- Menon, A. G. K. (1974). *A check list of fishes of Himalayan and the Indo-Gangetic plains* (pp. 136). Special publication, Inland Fisheries Society of India.
- Panda, D., Karna, S. K., Mukherjee, M., Manna, R. K., Suresh, V. R., & Sharma, A. P. (2016). Length–weight relationships of six tropical fish species from Chilika Lagoon, India. *Journal of Applied Ichthyology*, 32, 1286–1289. <https://doi.org/10.1111/jai.13174>
- Pauly, D. (1984). Fish population dynamics in tropical waters: A manual for use for programmable calculators. *ICLARM Studies and Reviews*, 8, 323. Manila, Philippines.
- Petrakis, G., & Stergiou, K. I. (1995). Weight–length relationships for 33 fish species in Greekwaters. *Fisherie Research*, 21, 465–469. [https://doi.org/10.1016/0165-7836\(94\)00294-7](https://doi.org/10.1016/0165-7836(94)00294-7)
- Sarkar, U. K., Pathak, A. K., Sinha, R. K., Sivakumar, K., Pandian, A. K., Pandey, A., Dubey, V. K., & Lakra, W. S. (2012). Freshwater fish biodiversity in the River Ganga (India): Changing pattern, threats and conservation perspectives. *Reviews in Fish Biology and Fisheries*, 22, 251–272. <https://doi.org/10.1007/s11160-011-9218-6>
- Talwar, P. K., & Jhingran, A. G. (1991). *Inland fishes of India and adjacent countries*, Vol. 1 (pp. 1541). Oxford and IBH Publishing Co..
- Verma, H. O., Verma, S. K., Mishra, S. K., Alam, A., Das, S. C. S., Thakur, V., Kumar, J., Jha, D. N., Srivastava, R. S., & Das, B. K. (2018). Length–weight relationships of *Johnius coitor* (Hamilton, 1822), *Osteobrama cotio* (Hamilton, 1822), and *Gonialosa manmina* (Hamilton, 1822), from the River Ganga, India. *Journal of Applied Ichthyology*, 34(6), 1361–1363. <https://doi.org/10.1111/jai.1380>

**How to cite this article:** Alam A, Jha DN, Verma SK, et al. Length–weight relationships of four small indigenous freshwater fishes from the subtropical Ganga River, India. *Lakes & Reserv.* 2020;00:1–4. <https://doi.org/10.1111/lre.12337>