Eco. Env. & Cons. 29 (May Suppl. Issue) : 2023; pp. (S483-S486)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i03s.082

First report on length-weight relationships of commercially important fishes in potamon zone of the river Kosi, Supaul, Bihar, India

Gyan Chandra[1]*, Parmanand Prabhakar[1], Sarvendra Kumar[1] and Vivek Shrivastava[2]

[1]*College of Fisheries, Kishanganj (Bihar Animal Sciences University, Patna), India
[2]Postgraduate Institute of Fisheries Education and Research, Kamdhenu University, Himmatnagar, Gujarat, India

(Received 17 December, 2022; Accepted 20 February, 2023)

ABSTRACT

The length-weight relationships of five fishes: *Mystus tengara*, *Mystus bleekeri*, *Ailia coila*, *Aspidoparia jaya*, and *Cabdio morar* of Koshi River, Bihar, India, were estimated. The study is the first report on the LWR of these five species from Koshi River, Bihar. The relationships were calculated using the formula: Log W = Log a + b Log L and length-weight parameters ("a" and "b"), and coefficients of determination (r2) were determined. The regression coefficient (b) values are 2.51, 3.38, 1.93, 2.62, and 2.63 for *Mystus tengara*, *Mystus bleekeri*, *Ailia coila*, *Aspidoparia jaya*, and *Cabdio morar* specimens, respectively.

Key words*: Length-weight Relationship, Koshi River, Bihar, India.*

Introduction

Length-weight relationships (LWRs) are one of the most frequently used analyses of fisheries data (Mendes *et al.* (2004). Length-weight relationships (LWRs) of fishes are essential in fisheries research for estimating the weight corresponding to a given length, for growth and stock assessment analysis, and for assessing the biomass of fishes (Petrakis and Stergiou (1995); Froese (2006); Valset *et al.* (2008). Besides, the LWR helps to identify the health status of fish in a particular population based on condition factors, to make morphometric comparisons among species and populations, for life-history comparisons among regions, and also supportive in comparing two different environments (Tesch, 1968; Gonçalves *et al.*, 1997; Moutopoulos and Stergiou, 2002; LeCren, 1951; Petrakis and Stergiou, 1995; Gomiero and Braga, 2003). Thus, fish's length-weight relationships (LWRs) are essential for fisheries management, fish catch estimations, and condition and frequency distributions of fish species (Hayes, 1995; Petrakis and Stergiou, 1995; Froese, 2006). Length-weight relationship ($W = aL^b$) is also used to calculate the weight of the fish from the length, where direct weight measurements are cumbersome and time consuming, especially in field studies (Sinovcic *et al.*, 2004; Macieira and Joyeux, 2009). Length-weight relationships (LWRs) are effective arithmetical relationships for a particular index of growth, maturity, and general condition of fish, including well-being, gonadal maturity, and life history (Le Cren, 1951).

The Koshi River is an important tributary of the Ganges River system that flows in the eastern part of India. It harbours rich, diverse fauna of many commercially important fishes and serves as an important source of fish that supports the livelihood and

employment of many surrounding fishing communities (Chandra *et al.*, 2010; Chandra and Saxena, 2013; Chandra and Saxena, 2014). Despite its fisheries' importance, studies on the biological aspects and their conservation are limited (Chandra and Fopp-Bayat, 2021). Hence, the present study of the length-weight relationships of five riverine fishes, *Mystus tengara* (Hamilton, 1822), *Mystus bleekeri* (Day, 1877), *Ailia coila* (Hamilton, 1822), *Aspidoparia jaya* (Hamilton, 1822) and *Cabdio morar* (Hamilton, 1822) was carried out in Koshi River at Supaul district of Bihar, India. The study is the first report on the LWR of these five species from the Koshi River, Bihar, India, and such records are not available in FishBase (Froese and Pauly, 2020).

The species are distributed in India, Bangladesh, Nepal as well as in Pakistan (*Mystus tengara, Mystus bleekeri, Ailia coila*, and *Cabdio morar*), Myanmar (*Mystus bleekeri, Cabdio morar*), Iran (*Cabdio morar*), Thailand (*Cabdio morar*), Bhutan (*Mystus bleekeri*), Indonesia (*Mystus bleekeri*), and Afghanistan (*Mystus tengara, Aspidoparia jaya*) (Talwar and Jhingran, 1991; Bhuiyan, 1964; Petr, 1999; Coad, 1981). It is a very popular food fish among the surrounding inhabiting population.

Materials and Methods

Fish samples were collected from June 2019 to June 2020 from the Koshi River (26°18'11"N; 86°43'52"E), a tributary of the Ganges River system in the Bihar state of India. Specimens were collected with the help of cast nets (25 mm mesh sizes) and gillnets (20–125 mm mesh sizes). Fishes were identified based on standard taxonomic literature (Jayaram, 1981; Talwar and Kacker, 1984; Talwar and Jhingran, 1991; www.fishbase.org); each specimen's total length was measured to the nearest 0.1 cm and total weighed to an accuracy of 0.1 g. The relationship between length and weight was calculated using the formula: Log W = Log a + b Log L where W and L are weight (g) and length (cm) of fish, "a" and "b" are intercept and slope of the regression line. And 95% confidence interval (CI) was determined for parameters "a" and "b" (Froese, 2006).

Results and Discussion

In total, 207 specimens of five riverine fishes, *Mystus tengara* (Hamilton, 1822), *Mystus bleekeri* (Day, 1877), *Ailia coila* (Hamilton, 1822), *Aspidoparia jaya* (Hamilton, 1822) and *Cabdio morar* (Hamilton, 1822) were studied. Sample size, minimum and maximum total lengths, length-weight parameters ("a" and "b"), and coefficient of determination (r^2) are presented in (Table 1). In the current study, the estimated values of "b" were between the expected ranges of 2.5–3.5, except for *Ailia coila,* whose "b" value is 1.9 (Gayanilo and Pauly, 1997; Froese, 2006).

Table 1.

The present study describes the first reference on the length-weight relationships of these five species from the Koshi River, Bihar, India, and such information is not available in Fish Base (Froese and Pauly, 2020). The mentioned species have been described as Least Concern (LC) per the IUCN, except for *Ailia coila,* which is near threatened (NT). Besides, little Ichthyobiological information is available about these species. Thus, the results of this study might be very helpful in estimations of different biological parameters that will be useful for future studies related to stock assessment, population dynamics, fisheries management and conservation of these fishes.

Based on the coefficient of determination (r^2) values, 92.37% of the variation in weight of *Mystus tengara*, 94.97% in that of *Mystus bleekeri*, 96.26% in that of *Ailia coila*, 79.47% in that of *Aspidoparia jaya*, and 92.68% in weight of *Cabdio morar* were found to be associated with the change in the length of the studied fish (Table 1). The correlation coefficients (r) recommend a significant ($p < 0.01$) positive relationship between length and weight in the studied fish; for *Mystus tengara*, *Mystus bleekeri*, *Ailia coila*, *Aspidoparia jaya*, and *Cabdio morar* specimen, and "r" values for these fishes were found 0.961, 0.974, 0.981, 0.891and 0.962, respectively.

The regression coefficient values (b) were 2.51, 3.38, 1.93, 2.62, and 2.63 for *Mystus tengara*, *Mystus bleekeri*, *Ailia coila*, *Aspidoparia jaya*, and *Cabdio morar* specimens, respectively. The "b" value for *Mystus bleekeri* was a little higher than three and lower than three for other species. This indicates that the weight of the *Mystus bleekeri* increased slightly more than the cube of its length; for other species, the "b" value was lower than three, indicating that this species increased more in length than in weight as it grew (Froese, 2006). However, the "b" value was 1.93 for near threatened (NT) *Ailia coila*, the lowest among all mentioned species. Variations were observed in the "b" value as the value depends on various factors such as habitat, season, fitness, degree of stomach

Table 1. Descriptive statistics and estimated parameters of length-weight relationships for five riverine fish species collected from June 2019 to June 2020, Kosi River, India

Sl. No.	Family	Species	Status	n	Total Length (cm)		a	b	95% CL of a	95% CL of b	r^2
					Min	Max					
1.	Bagridae	*Mystustengara* (Hamilton, 1822)	Least Concern (LC)	30	6.5	8.8	0.0263	2.5125	0.0115-0.0600	2.1093 – 2.9158	0.9237
2.	Bagridae	*Mystusbleekeri* (Day, 1877)	Least Concern (LC)	30	8.6	11.4	0.0030	3.3805	0.0011-0.0080	2.9491 – 3.8120	0.9497
3.	Schilbeidae	*Ailiacoila* (Hamilton, 1822)	Near Threatened (NT)	46	9.5	15.4	0.0628	1.9396	0.0409-0.0966	1.7739 – 2.1053	0.9626
4.	Cyprinidae	*Aspidopariajaya* (Hamilton, 1822)	Least Concern (LC)	61	6.4	10.2	0.0191	2.6276	0.0061 – 0.0592	2.1048 – 3.1503	0.7947
5.	Cyprinidae	*Cabdiomorar* (Hamilton, 1822)	Least Concern (LC)	30	7.8	10.3	0.0191	2.638	0.0077 –0.0475	2.2242 – 3.0512	0.9268

n, sample size; Min, minimum; max, maximum; a and b, parameters of length-weight relationship; CL, confidence limit; r^2, coefficient of determination.

fullness, gonadal maturity, sex, preservation techniques, and differences in the observed length ranges of the specimen caught (Wootton, 1990). In fishes, the values of "b" are in the range of 2 to 4 (Bagenal and Tesch, 1978; Koutrakis and Tsikliras, 2003); and the most common values vary between 2.5 to 3.5 (Gayanilo and Pauly, 1997; Froese, 2006). The growth of fishes is categorised into three forms, i.e., isometric growth, negative allometric growth and positive allometric growth. The value of "b" denotes the type of growth in fish. If the value of "b" = 3, then it denotes isometric growth (length and weight increase in the same proportion), and "b" `" 3 denotes allometric growth (b < 3 indicates negatively allometric, i.e., fish grows faster in length than in weight and b 3 shows positively allometric growth, i.e., fish grows faster in weight than in length) (Bagenal and Tesch, 1978). The growth pattern indicates the condition of the fish; a fish in good condition exhibit isometric growth. While lean fishes show negative isometric growth, and fat fishes exhibit positive allometric growth. Food unavailability and awful environmental conditions are the primary reasons for fish's negative allometric growth.

In the current study, the calculated parameters are almost in a similar range documented by the other researchers. Some differences in estimated parameters were observed, which may be due to differences in habitat, small sample size, size range, seasonal variation, the extent of stomach fullness, sex, sexual maturity, sampling procedure, and the health condition of fishes (Bagenal and Tesch, 1978; Wootton, 1992; Froese, 2006). Also, the "b" value is more sensitive than the "a" value, and it might fluctuate seasonally, and even daily, and among different habitats (Bagenal and Tesch, 1978).

The present study provides baseline information on the LWR of mentioned five species from Koshi River, Bihar, India, which will be very helpful for future exploitations, management, and conservation of these species. However, the LWR of particular specie is limited to the observed length ranges on which the study has been performed (Petrakis and Stergiou, 1995). Further studies on reproductive biology, population dynamics, and genetic diversity are essential for effectively utilising and conservating these fishes.

References

Bagenal, T.B. and Tesch, F.W. 1978. Age and growth. In: *Methods for Assessment of Fish Production in Freshwater*. 3rd edn.(Ed TB Bagenal.) Oxford, Blackwell Scientific Publication: 101–136.

Bhuiyan, A. L. 1964. Fishes of Dacca, Asiatic Soc. *Pak Dacca Publ*. 13: 72-73.

Chandra, G. and Fopp-Bayat, D. 2021. Trends in aquaculture and conservation of sturgeons: A review of molecular and cytogenetic tools. *Reviews in Aquaculture*. 13: 119–137.

Chandra, G. and Saxena, A. 2013. Morphometric characteristics and conservation of the vulnerable fish, *Eutropiichthys vacha* (Hamilton, 1822) in the rivers of Ganga and Kosi, North India. *Journal of Experimental Zoology,* India. 16(1): 97-99.

Chandra, G. and Saxena, A. 2014. Fisheries and Management Status of Gogabeel Lake, Katihar, Bihar. *Ecology, Environment and Conservation.* Supplement Issue: 123-126.

Chandra, G., Saxena, A. and Barat, A. 2010. Genetic diversity of two riverine populations of *Eutropiichthys vacha* (Hamilton, 1822) using RAPD markers and implications for its conservation. *Journal of Cell Molecular Biology*. 8(2): 77-85.

Chaudhry, S. 2010. *Aspidoparia jaya*. The IUCN Red List of Threatened Species 2010. https://dx.doi.org/10.2305/IUCN.UK.20104.RLTS.T166632A6251393.en.

Chaudhry, S. 2010. Cabdio morar. The IUCN Red List of Threatened Species 2010. https://dx.doi.org/10.2305/IUCN.UK.20104. RLTS. T166469A6215983.en.

Coad, B. W. 1981. Fishes of Afghanistan, an annotated check-list. *Publ. Zool. Natl. Mus. Can.* 14:23

Froese, R. 2006. Cube law, condition factor and weight–length relationships: history, metaanalysis and recommendations. *Journal of Applied Ichthyology*. 22(4): 241-253.

Froese, R. and Pauly, D. 2020. FishBase. World Wide Web electronic publication. Available at: http://www.fishbase.org (accessed on 27 July 2020).

Gayanilo Jr, F. C. and Pauly, D. 1997. The FAO-ICLARM Stock Assessment Tools (FiSAT) Reference Manual. 262P. FAO Computerized Information Services. *Fisheries.* (8).

Gomiero, L. M. and De Souza Braga, F. M. 2003. Relacao peso-comprimento e fator de condicao para Cichla cf. ocellaris e *Cichla monoculus* (Perciformes, Cichlidae) no reservatório de Volta Grande, rio Grande-MG/SP. *Acta Scientiarum. Biological Sciences*. 25(1): 79-86.

Hayes, D.B., Brodziak, J.K. and O'Gorman, J.B. 1995. Efficiency and bias of estimators and sampling designs for determining length-weight relationships of fish. *Canadian Journal of Fisheries and Aquatic Sciences*. 52(1): 84-92.

Hossain, M.A. and Afroze, S. 1991. Small fishes as a resource in rural Bangladesh. *Fishbyte.* 9(2): 16-18.

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. *Journal of Applied Ichthyology*. 25(1): 117-119.

Jayaram, K.C. 1981. Freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka.

Koutrakis, E.T. and Tsikliras, A.C. 2003. Length–weight relationships of fishes from three northern Aegean estuarine systems (Greece). *Journal of Applied Ichthyology*. 19(4): 258-260.

Le Cren, E.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *The Journal of Animal Ecology*. 201-219.

Macieira, R.M. and Joyeux, J.C. 2009. Length–weight relationships for rockpool fishes in Brazil. *Journal of Applied Ichthyology.* 25(3): 358–359.

Mendes, B., Fonseca, P. and Campos, A. 2004. Weight–length relationships for 46 fish species of the Portuguese west coast. *Journal of Applied Ichthyology*. 20(5): 355-361.

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(3) : 200-203.

Ng, H. H. and Dahanukar, N. 2011. *Ailia coila*. The IUCN Red List of Threatened Species 2011.

Ng, H. H. 2010. *Mystus bleekeri*. The IUCN Red List of Threatened Species 2010.

Ng, H. H. 2010. *Mystus tengara*. The IUCN Red List of Threatened Species 2010.

Petr, T. 1999. Coldwater fish and fisheries in Afghanistan. *Fish and fisheries at higher altitudes: Asia, FAO Fish. Technical Paper.* (385): 138-148.

Petrakis, G. and Stergiou, K. I. 1995. Weight-length relationships for 33 fish species in Greek waters. *Fisheries Research*. 21(3-4): 465-469.

Sinovcic, G., Franicevic, M., Zorica, B. and ÈikešKec, V. 2004. Length–weight and length–length relationships for 10 pelagic fish species from the Adriatic Sea (Croatia). *Journal of Applied Ichthyology.* 20(2): 156-158

Talwar, P. K. and Jhingran, A. G. 1991. *Inland Fishes of India and Adjacent Countries*, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi-Calcutta, II: 571-572.

Talwar, P. K. and Kacker, R. K. 1984. *Commercial Sea Fishes of India*. The Director, Zoological Survey of India, Calcutta.

Tesch, F. W. 1968. *Age and Growth In: Methods for Assessment of Fish Production In Fresh Waters*. Blackwell Scientific Publications, Oxford, IBP Handbk. 3: 93-123.

Vaslet, A., BouchonNavaro, Y., Louis, M. and Bouchon, C. 2008. Weight–length relationships for 20 fish species collected in the mangroves of Guadeloupe (Lesser Antilles). *Journal of Applied Ichthyology.* 24(1): 99-100.

Wootton, R. J. 1990. *Ecology of Teleost Fishes*. London: Chapman and Hall. pp: 405

Wootton, R. S. 1992. *Fish Ecology*. Great Britain: Thomson Litho.