J. Indian Soc. Coastal Agric. Res. 43(1):118-124(2025) https://doi.org/10.54894/JISCAR.43.1.2025.152535

Short Communication

Growth Pattern and Condition Factors of Seven Species from Kole Wetland: A Ramsar Site

LOVDEEP SHARMA[1*] and GAUTHAM KRISHNA, N.[2]

[1]Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi - 682 506, Kerala, India

[2]Department of Ocean Studies, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi - 682 506, Kerala, India

Received: 08.06.2024 Accepted: 10.12.2024

The present study reports growth pattern, condition (K) and relative condition (Kn) factors of seven small to medium-sized indigenous Smiliogastrin cyprinids, *viz., Pethia punctata, Puntius vittatus, P. parrah, P. mahecola, P. sophore, Dawkinsia filamentosa,* and *Systomus sarana* from Kole wetland, part of coastal ecosystem Vembanad-Kole, a Ramsar site in Kerala State, India. Results indicated that except for *P. punctata* and *D. filamentosa,* all other species exhibited positive allometric growth (b>3) whereas except *S. sarana* (K_n<1), all other species were enjoying good conditions (K and K_n>1) in the natural habitat. Information on the biometry of these floodplain wetland-dependent fish species including the preliminary information for three species *viz., P. punctata, P. vittatus,* and *P. parrah* will help in framing future managerial and conservation strategies. This study also reveals the condition of this coastal ecosystem and its suitability for these small indigenous fish species.

(***Key words:*** *Biometry, Condition factor, Conservation, Coastal wetland, Growth pattern)*

Biometric studies are crucial for designing conservation and management strategies for fish species (Zargar *et al.,* 2012). Knowledge about the length-weight relationship provides vital clues for the estimation of growth rate, age structure, and life history (Le Cren1951; Kohler *et al.,* 1996; Schneider *et al.,* 2000; Froese 2006). Condition (K) and relative condition (K_n) factors are biometric tools providing information on the suitability of habitat for fish species (Le Cren 1951; Mensah 2015; Mohammed *et al.,* 2016).

Afro-Asian, small-bodied cyprinids of the subfamily Smiliogastrinae are an indispensable part of the exploited fishery as well as ornamental fish trade (Skelton *et al.,* 1991; Ngor *et al.,* 2018). Among the Smiliogastrin barbs found in India, species of the genera *Dawkinsia, Pethia, Puntius, Haludaria* and *Systomus* are acclaimed as popular food and ornamental fishes (Raghavan *et al.,* 2013; Renjithkumar *et al.,* 2020). As there is a great dearth of information on biometrics of these species from the natural habitats, the current study aims to analyze the length-weight relationships and condition factors of the fishes in subfamily Smiliogastrinae from the artisanal fishery in 'Kole' wetland.

Kole wetland (flood plain wetland covering a total area of 13500 ha), part of the Vembanad-Kole wetland, one of the three Ramsar sites in Kerala State, India. Vembanad-Kole is one of the largest coastal wetland ecosystems of India (WISA, 2017). There has been a documented decrease in fisheries due to a variety of circumstances, including pollution, human intervention and an increase in alien fish species. Thus, the information available now can assist understand the current state of the wetland and its suitability for the same purpose by illuminating the growth patterns of small native fish species in Kole Wetland.

Individuals of seven species of Smiliogastrin barbs representing four genera were obtained monthly from November 2020 to October 2021, from regular fish landing centers in Kole wetland (Latitude 10.536°N, Longitude 76.176°E). The fish available in the landing centers were chiefly collected using gill nets (20-50 mm) and cast nets (26 mm). Immediately after procurement, total body length (TL) was measured to the nearest 0.02 mm and body weight (BW) to 10 mg accuracy using a Yamayo dial calliper and Scale -Tec electronic weighing balance respectively.

**Corresponding author:* E-mail: lovedeeps@kufos.ac.in

Length-weight relationships of fish were calculated using the logarithmically transformed form of W = a Lb (Le Cren, 1951), *i.e.* log W = log a + b log L; where W is the total body weight, L is the total length, and parameters a and b are the regression parameters (Le Cren, 1951; Froese, 2006). The 95% confidence limits of regression parameters as well as the coefficient of determination (R^2) were also determined (Froese, 2006). Before analysis, all the outliers were removed.

Condition factor (K) was estimated using the expression: $K= W*100/L^3$ (Hile, 1936), where W is the total body weight of fish and L is the total length. The relative condition factor (K_n) was assessed as, $K_n = W_o/W_c$ (Le Cren, 1951), where W_o is the observed weight and W_c is the calculated weight.

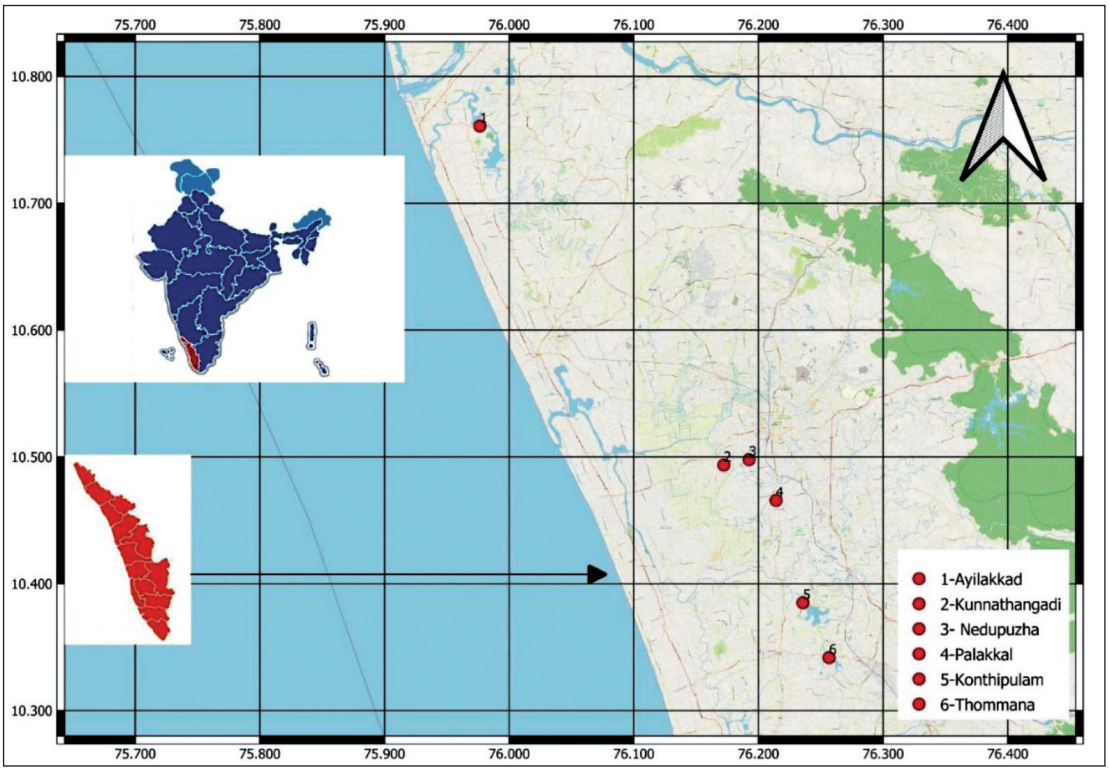

Fig. 1. *Map of Kole wetlands representing sampling stations*

A total of 1132 individuals of seven species of Smiliogastrin barbs belonging to four genera were used for analysis, wherein the sample size ranged from 62 mm for *Puntius parrah* to 380 mm for *Pethia punctata*. Descriptive statistics, estimated length-weight relationship parameters and the condition (K and K_n) factors are briefed in Tables 1 and 2 respectively. Among the species studied, *P. punctata* and *D. filamentosa* showed negative allometry (b<3) while all other five species exhibited positive allometry (b>3). Among the species analyzed, estimated K and K_n values were found to be >1 for all, except *S. sarana*.

This is the first report on LWRs, condition and relative condition factors of *Pethia punctata, Puntius parrah,* and *P. vitttatus* and the first report of LWRs for *Puntius mahecola, P. sophore, S. sarana* and *D. filamentosa* from Kole wetland. The present study reports a new maximum length for *P. punctata* (7.83 cm) which is not yet available in Fish Base.

The estimated 'b' values for all the species were falling within the expected range of 2.5-3.5 (Froese, 2006), but were different from previous studies. The information available on these species from India is remarkably insufficient and showed variation habitat-wise for the same species as *S. sarana* showed positive allometric growth (b=3.1) from Deepor Beel, Assam

Table 1. *Descriptive statistics and estimated length-weight relationship parameters of seven species from Vembanad-Kole wetlands, India*

Species	n	TL (cm)		BW (g)		Regression parameters		Confidence limits				r^2
		Min	Max	Min	Max	a	b	95% CL of a		95% CL of b		
Pethia punctata	380	3.39	7.83	0.631	4.412	0.0187	2.767	0.0150	0.0232	2.6355	2.899	0.8871
Puntius vittatus	221	1.34	4.85	0.034	1.992	0.0107	3.294	0.0085	0.0146	3.0723	3.5159	0.7971
Puntius parrah	62	5.54	11.00	2.689	19.404	0.0100	3.150	0.0054	0.0186	2.8561	3.4445	0.8861
Puntius sophore	72	3.26	9.26	0.495	13.39	0.0108	3.174	0.0088	0.0132	3.0674	3.2806	0.9808
Puntius mahecola	159	3.53	11.82	0.549	20.443	0.0116	3.044	0.0093	0.0145	2.9318	3.1569	0.9481
Dawkinsia filamentosa	166	1.85	13.00	0.067	32.887	0.0149	2.936	0.0126	0.0175	2.8524	3.0213	0.9665
Systomus sarana	72	2.14	17.42	0.128	98.554	0.0117	3.140	0.0107	0.0127	3.0906	3.1911	0.9967

Abbreviations:n, sample size; a, intercept; b, slope; CL, confidence limits; r^2, coefficient of determination; TL, total length; BW, total body weight

Table 2. *Condition and relative condition factors of seven species of Smiliogastrin barbs from Vembanad-Kole wetlands, India*

Species	n	K (mean)	K_n (mean)
Pethia punctata	380	1.3120	1.0251
Puntius vittatus	221	1.5255	1.0902
Puntius parrah	62	1.4015	1.0197
Puntius sophore	72	1.5084	1.0009
Puntius mahecola	159	1.2980	1.0191
Dawkinsia filamentosa	166	1.3558	1.0094
Systomus sarana	72	1.4863	0.9716

Abbreviations: n, sample size; K, condition factor; Kn, relative condition factor

Table 3. *Comparative account of Indian Smiliogastrin Cyprinids growth pattern*

Species	b value	Growth pattern	Location	Reference	Remark
Pethia ticto	3.09	Positively allometric	Padma river, Bangladesh	Hossain (2010)	Species very much similar to *P. punctata*
D. filamentosa	2.99	Negatively allometric	Chalakudy river, Kerala	Prasad and Ali (2007)	Similar pattern in present study
P. sophore	3.24	Positively allometric	Kolkata landing centers	Pal *et al.* (2013)	Similar pattern in present study
S. sarana	1.60	Negatively allometric	Deepor Beel, Assam	Das *et al.* (2015)	Positively allometric in present study

*There is dearth of data for comparison only few available have been presented in table.

(Das *et al.,* 2015) while reported following a negative allometric pattern in the Tamiraparani River (b = 2.24), Tamil Nadu (Kannan *et al.,* 2016). Similarly, *P. sophore* also showed variations in growth pattern (b = 0.94 to 1.59) from Deepor Beel, Assam (Das *et al.,* 2014); (b = 3.24) West Bengal (Pal *et al.,* 2013) and (b = 2.98) Bangladesh (Hossain *et al.,* 2012). *D. filamentosa* was reported to have b = 2.99 from Chalakudy River, Kerala (Prasad and Ali 2007) and *Puntius mahecola,* b = 2.95 from Chalakudy River (Renjithkumar *et al.,* 2021).

While no information is available on *Puntius vittatus* and *P. parrahto* date, the present study provides first hand information on their LWR as well as condition factors. Similarly, there is no previous literature available on the biometric aspects of *Pethia punctata,* the b value obtained in the present study was comparable only with the related species, *P. ticto* that exhibited positive allometric growth (b = 3.09) from the Padma River, Bangladesh (Hossain, 2010) whereas for similar species b values were reported to be ranging between 1.74 and 1.93 in the river Ganga, Gomti and Rapti (Sarkar *et al.,* 2013). Similarly, another related species, *P. gelius* exhibited positive allometric growth (b = 3.9) from the Ranganadi River in Assam, and the Simsang and Kynshi Rivers in Meghalaya (Kaushik *et al.,* 2019). Growth pattern (b value) variation within the species as well as between the species from different habitats, could be attributable to biological (size range, growth phase, gonadal maturity, feeding intensity) and environmental factors (Hossain *et al.,* 2012; Li *et al.,* 2014).

The deviation of K_n from unity may be attributed to differences in the availability of food and the consequence of physico-chemical features on the life cycle of fish species (Le Cren, 1951). Similar results with the values of condition and relative condition factors were observed in other Smiliogastrin barbs *viz. Pethia ticto,* (K>1) (Sarkar *et al.,* 2013) and *Puntius sophore* (K>1) (Rahman *et al.,* 2012). Also, the values of the relative condition factor for *P. sophore* (K_n ranged from 1.00-1.01) and *S. sarana* (K_n ranged from 0.99 -1.00) (Das *et al.,* 2014) matched with the results of this study. The K and K_n values can vary among populations due to innumerable factors, such as sex, season, and the degree of gonadal development (Le Cren, 1951; Froese, 2006).

LWRs estimated for each species under the study are significant in drawing out various demographic parameters of the population in the Kole wetland. This preliminary information on the size and growth pattern could be of use for future research, as the body size of fish is correlated with many life history characteristics. In addition, the maximum length (Lmax) can be used for deriving the asymptotic length ($L\infty$) as well as the length at the first maturity of each species.

The study provides essential data that can guide conservation strategies, sustainable management practices, and policy decisions aimed at preserving the ecological balance and health of the Kole wetland. This, in turn, ensures the long-term sustainability of the ecosystem and the services it provides.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

ACKNOWLEDGMENT

The authors acknowledges the cooperation and help rendered by the local fishers of Vembanad-Kole wetlands for providing samples for the study. Authors would like to thank the Dean, Faculty of Fisheries Science and the Head, Dept. of Fisheries Resource Management, KUFOS, for providing laboratory facilities.

REFERENCES

Das, M., Das, G. and Deka, P. (2015). Length-weight relationship and relative condition factor of *Puntius sophore* (Hamilton, 1822) and *Systomus sarana* (Hamilton, 1822) of Deepor Beel (wetland) of Assam, India. *International Journal of Fisheries and Aquatic Studies* **3**(2): 162-164.

Froese, R. (2006). Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology* **22**(4): 241-253. https://doi.org/10.1111/j.1439-0426.2006.00805.x

Hile, R. (1936). Age and growth of the cisco, *Leucichthys artedi* (Le Sueur), in the lakes of the northeastern highlands, Wisconsin. *Bulletin of the Bureau of Fisheries* **48**(19): 211-317.

Hossain, M.Y. (2010). Morphometric relationships of length-weight and length-length of four Cyprinid

small indigenous fish species from the Padma River (NW Bangladesh). *Turkish Journal of Fisheries and Aquatic Sciences* **10**(1): 131-134.

Hossain, M.Y., Rahman, M.M., Miranda, R., Leunda, J.P.M., Oscoz, M.A.S., Jewel, A.N. and Ohtomi, J. (2012). Size at first sexual maturity, fecundity, length-weight and length-length relationships of *Puntius sophore* (Cyprinidae) in Bangladeshi waters. *Journal of Applied Ichthyology* **28**(5): 818-822. https://doi.org/10.1111/j.1439-0426.2012.02020.x

Kannan, P.S.A., Jawahar, R.M.P., Jayakumar, N. and Sundaramoorthy, B. (2016). Stock assessment and reproductive biology of *Puntius sarana* (Hamilton,1822) in Tamiraparani River basin of south Tamil Nadu, India. *International Research Journal of Biological Sciences* **6**(2): 20-25.

Kaushik, G., Synnah, K., Tariang, K.U., Narayana, R.S. and Bordoloi, S. (2019). Length-weight relationships of four indigenous fish species collected in Assam and Meghalaya, India. Lakes & Reservoirs: *Research & Management* **24**(3): 299-301.

Kohler, N.E., Casey, J.G. and Turner, P.A. (1996). Length-weight relationships for 13 species of sharks from the western North Atlantic. *Oceanographic Literature Review* **7**(43): 698.

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* **20**(2): 201-219. https://doi.org/10.2307/1540

Li, Q., Xu, X.L. and Huang, J.R. (2014). Length-weight relationships of 16 fish species from the Liuxuhe national aquatic germplasm resources conservation area, Guangdong, China. *Journal of Applied Ichthyology* **30**: 434-435. https://doi.org/10.1111/jai.12378

Mensah, S.A. (2015). Weight-length models and relative condition factors of nine freshwater fish species from the Yapei Stretch of the White Volta, Ghana. *Elixir Applied Zoology* **79**: 30427-30431.

MoEFCC. (2020). *Ramsar Sites of India - Fact Sheets*. Ministry of Environment, Forest and Climate Change, Government of India, New Delhi.

Mohammed, A.A., Musa, L.M.A., Ali, R.A.S., Elawad, A.N. and Ali, S.M. (2016). The length weight relationship and condition factor of the Thinlip mullet *Liza ramada* and the flathead grey mullet *Mugil cephalus* (Mugilidae) fishes from Ain el-Ghzala lagoon, eastern Libya. *International Journal of Research and Review* **3**: 2504-2507.

Ngor, P.B., McCann, K.S., Grenouillet, G., So,N., McMeans, B.C., Fraser, E. and Lek, S. (2018). Evidence of indiscriminate fishing effects in one of the world's largest inland fisheries. *Scientific Reports* **8**(1): 1-12.

Pal, M., Mahapatra, B.K. and Mondal, B. (2013). Length-weight relationship and condition factor of *Puntius sophore* (Hamilton, 1822) collected from Kolkata and sub urban fish markets. *Environment and Ecology* **31**(3): 1255-1259.

Prasad, G. and Ali, P. A. (2007). Length-weight relationship of a cyprinid fish *Puntius filamentosus* from Chalakudy River, Kerala. *Zoos' Print* **22**(3): 2637-2638.

Raghavan, R., Dahanukar, N., Tlusty, M.F., Rhyne, A.L., Kumar, K.K., Molur, S. and Rosser, A.M. (2013). Uncovering an obscure trade: threatened freshwater fishes and the aquarium pet markets. *Biological Conservation* **164**: 158-169. https://doi.org/10.1016/j.biocon.2013.04.019

Rahman, M.M., Hossain, M.Y., Jewel, M.A.S., Rahman, M.M., Jasmine, S., Abdallah, E.M. and Ohtomi, J. (2012). Population structure, length-weight and length-length relationships, and condition-and form-factors of the Pool barb *Puntius sophore* (Hamilton, 1822) (Cyprinidae) from the Chalan Beel, North-Central Bangladesh. *Sains Malaysiana* **4**(7): 795-802.

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

Renjithkumar, C.R., Roshni, K. and Kurup, B.M. (2020). Exploited Fishery Resources in the Kallada River, Kerala, India. *Journal of Aquatic Biology and Fisheries* **8**: 93-97.

Renjithkumar, C.R., Roshni, K. and Ranjeet, K.(2021). Length-weight relations of 14 fish species (Actinopterygii) from the Chalakudy River, Western Ghats, India. *Acta Ichthyologica et Piscatoria* **51**: 263-265.

Sarkar, U.K., Khan, G.E., Dabas, A., Pathak, A.K., Mir, J.I., Rebello, S.C., Pal, A. and Singh, S.P. (2013). Length-weight relationship and condition factor of selected freshwater fish species found in River Ganga, Gomti and Rapti, India. *Journal of Environmental Biology* **34**: 951-956.

Sarkar, U.K., Roy, K., Naskar, M., Karnatak, G., Puthiyottil, M., Baksi, S., Kumari, S., Lianthuamluia, L. and Das, B.K. (2021). Assessing vulnerability of freshwater minnows in the Gangetic floodplains of India for conservation and management: Anthropogenic or climatic change risk? *Climate Risk Management* **33** (100325): 1-13.

Skelton, P.H., Tweddle, D. and Jackson, P.B.N. (1991). Cyprinids of Africa. In: *Cyprinid Fishes*. I.J. Winfield and J.S. Nelson (eds), Cyprinid Fishes. Fish & Fisheries Series, vol 3. Springer, Dordrecht. pp 211-239. https://doi.org/10.1007/978-94-011-3092-9_7

WISA. (2017). *Vemabanad - Kol Wetlands - An Integrated Management Planning Framework for Conservation and Wise Use*. Technical Report submitted to the IUCN and MoEF, New Delhi, Wetlands International South Asia, New Delhi, India.

Zargar, U.R., Yousuf, A.R., Mushtaq, B. and Dilafroza, J.A.N. (2012). Length-weight relationship of the crucian carp, *Carassius carassius* in relation to water quality, sex and season in some lentic water bodies of Kashmir Himalayas. *Turkish Journal of Fisheries and Aquatic Sciences* **12**(3): 683-689.