Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(1): 191-197

Received: 28-11-2016
Accepted: 29-12-2016

Minakshi Singh
Fish Biogenetics Lab
Department of Zoology
University of Lucknow,
Lucknow (U.P.), India

M Serajuddin
Fish Biogenetics Lab
Department of Zoology
University of Lucknow,
Lucknow (U.P.), India

Correspondence
M. Serajuddin
Fish Biogenetics Lab
Department of Zoology
University of Lucknow,
Lucknow (U.P.), India

Length-weight, length- length relationship and condition factor of *Channa punctatus* collected from three different rivers of India

Minakshi Singh and M Serajuddin

Abstract
Channa punctatus is commercially important freshwater teleostean fish, commonly known as green snake headed spotted murrel. A total of 261 samples of *C. punctatus* were collected from the Gomti, Ganga and Ken rivers characterized by different environmental conditions in order to study the intraspecific variations using length-weight relationship. A positive allometric growth (b>3) was recorded in all the sub-populations of the fish except in the females of Gomti River. The fish did not follow the cube's law strictly as increase in weight was found to be more in comparison to length in all the sub-populations of the fish except in the female of Gomti River where isometric growth was noted. Length-length relationship showed both lengths are highly correlated to each other (r=0.99). The value of condition factor was found to be more than 1 in all sub-populations of the fish indicated good condition of fish.

Keywords: *Channa punctatus*, length-weight relationship, length-length relation, condition factor

Introduction
The murrel, *Channa punctatus* (Bloch, 1793) is an inland water teleostean fish commonly known as green snake-headed spotted murrel. The *C. punctatus* is known to occur in lakes, ponds, rivers, impoundments, ditches, and oxygen deficient swampy areas because of their accessory respiratory organs which help the fish to survive in low oxygen conditions. The fish was also reported from brackish water [1] and beels [2]. The *C. punctatus* is distributed throughout the south Asian countries like Afghanistan, Pakistan, India, Sri Lanka, Nepal, Bangladesh, Myanmar and Yunnan in China [3]. The fish is economically important as a table fish and termed as 'lean fish' because of its very low lipid contents or no adipose tissues [4]. The demand of the fish always exceeds the supply in local market in India and neighboring countries. It fetches a good price when sold alive particularly in northern, eastern and north-eastern parts of India.
The study of length-weight relationship is considered to be important to get different kinds of information of fish in fish biology such as growth rate, age structure, age at first maturity and segregation of stocks [5-11]. Length-weight relationship as character can be used in defining taxonomic units, developmental pattern of life like metamorphosis, growth and onset of maturity [12], and to convert unknown weight from known length or vice versa because weight is function of length [13, 14].Information about climate and environmental changes and change in human practices can also be obtained through the data on length and weight relationship [15].
Fulton's condition factor (K) is an important parameter which represents wellbeing, fitness of fish, the fish which is heavier at particular length is considered to be in better condition [16]. Value of condition factor of a fish varies because of different factors like state of sexual maturity, availability of food sources, age and sex of some species [17].
The data on length-weight relationship is considered to be scanty for most of tropical fish [18, 19]. Length-weight relationship on *C. punctatus* was carried out by many workers, notable among them are [20-26]. But comparative study of length-weight relationship and condition factor on *C. punctatus* is scanty specifically of Ganga basin. Therefore, keeping in mind the paucity of information the present study was undertaken on length-weight and length-length relationships along with condition factor of *C. punctatus* collected from different rivers of the Ganga basin.

2. Materials and Methods

2.1. Sampling, study period and area of collection

A total of 261 samples of *C. punctatus* were collected from three different rivers namely Gomti at Lucknow (26˚51'30" N 80˚56'14" E), Ganga at Kanpur (26˚37'08" N 80˚16'26") and Ken at Banda (25˚46' N 80˚31' E) of Ganga basin of Uttar Pradesh using cast and drag nets with the help of fishermen.

2.2. Length-weight measurement and statistical analysis

Total length (TL) and standard length (SL) of fish were measured to nearest 1 mm using fish measuring board and weight was measured to nearest 0.001g using an electronic balance. Fish were dissected to determine the sex. The data of length and weight was log transformed and relationship equations were obtained using formula as given by Ricker [27]:

$W = aL^b$

Where "W" is weight in g, "L" is total length in cm, "a" is intercept of regression line and "b" is slope of the regression line.

Log form of the above equation is used as given by LeCren [28]:

Log W = Log a + b log TL

Log TL= Log a + b log SL

The t- test was performed to know the significant difference between the values of "b".

Fulton condition factor (K) was calculated using the formula:

$K = W_x100/L^3$

Where 'K' is Fulton's condition factor, W is weight of the fish in g, L is the standard length of the fish in cm, and the factor 100 is used to bring K close to unity.

The statistical methods such as correlation of coefficient, correlation of determination, regression, confidence level and t-test were calculated with the help of Graph Pad Prism 5.

3. Results

The length–weight relationship equations of males, females and combined (males & females), values of correlation of coefficient (r) and their types of growth of *C. punctatus* collected from Gomti, Ganga and Ken are given in Table 1.Weight is highly correlated with total length in all the populations of *C. punctatus* in the present study where the value of correlation of coefficient ranged between 0.9499–0.9963. The value of 'b' of length–weight relationships in all fish populations ranged from 3.095 to 3.287 (Fig. 2), and were highly significant (p<0.0001). The value of 'b' of length–weight relationships was found to be significantly different from 3.0 in all groups of *C. punctatus* in the present study except in the female of the Gomti River. Similarly, the pattern of growth was found to be positive allometric (b<3) in all the groups of three rivers except in the female of river Gomti where it was isometric (3.095). The logarithmic linear regression equations of length–weight and length–length relationships of males, females and combined of all the rivers are given in Figs. 1, 2 & 3). Highly correlated total length–standard length relationships were noted in different groups of *C. punctatus* of rivers Gomti, Ganga and Ken (Table 3).The minimum (r^2=0.9895) and maximum (r^2=0.9974) values of correlation of determination were noted in males of rivers Gomti and Ken respectively. A straight line was obtained between plots of log 'a' (intercept) over 'b' (slop) of male, female and combined (male & female) of *C. punctatus* collected from Gomti, Ganga and Ken rivers in the present study (Fig. 4). The 95% confidence levels of 'a' and 'b' are given in Table 2.

The values of Fulton's condition factor (K) recorded in the three populations of *C. punctatus* in the present study ranged between1.614-1.863, which was found to be more than unity indicated better condition in all the three riverine populations.

Table 1: Logarithmic regression equations of weight on length, values of correlation of coefficient and types of growth of male, female and combined (male & female) of *C. punctatus* of three rivers.

Source	Regression Equation	Correlation Coefficient 'r'	Type of Growth
GOMTI RIVER			
Male	Log W = -2.287 + 3.235 log TL	0.9499	Allometric
Female	Log W = -2.127 + 3.095 log TL	0.9779	Isometric
Combined	Log W = -2.195 + 3.156 log TL	0.9764	Allometric
GANGA RIVER			
Male	Log W = -2.354 +3.275 log TL	0.9899	Allometric
Female	Log W = -2.346 +3.278 log TL	0.9862	Allometric
Combined	Log W = -2.363 +3.287 log TL	0.9872	Allometric
KEN RIVER			
Male	Log W = -2.223 + 3.188 log TL	0.9963	Allometric
Female	Log W = -2.286 + 3.273 log TL	0.9828	Allometric
Combined	Log W = -2.295 + 3.277 log TL	0.9848	Allometric

Table 2: Different parameters of length-weight relationship of male, female and combined (male & female) of *C. punctatus* of three rivers.

River	Group	No.	Length -size	a	95% CL of 'a'	b	95% CL of 'b'	r^2	r	p -value
Gomti	Male	60	9.6 - 19.7	0.005	0.0032 – 0.0088	3.235	3.039 -3.43	0.9499	0.9746	0.001
	Female	59	9.3 – 19.7	0.008	0.0048 -0.012	3.095	2.919 – 3.271	0.9563	0.9779	0.05
	combined	127	9.3 - 21	0.006	0.0047 -0.0089	3.156	3.0033 -3.278	0.9533	0.9764	0.02
Ganga	Male	31	8.9 – 18.8	0.004	0.0028 – 0.007	3.275	3.097 – 3.453	0.9799	0.9899	0.01
	Female	35	9.5 – 15.7	0.004	0.0028 – 0.0073	3.278	3.083 – 3.473	0.9726	0.9862	0.01
	combined	69	8.9 – 18.8	0.004	0.0032 – 0.006	3.287	3.157 -3.417	0.9745	0.9872	0.001
Ken	Male	13	9.4 – 18.5	0.006	0.0037 -0.0097	3.188	3.007-3.369	0.9927	0.9963	0.05
	Female	44	8.1 – 21.1	0.005	0.0031- 0.0087	3.273	3.081-3.465	0.9658	0.9828	0.01
	combined	65	8.1 – 21.1	0.005	0.0035-0.0075	3.277	3.131-3.465	0.9698	0.9848	0.001

Table 3: Different parameters of total length-standard length relationship of male, female and combined (male & female) of *C. punctatus* of three rivers.

River	Group	No.	Length -size	a	95% CL of 'a'	b	95% CL of 'b'	r^2	r
Gomti	Male	60	9.6 - 19.7	0.785	0.7306-0.843	1.019	0.992-1.047	0.9895	0.9947
	Female	59	9.3 – 19.7	0.778	0.7318-0.826	1.022	0.999-1.047	0.9928	0.9964
	combined	127	9.3 – 21.0	0.782	0.749-0.8161	1.020	1.004-1.037	0.9917	0.9958
Ganga	Male	31	8.9 – 18.8	0.736	0.6949-0.779	1.042	1.020-1.065	0.9967	0.9983
	Female	35	9.5 – 15.7	0.752	0.6911-0.816	1.035	1.001-1.069	0.9917	0.9958
	combined	69	8.9 – 18.8	0.738	0.7016-0.777	1.041	1.021-1.062	0.9936	0.9968
Ken	Male	13	9.4 – 18.5	0.679	0.6175-0.749	1.073	1.037-1.110	0.9974	0.9987
	Female	44	8.1 – 21.1	0.776	0.7228-0.832	1.025	0.999-1.052	0.9931	0.9965
	combined	65	8.1 – 21.1	0.748	0.7079-0.790	1.039	1.018-1.059	0.9939	0.9969

Table 4: Condition factor of male, female and combined (male & female) of *C. punctatus* of three rivers.

River	Gomti			Ganga			Ken		
Group	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined
Condition factor	1.702	1.718	1.722	1.614	1.635	1.618	1.748	1.877	1.863

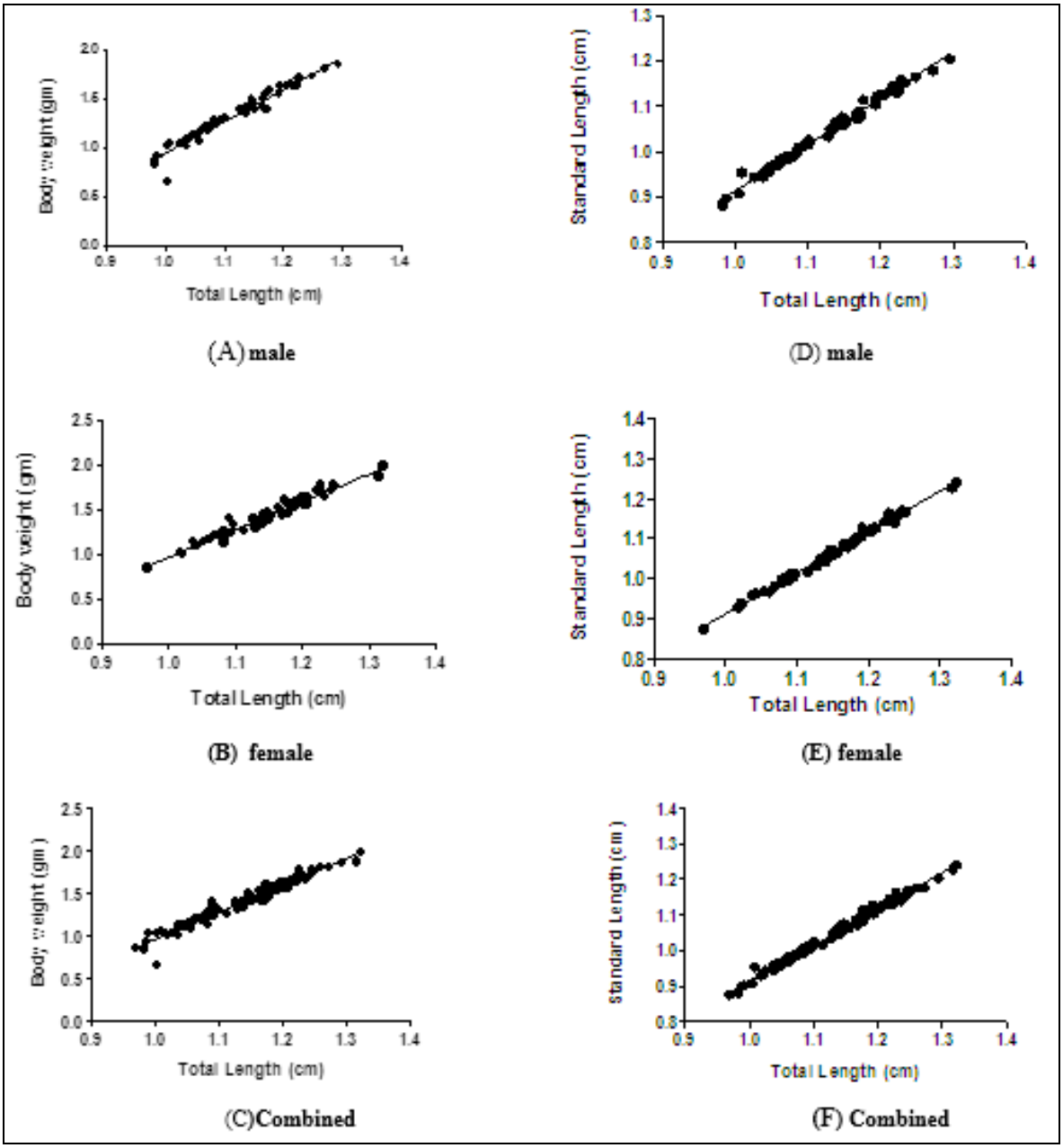


Fig 1: Regressions of length –weight (A,B,C) and length –length (D,E,F) relationships in male, female and combined (male & female) of river Gomti.

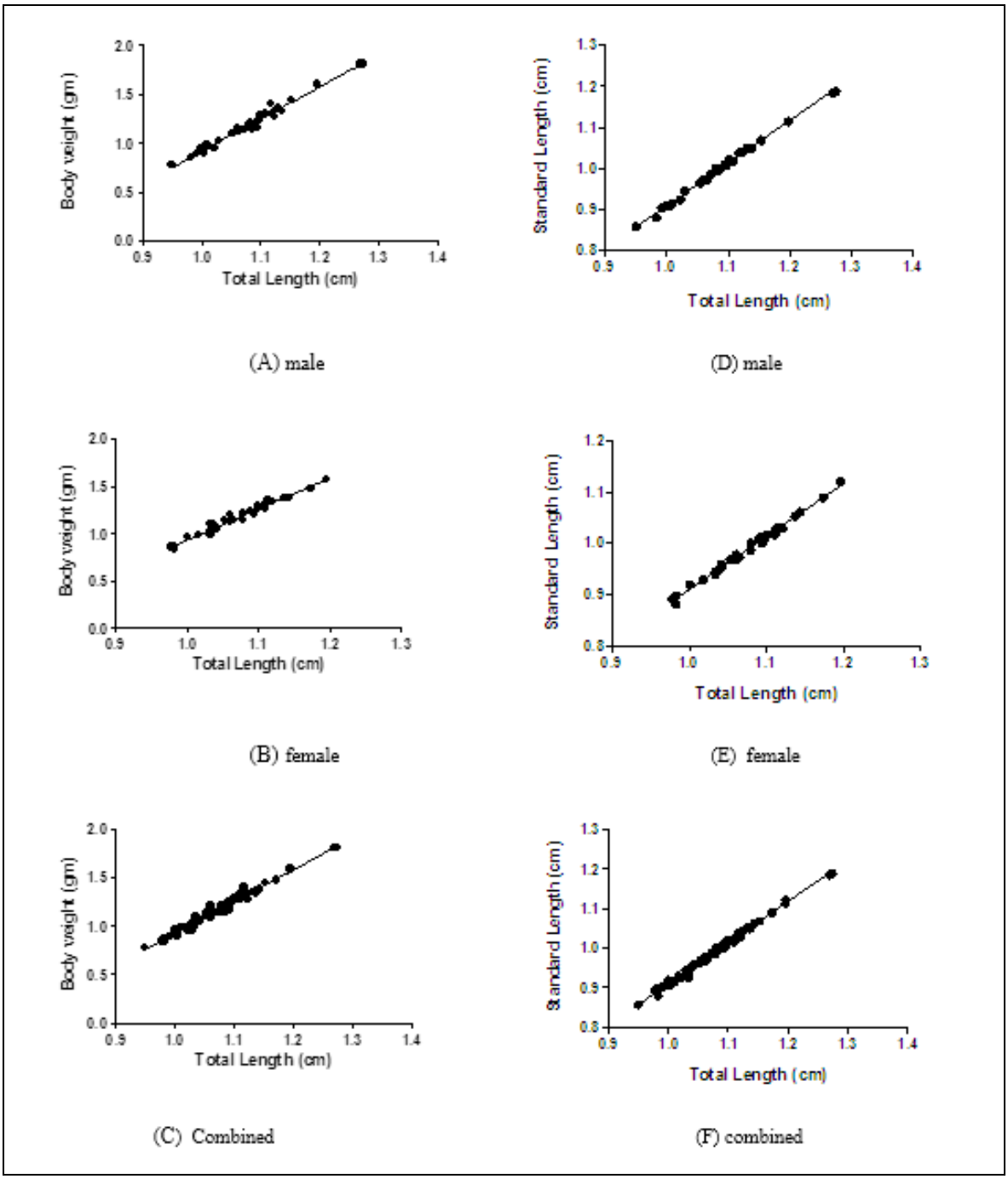


Fig 2: Regressions of length –weight (A,B,C) and length –length (D,E,F) relationships in male, female and combined (male & female) of river Ganga.

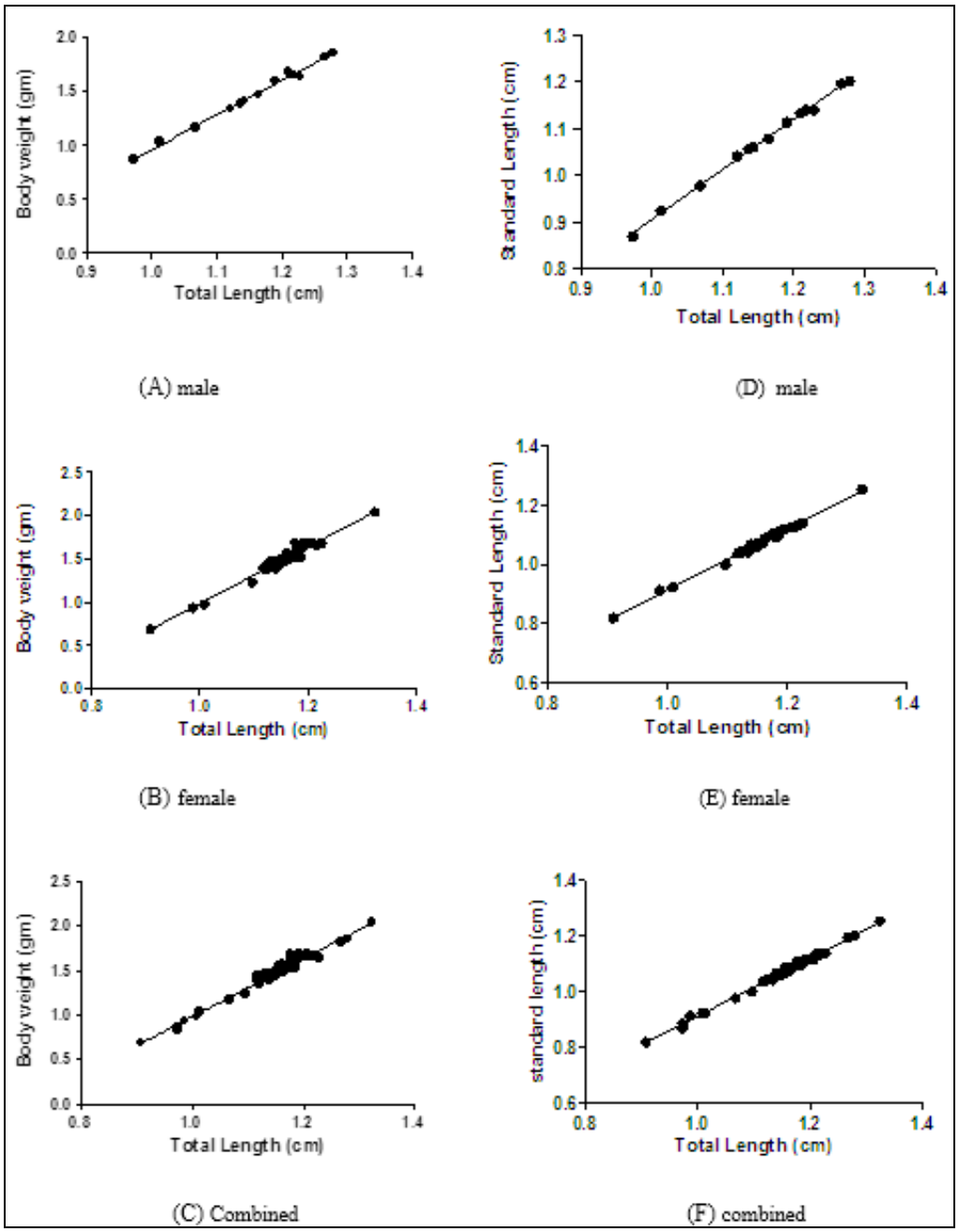
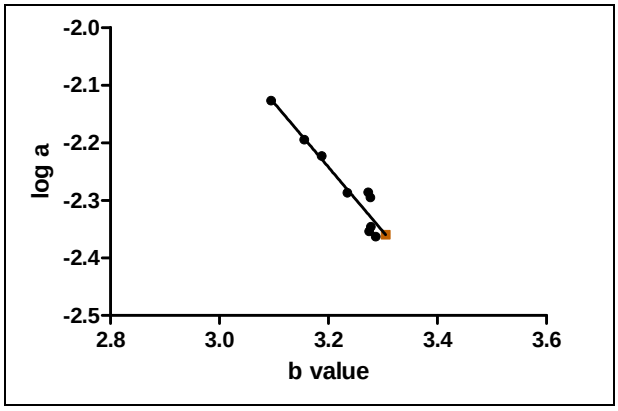


Fig 3: Regressions of length –weight (A,B,C) and length –length (D,E,F) relationships in male, female and combined (male & female) of river Ken**.**



( ) denotes the LWR of pooled samples

Fig 4: Regression plot between log 'a' over 'b' for length-weight relationship in all groups of *C. punctatus* of three rivers**.**

4. Discussion

The cube law of LeCren's concept hypothetically stated that the value of 'b' in ideal fish to be 3, indicating an isometric growth, which is widely used as a scale in length–weight relationship study. The values of 'b' in the present study ranged between 3.095–3.287 indicating positive allometric growth in all groups except in females of river Gomti, which followed the cube law strictly showing isometric growth. Contrary to the present finding, Kashyap *et al*. [26], reported positive allometric growth in female *C. punctatus* of river Gomti because of enormous growth of ovary while Haniffa[22] also recorded isometric growth in female of *C. punctatus* collected from Western Ghats River of Tamil Nadu, India. The departure from the cube law in other groups such as males, females and combined (male & female) of river Ganga and Ken, where positive allometric growth was noted, may be due to high dissolved oxygen concentration, circulation of

water and the rich availability of forage items to the fish. The positive allometric growth (b>3) recorded in the present study indicated that the fish became heavier because of favorable conditions of the habitat from which the fish was collected due to proportional growth in all directions. LeCren [28] pointed out that intraspecific variations in length–weight relationship may be because of variations in ecological conditions of habitats and physiology or either of them. The present finding is similar to those of Serajuddin *et al*. [24] and Mustafa[29] who reported variations in length-weight relationship associated with habitats difference in *C. punctatus* of Varuna River and *Esomus danricus* of Aligarh respectively and emphasized that the fish living in reverine condition show rapid growth. Tesch [30] also pointed out that length–weight relationship in fish can be affected by habitat and area besides other factors such as seasonal effect, degree of stomach fullness, gonad maturity, sex and health. Several workers reported positive allometric growth in freshwater fish; notable among them are [31- 39] in *Cirrhina mrigala, Catla catla, Labeo bata, Labeo rohita, Pristolepis fasciata, Pangasius pangsius*, *Pseudorasbora parva* and *Macrognathus aculeatus* respectively. The greater value of 'b' mainly depends on shape and fatness of individuals of fish. Isometric growth was also reported by [22, 24, 14] in *C. punctatus* collected from different freshwater habitats of India. Other workers who also reported isometric growth are [40-42] in *Oreochromis mossambicus*, *Macrognathus pancalus* and *Tor putitora* respectively. However the value of 'b' may fluctuates from 2 to 4 as suggested by [43, 30, 44, 7] A straight line between plots 'a' over 'b' of different populations of the fish in present study showed the absence of outliers as suggested by Froese [7].

Fulton's condition factor (K) represents health condition or well-being of fish. The fish having value of more than 1 in condition factor are said to be good in health condition [45]. In the present study, the value of 'K' in all the three populations of *C. punctatus* was found to be more than 1 which indicated the good health condition of fish collected from the three rivers in the present study (Table 4). The value of 'K' of the population of *C. punctatus* of river Ganga was lower than the populations of Gomti and Ken Rivers indicating comparatively poor condition in river Ganga because of polluted water which causes change in temperature, pH of water, low oxygen availability and sediment loads.

5. Acknowledgements

The authors thank the Head, Department of Zoology, University of Lucknow for providing facilities and administrative support and one of the authors also thanks to the Department of Science and Technology (DST-PURSE) and Rajiv Gandhi National Fellowship (RGNF) for financial help.

6. References

1. Pethiyagoda R. Freshwater fishes of Sri Lanka. Wildlife Heritage Trust, 1991.
2. Rahman AA. Freshwater fishes of Bangladesh. Zoological Soc. of Bangladesh, 1989.
3. Froese R, Walters C, Pauly D, Winker H, Weyl OL, Demirel N. A critique of the balanced harvesting approach to fishing. ICES Journal of Marine Science: Journal du Conseil. 2015, fsv122.
4. Ghosh S. Composition and distribution of lipids and fatty acids in two jeol fishes of West Bengal. Ph.D. thesis, University of Calcutta, 2006.
5. Kohler NE, Casey JG, Turner PA. Length-Length and Length-Weight Relationships for 13 Shark Species from the Western North Atlantic, 1995.
6. Morey G, Moranta J, Massutı E, Grau A, Linde M, Riera F, Morales-Nin B. Weight–length relationships of littoral to lower slope fishes from the western Mediterranean. Fisheries Research. 2003; 62(1):89-96.
7. Froese R. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. Journal of Applied Ichthyology. 2006; 22(4):241-253.
8. Vaslet A, Bouchon-Navaro Y, Louis M, Bouchon C. Weight–length relationships for 20 fish species collected in the mangroves of Guadeloupe (Lesser Antilles). Journal of Applied Ichthyology. 2008; 24(1):99-100.
9. Richter H, Luckstadt C, Focken U, Becker K. An improved procedure to assess fish condition on the basis of length-weight relationships. Archive of Fishery and Marine Research. 2000; 48(3):255-264.
10. Hossain MY, Ahmed ZF, Leunda PM, Jasmine S, Oscoz J, Miranda R, *et al*. Condition, length–weight and length–length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, southwestern Bangladesh. Journal of Applied Ichthyology. 2006; *22*(4):304-307.
11. Karakulak FS, Erk H, Bilgin B. Length–weight relationships for 47 coastal fish species from the northern Aegean Sea, Turkey. Journal of Applied Ichthyology. 2006; 22(4):274-278.
12. Thomas J, Venu S, Kurup BM. Length-weight relationship of some deep-sea fish inhabiting the continental slope beyond 250m depth along the West Coast of India. NAGA, World Fish Center Quarterly. 2003; 26(2):17-21.
13. Froese R. Short Communication Length-weight relationships for 18 less-studied fish species. Journal of Applied Ichthyology. 1998; 14:117-118.
14. Kashyap A, Awasthi M, Arshad M, Serajuddin M. Length-Weight, Length-Length Relationship and Condition Factor of Freshwater Murrel, *Channa punctatus* from Northern and Eastern Regions of India. World Journal of Fish and Marine Sciences, 2015; *7*(3):164-170.
15. Sarkar UK, Khan GE, Dabas A, Pathak AK, Mir JI, Rebello SC *et al*. Length weight relationship and condition factor of selected freshwater fish species found in River Ganga, Gomti and Rapti, India. Journal of Environmental Biology. 2013; 34(5):951.
16. Bagenal TB. Aspects of fish fecundity. Ecology of Freshwater Fish Production. 1978; 75-101.
17. Anibeze CIP. Length-weight relationship and relative condition of *Heterobranchus longifilis* (Valenciennes) from Idodo River, Nigeria. Naga, The ICLARM Quarterly. 2000; 23(2):34-35.
18. Dubey VK, Sarkar UK, Kumar RS, Mir JI, Pandey A, Singh Lakra W. Length–weight relationships (LWRs) of 12 Indian freshwater fish species from an un-impacted tropical river of Central India (River Ken). Journal of Applied Ichthyology. 2012; 28(5):854-856.
19. Mir JI, Shabir R, Mir FA. Length-weight relationship and condition factor of *Schizopyge curvifrons* (Heckel, 1838) from River Jhelum, Kashmir, India. World Journal of Fish and Marine Sciences. 2012; 4(3):325-329.
20. Basheer VS, Khan AA, Sidiqqui IA. Length-weight relationship of *Channa punctatus* (Bloch) from the river

Yamuna. Advances in Limnology. 1993, 241-246.
21. Sarkar SK. Length weight relationship and fecundity of *Channa punctata*. Journal of Ecobiology. 1996; 8(2):95-98.
22. Haniffa MA, Nagarajan M, Gopalakrishnan A. Length–weight relationships of *Channa punctata* (Bloch, 1793) from Western Ghats Rivers of Tamil Nadu. Journalof Applied Ichthyology. 2006; 22(4):308-309.
23. Chandra R, Jhan N. The analysis of length-weight relationship of *Channa punctatus* with relative physico-chemical parameters. Journal of Experimental Sciences. 2010; 1(5):4-5
24. Serajuddin M, Prasad L, PB, Pathak BC. Comparative study of length-weight relationship of freshwater murrel, *Channa punctatus* (Bloch1793) from lotic and lentic environments. World Journal of Fish and Marine Sciences. 2013; 5(2):233-238.
25. Kashyap A, Awasthi M, Serajuddin M. Length–weight relationship of freshwater Murrel, *Channa punctatus* (Bloch, 1793) sampled from Northern and Eastern parts of India. In Proc. 23rd Swadeshi Science Congress, 2013, 642-645.
26. Kashyap A, Awasthi M, Serajuddin M. Length-Weight and Length-Length Relationship of Freshwater Murrel, *Channa punctatus* (Bloch, 1793) Sampled from River Gomti in Lucknow Region (Uttar Pradesh). World journal of Fish and Marine Sciences. 2014; 6(4):336-339.
27. Ricker WE. Linear regressions in fishery research. Journal of the Fisheries Board of Canada. 1973; 30(3):409-434.
28. LeCren ED. The length weight relationship and seasonal cycle in gonad weight and condition in perch (*Perca fluviatilis*). Journal of Animal Ecology. 1951; 21:210-219.
29. Mustafa S. Length-weight relationship and condition factor of common minnow, *Esomus danricus* (Ham.) from different freshwater environments. Zoological Journal of the Linnean Society. 1978; 62(4):349-354.
30. Tesch FW. Age and growth. In: Method for assessment of fish production in fresh water. W.E. Ricker (Ed), Blackwell Scientific Publications, Oxford. 1968, 93-123.
31. Jhingran VG. Studies on the age and growth of *Cirrhina mrigala* (Ham.) from the river Ganga. In Proceeding of National Institute of Sciences, India. 1959; 52(3):107-137.
32. Natarajan AV, Jhingran AG. On the biology of *Catla catla* (Ham.) from the river Jamuna. In Proceeding of National Institute of Sciences, India. 1963; 298:327-355.
33. Khan RA. Studies on the biology of some important major carps. Unpublished Ph. D. Thesis, Aligarh Muslim University, Aligarh, 1972.
34. Chatterji A, Siddiqui AQ, Khan AA. Length - weight relationship of a carp, *Labeo bata* (Ham.). In Proceedings of the Indian Academy of Sciences-Section B.1977; 86(3):189-194.
35. Iqbal-Mir J, Kumar-Sarkar U, Prakash-Gusain O, Kumar-Dwivedi A. Length- weight relationships of the Indian Major Carp, *Labeo rohita* (Cypriniformes: Cyprinidae) from six drainages of Ganga basin, India. Cuadernos de Investigación UNED. 2015; 7(1):71-78.
36. Sekitar PKA, Hamid MA, Mansor M, Nor SAM. Length-weight Relationship and Condition Factor of Fish Populations in Temengor Reservoir: Indication of Environmental Health. Sains Malaysiana. 2015; 44(1):61-66.
37. Mortuza G. Length- Weight Relationships of Twelve Fishes from the River Padma near Rajshahi City, Bangladesh. Fisheries and Aquaculture Journal, 2015; 6(1):1-2.
38. Radkhah A, Eagderi S. Length-weight and length-length relationships and condition factor of six cyprinid fish species of Zarrineh River (Urmia Lake basin, Iran). Iranian Journal of Ichthyology, 2015; 2(1):61-64.
39. Pathak BC, Serajuddin M. A Comparative Study of Length-Weight Relationship and Condition Factor of Lesser Spiny Eel, *Macrognathus aculeatus* (Bloach) from the Different River Basins of India. World Journal of Fish and Marine Sciences. 2015; *7*(2):82-86.
40. Achakzai WM, Saddozai S, Baloch WA and Memon N. Length-Weight Relationships and Condition Factor of *Oreochromis mossambicus* (Peters, 1852) from Manchar Lake Distt. Jamshoro, Sindh, Pakistan. Sindh University Research Journal-SURJ Science Series. 2013; *45*(2): 201-206.
41. Pathak BC, Zahid M, Serajuddin M. Length-Weight, Length-Length Relationship of the Spiny Eel, *Macrognathus pancalus* (Hamilton 1822) sampled from Ganges and Brahmaputra river basins, India. Iranian Journal of Fisheries Sciences. 2013; 12(1):170-182.
42. Ali S, Barat A, Kumar P, Sati J, Kumar R, Haldar RS. Study of the length-weight relationship and condition factor for the Golden Mahseer, *Tor putitora* from Himalayan rivers of India. Journal of Environmental Biology. 2014; 35(1):225-228.
43. Hile R. Age and growth of the cisco Leucichthys artedi (Le Sueur), in the lakes of the north-eastern highlands, Wisconsin. Bulletin of U.S. Bureau of Fisheries. 1936; 48:211-317.
44. Carlander KD. Handbook of freshwater fishery biology. Life history data on freshwater fishes of the United States and Canada, exclusive of the Perciformes. 1969, 1.
45. Nash RD, Valencia AH, Geffen AJ. The origin of Fulton's condition factor-setting the record straight. Fisheries. 2006; *31*(5):236-238.