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Assessment Of Length-Weight Relationships And Condition Factors In *Rita Rita* (Hamilton, 1822) Of Gomti River, Lucknow, India

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Abstract

The objective of this research is to assess the length-weight relationship (LWR) as well as Fulton's condition factor of freshwater catfish species i.e., *Rita rita* from Gomti River, Lucknow, Uttar Pradesh. A total of 319 fish specimens were randomly sampled from January 2022 to December 2022. The results revealed the values of 'b' for male, female, and pooled populations are 2.68, 2.73, and 2.70 respectively which represents negative allometric growth. The coefficient of correlation, 'r^2' between total length and body weight for males, females, and pooled population were estimated as 0.931, 0.934, and 0.933 which is significant at a 1% level. The fish were found to be in good health condition, as the calculated value of Fulton's condition factor varied from 1.33 to 1.39. The present research is beneficial as it offers pertinent data for studying fish biology, assessing the condition of fish in their habitat, and evaluating parameters about population dynamics.

KEYWORDS: Catfish, allometric growth, Fulton's condition factor, population dynamics.

Introduction

Fish serves as a vital nutritional component owing to the presence of high protein. Overfishing of commercially important fish species and environmental deterioration caused by pollution are the major reasons for decline of the fish population (Coll *et al.*, 2010; Zhou et al., 2010). One of the most important components in species management is the statistical study of morphometric features. In the last few years, the statistical association of morphometric features has been recognized as important in all systematic and taxonomic investigations to answer many difficulties of fish life history. Morphometric measurements and statistical correlations of fishes are crucial for fisheries biology (Brooks and Mustafa, 2008) and taxonomy investigations (Simon *et al.*, 2010). These interactions can provide information about fish status and development trends (Oscoz *et al.*, 2005; Tesch and Bagenal, 1978).

The length-weight relationship and condition factor are crucial for the fishing sector as they not only help stock evaluation of fishing resources but also enable comparisons of physical health attributes, life histories, and morphology across various fish species or populations from different environments or areas (King, 2007; Beyer, 1987; Bobori *et al*., 2010, Goncovales *et al*., 1997; Santos *et al*., 2002). During Yield assessment, weight can be calculated by using length data of length weight relationship (Pauly, 1993). The mathematical

association between the two variables, weight, and length, is an appropriate gauge for assessing the fish's development, survivability, reproduction, maturity, and overall well-being. (Le Cren, 1951).

Fish can attain either isometric growth, positive allometric growth, or negative allometric growth. Suppose a fish grows isometrically, which is linked to no change in the body form of the fish. Fishes showing positive allometric growth become relatively stouter or deeper-bodied as they increase in length on the other hand fishes growing with negative allometric growth suggest that the fish tend to become slenderer as it increases in weight (Riedel *et al.*, 2007). The ecological appropriateness of a particular water body for the growth of fish may also be determined by the condition factor, which can also consider seasonal variations, the quality of the food, and the kind of aquatic systems, such as rivers or lakes (Yilmaz *et al*., 2012; Alam *et al*., 2014; Mouludi-Saleh and Eagderi, 2019).

When considering the catfishes, they contribute to the overall biodiversity of aquatic ecosystems. They play a role in maintaining the balance of the food web by consuming smaller organisms and serving as prey for larger predators. Any changes in the catfish population can indicate the health of the aquatic environment, and their presence or absence can be used as indicators of water quality and habitat conditions deciding environmental health (Dubey 1994). They also serve as economically important by providing food supplies and employment opportunities to local people who inhabit the area near the river banks especially when considering the Gomti River which is an important tributary of the Gangetic basin (Lal and Dwivedi 1969). Catfish species are often targeted by local fisheries for their commercial value by contributing in the livelihoods of many local fishermen who rely on fishing activities for their income.

Catfish are a popular food source for local communities provide a protein-rich diet and are an important part of the culinary traditions in many regions Tripathi (1996). Fishing activities related to catfish provide employment opportunities for individuals involved in the fishing industry, including fishermen, processors, and distributors. Catfish play a role in nutrient cycling in aquatic ecosystems. Feeding on organic matter contributes to the breakdown of dead plant and animal material, helping to recycle nutrients within the ecosystem, helping control aquatic vegetation, and maintaining the balance of the ecosystem that can indirectly contribute to erosion control along riverbanks. Catfish may hold cultural and traditional significance for local communities, being part of folklore, rituals, or ceremonies. In some areas, catfish are targeted by recreational anglers, contributing to tourism and local economies associated with outdoor activities (Gupta and Banerjee 2014).

The Gomti River, not only supports a rich biodiversity of various hydrofaunal species but also offers nutritional security and livelihood to the human population by harboring certain commercially important catfishes, especially *Rita rita*, which has been studied with special reference in a length-weight relationship from the Lucknow region. Hence, the study will provide an important implication of the overall status of the catfish *R. rita* from the Gomti River and its fate in the ecosystem.

Materials and Methods

Site description and fish identification

From January 2022 to December 2022, fish samples of *Rita rita* (Hamilton, 1822), were randomly collected from the Gomti River (26°50'4"N 80°54'52" E) near Dhobi Ghat, Pakka Pul, Lucknow, Uttar Pradesh with the help of local fishermen. The Gomat Taal, also called Fulhaar Jheel, is the source of the Gomti river, which receives water from both the monsoon and groundwater and is located close to Madho Tanda in Pilibhit, India. It passes through Uttar Pradesh for 960 kilometers (600 mi) before joining the Ganges River close to Saidpur, Kaithi in the Varanasi district. The river basin is also home to a diverse range of flora, including submerged plants, floating vegetation, and riparian trees. The collected fish specimens were then identified following the characteristics published by Talwar and Jhingran, (1991).

Using cast nets with various mesh sizes from January 2022 to December 2022, host fish samples were randomly collected from the Gomti River (26°50'4"N 80°54'52"E) near Dhobi Ghat, Pakka pul, Lucknow, Uttar Pradesh. The collected fish specimens were then identified in accordance with Talwar and Jhingran, (1991).

Length-weight Measurements and Condition Factors

The length-weight association for males, females, and both sexes was calculated using the equation $W = a L^b$ (Le Cren, 1951). Where 'W' is the total weight (in grams), 'L' is the total length (in centimeters), "a" is a body form coefficient, and "b" is an exponent indicating isometric growth when equal to 3 and allometric growth when significantly different from 3 (Simon and Mazlan, 2008; Simon *et al*., 2009).

Statistical Analysis

A linear regression model was used to estimate the parameters "a" and "b" of the exponential curve using length overweight data that had been log-transformed, log TW = log a + b log TL. The linear regression coefficients "a" and "b" were determined in the manner of Lagler (1966), Rounsefell, and Everhart (1953). Fulton's condition factor (Fulton, 2022), 'K', was calculated using the formula $K= (TW/TL^3) *100$, where 'K' stands for Fulton's condition factor, 'TW' stands for total weight, and 'TL' refers to the total length. K is brought close to unity in this case by employing factor 100. The correlation data was analyzed by using the analysis of variance (ANOVA) statistical tool.

Ethics statement

To avoid any form of harm to the experimental fish, the national guidelines of the ethical committee (CPCSEA, 2006) were strictly complied with during the period of experimental procedures and sampling.

3 RESULTS

3.1 Length-weight relationship

For examining the length-weight relationship in *Rita rita* fish, 319 specimens were randomly sampled, and separate length-weight equations were made for the male, female, and pooled populations. The scatter diagram demonstrated a-linear curve when the length was plotted against their respective weight as depicted in Figures 1, 2, and 3.

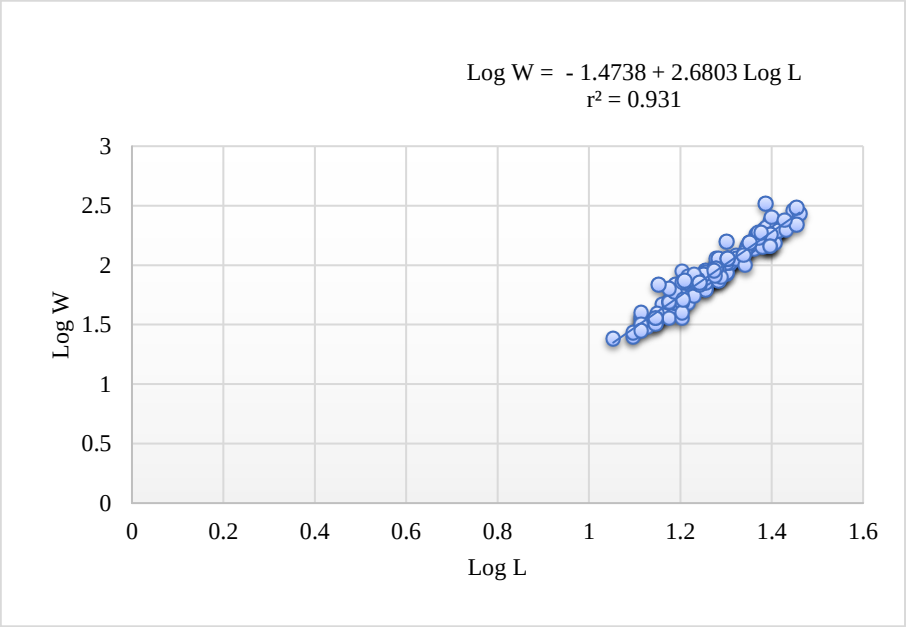

Fig. 1. Length-weight relationship in males of *Rita rita*

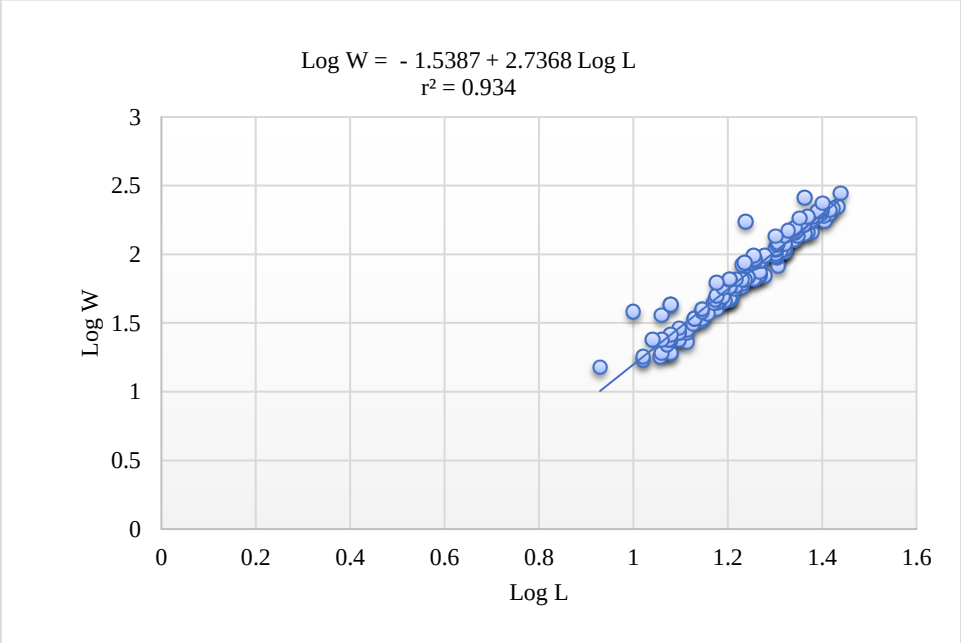

Fig. 2. Length-weight relationship in females of *Rita rita*

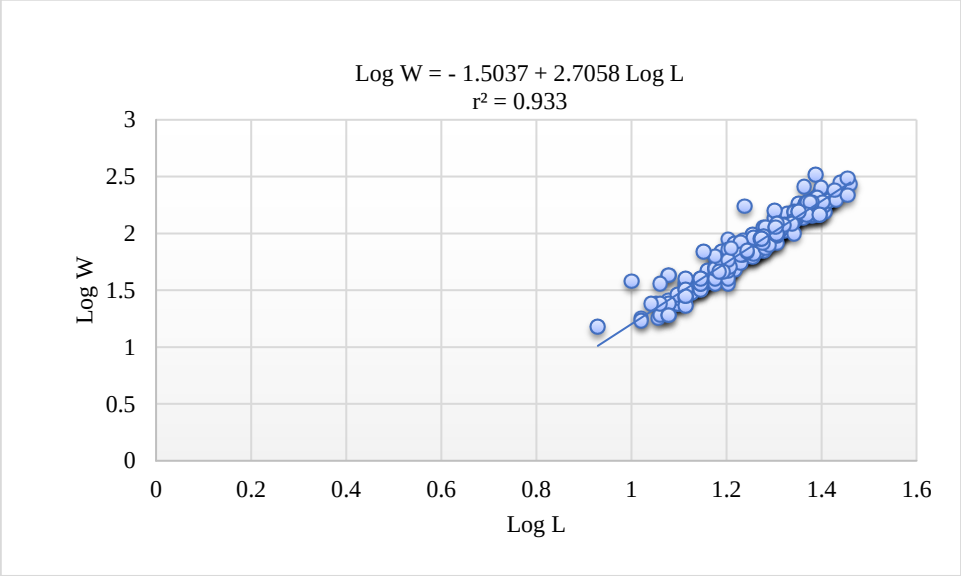

Fig. 3. Length-weight relationship in pooled population of *Rita rita*

Logarithmic Regression

Logarithmic regression equations of weight and length relationships and growth patterns are shown in Table 1, while Table 2 shows the statistical analysis of the different length-weight attributes for males, females, and the pooled population. For males, females, and the pooled population, the coefficient of determination, or "r^2" was found to be 0.931, 0.934, and 0.933, respectively. These values are significant at the 1% level showing a correlation between length and weight of the sampled fish.

Table 1: Logarithmic regression equations of weight on length, values of coefficient of correlation (r^2) and types of growth of male, female and pooled (male & female) of *Rita rita*.

Sex	Regression equation	Cofficient of correlation (r2)	Growth Pattern
Male	Log W = - 1.4738 + 2.6803 Log L	0.931	Allometric
Female	Log W = - 1.5387 + 2.7368 Log L	0.934	Allometric
Pooled population	Log W = - 1.5037 + 2.7058 Log L	0.933	Allometric

Table 2: Descriptive statistics of length and weight parameters of *Rita rita*

Sex	No. of fishes	Range length (cm)	Range weight (g)	Mean length (cm)	Mean weight (g)	a	b	r^2
Male	182	11.3-28.9	24-330	19.302	104.483	0.229	2.680	0.931
Female	137	8.5-27.5	15-278	18.148	94.189	0.214	2.736	0.934
Pooled	319	8.5-28.9	15-330	18.807	100.062	0.222	2.705	0.933

Fulton's condition factor (K)

The Fulton's condition factor of *Rita rita* fish was estimated for males, females, and the pooled population separately. The K value was highest in females, followed by the pooled population and the males. The estimated values with average, standard error and range are shown in Table 3. The values of the condition factor ranged from 1.331 (males) to 1.393 (females) to 1.358 (pooled), which are indicative of the good health condition of sampled fish. The 'K' values were classified as follows by Barnham PSM and Baxter (1998) 1.60 (excellent), 1.40 (good), 1.20 (fair), 1.00 (poor), and 0.80 (highly poor). When the categorization was applied to the current study, the condition of the fish was fairly good. No significant variation was observed when considering the Fulton's condition factor between males, females, and pooled samples ($p< 0.5$).

Table 3: Fulton's Condition Factor values of *Rita rita*

Sex	n	Average	S E	Max	Min
Male	182	1.331	0.074	2.409	0.878
Female	137	1.393	0.117	3.8	0.98
Pooled	319	1.358	0.095	3.8	0.878

DISCUSSIONS

The length-weight relationship's exponent value (b) plays a key role in predicting the growth pattern of many fish species (Froese, 2006). The computed 'b' values in the current study for male, female, and combined populations were 2.680, 2.736, and 2.705 respectively which fell under the normal distribution frequency of exponent b between 2.5 to 3.5. (Froese, 2006). The results showed that the females have the greatest 'b' value, indicating that they are in good physical health and acquire weight more quickly relative to length than the males and the pooled population. As noted by Le Cren, 1951; Yildrim *et al.*, 1998 differences in "b" values may be caused by general fish conditions including age, sex, reproductive and feeding activity, and specific environmental factors. As $b<3$, the growth pattern exhibited by *Rita rita* fish is negative allometric growth which is also suggested by Ankita *et al*, 2022. Negative allometric growth in *Rita rita* also coincides with the negative allometric growth pattern of *Wallogo attu* from the Ganga, Yamuna, and Gomti rivers as reported by Sani *et al.* 2010; Sarkar *et al.* 2013. According to Wootton, 1990 $b>3$ indicates a negative allometric growth, where increment in length is more than the weight gain, and if $b<3$, indicates a positive allometric growth, where weight gain is higher than the length increment.

Fulton's condition factor

Fish population, growth rates, and feeding intensity may all be tracked and evaluated using condition factors (Oni *et al.*, 1983; Blackwell *et al.*, 2000). The condition factors can also act as a good index to evaluate the state of the aquatic ecosystem of the fish habitat which can be heavily impacted by both biotic and abiotic environmental factors (Barnham, 2003). If the value of Fulton's condition factor (K) of a fish species is more than 1 the overall fitness of fish species is presumed as the condition factor represents the health condition and well-being of fish (Nash *et al*, 2006). The K value of females (1.393) was higher than the pooled population (1.358) and males (1.331) in the present study showing that females are in better condition than the pooled population and the males (Table 3). The Fulton's condition factor was found to be more than 1 in all three populations determining that the fishes are living in good condition.

Conclusion

The present work offers the source of information on the length-weight relationship and Fulton's condition factor for the population of *Rita rita* fish from the Gomti riverine ecosystem of Lucknow, Uttar Pradesh. The

current study on the length-weight relationship in *Rita rita* fish shows deflection from the cube law which suggests negative allometric growth. The Fulton's condition factor (K) for males, females, and the pooled population was more than 1, indicating that the species in this river is in good condition and is growing well. To demonstrate that the aquatic system supports a greater growth rate of fish, comprehensive research incorporating the impact of environmental factors in varying growth rates in diverse aquatic systems and the water quality indicators is necessary. The findings of the study are important for the general idea of the status of *R. rita,* inhabiting the Gomti River and the local areas, for its species richness and steps in conservation policies caging it as lower risk near threatened in India.

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REFERENCES

1. Alam, M.M., Rahman, M.T. & Parween, S. (2014). Morphometric characters and condition factors of five freshwater fishes from Pagla River of Bangladesh. *International Journal of Aquatic Biology*, 2(1), 14-19.
2. Ankita, Khan M.A., Khan S. (2022). Relationships between length-weight, length-length, and fish length to otolith morphometry in *Rita rita* (Hamilton, 1822). *Zoology and Ecology*, 32(1), 49–55.
3. Bagenal, T.B., Tesch F.W. (1978). Age and growth. In: Bagenal, T.B. (ed), Methods for assessment of fish production in freshwater, 3rd ed. Blackwell Scientific Publication: Oxford, UK.
4. Barnham, Charles A & Baxter, Alan. F & Victoria. Department of Primary Industries. (2003). Condition factor, K, for Salmonid fish [electronic resource] / Charles Barnham, PSM & Alan Baxter.
5. Beyer, J.E. (1987). On length-weight relationships, Part 1: Computing the mean weight of the fish of a given length class. *Fishbyte*, 5(1), 11-13.
6. Blackwell B.G., Brown M.L., & Willis D.W., (2000) Relative weight (wr) status and current use in fisheries assessment and management. *Reviews in Fisheries Sciences*, 8 (1), 1-44.
7. Bobori, D., Moutopoulos, D.K., Bekri, M., Salvarina, I. and Munoz, A.P. (2010), Length-weight relationships of freshwater fish species caught in three Greek Lakes. *Journal of Biological Research,* 14: 219-224.
8. Coll, M., Piroddi, C., Steenbeek, J., Kaschner, K., Ben Rais Lasram, F., Aguzzi, J. & Voultsiadou, E. (2010). The biodiversity of the Mediterranean Sea: estimates, patterns, and threats. *PloS one*, 5(8), e11842.
9. Committee for Control and Supervision of Experiments on Animals (CCSEA) (2006). Guidelines. https://ccsea.gov.in
10. Dubey G.P. (1994) Endangered, vulnerable and rare fishes of west 67 coast of India. Threatened fishes of India, Proceedings of the National seminar on endangered fishes of India held at National Bureau of Fish Genetic Resources, Allahabad, 77-95.
11. Froese, R. (2006). Cube law, condition factor, and weight–length relationships: history, meta-analysis, and recommendations. *Journal of Applied Ichthyology*, 22(4), 241-253.
12. Fulton, T. W. (2022). The sovereignty of the sea: a historical account of the claims of England to the dominion of the British seas, and of the evolution of the territorial waters. DigiCat.
13. Goncovales, J.M., Bentes, S.L., Lino, P.G., Riberio, J., Canario, A.V.M. and Erzini, K. (1997). Weight-Length relationship for selected fish species of the small-scale demersal fisheries of the South and South-west coast of Portugal. *Fisheries Research*, 30: 253-256.
14. Gupta S. and Banerjee S. (2014). Indigenous ornamental fish trade of West Bengal. Narendra Publishing House, New Delhi, 63
15. Jhingran, V.G. (1991). Fish and Fisheries of India. 3rd ed. Hindustan Publishing Corporation, Delhi, India
16. King, M. (2007). Fisheries Biology, Assessment and Management. 2007. 2nd edition, Blackwell Scientific Publications, Oxford. 189-192.
17. Lagler K. F., (1966) Freshwater fishery biology (2nd edn.). Brown W. M. C. (ed), Co. Dubuque, Iowa, 421 pp.
18. Lal M.S. and Dwivedi A.S., (1969) Studies on the fishery and biology of a freshwater teleost, *Rita rita*. 1. Racial studies, Indian J. Zool., 9(2), 79-90

19. Le Cren, E.D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in perch (*Perca fluviatilis*). *Journal of Animal Ecology*, 20: 201–19.
20. Mouludi-Saleh, A. and Eagderi, S. (2019). Length-weight relationship and condition factor of ten fish species (Cyprinidae, Sisoridae, Mugilidae, Cichlidae, Gobiidae, and Channidae) from Iranian inland waters. *Journal of Wildlife and Biodiversity*, 3(4): 12-15.
21. Mustafa, M. G., & Brooks, A. C. (2008). Status of fisheries resource and management approach in the open Beels of Bangladesh: a comparative case study. *Asian Fisheries Science*, 21:189-203.
22. Nash, R.D., Valencia, A.H., Geffen, A.J. (2006). The origin of Fulton's condition factor is setting the record straight. *Fisheries*, 31(5): 236-238.
23. Oni, S.K., Olayemi, J. Y., and Adegboye, J. D. (1983). Comparative physiology of three ecologically distinct freshwater fishes, *Alestes nurse* Ruppell, *Synodontis schall* Bloch and *S. schneider* and *Tilapia zilli* Gervais. *Journal of Fish Biology*, 22: 105–109.
24. Oscoz, J., Campos, F., & Escala, M. C. (2005). Weight–length relationships of some fish species of the Iberian Peninsula. *Journal of Applied Ichthyology*, 21(1), 73-74.
25. Pauly, D. (1993) Fishbyte section. Editorial. Naga. *ICLARM Quart.*, 16(26), 26.
26. Riedel, R., Caskey, L. M., and Hurlbert, S. H. (2007). Length-weight relations and growth rates of dominant fishes of the Salton Sea: implications for predation by fish-eating birds. Lake and Reservoir Management. 23, 528-535.
27. Rounsefell G. A., Everhart W. H., (1953). Fisheries science: its methods and application. John Willey and Sons, Inc., New York, 440 pp.
28. Sani, R, Gupta, B.K., Sarkar, U.K., Pandey, A., Dubey, V.K., Singh Lakra, W. (2010). Length–weight relationships of 14 Indian freshwater fish species from the Betwa (Yamuna River tributary) and Gomti (Ganga River tributary) rivers. *Journal of Applied Ichthyology,* 26, 456– 459.
29. Santos, M.S., Gasper, M.B., Vasconselus, P., and Monterio, C.C. (2002). Weight-length relationship for 50 selected fish species of the *Algarve coast* (southern Portugal). *Fisheries Research*, 59, 289-295.
30. Sarkar, U.K., Khan, G.E., Dabas, A., Pathak, A.K., Mir, J.I., Rebello, S.C., 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 B*iology, 34, 951–956.
31. Simon K. D., Bakar Y., Samat A., Zaidi C. C., Aziz A., Mazlan A. G., (2009). Population growth, trophic level, and reproductive biology of two congeneric archer fishes (*Toxotes chatareus*, Hamilton 1822 and *Toxotes jaculatrix*, Pallas 1767) inhabiting Malaysian coastal waters. *Journal of Zhejiang University Science B* 10(12), 902–911.
32. Simon, K.D., & Mazlan, A.G. (2008). Length-Weight and Length-Length Relationships of Archer and Puffer Fish Species. *The Open Fish Science Journal*, 1, 19-22.
33. Simon, K.D., Mazlan, A.G., Samat, A., Zaidi, C.C., and Aziz, A. (2010). Size, growth and age of two congeneric archer fishes (*Toxotes jaculatrix* Pallas, 1767 and *Toxotes chatareus* Hamilton 1822) *Sains Malaysian*, 39(5), 697–704.
34. Talwar, P. K., and Jhingran, A. G. (1991). Inland fisheries of India and adjacent countries.Vol.I& II. New Delhi: Oxford & IBH Publishing Company, 1–1158.
35. Tripathi S.D. (1996) Present status of breeding and culture of catfishes in south Asia. In Legendre, M. and Proteau J.P. (Ed). The biology and culture of catfishes, Aquat. Living Resour., 9, Hors Serie, 219-228.
36. Wootton, R.J. (1990). Ecology of Teleost Fishes. Fish and Fisheries Series 1. London: Chapman & Hall, 404 pp.
37. Yildrim A., Erdegan O., Turkmen M., and Demir B.C., (1998). The Investigation of some Reproduction characteristics of The *Alburnoides bipunctatus fasciitis* (Nordman, 1840) living in Oltu Stream of Coruh River (Artvin, Turkey). *Turkish Journal of Zoology*, 25: 163-168.
38. Yilmaz, S., Yazicioglu, O., Erbaþaran, M., Esen, S., Zengin, M. and Polat, N. (2012). Length-weight relationship and relative condition factor of white bream. *Blicca bjoerkna* (L., 1758), from Lake Ladik, Turkey. *Journal of Black Sea/Mediterranean Environment*, 18(3), 380- 387.
39. Zhou, S., Smith, A.D., Punt, A. E., Richardson, A.J., Gibbs, M., Fulton, E.A., ... & Sainsbury, K. (2010). Ecosystem-based fisheries management requires a change to the selective fishing philosophy. *Proceedings of the National Academy of Sciences*, 107(21), 9485-9489.