



Studies on Length-weight Relationship of *Noemacheilus montanus* (McClelland) from River Yamuna, India

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ABSTRACT

The length-weight relationship of 110 fishes including 52 males and 58 females from the snow-fed River Yamuna in Uttarakhand, India, was investigated in the present study. The value of “b” ranged between 1.016 and 1.089. The length-weight relationship parameters of *Noemacheilus montanus* showed low positive allometric growth, with a ‘b’ value of 1.016 for males and 1.089 for females for the fish length from the snow-fed River Yamuna. During this study the regression coefficient (b) value i.e. 1.089 for females is observed to be slightly higher when compared to that of males (1.016).

Keywords: Length-weight relationship, *Noemacheilus montanus*, River Yamuna.

INTRODUCTION

Studies on the length-weight relationship are important in fisheries science because it reveals relevance to fish population dynamics and stock growth patterns. According to Patil et al. (1993), the research of length-weight and their relationship is crucial in the study of fish stock growth in a specific area. According to Beverton and Holt (1957), in order to develop appropriate yield equations for estimating population strength, the mathematical relationship between length and weight for enabling the inter-conversion of these variables is essential. Ichthyologist has studied the length-weight relationship, condition factor, and relative condition factor in various freshwater fishes (Thakre & Bapat, 1984; Bali & Sharma 2002; Uniyal et al., 2004; Bahuguna et al., 2005, 2009a-b, 2010b, 2017, 2021a; Laskaret al., 2005; Kumar et al., 2006a; Sarkar et al., 2008; Dobriyal et al., 2010; Bahuguna & Joshi 2010, 2012b; Joshi et al., 2009a,

2014b; Rashid et al., 2019 and Rayal et al., 2021c). The body parameters of a fish frequently change with aging (Dobriyal 1988; Dobriyal & Singh 1990; Dobriyal & Negi 2001; Bahuguna 2013; Bahuguna & Balodi 2015; Joshi et al., 2017). The length of fish has a special relationship with its weight.

Sexual dimorphism has been reported in a few hill-stream fishes and prawns (Dobriyal et al., 2007; Bahuguna et al., 2010c; Bahuguna and Kumar 2013). Joshi et al. (2013, 2014a-b) studied the various biological aspects like fecundity, sex ratio, length-weight relationships and aging of *Noemacheilus* species in different water bodies of Uttarakhand. There is currently no information on the length-weight relationship of the cold-water fish *Noemacheilus montanus*, thus the current study was undertaken to determine the pattern of growth and overall condition of this species in natural cold waters for use in fisheries management and assessment.

MATERIAL AND METHODS

River Yamuna is the longest tributary of the Ganga, and it flows from the Yamnatri glacier in Uttarakhand, which is located at a height of 6387 meters from the Banderpooch peaks in the lower Himalayas. It runs through Uttarakhand, passes through Himachal Pradesh's Paonta sahib, and then through Haryana, Uttar Pradesh, and Delhi. It ultimately joins the Ganga in Prayagraj's Triveni Sangam. Due to the impoundment of water for several reservoirs and hydroelectric power plants such as the Aasan Barrage, Dakpathar Barrage, Hathnikund Barrage, Dhalipur Dhakrani powerhouse, Kulhaal powerhouse, etc. its habitat has changed from riverine to lacustrine. The Aasan Barrage was designated as Uttarakhand's first Ramsar site in 2020. From January 2021 to December 2021, fish samples were taken from the commercial catch at the first landing center in the Kulhaal region (Rayal et al., 2020). Traditional fishing gear (Bahuguna et al., 2010a; Bahuguna & Joshi 2012a; Bahuguna 2020, 2021; Rayal et al., 2021a-d) was used to catch the fish. The fish were measured in terms of total length and weight while still in fresh condition. Randomly selected individuals' total body length (TL) and body weight (BW) were measured to the closest 0.1 cm and 0.1 g precision, respectively. Following that, samples were taken to the lab for subsequent identification and taxonomic studies. For identification, Day (1878), Talwar and Jhingran (1991), Jayaram (2010), Bahuguna and Dobriyal (2019) were used as standard keys and literature. The fish were preserved in 10% formalin, labeled, and put in plastic boxes before being delivered to the lab, where the specimens were dissected and the sex verified.

The monthly data was divided into 10mm size groups, ranging from 5.1 to 8.2mm for males and females, respectively. The data were pooled individually for males and females at 10mm class intervals once the sex was confirmed externally. The formula $W = aL^b$ was used to determine length-weight regression for males and females individually, where W represents weight in grams, L is length up to the caudal fork in mm, and a and b are constants.

RESULTS

A length-weight relationship was studied in 110 fish (52 male and 58 female) from the snow-fed River Yamuna in Uttarakhand, India.

Length-weight relationship for *Noemacheilus montanus*

Table-1 displays the results of a regression analysis of the length-weight relationship for *Noemacheilus montanus* by gender and season. The fish samples were sorted by season and gender, revealing close relationships between

their length and weight. For gender and season-wise data, the regression coefficient ranged from a minimum of 1.016 to a maximum of 1.089 for the male and females, respectively. During the analysis, it was observed that the total length-weight of *Noemacheilus montanus* was positively correlated for males ($r=0.7010$) and females ($r=0.8423$) separately. For male fishes, it ranged from a minimum of 0.805 ($r=0.7712$) during the monsoon to a maximum of 1.103 ($r=0.8534$) during the winter, while for female fishes, it ranged from a minimum of 0.911 ($r=0.8019$) during the monsoon to a maximum of 1.131 ($r=0.8907$) during the winter.

Table-1: Regression examination and coefficient of correlation on the length-weight relationship of *Noemacheilus montanus*.

S.N.	Condition	Parabolic Equation	Correlation Coefficient "r"
1	Sex wise data		
	Female	$W = -4.121 L^{1.089}$	0.8423
	Male	$W = -4.324 L^{1.016}$	0.7010
2	Season and Sex wise		
	Male		
	Spring (Mar, Apr)	$W = -4.223 L^{0.879}$	0.8587
	Summer (May, Jun)	$W = -4.128 L^{1.200}$	0.8210
	Monsoon (Jul, Aug)	$W = -4.341 L^{0.805}$	0.7712
	Autumn (Sep, Oct, Nov)	$W = -3.794 L^{0.964}$	0.8246
	Winter (Dec, Jan, Feb)	$W = -3.360 L^{1.103}$	0.8534
	Female		
	Spring (Mar, Apr)	$W = -3.341 L^{0.944}$	0.8304
	Summer (May, Jun)	$W = -4.210 L^{1.255}$	0.8480
	Monsoon (Jul, Aug)	$W = -3.329 L^{0.911}$	0.8019
	Autumn (Sep, Oct, Nov)	$W = -2.851 L^{0.980}$	0.8207
	Winter (Dec, Jan, Feb)	$W = -3.905 L^{1.131}$	0.8907

DISCUSSION

The length-weight relationship of an aquatic animal is a measure of the growth pattern. Growth is an important component of biological production, which affects overall production directly. The parameters of body mass weight-length relationship of *Noemacheilus montanus* in this study exhibited lower positive allometric growth with

a 'b' value of 1.016 for males and 1.089 for females in relation to fish length from snow-fed River Yamuna. In the present study, it was noticed that the regression coefficient (b) of females (1.089) is observed to be slightly higher when compared to that of males (1.016). From this trend it may be presumed that females gained more weight with an increase in length, indicating better well-being. Comparable observations were reported by Bahuguna and Baluni (2019) in freshwater fish, *Puntius conchoni* from the Mandal River. The 'b' values were seasonally high in *Noemacheilus montanus* as 1.200 for males and 1.255 for females. These higher values were either due to the maturation of gonads or due to a favorable feeding environment. In fishes, food availability and water temperature played an important role in growth dynamics. The differences in the values of the 'b' parameter between the studied species probably result due to differences in feeding and breeding behavior.

Joshi et al., (2014b) reported the length-weight relationship of *Noemacheilus montanus* and observed that the values of 'b' were 0.966 to 1.114 from the Kumaun region in the spring-fed Rai Gad stream. Bahuguna (2021) observed that the length-weight relationships of a species could vary according to season and locality. In the present study, the growth rate of freshwater fish *N. montanus* varied depending on several factors such as food availability, month and season of the year, and reproductive cycle. *Noemacheilus montanus* exhibited low allometric growth throughout the study period which indicated that they are affected by multiple environmental factors.

The study of the length-weight relationship has been made by Le Cren (1951) in *Preca fluviatilis* who reviewed the cubic parabola into a general parabola. The value of "b" varied from 2.5 to 4.0 in the studies of Martin (1949). If the fish retain the same shape it grows isometrically and the length exponent "b" has the value 3.0. A value significantly larger or smaller than three shows that fish becomes heavier or lighter for its length as it grows, and this may be due to metamorphosis and onset of maturity (Huxley, 1932; Frost, 1945).

Rashid et al. (2019) reported in *M. armatus*, the regression coefficient for gender varied from 3.997 for males and a minimum of 3.97 for female fishes. The Length-weight relationship of *Garra lamta* was found significantly narrow. The value of 'b' fluctuated from 1.035 to 3.164. Bahuguna et al. (2010b) noticed that the length-weight relationship of *Garra lamta* from the Kalapani stream showed lower growth rates due to the ecological condition of the stream.

After all, we can say, the length-weight relationship in

fishes can be affected by habitat and area as well several other factors like as riparian and seasonal effect (Sagir et al., 2018; Baluni & Chandola, 2019), periphyton food (Baluni et al., 2017, 2018, 2020; Baluni 2020; Bahuguna & Baluni 2019; Bahuguna et al., 2021b), availability of microzoobenthos (Bahuguna et al., 2019a, 2020b; Bahuguna & Dobriyal, 2019; Pesic et al., 2019a-b, 2020a-b; Negi et al., 2021a-b), macrozoobenthos density and diversity (Dobriyal et al., 2009, 2011; Bahuguna and Negi 2018; Bahuguna and Dobriyal 2018; Bahuguna et al., 2019b, 2020b; Mamgain et al., 2021) and time of gonad maturity (Dobriyal et al., 1999; Bisht et al., 2005; Kumar et al., 2006b; Joshi et al., 2008, 2009b; Bahuguna and Kumar 2011; Bahuguna 2012; Bahuguna & Dobriyal 2013; Bahuguna et al., 2020c; Rayal et al., 2021d) and fish ageing (Dobriyal 2004).

CONCLUSION

Noemacheilus montanus species is predominantly found in snow-fed River Yamuna. The length-weight relationships of *Noemacheilus montanus* showed lower positive allometric growth with a 'b' value of 1.016 for males and 1.089 for females. The correction coefficient "r" showed there was a high correlation between length and weight. From the trend so obtained it may be presumed that females gained more weight with an increase in length, indicating better well-being.

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