J. Mountain Res. ISSN: 0974-3030
Vol. 12, (2017) 81-86

Studies on the ageing biology of hill stream loach, *Noemacheilus montanus* from Kumaun Himalaya, India

Anita Joshi[1] • Pramod Kumar[1] • Naveen Chandra Khanduri[2] • Pankaj Bahuguna[2]*
[1]*Department of Zoology, R.H. Govt. P. G. College Kashipur, Uttarakhand, India.*
[2]*Department of Zoology, Fish Biology and Aquatic biodiversity Lab., A.P.B.G.P.G. College Agustyamuni- 246421, Uttarakhand, India.*

*Corresponding Author Email: pankajpaurii@gmail.com

Received: 18.10.2017; Revised: 05.11.2017; Accepted: 17.12.2017

Abstract: The present study provides an account of the age and growth of a hillstream loach, *N. montanus* from Kumaon Himalaya. One hundred species of *N. montanus* were collected from Rai stream i.e., tributary of the river Kali and were examined for ageing biology. Vertebrae were considered as experimental material for age determination often getting a straight line relationship between fish length and vertebrae diameter. On the basis of above observation it may concluded that the life span of the *N. montanus* is maximum three years.

Keywords: *N. montanus* • vertebrae • age • loach

Introduction

Age determination is an important tool in fishery biology, especially for the assessment of life history, growth rate, age at the first maturity and population dynamics. Different methods have been employed for the determination of fish age. Scales, otoliths, vertebrae, fins, spines, fin rays etc. are some of the common structures used in fishes. Age calculated from these structures is usually verified by length-frequency analysis. Immense work has been done on age determination and growth estimation in fishes till date. Some chief contributors are Kler (1916); Lee (1920); Jhingran (1957); Bagenal and Tesch (1978), Dobriyal and Singh (1990); Johal et al. (2000); Bahuguna (2013); Khan et al. (2015); Bahuguna and Balodi (2015) and Mahé et al. (2016).

Material and Methods

Sample Collection: The study material consisted of 100 specimens of *Noemacheilus montanus.* Month wise fish samples were collected from October 2013 to September 2015 in spring-fed Rai stream of Kumaun Himalaya. Fishes were caught using X-net and hand picking method.

Body Measurement: Total length (TL) of each fish was measured from the tip of the snout to the longest fin ray of the caudal fin. All fish samples were measured to the nearest 1 mm. Each fish was weighed separately on a weighing balance. Age determination and growth rate mechanism of *N. montanus* (McClelland) was calculated following the vertebrae method. The trunk vertebrae from 100

specimens were observed in the present study. Specimens were dissected (open) and transverse section of its Centrum was cut with the help of a clean sharp razor. It was then kept in clove oil to impart transparency. Finally the cleared trunk vertebrae were kept in an envelope for further examination. The fish length and vertebrae radius relationship was examined with the help of standard regression analysis.

Vertebrae were subjected for further examination, which includes the identification of annuli and measurement of focus. Besides, monthly minimum width in terminal zone (i.e. the distance from last annuli to margin) was also noticed for each vertebrae round the year. The data was further analyzed to find out the month and probable cause of annuli formation.

Back calculation for vertebrae: The growth rate of fish was calculated by back calculation method as suggested by Lea (1910).

The formula read as: $\mathbf{l_n = V_n / V.\ l}$

Where: l_n = Length of fish when annulus "n" was formed, l = Length of fish when vertebrae sample was obtained, V_n = Vertebrae radius of annulus "n" at l_n and V = Vertebrae radius.

Results

It is observed that the vertebrae structures of *N. montanus* (McClelland) were very suitable for age determination. Vertebrae are found to be circular in most of the cases. The opaque and hyaline zones were clearly distinct, hence the circular ring, were considered as annuli. Each annulus comprised of two growth rings. The age and growth pattern in *N. montanus* (McClelland) based on the various length groups is provided in Table 1. The relationship between fish length and vertebrae radius is shown in Figure 1. It was calculated as: VR = -24.28 +1.245 FL, r = 0.0867, r^2 = 0.753. (VR = vertebrae radius, FL = fish length, r = Coefficient of correlation, r^2 = Coefficient of determination.

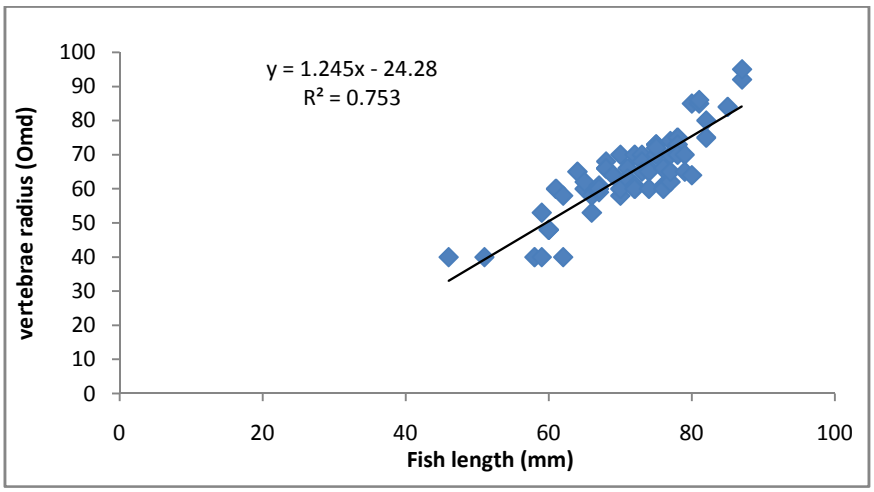

Figure 1 Regression between fish length and vertebrae radius in *N. montanus.*

Time of annulus formation: In the present investigation maximum three age rings were counted (Fig. 3–5) Minimum width in terminal zone for vertebrae was observed during July-August (Fig. 2).

Growth rate of fish by back calculation method

The growth rate of *N. montanus* (McClelland) was also determined by the back calculation method based on trunk vertebrae. It was observed that the first ring was formed at an average length of 51.77 mm. The second and third rings were appeared at an average length of 64.74mm and 74.11mm respectively. The annual increment (h) of 51.77mm, 12.97mm and 9.36mm were observed from first to third year (Table 2).

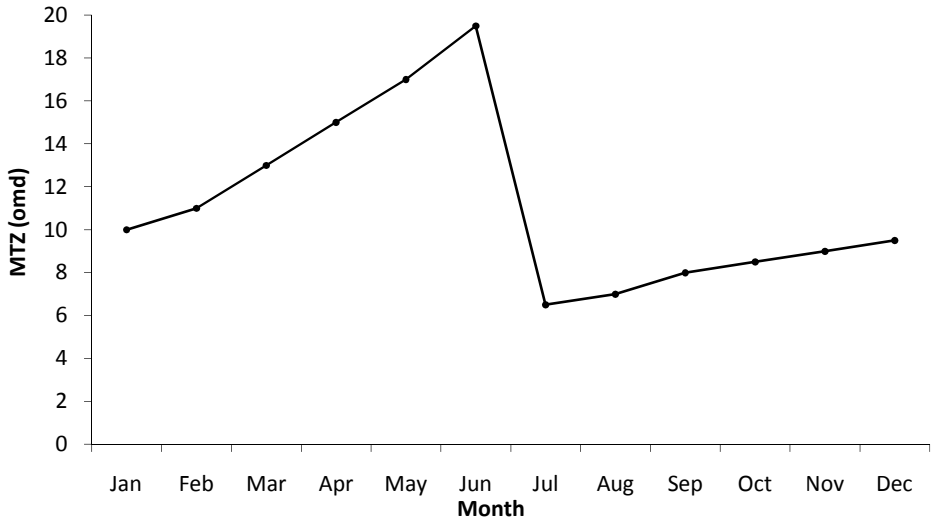

Figure 2 Minimum width in terminal zone of age in the vertebrae of *N. montanus.*

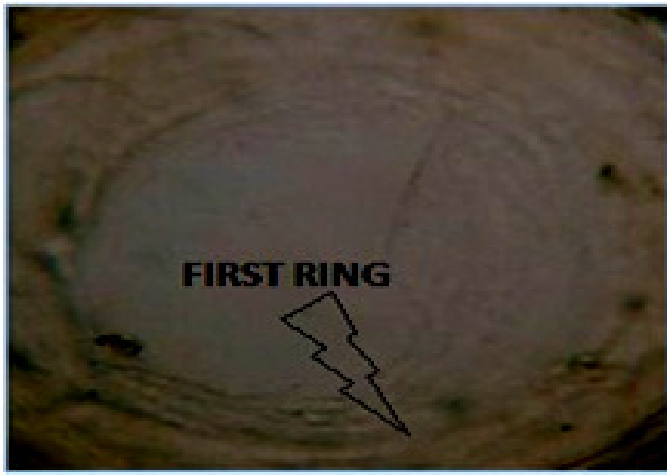

Figure 3 One year ring.

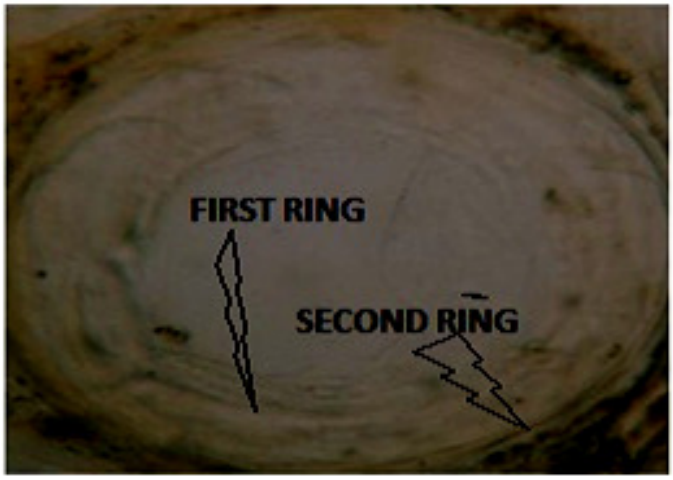

Figure 4 Two year ring.

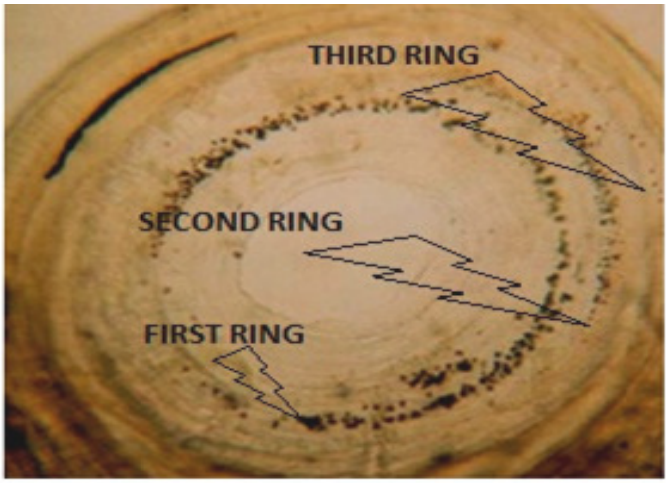

Figure 5 Three year ring.

Table 1 Data on the Age and Growth of *N. montanus* based on various length groups.

Fish length (mm)	V.R. (Ocular Micrometer division) 1 Omd = 0.016mm	VRn_1 (OMD)	VRn_2 (OMD)	VRn_3 (OMD)	Ln_1 (mm)	Ln_2 (mm)	Ln_3 (mm)
46 –55	19–39* 31.20±5.17	17–21 19±5.62	–	–	34.31–40.23 37.78±2.59	–	–
56– 65	25–44 34.60±7.86	15–24 22.12±4.52	25–40 32.90±4.90	–	40.11– 49.30 46.97±3.68	56.41–64.12 59.83±3.77	–
66–75	31–52 42.23±6.81	18–26 23.85±1.95	25–36 30.90±3.80	35–50 45.27±4.12	41.73–53.75 52.85±6.61	56.41–67.12 61.49±4.77	67.71–74.51 70.13±32.79
76–85	50–61 55.18±5.98	21–33 26.12±6.61	34–41 37.57±2.07	43–56 50.28±5.11	49.80–58.19 56.91±1.49	57.81–65.33 63.51±1.04	69.44–79.36 74.98±3.20
86– 95	52–71 65.10±3.14	28 –38 32.14±4.12	37–51 44.15±4.15	48–68 59.89±5.37	53.58-65.75 61.23±4.67	64.35-79.66 73.54±4.16	71.54–87.67 79.57±5.39

VR = Vertebrae radius, VRn_1 = Vertebrae radius at annulus n_1, Ln_1 = Length of fish at the time of annulus n_1 formation.
*= MIN-MAX; AVERAGE±SD

Table 2 Back calculated length of *N. montanus* based on age class collected from Rai Gad stream during October 2013 to September 2015.

Age Class	No. of fish studied	Average fish length at the time of capture (mm)	L_{n1} (mm)	L_{n2} (mm)	L_{n3} (mm)
I	49	(56.54±3.68)	(52.52±4.02)	-	-
II	31	(70.75±6.85)	(47.91±4.10)	(63.78±5.33)	-
III	20	(84.75±3.87)	(55.60±3.10)	(65.70±1.19)	(74.11±2.12)
Average values		(70.85±8.24)	(51.77±5.07)	(64.74±1.68)	(74.11±2.12)
h (annual increment)			51.77	12.97	9.36

Ln_1 = Fish length at the time of annulus formation. n_1.

Discussion

In fish, nearly 90% of calcium is deposited in the skeleton and scales. Vertebrae were reported as the most suitable ageing structure in comparison to scales and otoliths in *Pleuronectes flesus luscus* (Polat et al., 2001). Yilmaz and Polat (2002) also

reported that vertebra was more accurate in estimation of age determination in shad, *Alosa pontica*. The study of age determination in fish depends on annual growth marks in certain skeletal part of fish, which are formed as a result of irregular growth and metabolism. Temperature and spawning are the important causative factors responsible for annulus formation (Holcik, 1967; Natrajan and Jhingran, 1963).

On the basis of regression analysis we obtained straight-line relationships between *N. montanus* fish length and vertebrae radius. Age rings, which were maximum three, were studied by vertebrae. On the basis of minimum width in terminal zone of vertebrae, it was found that the ring formation occurred in the month of July-August when natural environment was disturbed due to monsoon. Further, spawning stress during this period may be responsible for ring formation as the fishes perform heavy spawning during May-July which might have disturbed the growth rate.

Qasim (1973) suggested that in general, all fishes have annual cycles of maximum growth corresponding to summer and autumn when temperature and food supply are moderate and suitable ambient conditions. Lea (1910) observed in the young herrings the rate of increase in length, deducted from the scales was greater when there was a rise of temperature in springs but it decreased before the temperature attained its maximum. Dobriyal and Singh (1990) in *Barilius bendelisis* also noted the growth rings as spawning marks. According to Kohli and Goswami (1989) who worked on the pectoral spine of *H. fossilis*, the annual rings were formed in May-June, which is the spawning period of fish in Assam. It was observed that the feeding intensity was low during this period. Hence, the formation of growth rings can be attributed to the cumulative effect of "nutrition and spawning".

In the present study we used back calculation for vertebrae study instead of correction factor. In the present investigation maximum 3 age rings were noted in vertebrae structure. The maximum width in terminal zone was observed during April to June in vertebrae (15-19.5 omd), thus indicating these months are most distant months of age ring formation. July-August were observed as the probable months of age ring formation, as well as the least minimum width in terminal zone was also observed in these months. From the study of vertebrae tool for age determination only one frequency of ring formation was confirmed in *N. montanus*. During the month of May and June highly mature eggs were found in the abdominal cavity which might have affected the feeding intensity of fish therefore low feeding factor was noticed during these months. It could be said that like spawning stress, low feeding was also a causative factor for ageing in *N. montanus*. In the present investigation with the help of back calculation method it was noticed that the first, second and third ring were formed at an average fish length of 51.77±5.07, 64.74±1.68 and 74.11±2.12mm respectively. On the basis of above observation it may concluded that the life span of the *N. montanus* is maximum three years.

References

Bagenal TB and Tesch FW (1978) Age and growth. Pages 101-136 in Bagenal, T. B; Ed. Methods for assessment of fish production in fresh waters. 3rd Ed. Blackwell Scientific Publications, Oxford, England.

Bahuguna P (2013) Age determination and growth rate of fresh water fish *Puntius conchonius (Ham.-Buch.)* by a use of trunk vertebrae. *Period. Res.* 2(1): 46-51.

Bahuguna P and Balodi VP (2015) Age And Growth of *Puntius Conchonius (Ham.-Buch.)* From Mandal River (District: Pauri Garhwal), Uttarakhand, India. *Int. J Sci. Rec.* 4 (6): 167-170.

Dobriyal AK and Singh HR (1990) Ecological studies on the age and growth of *Barilius bendelisis* (Ham.) from India. *Arch. Hydrobiol*. 118: 93-103.

Holcik J (1967) Age, growth and history of the roach *Rutilus rutilus* carpathorossicus vladykov,

1930, in the orava valley reservoir. *Zool listy*. 16(1): 87-98.

Jhingran VG (1957) Age determinati of the Indian major carps, *Cirrhinus mrigala* (Hamilton) by means of scales. *Nature.* 79:468-469.

Johal MS, Esmaeili HR and Tandon KK (2000) Reliability of urohyal bone of silver carp. *Hypophthalmichthys molitrix* (Vol. 1844) for age determination. *Curr. Sci*. 79: 27-280.

Khan S, Khan MA, Miyan K and Lone FA (2015) Precision of age estimates from different ageing structures in selected freshwater teleosts. *J. Env. Biol.* 36: 507-512.

Kler VO (1916) Some data on age determination in fish from bones. *Vestnik Rybopromyshlen-* nosti 3.

Kohli, MPS and Goswami UC (1989) Studies on age and growth of an Air-Breathing catfish *Heteropneustes fossilis* (Bloch.). *J. Inland Fish. Soc. India*. 21(2): 17-24.

Lea E (1910) On the methods used in Herring investigation. *Publs. Circonst. Perm. Int. Explor. Mer.* No. 53

Lee RM (1920) A review of the method of age and growth determination by means of scales. *Fish. Invest. Lond. Ser.* 2(4): 2-32.

Mahé K, Rabhi K, Bellamy E, Elleboode R, Aumond Y, Huet J and Roos D (2016) Comparison between the opercular bones, the scales and the otoliths to investigate the growth of the brilliant pomfret (*Eumegistus illustris*) off the coast of Reunion Island (SW Indian Ocean). *Int. J Fish. Auua. Studies.* 4(1): 176-179

Natrajan AV and Jhingran VG (1963) On the biology of *Catla catla* (Ham.) from the river Jamuna. *Proc. Nata. Inst. Sci. India*. 29(B): 326-355.

Polat N, Bostanci D and Yilmaz S (2001). Comparable age determination in different bony structures of *Pleuronectes flesus luscus* Pallas, 1811 inhabiting the Black Sea. *Turk. J. Zool.* 25: 441–446.

Qasim SZ (1973) Some implications of the problem of age and growth in marine fishes from the Indian waters. *Indian. J. Fish.* 20: 352-371.

Tandon KK and Oliva O (1977) The growth of the sheath fish, *Silurus glanis* in Czechoslovakia. *Vest. Cs. Spolec. Zool.* 41 (4): 271-282.

Yilmaz S and Polat N (2002) Age determination of shad (*Alosa pontica* Eichwald, 1838) inhabiting the Black Sea. *Turk. J. Zool.* 26: 393-398

****