STUDIES ON THE AGE AND GROWTH OF *LABEO CALBASU* (HAMILTON) WITH AN EXPLOITATION PATTERN FROM THE GANGA RIVER SYSTEM, UTTAR PRADESH (INDIA)

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ABSTRACT

Samples were collected to study the age and growth of *Labeo calbasu* (Hamilton) from the river Ghaghra (Guptarghat centre, Faizabad). The scales of *L. calbasu* have been used for age and growth studies in present paper. Study of the marginal rings on the scales of *L. calbasu* indicates their annual nature. The fish attained growth in 1st 18.7 cm, 2nd 27.8 cm, 3rd 35.7 cm, 4th 41.8 cm, 5th 46.9 cm, 6th 54.9 cm and 7th 57.4 cm years of the life. The growth rate was observed 18.7, 9.1, 7.9, 6.7, 5.1, 8.0 and 2.5 cm for 1st to 7th age classes respectively. The age groups 1+ to 4+ constituted 91.17% of the total exploited population and 8.83% of remaining age groups (5+ to 7+). The maximum exploited population was observed in 2+ age group with 33.68%. Overall exploitation pattern was systematic and a good indicator for heavy recruitment.

Key words: Age, Growth rate, Exploitation, Recruitment, Ghaghra river, *Labeo calbasu*.

INTRODUCTION

River Ghaghra is a tributary of the Ganga, which is also helpful in increasing the volume of water and fish population. The Ganga river system, which has a total length of about 8,470 km, is among the largest river system in the world and it is a major source of captures fisheries in India (Singh, 1999). The India major carp, *L. calbasu* (Hamilton) locally known as kalbasu is inhabitant in the river Ghaghra. The available literature suggests that *L. calbasu* is an important commercial species through out the Indo-Bangladesh subcontinent (Dwivedi *et al.*, 2004). It is also found in Pakistan, Myanmar (Alam *et al.*, 2000) and Nepal (Chondar, 1999). *L. calbasu* support an important commercial fishery in rivers, but also well established in natural lakes and several artificial reservoirs and ponds. It is very common in the commercial catch of rivers Narmada, Godavari, Yamuna and Ganga (Chondar, 1999) and especially in the North-eastern region of Bangladesh (Alam *et al.*, 2000). In Allahabad region, it constituted 17.0% (Gupta and Tyagi, 1992) and 14.2% of the commercial catch (Singh *et al.*, 1998).

The growth in animals is considered in terms of increasing in volume (weight) (Zafar *et al.*, 2003). The studies on age and growth in different fish species by hard parts are done by several workers (Jhingran, 1957; Walfert and Miller, 1978; Rawat and Nautiyal, 1996; Johal *et al.*, 1996, 1999, Jepsen *et al.*,1999; Bhatt *et al.*, 2000, 2004 and Nautiyal and Negi, 2004). However, in other part of country some short and fragmentary work has been conducted by Rao and Rao (1972), Gupta and Jhingran (1973), Tandon *et al.* (1989) and Singh (1999)

on the age and growth of *L. calbasu*. As far as the *L. calbasu* is concerned, no work has been reported from the Ghaghra river.

Exploitation pattern of a population represents the ratio of different age classes in a population to each other at a given time (Nikolskii 1980). Exploited and unexploited population growth is the change in length and weight over the time. Seth and Katiha (2001) made the study on exploitation of *Aorichthys seenghala* in the Yamuna and Ganga rivers at Allahabad and Bhatt *et al.* (2004) in *Tor putitora* from foothill section of the Ganga river. But there is no published information on *L. calbasu* regarding age, growth and exploitation pattern in the Ghaghra river. Estimation of age and growth of fishes and their exploitation pattern is useful in solving basic life history problems of the species and also essential for future policies and management of the fishery.

MATERIALS AND METHODS

The samples were collected during December 2003 to March 2005 form the Guptarghat at Faizabad. Key scales were taken from below the dorsal fin (3rd or 4th rows) and above the lateral line of the *L. calbasu* for age determination. Scales from 193 specimens (total length 15.4 to 57.4 cm) were examined. The total length was measured from tip of the snout to the end of caudal fin rays. The key scales were thoroughly washed in tap water until all extra matter got completely removed and mounted intact in between two glass plates. The annuli formation was determined according to the method suggested by Bagenal (1978) and adopted by Nautiyal (1990). Almost all the growth checks appeared as light (relatively transparent) bands except the one, concentrically arranged around the whole anterior sculptured part of the scales. Exploitation pattern was determined on the basis of specimen numbers of each age group then converted into percentage.

Table 1 Size range distribution of *L. calbasu* at various age revealed by scale study.

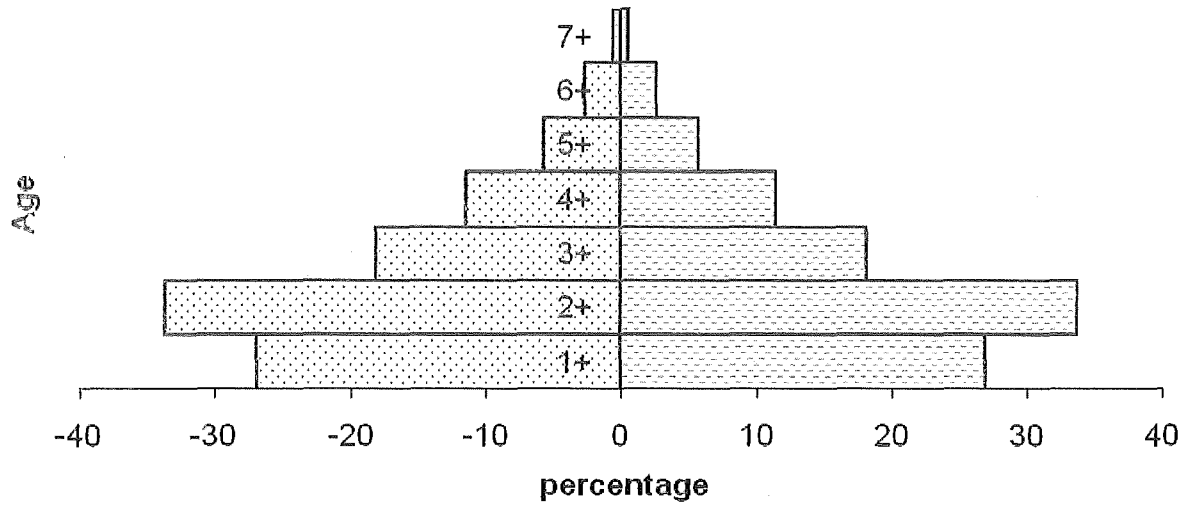
Size range (cm)	Number of completed growth rings						
	1	2	3	4	5	6	7
15.1-19.0	31						
19.1-23.0	21	5					
23.1-27.0		22	1				
27.1-31.0		24					
31.1-35.0		14	15				
35.1-39.0			16	3			
39.1-43.0			5	13	2		
43.1-47.0				5	3		
47.1-51.0				1	5	3	
51.1-55.0					1	2	
55.1-59.0							1
Total	52	65	37	22	11	5	1

Table 2 Mean length and percentage composition of *L. calbasu* at various ages as estimated by scale methods.

Years classes	No. of specimen	Mean length (cm)	Growth rate (cm)	Length Range (cm)	Exploited population (%)
1+	52	18.7	18.7	15.4-22.8	26.94
2+	65	27.8	9.1	21.9-33.8	33.68
3+	37	35.7	7.9	25.0-41.5	18.17
4+	22	41.8	6.7	36.8-47.8	11.39
5+	11	46.9	5.1	41.5-51.4	5.69
6+	5	54.9	8.0	51.8-56.4	2.59
7+	1	57.4	2.5	57.4	0.52

Age	%	%
1+	26.94	-26.94
2+	33.68	-33.68
3+	18.17	-18.17
4+	11.39	-11.39
5+	5.69	-5.69
6+	2.59	-2.59
7+	0.52	-0.52

Fig. 1 Exploitation pattern of *Labeo calbasu*



RESULTS AND DISCUSSION

L. calbasu possesses typical cycloid scales; each scale consists of one anterior field (AF), one posterior field (PF), two lateral fields (LF), and a focus (F), which represents the origin of scale and become inconspicuous. The anterior field is comparatively transparent, embedded in skin and posterior exposed field bears chromatophores. An examination of key scales revealed the presence of alternating transparent zone (fast) and opaque zone (slow) which were together considered as an index of one year growth ring. Each opaque zone consists of compactly packed discontinuous and broken circuli preceded by a transparent zone, which is represented by a number of comparatively wide spaced circuli. The distance between growth checks decreases in old age fishes due to close spacing of growth checks on the scales. Similar type of observation described by Natrajan and Jhingran (1963) in *Catla catla* from the river Yamuna, Kamal (1969) in *C. mrigala* from the river Yamuna, and Gupta and Jhingran (1973) in *L. calbasu* from the river Yamuna.

Analysis of samples revealed that the 1st to 7th growth rings appeared from 15.1-19.0, 19.1-23.0, 23.1-27.0, 35.1-39.0, 39.1-43.0, 47.1-51.0 and 55.1-59.0 cm size groups of samples, respectively (Table 1). Similar type of observation recorded by Kamal (1969) obtained 1st to 7th growth rings which were laid in 201-220, 401-420, 601-620, 681-700, 761-780, 821-840, 901-920 and 921-940 mm of fishes, respectively in *C. mrigala* from the river Yamuna. Kurup (1997) recorded similar pattern in *Labeo dussumieri* from the river Pampa (Kerela), where 1st, 2nd, 3rd, 4th, growth rings were laid in samples of 240-259, 280-299, 340-359, and 380-399 mm.

The fishes measuring from 15.4 cm to 57.4 cm in 1+ to 7+ age groups. The present observations show that the fish attained the mean length in 1st year 18.7 cm, 2nd year 27.8 cm, 3rd year 35.7 cm, 4th year 41.8 cm, 5th year 46.9 cm, 6th year 54.5 cm and 7th year 57.4 cm. The growth rate in *L. calbasu* was recorded 18.7, 9.1, 7.9, 6.7, 5.1, 8.0, and 2.5 cm for 1+ to 7+ age groups, respectively (Table 2). The maximum growth rate attained in first two years of life was found 18.7 cm and 9.1 cm, respectively. Subsequently the growth was slow. The slow growth rate was observed after the second year that may be attributed to the fishes attaining maturity after second year of life. It is well known that the growth potential is used for the gonad development (Srivastava, 2004). Several factors can account for the fluctuation in the growth rate. The quantity and quality of available food (Nautiyal, 1990) and spawning cycle (Khan and Siddique, 1973) influenced the growth rate of fish. Gupta and Jhingran (1973) and Singh (1999) recorded more or less similar findings in *L. calbasu* from the Yamuna and Ganga rivers system, respectively at Allahabad. Oliva-Paterna *et al.* (2002) found that *Cobitis paludica* grows rapidly before first spawning (second year). Similarly, Fernandez-Delgado and Herrera (1995a, b) observed a high growth rate during the first year in other small or large fish species.

Growth in fishes is not throughout the year and the fluctuations in the growth expressed itself on scales of the fish. The length of fishes increasing and decreasing was not found in systematic order. The fluctuations in fish length indicate the fish growth, compensation. It is common in almost all natural stocks of fishes fresh water, brackish water and marine water, (Srivastava, 2004).

The exploitation pattern of the *L. Calbasu* fluctuated between 1+ to 7+ age groups (Table 2). The 2+ age group was maximum exploited with 33.68% (Table 2 and Fig. 1). The age groups 2+ to 3+ constituted 51.85% of the total stock. Nautiyal and Negi,

(2004), studied age structure of *Barilius bendelisis* and found 94.12% in 0+ and 1+ age groups. The age groups 2+ to 4+ accounted for 73% in *Tor putitora* in foothill section of the river Ganga (Bhatt *et al.*, 2000). The riverine fish population is divided into two groups, exploited and unexploited. Exploited population usually a portion is either not caught by the gear or not harvested in early times or months or years. When exploited population and mortality are higher than the recruitment, the population is decreased and when the recruitment is higher than the exploited population and total mortality, the population gets increased. The present exploitation pattern of the Ghaghra river is systematic and a good indicator for heavy recruitment because mature population (2+ to 7+ age groups) was highly exploited. However, in the Ganga river system more or less all commercially important fishes are overexploited, especially carp groups (*L. rohita, C. catla, C. mrigala, T. tor and T. putitora*). Badoni *et al.* (2005) stated that the overexploitation, poisoning, deforestation and pollution were main causes for depletion of fish fauna of the Alaknanda tributaries. The data on exploitation pattern can also be used to draw influences on health of the population, mortality and survival rate (Nikolskii, 1980; Bagenal, 1978; Rounsefell and Everhart, 1985 and Nautiyal and Negi, 2004). Kendiegh (1980) reported that the number of age class in a population is greater when the survival rates are high. The study of exploitation pattern indicates that *L. calbasu* exploitation is systematic and at present the riverine environment of the river Ghaghra (Faizabad) is suitable for *L. calbasu* fishery.

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REFERENCES

Alam, M., S.M. N. Amin and A.K.Y. Haroon, 2000. Population dynamics of *Labeo calbasu* (Hamilton) in the Sylhet basin, Bangladesh. *Indian J. Fish.*, 47(1): 1-6.

Badoni, A.K., Bisht, B. and Baguguna, S.N., 2005. Conservation and management of fish fauna of three important Alaknanda tributareies of district Tehri Garhwal, Uttranchal. Flora and Fauna, 11: 3-4.

Bagenal, T., 1978. *Methods for Assessment of Fish Production in Fresh Waters,* Blackwell Scientific Publication Oxford, pp1-356.

Bhatt, J.P., Nautiyal, P. and Singh, H.R., 2000. Population structure of Himalayan mahseer a large cyprinid fish in the regulated foothill section of the River Ganga. *Fish. Res.,* 44(3): 267-271.

Bhatt J. P., Nautiyal, P. and Singh, H.R., 2004. Status (1993-1994) of the endangered fish Himalayan mahseer *Tor putitora* (Hamilton) (cyprinidae) in the mountain reaches of the river Ganga. *Asian Fish. Sci.,* 17: 341-355.

Chondar, S.L., 1999. *Biology of Finfish and Shellfish*. SCSC Publishers (India) Howrah, pp 1-514.

Dwivedi, A.C., Tewari, N.P. and Singh, K.R., 2004. Present structure of capture and culture fishery of the Faizabad District (U.P.). *Bioved,* 15(1, 2): 95-98.

Fernandez-Delgado, C. and Herrera, M., 1995a. Age structure, growth and reproduction of *Leuciscus pyrenaicus* in a

intermittent stream in the Guadalquivir river basin, (southern Spain). *Hydrobiologia,* 299: 207-213.

Fernandez-Delgado, C. and Herreram, M., 1995b. Age structure, growth and reproduction of *Rutilus lemmingii* in a intermittent stream in the Guadalquivir river basin, (southern Spain). J. Fish. Biol., 46: 371-380.

Gupta, R.A. and Tyagi, R.K., 1992. Analytical approach to analysis of fish stock of Ganga river system. *J. Inland. Fish. Soc. India,* 24(2): 20-27.

Gupta S.D. and Jhingran, V.G., 1973. Aging of *Labeo calbasu* (Hamilton) through its scales. J. Inland Fish Soc. India, 5: 126-128.

Jepsen, D.B., Winemillller, K.O., Taphorn, D.C and Rodriguez Olarte, D., 1999. Age structure and growth of Peacok cichlids from rivers and reservoirs of Venezuela. J. Fish. Biol., 55: 433-450.

Jhingran, V.G., 1957. Age determination of Indian major carps (*Cirrhinus mrigala*) by means of scales. Nature London, 179: 468-469.

Johal, M.S., Tandon, K.K. and Kaur, S., 1996. Scale structure, age and growth of *Labeo calbasu* (Hamilton) from northern India. *Acta. Hydrobiologica,* 38(1&2): 53-63.

Johal, M.S., Tandon, K.K. and Sandhu, G.S., 1999. Age and growth of an endangered cold water fish Golden mahseer, *Tor putitora* (Hamilton) from Gobindsagar, Himachal Pradesh, India. Ichthycl, 6: 59-73.

Kamal, M.Y., 1969. Studies on the age and growth of *Cirrhinus mrigala* (Hamilton) from the commercial catches at Allahabad. *Proc. Nat. Inst. Sci. India,* 35(B): 72-92.

Kendiegh, S.C., 1980. *Ecology with Special Reference to Animal and Man*. Printice-Hall of India, New Delhi, India, pp 2-425.

Khan, R.A. and Siddique, A.Q., 1973. Studies on age and growth of Rohu, *Labeo rohita* (Ham.) from a pond (moat) and the river Ganga and Yamuna. *Proc. Indian Nat. Sci. Acad.,* 39B: 542-597.

Kurup, B.M., 1997. Age and growth of *Labeo dussumieri* (Val.) (Pisces: Cyprinidae) from the river Pampa, Kerala. *Indian J. Fish.*, 44(2): 155-163.

Natrajan, A.V. and Jhingran, A.G., 1963. On the biology of *Catla catla* (Hamilton) from the river Yamuna. Proc. Nat. Inst. Sci. India, 29B (3): 326-355

Nautiyal, P., 1990. Natural history of Garhwal Himalayan Mahseer. Growth rate and age composition in relation to fishery, feeding and breeding ecology. In: *Proc. 2nd Asian Fisheries Forum,* pp 769-772, R. Hirano and I. Hanyu (Eds.), Tokyo, Asian Fisheries Society, Manila.

Nautiyal, P. and Negi, R.S., 2004. Population structure, dietary resources utilization and reproductive strategies of sympatric *Barilius bendelisis* and *Barilius vagra* in lesser Himalayan mountain streams. In: *21th Century Fish Research,* pp 43-68, B.N. Pandey (Ed.), A.P.H. Publishing Corporation, Delhi.

Nikolskii, G.V., 1980. Theory of Fish Population Dynamics as the Biological Background for Rational Exploitation and Management of Fishery Resources. Singh,

Bishan and Singh, Mahendra Pal, Dehra Dun (India) and Otto Koeltz Science Publishers Kooenigstein, W. Germany, pp 1-323.

Oliva-Paterna F.J., Torralva, M.M. and Fernandez-Delgado, C., 2002. Age, growth and reproduction of *Cobitis paludica* in a seasonal stream. *J. Fish. Bio.*, 60:389-404.

Rao, G.R. and L.H. Rao, (1972). On the breeding biology of *Labeo calbasu* (Ham. Buch.) from the river Godavari. *J. Inland Fish. Soc. India,* 4:74-86.

Rawat, V.S. and Nautiyal, P., 1996. An evaluation of age and growth rate determination from pectoral and dorsal fin region scales of a hill stream teleosts *Barilius bendelisis* (Ham) with a note on difference in their structure. *Indian J. Fish.,* 43(2):171-178.

Rounseefell, G.A. and Everhart, W.H., 1985. *Fishery Science, Its Methods and Applications*. International Books and Periodicals supply Service, New Delhi, pp 1-444.

Seth, R.N. and Katiha, P.K., 2001. The riverine fisheries of large sized siluroids with special reference to *Aorichthys seenghala* (Sykes). J. Indian Fish. Assoc., 28:1-9.

Singh, H.R., A.I. Payne, S.K. Pandey and P.R. Singh, (1998). Time scale changes in the catch structure of fishery in Allahabad. *Proc. Nat. Acad. Sci. India,* 68B:15-21.

Singh, P.R., 1999. Fishery biology of *Labeo calbasu* (Hamilton). D. Phil thesis submitted to the University of Allahabad, Allahabad.

Srivastava, C.B.L., (2004). *Fishery Science and Indian Fisheries*. Kitab Mahal Allahabad, pp 1-527.

Tandon, K.K., Johal, M.S. and Kaur, S., (1989). Remarks on the age and growth of *Labeo calbasu* (Pisces Cyprinidae) from Rajasthan India. *Vest. Cs. Spolec. Zool.,* 53: 153-160.

Walfert, B.R. and Miller, T.J., 1987. Age, growth and food of northern pike in eastern lake Ontario. Trans. Am. Fish. Soc., 107:696-702.

Zafar, M., Mussaddeq, Y., Akhtar, S. and Sultan, A., 2003. Weight-length and condition factor relationship of Thaila, *Catla catla* from Rawal Bam Islamabad, Pakistan.Pak. J. Biol. Sci., 6:1532-1534.