

Length Frequency, Sex-Ratio and Diet Composition of a Hill Stream Loach *Nemacheilus Moreh* (Sykes)

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Abstract

The length of *Nemacheilus moreh* varied between 32 mm and 70 mm. The length frequency distribution indicates that the maximum percent frequency was in 55 to 59 mm in which fish attains maturity at the end of first year. It has been observed that during early stage of life growth rate was found to be higher up to 7.5 to 8.5 mm per month. The sex ratio has been calculated for 178 males (47.59%) to 196 females (52.40%) shows statistically significant (1: 1 at 5° level) but at the smaller length group the males are predominant to females while in higher length group females found significantly more than males. Dietary composition of *Nemacheilus moreh* showed planktophagus and omnivorous feeding habit and bottom feeder browsing the substratum results in to sand particles in stomach. Length frequency, sex ratio and feeding intensity of *Nemacheilus moreh* showed co-relation with its reproductive cycles.

Keywords: *Nemacheilus moreh*, Length group, length frequency, sex ratio, stomach contents.S

Introduction:

Present study has been designed to study the edible fish *Nemacheilus moreh* from Mula -Mutha river system in northern western ghats, Pune in Maharashtra state, situated between 17°54" and 19°21" N latitude and 73°24" to 75°14" E longitude in

western India. The river system is contributed by several streams originating along the crest of sahyadries (Western Ghats) and finally drains to Krishna river system about 200 Km to South east of Pune. *Nemacheilus moreh*, is a small fish plays vital role in torrential ecosystem and contribute immense importance in fish biodiversity. Though it is not productive and economically important, it is pretty common in river Mutha and tribal people, and the "Katkari" catch them on commercial point of view. *N. moreh* are known to have the potential to withstand extreme ecological conditions.

In length frequency studies, knowledge of age and growth is an important prerequisite to understand the dynamics of population. A study on growth is essential for determining the exploitable growth of stock and yield for fishing¹. Length frequency polygon method is adopted to determine the age and growth in tropical fishes, by several researchers^{2,3,4,5,6}. Sex ratio indicates the proportion of male to female in population. In nature the ratio is expected to be 1:1. This study helps to understand segregation and availability of sexes⁷. Knowledge of sex ratio is essential for fishery management^{8,9,10}. Fishes have adapted to a wide variety of food. Some of them feed exclusively on plant (herbivore) while other feed on animal (carnivore) while a large number of species are omnivore. The feeding intensity of the fish varies with season and also with availability of food¹¹.

The literature survey showed that allometric scaling of *Nemacheilus moreh* is studied¹², but there is lack of information on length frequency, sex ratio and diet composition of *Nemacheilus moreh*. The objective of the present study was to find out the age of fish at first maturity, sex ratio at varied length group and diet composition of *Nemacheilus moreh*.

Material and methods:

During the study, total of 374 *Nemacheilus moreh* (178 males and 196 females) were sampled, Length was measured from the tip of caudal fin. Standard length was measured from the tip of premaxila to the base of caudal fin to the nearest mm. The collected fishes were grouped in various class intervals. Weight of the fish was determined to the nearest 0.1gm. Measurements of length and weight were taken in fresh condition after wiping the fish with blotting paper.

The total length frequency distribution of *N. moreh* was shown by graphic representation. The frequencies are converted into percentages and these are plotted against the respective length groups. Inference on length frequency distribution was based on number of samples taken as cross sections of the natural population.

Sex ratio was calculated for each month against total catch of each size group. Chi-square value was calculated for each month of each size group. Significance was determined by using table value at 5⁰ variable.

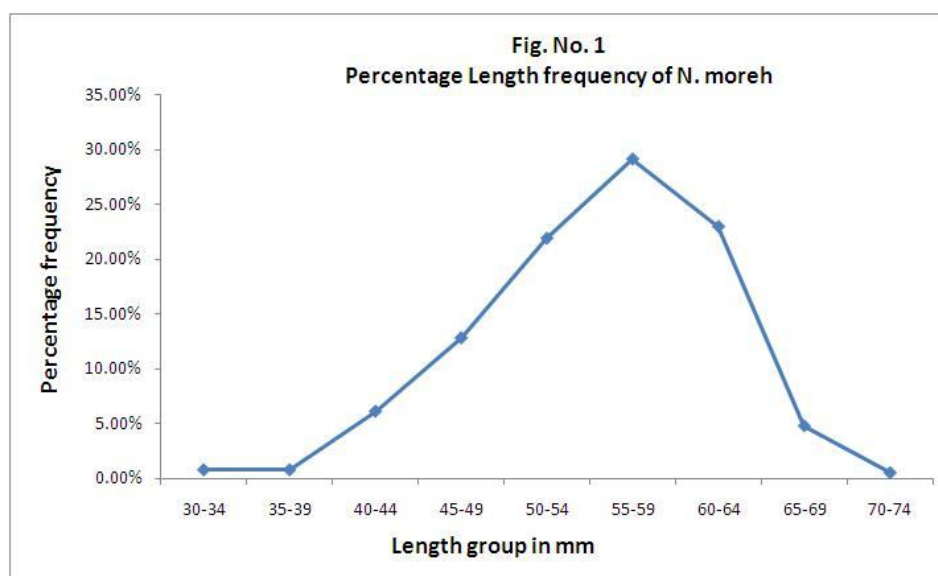
The *N. moreh* were sampled from April 1997 to March 1998 by random sampling method. Fishes were dissected; stomach was carefully taken out from digestive tract. It was preserved in 5% formalin, occurrence methods was used for qualitative analysis of food.

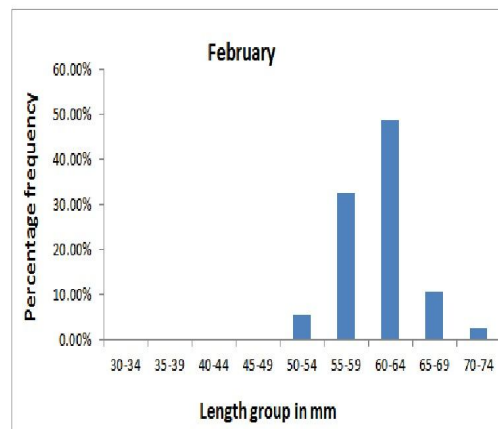
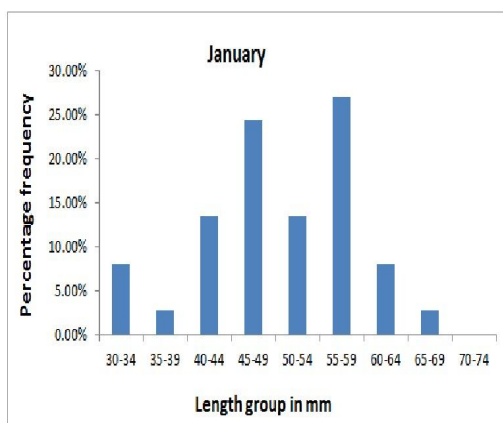
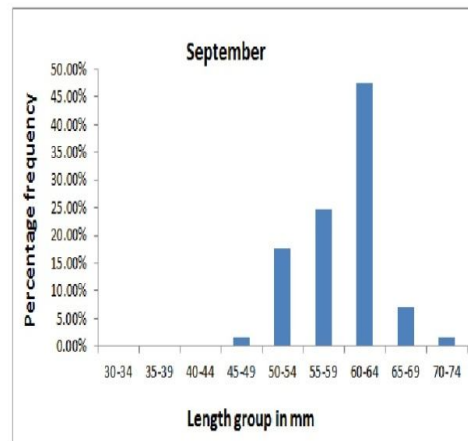
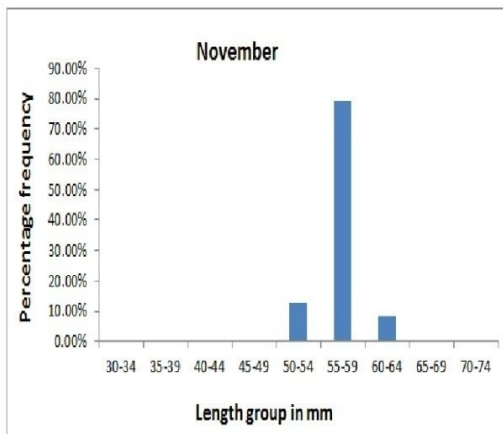
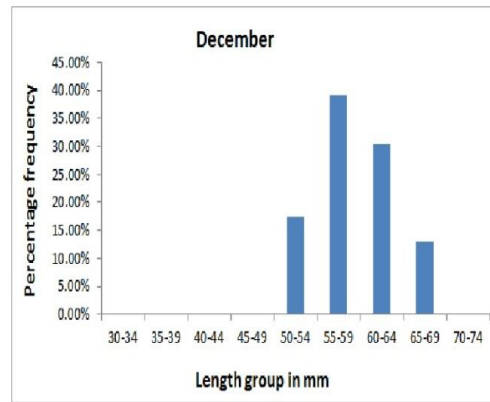
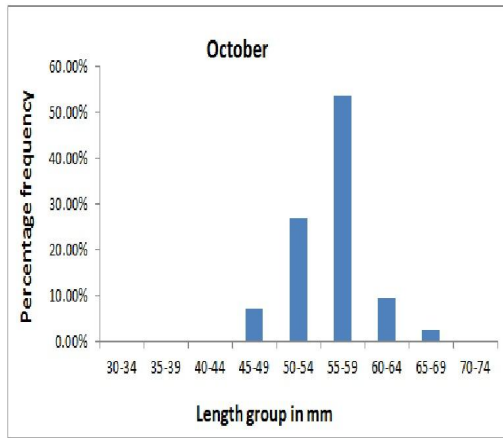
Result and Discussion:

Length frequency in relation to growth:

The length of *Nemacheilus moreh* varied between 32 mm and 70 mm. The male were found up to 65 mm, while few female fish upto 70 mm (0.53%). The length frequency distribution (Figure 1) indicates that, the maximum percent frequency out of 374 fishes was in length group 55-59 mm. In this size group more than one peaks are recorded (Figure 2) indicating either a prolonged spawning season or maturity in broods of two successive spawns in a year. It could be seen that the maximum frequency, 29.14% (Fig. 1) and more than one peak (Fig. 2) are encountered at length group of 55-59 mm. It could therefore be referred that, *N. moreh* attain a length of 55-59 mm at the end of first year and grow at the rate of 4.58 to 4.91 mm per month, and spawns twice a year (September and February). During early stage of life, growth rate is found to be higher up to 7.5 to 8.5 mm/month, but with the age as growth rate was found decreased, (1.66 mm/month at the end of second year).

The present observation was based on randomly collected samples. In the present study, the males do not acquire larger size similar to females, indicating low life span than females. Moreover, the females of larger size are very less (0.53%). It seems that, at older age the mortality might higher. It appears that the female attains larger size than male due to the different growth rates¹³. The smaller size group fishes grow at a faster rate whereas the larger size group fishes grow at slower rate¹³. In *N. moreh* the growth rate found similar as mentioned to above results. Using length frequency polygon, various age groups has been studied in *P. erumeri* and *P. arsius*¹⁴. *N. moreh* shows various age groups from 4 months to two years, and length groups, between 30-34 and 70-74 mm. It would appear that, *N. moreh* are short lived species having a life span of less than two years. Results obtained are very closer to the results on *S. gibbosa*¹⁵ and *S. albella* fish¹⁶.





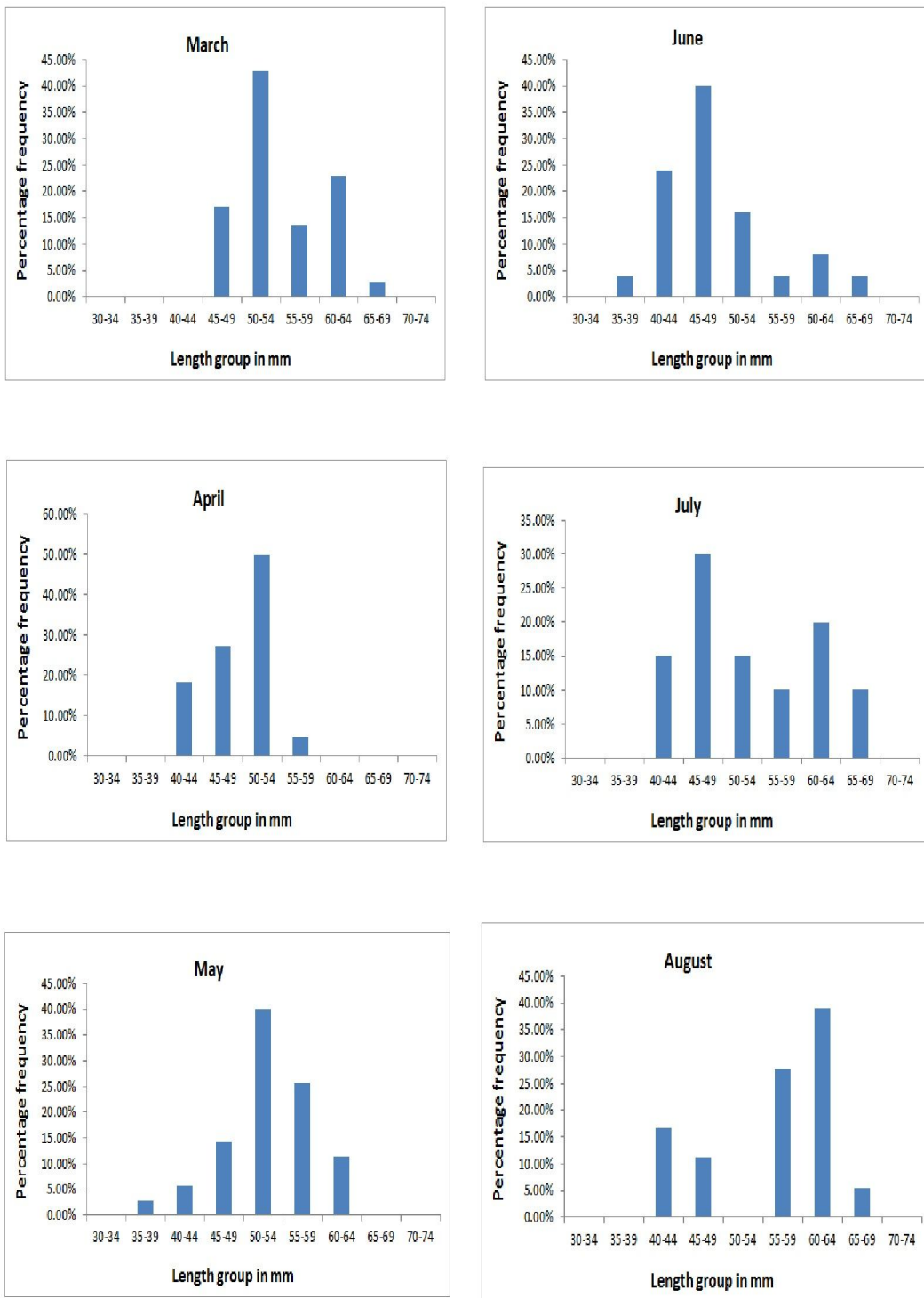


Fig. No. 2: Monthwise Percentage Length frequency of *N. moreh*

Sex-Ratio

The sex ratio has been calculated for 178 males (47.59%) to 196 females (52.40%). It is statistically significant (1: 1 males to females, at 5% level) in November, December 1998 and February, March, April, June, July and August 1999 (Table 1). In the month of October 1998 and January 1999, the sex ratio found; not significant at 5% level, where in the month of October females were outnumbered to males and hence ratio was at 2.4: 1. Similarly during the month of January 1999, male were outnumbered to females and ratio was at 2.36: 1. In the month of September 1998, the male were outnumbered to female and ratio was at 1.16: 1. In the month of May 99 the females were outnumbered male and ratio was at 1.9: 1. Sex ratio in each length group is shown in (table 2). Initial length group / smaller length group males predominated in 30-34 mm, only males were observed (3:0) and in length group 35-39mm. The male were significantly more than females (at 5% level). In the middle length group of 40 mm to 59 mm, proportions of sexes were almost equal with slight variation. In the 60 mm to 69 mm length group, females found significantly more than males. In the 70-74 length group only females were observed (3:0).

Maturity in *Nemacheilus moreh* found at the similar age in both the sexes. In *M. cephalus* the females matured earlier than males¹⁷, males matured at 23.29 Cm, while female did at 24-35 Cm^{18,19}. In the present study, the male and female both attains sexual maturity at length 45-49 mm. Moreover, the males outnumbered females. It seems that, males get mature earlier than females. Sex ratio in relation with length frequency suggest that, during early years of life, initially; there was a preponderance of males, possibly as a result of higher mortality among females but with advancement of age, male mortality increases until females predominate. Previous studies reported that males mature before females in Great lakes^{20,21}. Similar result was also observed in the winter Hilsa of the river Hoogly²² and in *Rhinomugil corsula*²³.

Nemacheilus moreh as spawns twice a year, males may aggregate during spawning season and the males were outnumbered in September and January, subsequently after spawning, male number was decreased. It can predict that, male may not bare trace of the spawning and leads to mass death. The females were found to be outnumbered in the month of post spawnig season.

Table No. 1: Month-wise Sex Ratio in *N. moreh*

Sr. No.	Month & Year	Total No. Of Fishes	Male				Female				$\chi^2=A+B$	Ratio	Remarks
			Observed frequency	Expected frequency	D=of-ef	A D2/e	Observed frequency	Expected frequency	D=of-ef	B D2/e			
1	Sep-98	57	31	27.128	3.872	0.553	26	29.872	-3.872	0.502	1.055	1.16:1	Sign.
2	Oct-98	41	12	19.513	-7.513	2.893	29	21.487	7.513	2.627	5.52	1.02:4	Non Sign.
3	Nov-98	24	12	12.85	0.578	0.029	12	12.578	-0.578	0.027	0.056	1:01	Sign.
4	Dec-98	23	10	10.946	-0.946	0.082	13	12.053	0.947	0.074	0.156	1.01:3	Sign.
5	Jan-99	37	26	17.61	8.39	3.997	11	19.39	-8.39	3.63	7.627	2.36:1	Non Sign.
6	Feb-99	37	18	17.61	0.39	0.009	19	19.39	-0.39	0.008	0.017	1.01:05	Sign.
7	Mar-99	35	17	16.658	0.342	0.007	18	18.347	-0.347	0.007	0.014	1.01:05	Sign.
8	Apr-99	22	9	10.471	-1.471	0.207	13	11.529	1.471	1.188	0.395	1.01:4	Sign.
9	May-99	35	12	16.658	-4.658	1.302	23	18.342	4.658	1.183	2.485	1.01:9	Sign.
10	Jun-99	25	12	11.898	0.102	0.001	13	13.102	-0.102	0.001	0.002	1.01:9	Sign.

11	Jul-99	20	10	9.519	0.481	0.024	10	10.481	-0.481	0.022	0.046	1:01	Sign.
12	Aug-99	18	9	8.567	0.433	0.022	9	9.433	-0.433	0.02	0.042	1:01	Sign.
	Total	374	178				196						

Chi-square table value χ^2 n-1, χ^2 n-2, χ^2 1% = 3.84 @ degree of freedom 0.05 and @ degree of freedom 0.01 = 6.64 * Sign = Significant, Non. Sign.= Non-significant

Table No. 2: Length-wise Sex Ratio in *N. moreh*

Sr. No.	Length group in mm	Total No. Of Fishes	Male				Female				$\chi^2=A+B$	Ratio	Remarks
			Observed frequency	Expected frequency	D=of-ef	A D2/e	Observed frequency	Expected frequency	D=of-ef	B D2/e			
1	30-34	3	3	1.428	1.572	1.731	0	1.572	-1.572	1.572	3.303	3:00	Sign.
2	35-39	3	2	1.428	0.572	0.229	1	1.572	-0.572	0.208	0.437	2:01	Sign.
3	40-44	23	10	10.94	1.053	0.101	11	12.053	-1.053	0.092	0.193	1.09:1	Sign.
4	45-49	48	24	22.845	1.155	0.058	24	25.122	-1.155	0.053	0.111	1:01	Sign.
5	50-54	82	35	39.027	-4.027	0.416	47	42.73	4.27	0.377	0.793	01.01:3	Sign.
6	55-59	109	57	51.877	5.123	0.506	52	57.123	-5.123	0.459	0.965	1.09:1	Sign.
7	60-64	86	39	40.93	-1.93	0.091	47	45.07	1.93	0.083	0.174	01.01:0	Sign.
8	65-69	18	6	8.567	-2.567	0.769	12	9.433	2.567	0.699	1.468	1:02	Sign.
9	70-74	2	0	0.952	-0.952	0.952	2	1.048	0.952	0.865	1.817	0:02	Sign.
	Total	374	176				196						

Chi-square table value χ^2 n-1, χ^2 n-2, χ^2 1% = 3.84 @ degree of freedom 0.05 and @ degree of freedom 0.01 = 6.64

* Sign = Significant

Food and Feeding Habits

For the study of food and feeding habits, 88 specimens were analyzed. The stomach contents of *N. moreh* consist of decayed organic matter, unicellular and multicellular filamentous algae, diatoms, rotifers (rotaria), nematodes (worms), sand particles and miscellaneous matters and arthropods consisting, drosophilla fly, the remnants of mosquitoes, prawns, cyclops, mayfly, nymph, unidentified insect larvae, crustacean larvae including zoea and mysis forms and eggs of aquatic organisms. Qualitative analysis of gut content gives the food preference of fish. Arthropods and Nematodes seem to be forming the major diet, while diatoms and algae were found in moderate amount. Seasonal variations and fluctuations have been observed. During Rainy and winter season, arthropods and nematodes are noticed predominantly, while during summer season, the algal matter. In females, conspicuous reduction in the feeding activity is noticed from July-October and from June to March. There was not any fluctuation in feeding activity in males.

The sand particles present in the stomach indicate that, the fish is a browser on bottom deposits which include large amounts of sand particles taken in by a fish. Same observation has been recorded in *Liza persia*²⁴. Fish stomachs found gorged, 3/4th considering as active feeding, and 1/4 as reduced feeding. During the spawning period, the stomach was found empty or 1/4 full, which may be due to considerable increase in the size of gonads. The feeding intensity of the mature fish decreases during the spawning season^{25,26,27,28}. The gut contents of *N. moreh* reflect the omnivorous feeding habits. It also show low feeding intensity when the ovaries were matured.

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References:

- [1] Beverton, R.J.R. and S.J. Holt (1957): On the dynamics of exploited fish Population. *Fish. Invest. Lond Sev.*, 2 (19): 533.
- [2] Al Hakim, A.W.H., Al-Mehdi, M.I.A. and Al Salman A. H. (1981). Determination of age, growth and sexual maturity of *barbus grypus* in Duckan reservoir of Iraq. *J. Fish. Biol.*, 18: 299-308.
- [3] Menezis M.R. (1980): Some observations on the morphometry and biology of *Psettodes erumei* (Bloch.) and *Pseudorhombus arsius* (Ham. Buch.) from the Goa region. *Mahasagar Bulletin of the National Institute of Oceanography* 13 (4): 377-381.
- [4] Okera W. (1974): morphometries, 'condition' and gonad development of the east African *Sardinella gibbosa* (Bleeker) and *Sardinella ablella* (vaL) *J. Fish. Biol.* 6: 801-812.
- [5] Ketchen K.S. (1972): Size at maturity, fecundity, and embryonic growth of the spiny dogfish (*Squalus acanthias*) in British Columbia waters. *J Fish. Res. Bd Canada* 29: 1717- 1723.
- [6] Reddy Y.S. and Babu Rao, M. (1993). Studies on length frequency and ova-diameters of *Heteropneustes fossilis* (Block) from an eutrophic lake, Hussain Sagar, Hyderabad, Andhra Pradesh. *J Aqua. Biol.* Vol. 8 No.1 14-17.
- [7] Kumthekar, V. R. (1988). Biology of cyprinid fish, *Cirrhina reba* (Ham.) from Marathwada Region. *Ph.D. Thesis*, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- [8] Surendra Babu, K. and Neela Kantan, B. (1983). Biology of *Liza parsia* in the Kali estuary, Karwar. *Mahasagar.*, 16 (3): 381-389.
- [9] Usha P.G. and N.B. Nair (1994): On the maturity and spawning of the esturine catfish *Arius subrostratus* and *S. valenciennes*. *J Anim. Morphol. physiol.*, 47,(1), 51 -60.
- [10] Sharma S.Y. P.B. Jaya Raju & T.J.S. Alankara Rao (1996): Reproductive biology of a tropical freshwater cat fish *Mystus cavacius* (Siluriformes-Bagaridae) from Gunthur, India. *J. Aqua. Biol.* 11 (1&2), 33-40.
- [11] Singh, H.R. and Bahuguna, S. N. (1984): West. Cs. Spolic. *Zool.* 48: 64-68.
- [12] Kharat, S. S., Y. K. Khillare and Neelesh Dahanukar (2008). Allometric scaling in growth and reproduction of a freshwater loach *Nemacheilus mooreh*. *Electronic Journal of Ichthyology*. March, 2008 (1).
- [13] Sukumaran K.K. (1978): Studies on the fishery and Biology of *Solenocera crassicornis* (H. Milne Edwards) from Bombay waters *J Mar. Biol. Ass. India.*, 20 (1&2): 32-39.

- [14] Maria R. Menzes (1980): Some observations on the morphomerly and Biology of *Psettoodes erumei* (Bloch) and *Pseuldorhombus arsius* (Hamilton- Buchanan) from the Goa region. *Mahasagar. Bulletin of the National Institute of Oceanography*. 13 (4) (1980) 377-381.
- [15] Holt, S.J. (1960): A preliminary comparative study of the growth, maturity and mortality of sardines. *In Proc. World sci. Meeting on Biology of sardines and Related species*. 2, PP 535-561. Rome: FAO.
- [16] Sekharan, K.V. (1968a): Growth rates of the sardines, *Sardinella albella* (Val) and *S. gibbosa* (Bleek.) in the mandapam area. *Indian J Fish*. 15, 68-80.
- [17] Silva E.I.L. and S.S De-silva (1981): Aspects on reproductive biology of grey mullet. *Mugil* . Populations of coastal lagoon . *J. Fish. Biol*. 19. 1-10.
- [18] Fauzi, H. (1936): Successful stocking of Lake Qaroun with mullets (*Mugil cephalus* Linn. and *M. Capiro* Cuv. and Val) from the mediterranean. *Inst. Revue. Ges. Hydrobiol. Hydrogr*. 33: 434-339.
- [19] Broadhead, G.C. (1953): Investigation of the black mullet, *Mugil cephalus* in northwest Florida *Tech. Ser. Pta. State Board Conserv*. 7: 1-33.
- [20] Bailey, M. M. (1963). Age, growth and maturity of round white fish of the Apostle Island and Isle Royale regions Lake superior. *U.S. Fish. Wild I- serv. Fish. Bull*. 63: 63-75.
- [21] Marz, D. (1964): Age and growth of the round white fish (*Prosopium cylindraceum*) in lake michigan. *Trans. Amer. Fish. Soc*. 93: 46-53.
- [22] Pillay T V R (1958) biology of the *Hilsa ilisha*. *Indian J. Fish*. 5: 201-257
- [23] Mortuza G. M. and Rahman Tafeequa, (2006), Length- weight relationship, condition factor and sex ratio of fresh water fish *Rhinomugil corsula*. From rajshahi, Bangladesh, *J. Bio-Sci*. 14: 139- 141.
- [24] Surendra Babu, K. and Neela Kantan, B. (1983). Biology of *Liza parsia* in the Kali estury, Karwar. *Mahasagar.*, 16 (3): 381-389.
- [25] Wijeyaratne, M.J.S. and Costa, H.H.(1988 a). The food, fecundity and gonadal maturity of *Valamugil cunnesius* (Pisces. Mugilidae) in the Negombo lagoon, Sri Lanka. *Indian I. Fish* 35(2): 71-77.
- [26] Luther, G. (1962). The food habits of *Liza macrolepis* (Smith) and *Mugil cephalus*. *Indian J. Fish.*, 9, 604-626.
- [27] De sliva and Wijeyaratne, M.J.S. (1977). Studies on the biology of young grey mullet, *Mugil cephalus* L. II - Food and feeding. *Aquaculture* 12; 157-167.
- [28] Wijeyaratne, M.J.S. and Costa, H.H. (1990). Food and feeding of two species of Grey mullets *Valamugil buchanani* (Bleeker) and *Liza vaigiensis* Quoy and gaimard inhabiting backwishwater environments in Srilanka. *Indian J Fish.*, 37(3): 211-219.

