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Research Article

ASSESSMENT OF AGE AND GROWTH OF EXOTIC FISH TILAPIA (*OREOCHROMIS MOSSAMBICUS* P.) IN LAKE JAISAMAND, INDIA

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ABSTRACT
This study based on the examination of scales of 90 tilapia (*O.mossambicus* P.) individuals from commercial catch from Jaisamand Lake, Udaipur (India). The growth parameters including growth characteristics (C_{th}), specific linear growth (C_l), growth constant (C_{lt}), specific rate of weight increase (C_w), index of species average size (Øh) and index of population weight growth intensity ($ØC_w$) were estimated. In studied population age composition varied between 1+ to 4+ year class and 3+ age group was dominated. The mean total length (30.450 cm) and weight (534.950 gm) were observed. The specific rate of linear growth (C_l) and specific rate of weight increase (C_w) in this study observed decreasing trends with increasing of age. The growth constant (C_{lt}) and average growth constant ($C_{lt(Ave)}$) during the initial year of life is high indicate that the fish had active growth period during first year. In view of these findings it can be inferred that environment of Lake Jaisamand is conducive and offers opportunities for high growth as well as wellbeing for tilapia. This study on age and growth may serve as a good tool for regulating tilapia population in this water body in future.

Key Words: *Tilapia, Age and Growth, Jaisamand Lake, Conservation*

INTRODUCTION
The Jaisamand Lake is one of the largest men made freshwater body situated on 24° 14' N latitude and 73° 57' E longitude at an altitude of 587 m (MSL) with a maximum depth of 32 m and mean depth of 15 m. It was constructed in 1729 AD about 56 km away in South East of Udaipur city in the southern Rajasthan. The age old existence of the lake and specific morphometric features provide opportunities for the high biological production. Kohli *et al.*, (1998) estimated the productivity, nutrients status and biodiversity of microfauna and flora of various water bodies including Lake Jaisamand of southern Rajasthan. Durve (1976) reported for high fish production comparable to the most productive standing water bodies.

The exotic fish Tilapia (*Oreochromis mossambicus P.*) was noticed in 1991 in fish catch (Anon, 1995) probably it was accidental entry with seed of Indian major carp. The prolific breeder, strong parental care and omnivorous feeding habit are the main reasons for overcrowding of tilapia in the water body and it survives longer due to hardiness and adaptability. The potential for overcrowding leads to recruitment alteration and competition for food (Courtenary and Stauffer, 1984; Fuller *et al.*, 1999; Ujjania *et al.*, 2004). The fish production and community structure of local fish fauna were affected by high density and abundance of tilapia.

The fish production data fluctuation due to contribution of tilapia suggest simultaneous impact on the total production of the Indian major carps and cat fishes as evident from the data (Singh, 1994; Ujjania, 1997; Durga and Srivastava 2008; Ujjania *et al.*, 2004). Similarly, Courtenary and Hensley (1979) reported decrease in population size of established exotic fishes due to overcrowding of spotted tilapia in canal. Age and growth data of fish is in congestion with length and weight measurements which can give the information on stock composition, age and maturity, life span, mortality, growth, production etc. These studies have earlier been done by Chacko and Krishnamoorthy (1951), Gupta and Jhingran (1973) and Bhatnagar (1979). Ujjania (1997) worked on age and growth of *O. mossambicus* from Lake

Jaisamand, Udaipur (India) by examining scales. Similar studies were also done by Ibrahim *et al.*, (2008), Mahmoud and Mazrouh (2008) and Kariman and Alaa (2009) in cichlids.

The objective of present study was to provide update information on the growth and effects of tilapia on domestic fauna in Jaisamand Lake

MATERIALS AND METHODS

Collection of Sample

For the present investigation fish production data of Jaisamand Lake were collected from Department of Fishery (Government of Rajasthan), Udaipur and key scales from 90 fish specimens were randomly collected from 'Namla' fish landing center of Jaisamand Lake (Figure 1) during the fishing year 2012-13. These key scales were preserved in small paper envelopes bearing with fish details like total length (cm), weight (g), date of collection etc.

Scale Analysis

The scales were dipped in 1 % KOH solution for 5-10 minute and gentle wash with tap water to remove extraneous matter and mucous and these clean scales were examined under 4P scale reader.

Back Calculation of Length

The length of the fish at the time of formation of annuli could be estimated using following relationship given by Bagenal and Tesch (1978):

$$L_n = a + \frac{S_n}{S} \times (L - a)$$

Where: L_n is length of fish when the annulus 'n' was formed, L is length of fish when scale sample was obtained, S_n is radius of annulus 'n', S is total scale radius and a is correction factor i.e. intercepting point between TL and Scale Radius (Figure 2).

Growth Parameters Based on Scale Analysis

The growth parameters such as growth characteristics (C_{th}), specific linear growth (C_l), growth constant (C_{lt}), specific rate of weight increase (C_w), index of species average size (Øh) and index of population weight growth intensity ($ØC_w$) were also estimated to follow the below mentioned equations:

$W = aL^b$ (Biswas, 1993)

$\text{Log } W = \text{Log } a + b \text{ Log } L$ (LeCren, 1951)

$$C_l = \frac{L_n - L_{n-1}}{L_{n-1}} \times 100$$ (Chugunova, 1963)

$$C_w = \frac{W_n - W_{n-1}}{W_{n-1}} \times 100$$ (Chugunova, 1963)

$$C_{th} = \frac{\text{Log } L_n - \text{Log } L_{n-1}}{0.4343} \times L_{n-1}$$

$$C_{lt} = \frac{\text{Log } L_n - \text{Log } L_{n-1}}{0.4343} \times \frac{t_2 + t_1}{2}$$ (Chugunova,1963)

$$Øh = \frac{\sum h = 1}{nj + a}, \quad h = nj + a \quad \text{(Balon, 1971)}$$

$$ØC_w = \frac{\sum C_w = 1}{nj + a}, \quad C_w = nj + a \quad \text{(Balon, 1971)}$$

Where: L_n, L_{n-1} is total length of fish at ultimate and penultimate age, W_n, W_{n-1} is weight of fish at ultimate and penultimate age, j is juveniles, 'a' is adult, h is absolute increase in length and t_1, t_2 is time intervals between ultimate and penultimate age.

Statistical Analysis

Statistical analysis of observed data was done by PAST software.

RESULTS AND DISCUSSION

In present study structural details of cycloid scales of tilapia were characterized by distinct markings which was represent the growth periods. It was depicted in figure 1 and table 1 that specimen were belongs to age class +1 (9), +2 (15), +3 (54) and +4 (12) with 17.833 cm / 99.167 g, 27.500 cm / 390.200 g, 32.083 cm / 576.778 g and 36.256 cm / 854.500 g length / weight at the time of capture respectively (Table 1).

The growth parameters on the basis of scales calculated which revealed notable increase 11.619, 20.259, 28.070 and 33.301 cm in length and 30.209, 151.871, 395.825 and 653.531 g in weight for I, II, III and IV year classes respectively. These observations interpreted that tilapia enjoy favorable environmental conditions of the aquatic environment of Lake Jaisamand and observed high growth and well being in tilapia could be justified. Kelly (1957) observed 84 gm growth in 18 weeks whereas Raskamp (1960) considers growth 85-120 gm in 8 months in Tilapia to be a sign of fast growth.

Under Indian conditions Chacko and Krishnamoorthy (1954) reported a growth of 22 cm in 8 months for *T. mossambica* and considered this as fast growth. During the study period (1996-1997) the highest size/weight of tilapia recorded by Ujjania (1997) from Lake Jaisamand and it was 43.5 cm/1620 gm, respectively. In the present study it was also confirmed that Tilapia attained average length of 24.3 cm and weight of 330 gm in one year that is comparable to the observations of Chacko and Krishnamoorthy (1954).

From the growth performance of Tilapia as noted from back calculated growth parameters (Table 2) it is evident that the average specific size (Øh) was 12.95 and the Index of population weight growth intensity ($ØC_w$) was 82.43. These results are fairly comparable to that of Johal and Tandon (1987) reported in Indian major carps. These results also indicate that the fish attained maximum length increment in the + 1 year class (C_I 22.95) as compared to the +2 year class (C_I 19.94). In corroborates with weight gain wherein, the fish also attained maximum weight (C_w 89.34) between I and II as compared to (C_w 72.52) during II and III year classes. The growth constant (C_{lt}) and average growth constant ($C_{lt(Ave)}$) during the initial year of life is high (Table 2) indicate that the fish had active growth period during first year.

Based on average growth constant, growth periods have been demarcated in fishes (Johal and Tandon, 1987). Balon (1968) suggested that average value of growth characteristics (C_{th}) is useful parameter for demarcating the growth periods. In the present study, the value of growth characteristics (C_{th}) showed notable increment in the catch size. These growth trends clearly indicate that there was a well-marked irregularity in (C_{th}, C_w) growth during different years. This conforms to the earlier studies on *Labeo rohita* (Johal and Tandon, 1985).

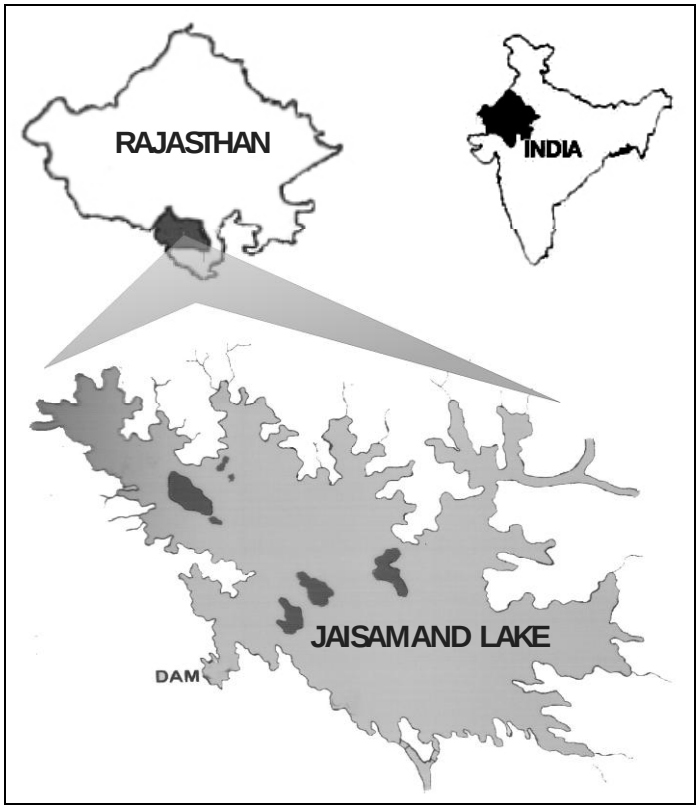

Figure 1: Map of study area

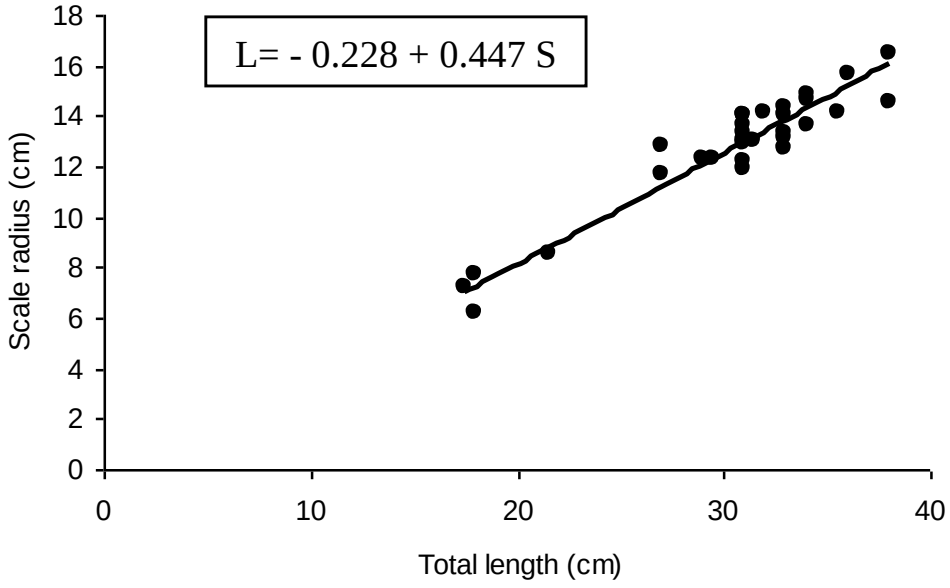

Figure 2: Graph between Total length (cm) and scale radius (cm)

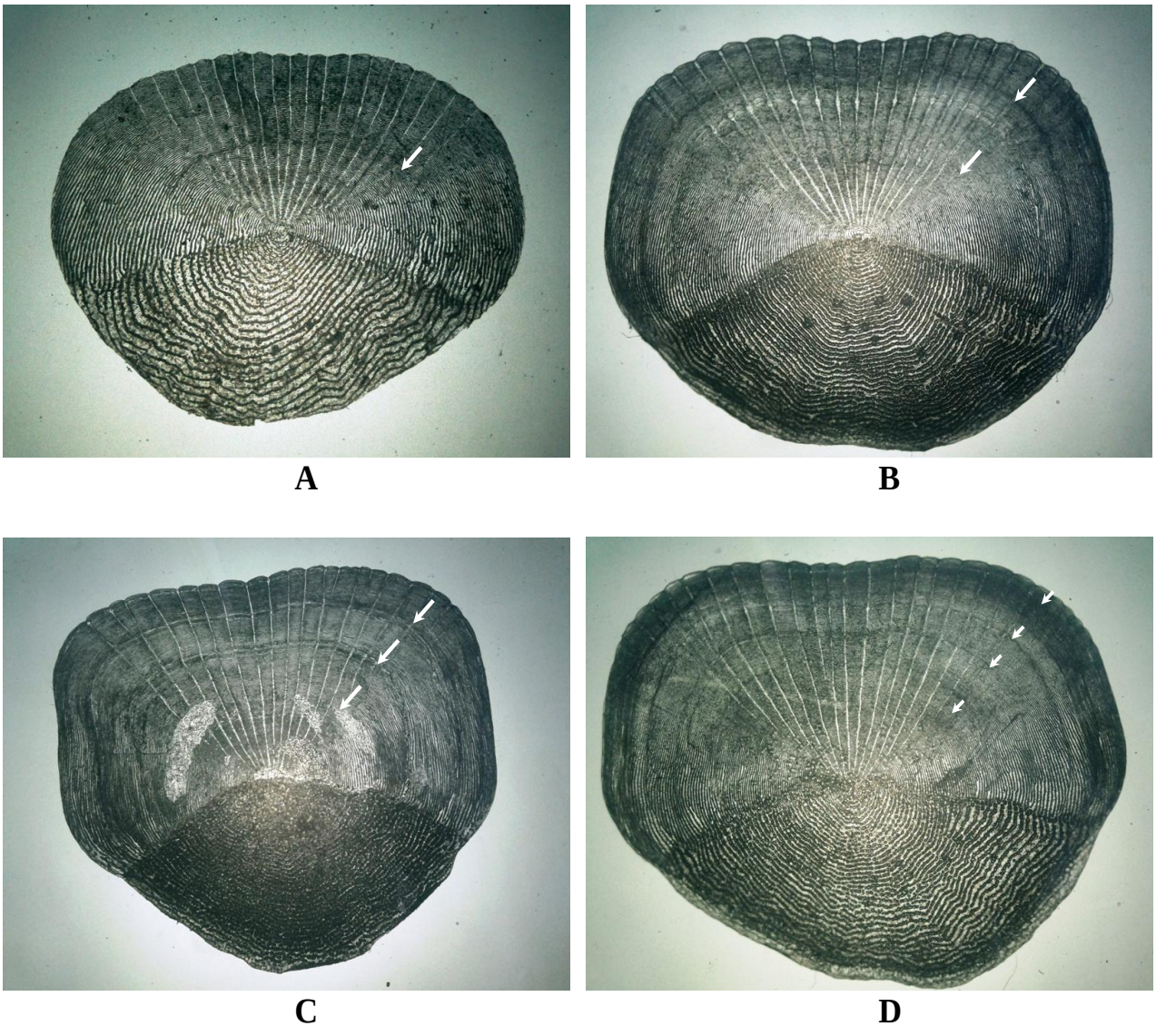

Figure 3: Images of Tilapia scale
A is 1+ year class
B is 2+ year class
C is 3+ year class
D is 4+year class

In the present study, all the studied cichlid species attained their highest growth rates in length during the first year of life, after which a gradual decrease was noticed with further increasing in age (Table 2). These results are in accordance with these of Ibrahim *et al.*, (2008) and Mahmoud and Mazrouh (2008). In view of above findings, it can be inferred that environment of Lake Jaisamand is conducive for tilapia which offers opportunities for high growth and well being of this fish. As the above stated growth increase seems to be high under Indian conditions especially in wild waters, these data may serve as a good tool for regulating Tilapia population in this water body in future. The above findings also indicate that there is need to monitor age and growth parameters regularly together with studies on fish population structure and dynamics in a more comprehensive manner.

Table 1: Annual Growth of fish in terms of Length (cm) and weight (gm)

Age Group	No of specimens		TL (cm) of fish at capture time	WT (gm) of fish at capture time	Average Back calculated length (cm)				Average Back calculated weight (gm)			
					L_1	L_2	L_3	L_4	W_1	W_2	W_3	W_4
		Min	17.500	98.500	8.182				9.979			
1+	9	Max	18.000	100.000	14.516				54.810			
		Mean	17.833	99.167	10.645				26.364			
		Min	21.500	169.000	9.612	18.212			16.103	107.524		
2+	15	Max	31.000	531.000	12.000	21.923			31.135	186.560		
		Mean	27.500	390.200	11.235	20.962			25.999	165.328		
		Min	29.000	452.500	10.394	16.250	24.357		20.315	76.638	255.074	
3+	54	Max	35.500	744.000	14.351	24.316	31.114		52.979	253.790	527.939	
		Mean	32.083	576.778	11.820	20.256	28.090		30.682	152.330	395.591	
		Min	33.000	655.500	10.076	16.878	25.443	32.244	18.527	85.775	290.356	586.966
4+	12	Max	38.000	932.500	13.818	21.879	32.703	36.848	47.346	185.442	612.126	872.635
		Mean	36.250	854.500	12.460	20.049	28.925	34.389	36.095	146.996	439.243	717.912
		Min	17.500	98.500	8.182	16.250	24.357	32.244	9.979	76.638	255.074	586.966
Total	90	Max	38.000	932.500	14.516	24.316	32.703	36.848	54.810	253.790	612.126	872.635
		Mean	30.450	534.950	11.691	20.356	28.242	34.389	30.209	153.946	403.528	717.912

Table 2: Growth parameters and growth rate of fish

Parameters	Age of fish or Year class			
	1	**2**	**3**	**4**
L	11.691	20.259	28.070	33.301
H	11.691	8.569	7.811	5.231
∅H	8.325			
C_l	73.293	38.554	18.636	
C_{th}	6.428	6.606	4.797	
C_{lt}	0.825	0.489	0.256	
$C_{lt(av)}$	0.825	0.373		
W	30.209	151.871	395.825	653.531
w	30.191	121.662	243.954	257.706
C_w	402.736	160.633	65.106	
$\varnothing C_w$	209.492			

L : Back calculated length (cm).
h : Annual length increment (cm).
∅h : Index of species average size
C_l : Specific rate of linear growth
C_{th} : Growth characteristics
C_{lt} : Growth constant
$C_{lt(Av)}$: Growth constant average
W : Calculated weight (gm).
w : Annual weight increment (gm).
C_w : Specific rate of weight increase.
$\varnothing C_w$: Index of weight growth intensity

This would help in assessing status and changing trends of Tilapia population in Lake Jaisamand. Such efforts would also help in assessing any probable adverse impact of Tilapia on indigenous carp fishery of this lake. The results of this research clearly point out that Tilapia population is likely to grow further in this lake unless suitable remedial measures at war footings are adopted.

REFERENCES

Anon (1995). Menace of Indian fishes of Lake Jaisamand due to occurrence of African fish. Rajasthan Patrika 11-12.

Bagenal T and Tesch FW (1978). Age and growth. In: Methods for assessment of fish production in freshwaters, IBH handbook No. 3, 3rd edition, Blackwell Scientific Press, Oxford 101-136.

Balon EK (1971). A short methodological outline for production survey of freshwater fish population (with example from Lake Kariba). UNDP/FAO, Central Fisheries Research Institute, Zambia 1-18.

Balon EK (1968). The periodicity and relative indices of the growth of fishes (with notes on their terminology). *In*: *International Conference of Aging and Growth of Fishes*, Smolenice, Czechoslovakia 115-143.

Bhatnagar GK (1979). Studies on the age and growth of *Labeo fimbriatus* (B.) from river Narmada. *Journal of Inland Fisheries Society of India* **11**(2) 96-108.

Biswas SP (1993). Length-weight relationship and condition factor. *In*: Manual of Methods in Fish Biology. New Delhi, South Asian Publishers 60-64.

Chacko PI and Krishnamoorthy B (1951). Age and growth of carp *Labeo fimbriatus.* B. as revealed by scales. IPFC Technical Papers (Summary).

Chacko PI and Krishnamoorthy B (1954). Observation on *Tilapia mossambica* P. in Madras. *Journal of the Bombay Natural History Society* **52**(2)B 349-353.
Chugunova NI (1963). Handbook for the study of age and growth of fishes. The National Science Foundation, Washington 132.
Courtenary WR Jr and Hensley DA (1979). Range expansion in southern Florida of introduced spotted tilapia, with comments on its environmental impress. *Environmental Conservation* **6**(2) 149-151.
Courtenary WR Jr and Stauffer JR (1984). Distribution, biology and management of exotic fishes. The Johns Hopkins University Press, Baltimore Maryland 322-373.
Drenner RW, Vinyard GI, Gophen M and Cornas MC (1982). Feeding behaviour of the cichlid *Sarotherodon galilaeus*: Selective predation on Lake Kinneret zooplankton. *Hydrobiologia* **87** 17- 20.
Durga IA and Srivastava RM (2008). Tilapia invasion and its control in Jaisamand Lake, Udaipur: A case study. *In*: Mangement of freshwater ecosystem, edited by Sharma *et al.*, (Agrotech Publishing Academy, Udaipur) 327-335.
Durve VS (1976). The Fisheries of Lake Jaisamand, Rajasthan. *Journal of Inland Fisheries Society of India* **8** 19-23.
Fuller PL, Nico LG and Williams JD (1999). Nonindigenous fishes introduced into inland waters of the United States. American fishery society, Special publication 27, Bethesda Maryland 435-441.
Gupta SD and Jhingran AG (1973). Aging *Labeo calbasu* (Ham) through its scale. *Journal of Inland Fisheries Society of India* **5** 126-128.
Ibrahim SM, Shalloof KASH and Salama HMM (2008). Effect of environmental conditions of Abu Zaabal Lake on some biological, histological and quality aspects of fish. *Global Vetrinaria* **2** 257- 270.
Johal MS and Tandon KK (1985). Use of Growth parameters in *Labeo rohita* (Pisces: Cyprinidae). *Vest. Cs. Spolec. Zool.,* **49** 101-107.
Johal MS and Tandon KK (1987). Age and growth of *Cirrhinus mrigala* from northern India. *Vest. Cs. Spolec. Zool.,* **51** 177-182.
Kariman A Shalloof and Alaa M El-Far (2009). Age, growth and fishery biology of cichlid species in bu-Zaabal Lakes, Egypt. *Egyptian Journal of Aquatic Biology and Fisheries* **13**(2) 101-116.
Kelly HD (1957). Preliminary studies on *Tilapia mossambica* P. relative to experimental pond culture. *Proceedings of 10th Annual Conference of the Southeastern Association of Game and Fish Commissioners* 139-149.
Kohli MPS, Prakash C and Jhadhav RJ (1998). Aquatic productivity indices in four tribal districts of Rajasthan with special reference to fisheries development. *Punjab Fisheries Bulletin* **20** 53-62.
LeCren ED (1951). The Length-weight relationship and seasonal cycle in gonad weight and condition in perch *(Pena fluviatilia). Journal of Animal Ecology* **20** 201-219.
Mahmoud HH and Mazrouh MM (2008). Biology and fisheries management of *Tilapia species* in Rosetta branch of the Nile River, Egypt. *Egyptian Journal of Aquatic Research* **30** 272- 285.
Raskamp GA (Jr.) (1960). *Tilapia mossambica* P.: Preliminary findings in Netherlands, New Guinea, I.P.F.C. Occasional Paper 66/1.
Singh S (1994). Some aspects of fishery and biology of *Labeo rohita* (Ham.) from Lake Jaisamand, Rajasthan, MSc (Agriculture) Thesis, Rajasthan Agricultural University, Bikaner.
Ujjania NC (1997). Some aspects of fishery and biology of exotic fish Tilapia (Oreochromis mossambicus P.) from lake Jaisamand Udaipur (Rajasthan). MSc (Agriculture) (Lim. And Fish) thesis, Rajasthan Agricultural University, Bikaner.
Ujjania NC, Sharma LL and Jain AK (2004). Base line data on age and growth of Tilapia (*Oreochromis mossambicus* P) from Lake Jaisamand Udaipur (India). *Proceedings of 6th International Symposium on Tilapia in Aquaculture*, 13-15 September 2004 Manila Philippines 699-708.