Biolife 1(2):-45-53, 2013
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournal.com
BIOLIFE ORIGINAL ARTICLE

REPRODUCTIVE BIOLOGY OF TWO FRESH WATER FISHES, *OMPOK BIMACULATUS* AND *O. MALABARICUS* (BLOCH) OF THE RIVER AMARAVATHY, TAMIL NADU, INDIA

Arthi T, Nagarajan S[1], **Sivakumar A A[2]** and Vijayaraman K[2]

[1]ENT Clinic, No.58, Cowley Brown Road, R. S. Puram, Coimbatore – 641 002, Tamil Nadu, India
[2]Present Address: Department of Environmental Studies, KSG College of Arts and Science, Coimbatore - 641 015, Tamil Nadu, India
E-mail: aasivakumar52@gmail.com

ABSTRACT

O. bimaculatus and *O. malabaricus* are found to breed throughout the year with significant increase during specific time, supported by ova diameter studies, seasonal occurrence of maturity stages, gonado-somatic index and relative condition factor ('Kn'). Individuals of *O. bimaculatus* and *O. malabaricus* seem to spawn once in a breeding season. The spawning peaks for *O. bimaculatus* (September) and for *O. malabaricus* (July) are confirmed by the occurrence of high percentage of fully mature specimens and a rise in 'Kn' values, during the respective months. 50% of males and females of *O. bimaculatus* seem to mature in the size range of 200-210 mm and 189-199 mm, respectively, which is attained at the end of the second year or at the beginning of the third year. In *O. malabaricus*, 50% of males in the 333-353 mm size group and females in 328-348 mm size group attain maturity at the age of the second year.

Key words : Maturation and Spawning, fresh water fishes, *Ompok bimaculatus* and *O. malabaricus*

INTRODUCTION

It is a well known fact that information on fish biology is of utmost importance to fill up the lacuna of the present day knowledge. This helps in increasing the technological efficiencies of the fishery entrepreneurs for evolving judicious pisciculture management. The Indian fresh water fish fauna is an assemblage of nearly 2500 species, falling into three main families known as, *Cyprinidae*, *Siluridae* and *Channidae*, inhabiting in the inland waters. The reproductive capability of a fish stock is determined by its fecundity. Fecundity is explained in simple terms as number of potential eggs in the ovary. The release of them is known by a process called 'spawning'. Attempts are continually made from the past decades to investigate further and continually reported.

Alikunhi (1956) made observations on fecundity, larval development and early growth of *Labeo bata*. Fairall and Dhamman (1977) studied the fecundity of two species of *Labeo* viz., *L. umbritus* and *L. carpensis* and stated that the fecundity of both species was highest in the larger size groups. Rao (1974) studied on *Labeo fimbriatus* from Godhavari river. Fecundity in relation to the total body weight and gonad weight in *Rasbora daniconius* was observed by Nagendran *et al.* (1981).

However, a large majority of fishes are yet to be analyzed well. Enhancement of a fish population depends on this process. Growth of the fish, the length and weight parameters, have positive influence on reproduction. In general the fecundity is more closely related to length than the somatic weight or ovary weight.

Knowledge on factors like size at maturity, spawning, sex-ratio, ova diameter studies and fecundity are essential pre-requisites in any fishery management and conservation. This helps in accomplishing efforts to increase the amount of harvest. In view of that, studies are made to analyze thoroughly the reproductive potential because of its application in the determination of enhancing the yield. Resourceful information on maturation and spawning of *O. bimaculatus* and *O. malabaricus* from freshwaters are inadequate from southern part of India. Hence, an attempt has been made on these aspects.

MATERIALS AND METHODS

The study area is located 20 km south of Udumelpet Taluk in Coimbatore District, southern part of India, at a *latitude* of 10^0 29' and *longitude* of 77^0 10'. Fish samples were collected from the River Amaravathy, for a period of one year, from August 2005 to July, 2006. Specimens were brought to the laboratory and after noting the parameters for length weight study, the body was dissected and the gonads were examined. The gender identification was done as male, female and unsexed. The general appearance, extension in the body cavity and the colour of the gonads were noted. The stage of maturity of the gonads was recorded as below:

Male:

Stage -1 (immature) : Testes white, slender, threadlike, opaque occupying less than half of body cavity.

Stage -2 (maturing) : Testes milky white, slightly flattened, occupying more than half but less than $2/3^{rd}$ of body cavity.

Stage – 3 (mature) : Testes creamy yellow, with undulating margins, flattened and occupying three-fourths of body cavity.

Stage - 4 (spent) : Testes dirty white, shrunken, no milt oozes out on pressure, occupying half of body cavity.

Female

Stage- 1 (immature) : Ovaries transparent and appear whitish- grey in colour, ovaries occupying less than half the length of body cavity.

Stage- 2 (maturing) : Ovaries are pale yellow in colour and granular in appearance. Ovaries increase in length and occupy half the length of abdominal cavity.

Stage -3 (mature) : Ovaries with orange yellow coloration and distinct granular appearance. Although ova are seen through the ovarian wall, they do not come out through the genital aperture when the slight pressure on the belly of the fish is applied. Ovaries occupy nearly the entire length of the body cavity.

Stage -4 (Ripe) : Ovaries occupy the entire length of the body cavity. They are orange yellow in colour and bulge at various places due to the pressure of ova. The transparent ova are visible to the naked eye and they come out through the genital aperture with the application of the slight pressure on the belly of fish. The blood vascular supply increase and numerous capillaries are distributed over the surface of ovaries.

Ovaries were removed, blotted dry with absorbent paper, measured to the nearest mm in length and weighed to the nearest mg and preserved in modified 'Gilson's fluid' as

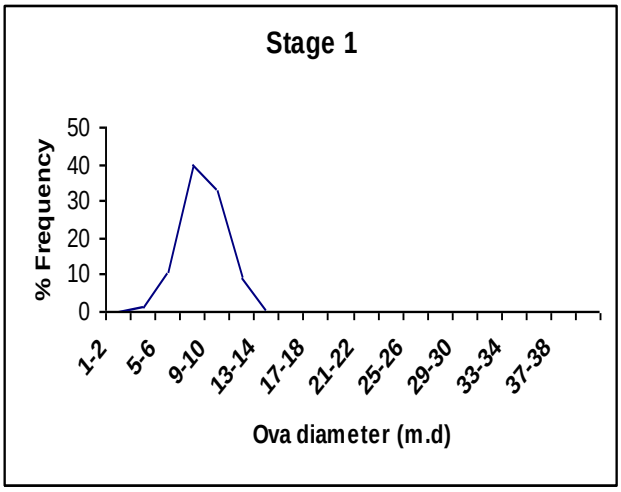
recommended by Simpson (1951), for minimum of two weeks and the vials are periodically agitated to ensure separation of eggs from the connective tissue. Ova sampling from anterior, middle and posterior regions of sampled ovaries are taken. One hundred ova were measured from ovaries in different stages of maturity, using an ocular micrometer.

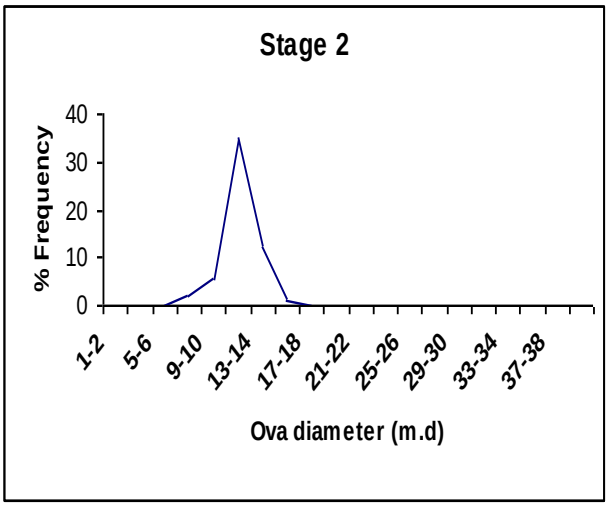
RESULTS

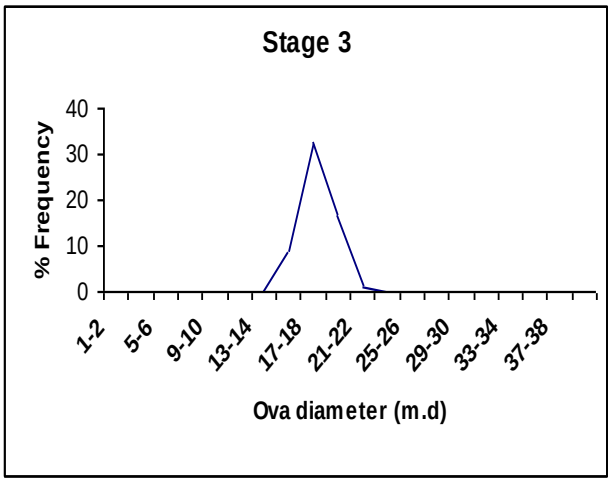
Development of ova to maturity and frequency of spawning:

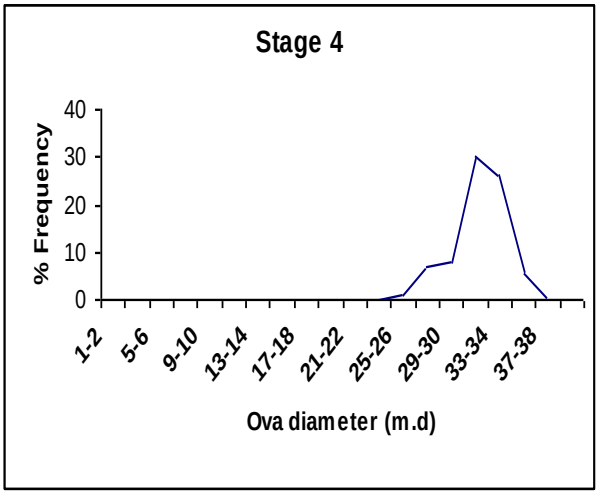
The diameter of ova of all stages of maturity were measured and the frequency of spawning in *O. bimaculatus* and *O. malabaricus* were recorded initially from ovaries of all stages, as described above, to study the development of ova to maturity. The immature ova, up to 4 mmd (micrometer division) were more in numbers than the maturing ones. Hence only those measuring 5 mmd and above were taken into consideration in all the stages. The diameter frequencies were grouped and presented in Fig. 1 and 2.

Fig. 1. Frequency distribution of ova diameter in different stages of maturity in *Ompok bimaculatus* (Stages 1-4)









In *O. bimaculatus* (Fig. 1) during stage 1, maximum number of ova wre recorded between 9 and 10 mmd. This peak value was shifted to 13 – 14 mmd in stage 2. Further shifting of the peak value from 13-14 mmd to 17-18 mmd was observed in stage 3. In ripe ovaries (stage 4), the peak value has been recorded with the diameter of 33- 34 mmd. The ova of this species grow up to the maximum size of 37 – 38 mmd.

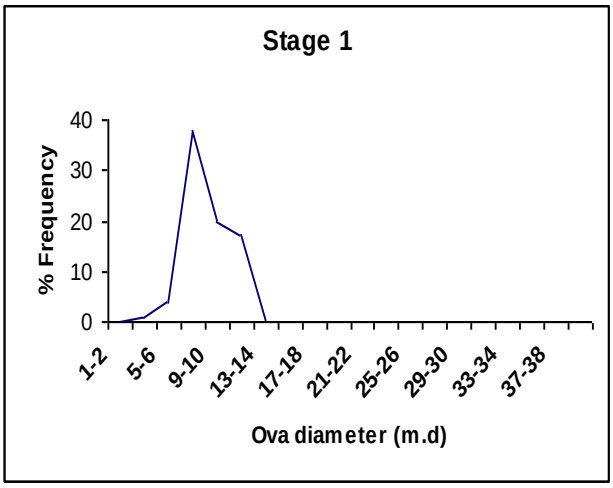
In *O. malabaricus* (Fig. 2) maximum number of ova, measuring between 9 and 10 mmd, were recorded in stage 1. This peak value, recorded at 9 - 10 mmd in stage 1, has been shifted to 11 –

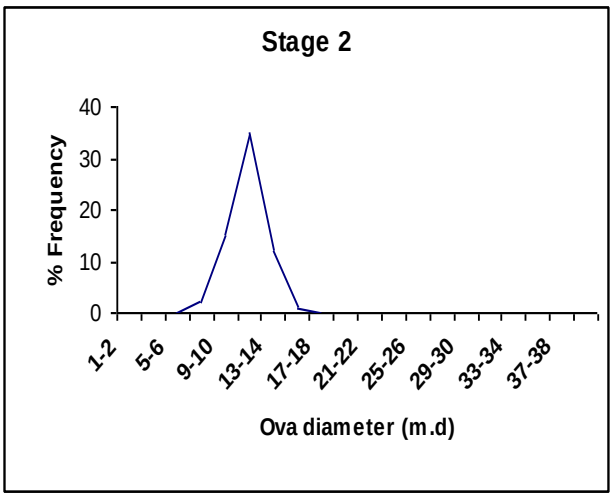
12 mmd in stage 2. Further shifting of the peak value from 11 - 12 mmd to 17 – 18 mmd can be observed in stage 3. In stage 4, the peak value has been recorded in 31-32 mmd size group. The maximum size of ova recorded in ripe ovaries of this species was 37-38 mmd.

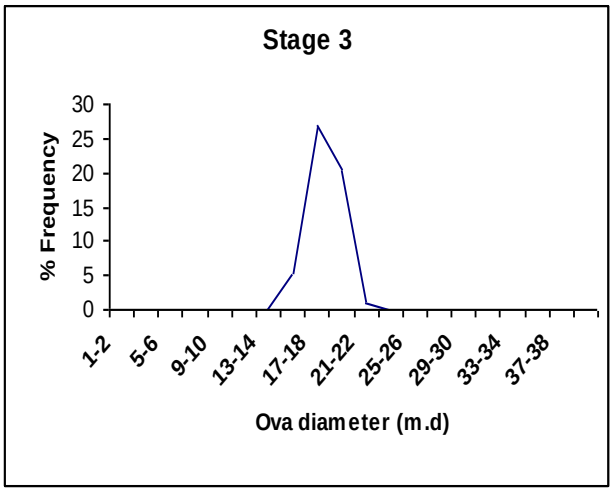
The frequency polygons of diameters of mature ova of both species indicate that they essentially spawn once a year.

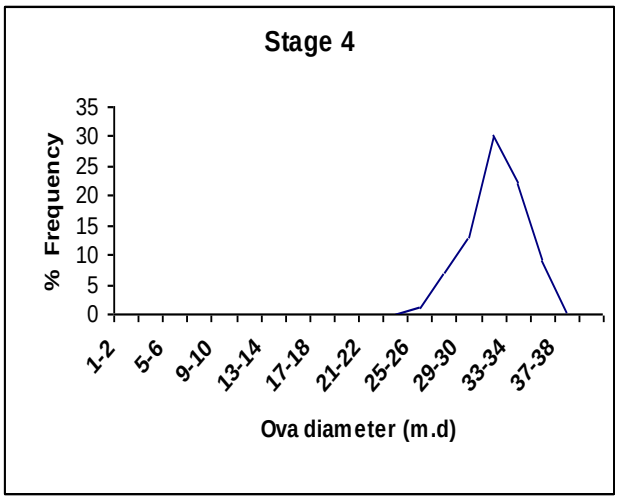
Seasonal occurrence of maturity stages:
In order to determine the spawning season, the different maturity stages of gonads, during different months of the year, were recorded and plotted separately for *O. bimaculatus* and *O. malabaricus.*

Fig. 2. Frequency distribution of ova diameter in different stages of maturity in *Ompok malabaricus.*



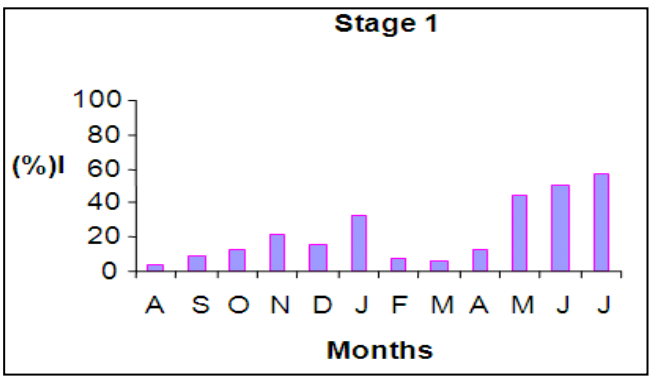


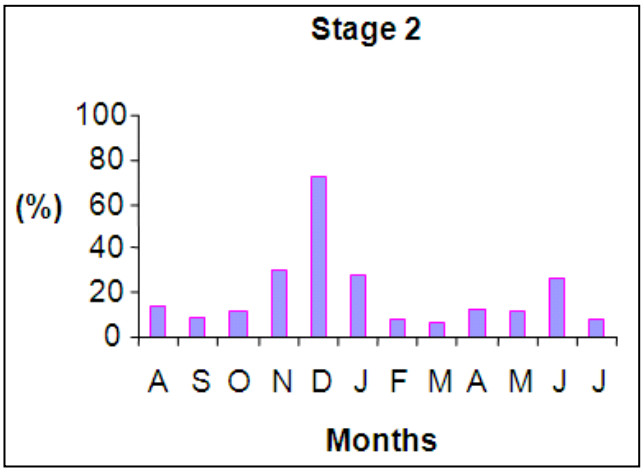


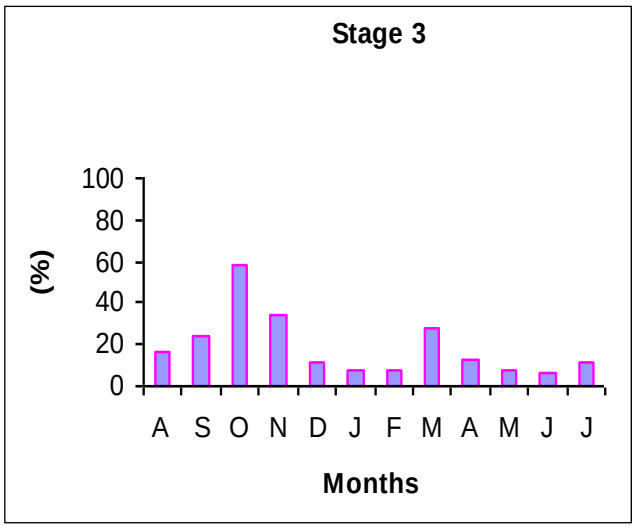


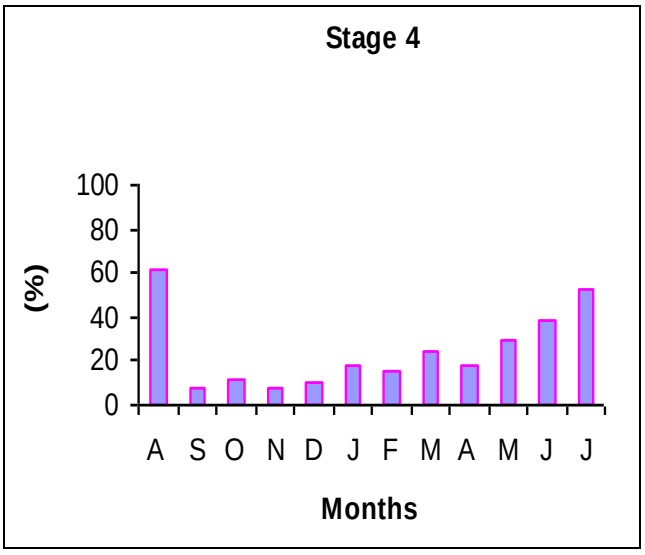
Fully mature testes and ovaries, though occurred throughout the year, maximum percentage of fully matured gonads are usually recorded prior to release of gametes. In *O. bimaculatus*, the peak percentages recorded in August (Fig. 3).

Fig. 3. Percentage of different maturity stages of ovary in relation to different months in Ompok *bimaculatus*





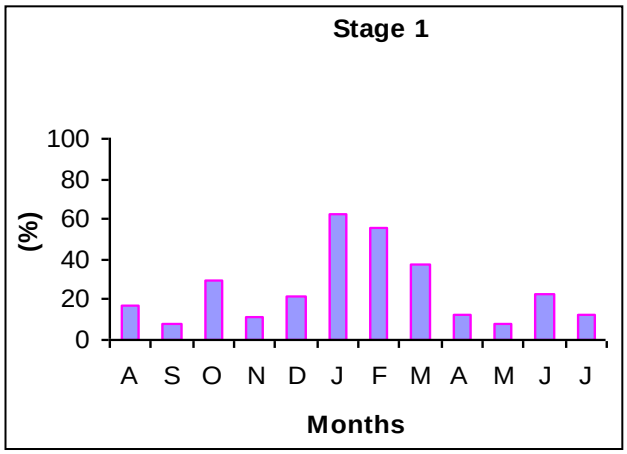


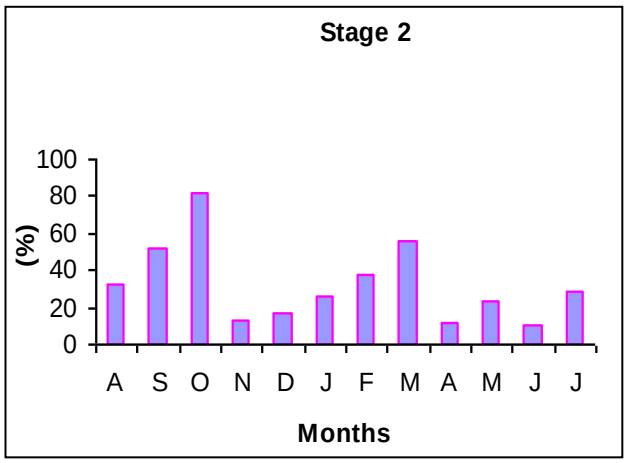


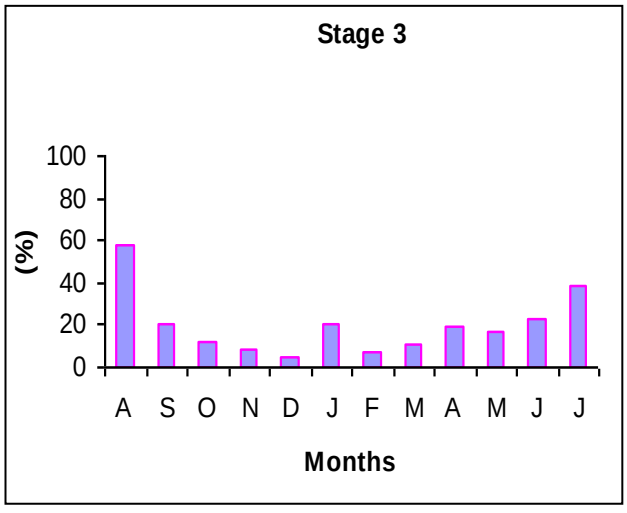
This indicates that *O. Bimaculatus*, though potentially spawns round the year, maximum activity occurs around August and completes a major spawning in September.

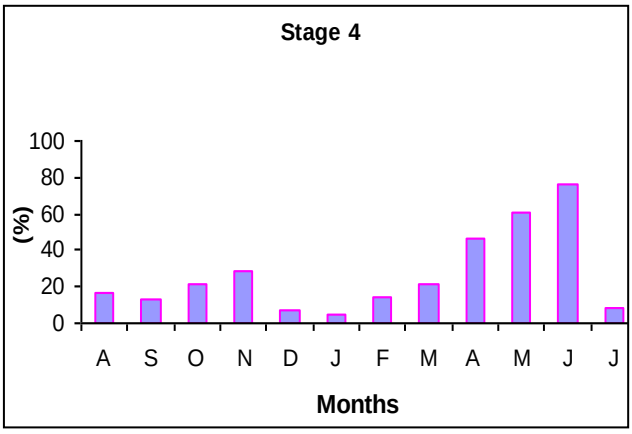
In *O. malabaricus*, matured gonads were seen in different months, with higher percentages in June (Fig. 4). Hence it is presumed that the peak activity of spawning occurs around June and completes in July.

Fig. 4. Percentage of different maturity stages of ovary in relation to different months in *Ompok malabaricus*









Gonado-Somatic Index (G.S.I.):

The gonads enlarge to mature as the fish grow. Till the maturity reaches the ripened stage, the relationship of growth of gonads with that of fish is directly proportionate. However, with spawning, as the ova are delivered and the gonad is spent, the weight of it is likely to decrease. This relationship is better understood by employing Gonado-Somatic Index (**GSI**). It is calculated by using the following formula:

$$G.S.I. = \frac{\text{Weight of the gonad}}{\text{Weight of the fish}} \times 100$$

Hence, the GSI steadily increases till the development of gonads into ripening. Then there is a notable decline with spawning. This index is calculated for both males and females separately and the monthly mean value was then plotted. The higher gonado-somatic index values were obtained in *O. bimaculatus* during august with a fall in September (Fig. 5). This corresponds with the spawning period. In *O. malabaricus* the higher G.S.I. values were observed during April – May (Fig. 6)

Fig. 5. Gonado-Somatic Index for *Ompok bimaculatus*

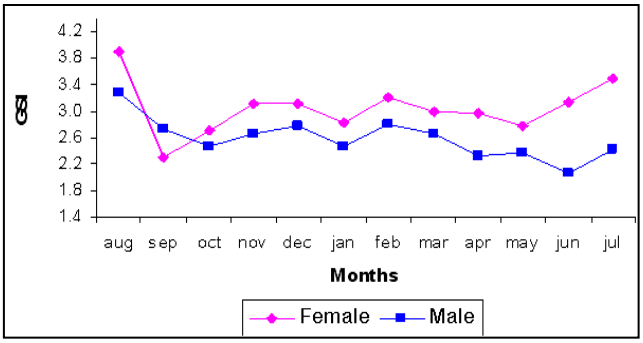
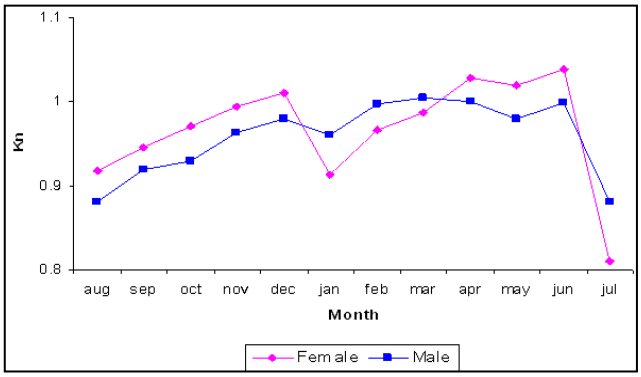


Fig. 6. Gonado-Somatic Index for *Ompok malabaricus*



Relative Condition Factor ('Kn'):

The condition factor was calculated by using the formula:

$$K = \frac{W \times 100}{L^3}$$

This equation is based on the ideal form of a fish where, in the length-weight formula $W = aL^b$, where, 'b' is equal to 3, and the 'Cube Law' is obeyed. When 'b' is not equal to 3, then the 'k' computed by this formula, as seen frequently, changes with length (Le Cren, 1951). The effect of length on k, however, can be eliminated by computing the relative condition factor based on empirical length-weight relationship and is calculated from the formula:

$Kn = \hat{W} / W$

Where, Kn = relative condition factor

$\hat{W}$ = observed weight

W = calculated weight

The difference between 'K' and 'Kn' is that the former is measuring the deviation of an individual from a hypothetical 'ideal fish', while the latter is measuring the deviation of an individual from the average weight for length.

The relative condition factor ('Kn') was calculated for individual fish using the method described by Le Cren (1951). The monthly mean relative condition factor value was recorded for the *O. bimaculatus* and *O. malabaricus* (Fig. 7 & 8).

Fig. 7. Monthly mean 'Kn' values for adults of *Ompok bimaculatus*

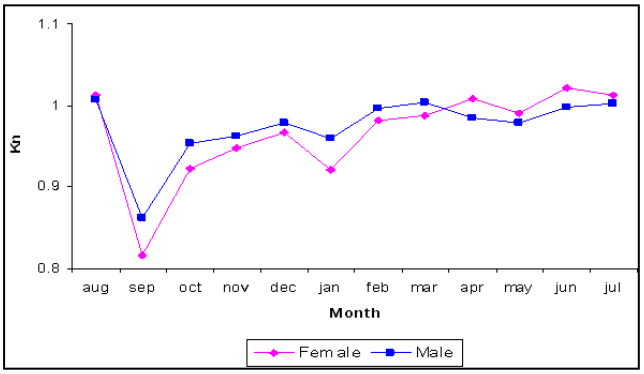
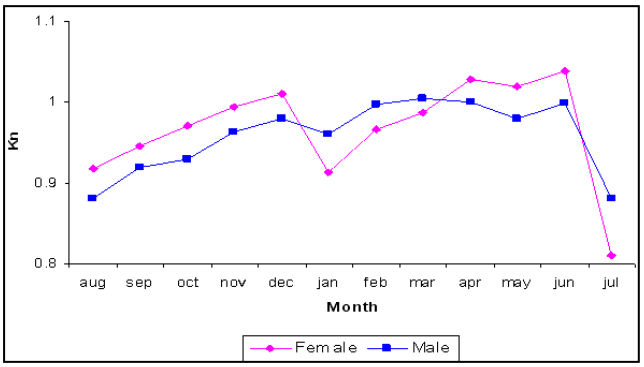


Fig. 8. Monthly mean 'Kn' values for adults of *Ompok malabaricus.*



In addition, mean 'Kn' values were calculated for different length groups of adult fishes (Fig. 9 & 10). Adult fishes in length group around 300mm in both species showed recording of fall in their Kn value with a nadir type of inflection. Maturity and spawning could be attributed for this.

Fig. 9. Mean 'Kn' values for different length groups of adults in *Ompok bimaculatus*

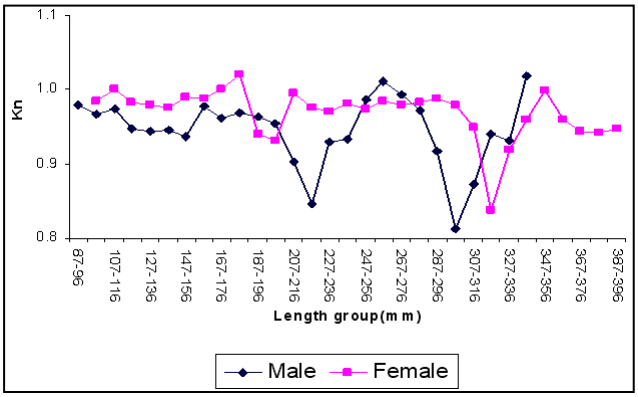
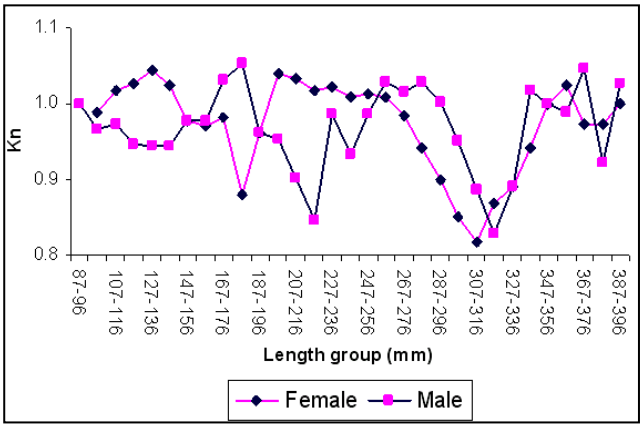


Fig. 10. 'Kn' values for different length groups of adults of *Ompok malabaricus*



In both species, a rise in 'Kn' value corresponds with a rise in gonadal activity as evidenced further by the seasonal occurrence of maturity stages and G.S.I. values. From the studies on the modal distribution of ova, seasonal occurrence of maturity stages, gonado-somatic index and relative condition factor, the following conclusions can be drawn: Both the species breed throughout the year. *O. bimaculatus* shows peak spawning activity during the months of August and September. O. *malabaricus* shows peak spawning activity during the month of June and July.

DISCUSSION

In the present study, both species were found to breed throughout the year with significantly higher records in specific time. In *O. bimaculatus* the peak activity found was between August and September, and in *O. malabaricus*, between June and July. These observations agree with the reports on seasonal breeding made by Raj (1916), Thomas (1969), Khan (1972),

The condition factor is calculated by utilizing the somatic weight. The weight steadily increases as the gonad matures and with the discharge of gametes it is likely to fall. This influence enables the 'Kn' and 'GSI' factor calculations and thereby determining for spawning. The variation in these factors are known and this is attributed to different factors in the case of different fishes as observed by Parameswaran *et al*. (1974), Hanumantha Rao (1974),

Chanchal *et al*. (1978) and Somvanshi and Bapat (1985).

Fishes in length group around 300 mm in both species showed a sharp decline in their Kn value, indicating the attainment of maturity and spawning. Sivakami (1982) recorded the minimum size of maturity of *O. bimaculatus* from Bhavani Sagar area as 230 mm. Spawning was found to occur throughout the year with peak recordings in October in that area. Maturity on the basis of ova diameter is a time tested study (Frances and Clark, 1931). It is a character specific to the species and hence inter species variation is known. The peak diameter around which the maximum no of matured eggs found were around 30 mmd. Seasonal variation in identifying the matured eggs are known as there can be migration from the area during spawning season (Pillay and Shaw, 1949; Kulkarni,1950; Karamchandani, 1961). *O. bimaculatus* and *O. malabaricus* showed no undue variation in distribution of maturity. Hence it is difficult to extrapolate on the migratory spawning activity in the absence of additional information.

REFERENCES

1. **Alikunhi, K. H**. 1956. Observations on the fecundity, larval development and early growth of *Labeo bata.* (Ham). Ind. J. Fish., 3: 216-229.

2. **Bhattacharya, R**. 1946. On the life history of *Ophicephalus striatus* Bloch. Proc. Indian Sci. Congr., 33(3): 125 – 129.

3. **Chanchal, A. K., B. N. Pandey and S. P. Singh.** 1978. Studies on some aspects of biology of *Anabus testitudineus* (Teleostei: *Anabantidae*). Bull. Ind. Soc. Ich.,4: 15-19.

4. **Fairall, N. and K. C. Dhamman**. 1977. Population structure of two *Labeo* species in the Hendrik Verwverd dam as determined by gill net sampling. J. Limnol. Soc. South. Afr. , 3(1): 9-12.

5. **Frances, N. and F. N.Clark.** 1931. Maturity of the California sardine (Sardina caerulea), determined by ova diameter measurements. Fish Bulletin No. 42.

6. **Hanumantha Rao, H**. 1974. Studies on the biology of *Cirrhinus mrigala* (Hamilton) of the river Godavari. Indian J. Fish.**,** 21(2): 303 – 322.

7. **Hosaini,V. H. and M. Rahimullah.** 1946. Early developmental stages of *Ophicehalus punctatus* (Bloch). Proc. Indian. Sci. Congr. , 33: 169 – 171.

8. **Karamchandani, S. J.** 1961. On the location of spawning grounds of Indian Shad, *Hilsa ilislia* (Hamilton) in the freshwater regions of the Narbada river. Curr. Sci., 30: 373-375.

9. Khan, R. A. 1972. Studies on the biology of some important major carps. Ph.D. Thesis. Aligarh Muslim University, Aligarh.

10. **Kulkarni, O. V**. 1950. Breeding habits, eggs and early life history of the Indian Shad, *Hilsa ilisha* (Ham.), in the Narbada rive. Proc. nat. Inst. Sci. India. B.,15: 169-176.

11. **Le Cren. E. D**. 1951. The length-weight relationship and seasonal cycle in the gonad weight and condition in the perch, *Perca fluviatilis*. J. Anim. Ecol., 20: 201-219.

12. **Nagendran, R., K. Shakuntala, G. N. Natarajan and H. R. Kuasan.** 1980. Observation onthe fecundity of the cyprinid, *Rasbora daniconius*. Proc. Indian Acad. Sci., 90 (4): 381-388.

13. **Parameshwaran, S., C. Selvaraj and S. Radha Krishan**. 1974. The study of the biology of *Labeo gonius* in confined waters. Ind. J. Fish., 21(1): 54-75.

14. **Pillay, T. V. R. and J. S. Shaw**. 1949. The inland fisheries of Kodinar in Kathiawar. J. Bombay nat. Hist. Soc., 48: 775-781.

15. **Raj, B. S.** 1916. Notes on the freshwater fish on Madras. *Rec. Indian Mus.,* 12: 249-294.

16. **Rao, R.** 1974. Observations on the age and growth, Maturity and fecundity of *Labeo fimbriatus*.(Bloch) of the Godavari River. *Ind. J. fish.*, 21(2): 427-444.

17. **Simpson, A. C**. 1951. The fecundity of the plaice. Fish. Invest. Min. Agrl. Fish. U K Series II. 17(5):1-27.

18. **SivSivakami S.** 1987. Length-weight relationship and relative condition factor in *Ompok bimaculatus* (Bloch) from Bhavanisagar reservoir, Tamil Nadu. Indian Journal of fof Fisheries. 34: 136-140.

19. **Smith, O. R.** 1947. Returns from natural spawning of cut throat trout and eastern brook trout. Trans. Am. Fish. Soc., 74: 281-296.

20. **Somavanshi, V. S. and S. S. Bapat.** 1985. Study on condition factor in a hillstream fish, *Garra mullya* (Sykes), Matsya, 11: 86-89.

21. **Thomas, P. A**. 1969. Goat fishes (Fam. Mullidae) of the Indian seas. Mar. Biol. Assoc. India. Memoir., III. 7: 152-157.

22. **Varghese, T. J.** 1962. Observations on the biology of Reconda russelliana (Gray). Ind. J. Fish., 8: 96-106.

23. **Varghese, T. J.** 1973 b. The fecundity of the rohu, *Labeo rohita* (Ham). Proc. Indian Acad. Sci., 77: 214-224.

24. **Varghese, T. J**. 1976. Studies on the fecundity of *Carcoilcia ramacarati* (Ham-Buch). Proc. Indian Acad. Sci., 83: 47-54.

25. **Winters, J. H**. 1971. Fecundity of the right and left ovaries of the grand bank capelin (*Mallotus villosus*). J. Fish. Res. Bd. Canada, 28: 1029-1033.

26. **Wooten, R. J**. 1973. Fecundity of 3 spined stickle back *Gastrostreus aculeatus L*. Fish. Biol., 5: 683- 688.