

# NOTES ON THE BIONOMICS, BREEDING AND GROWTH OF THE MURREL, *OPHICEPHALUS STRIATUS* BLOCH\*

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## INTRODUCTION

CONSIDERABLE information is now available on the bionomics and development of the murrel, *Ophicephalus striatus* (Willey, 1910; Raj, 1916; Rahimullah, 1946; Bhattacharya, 1946; Mookerjee *et al.*, 1948). Though a fairly complete account of the life-history is available there are still several points with regard to breeding, brood care, growth, age and maturity of the species that require elucidation.

Murrel forms the bulk and mainstay of the pond fisheries in several parts of peninsular India. Though a predator, its occurrence in different types of habitats, its tenacious life, and its agreeable flesh of high nutritive value make it an important food fish which, at present, is hardly cultured on scientific lines anywhere in India. Accurate data on its growth and natural food in different stages, age, and size at maturity, etc., are of great importance in the successful cultivation of the species. Certain observations made and experiments carried out since 1945 to elucidate some of the above aspects are briefly reported in this paper.

## BREEDING

Observations of Thomas (1870), Day (1889), Willey (*op. cit.*), Raj (*op. cit.*), Khan (1925), Rahimullah (*op. cit.*), Jones (1946) and Mookerjee, *et al.* (1948) indicate that (a) intensive breeding of *O. striatus* takes place during the rainy months, (b) this breeding depends on the prevailing climatic conditions, the single peak period in north India including the Punjab extending from April to August, (c) the double peak in peninsular and southern India, corresponding to the two monsoon seasons, June-July

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and November-January, and (d) the breeding takes place on a limited scale during other months also. From the foregoing it would appear that the species breeds all through the year. In the present study active breeding was observed from November to January in Madras; and a three-day old brood of fry was located in a pond at Azhicode, Cochin, in the middle of March. The pond at Azhicode was dewatered and desilted on 2-3-1951, and nine murrels (*O. striatus*), 6" to 9" long, rescued from the silt of an adjoining dry canal were released in the pond on 6-3-1951. The water in the pond was perfectly clear, 2½ feet deep and devoid of all macrovegetation. There was no rain in the locality during the period. On 14-3-1951 a brood of early fry was found in the pond, being guarded by the parent fishes. Eggs would, therefore, have been laid on 10/11-3-1951, i.e., only 4-5 days after introducing the fish in the pond. The fish had spawned in spite of the fact that weeds used for building nests were not present.

The breeding habits and brood care of the murrels have also been described by several workers. According to Raj (*op. cit.*) both the parents (the male in particular) keep guard of the nest. Bhattacharya (*op. cit.*), however, states that the adult (the female more often) nurses the offspring and protects them. Disparity in size between the parents guarding the spawn or brood is very often seen. The larger, female parent is more assiduous in brood care and is constantly found with the young ones. The smaller, male parent is also seen in the vicinity, looking for intruders and chasing them away, but it quickly swims away from the brood on the slightest apprehension of danger like a passing shadow or some little disturbance. Even under circumstances of apparent danger the female stays on with the brood and will swim away only when the danger becomes imminent. It is also the first to return to the young ones after the danger is past. In the Azhicode pond the parents guarding the brood were of almost equal size.

Eggs collected from a single nest were found to be in two distinct stages of development, some of them (about 25%) with the embryo differentiated and the rest only in advanced stages of cleavage. This probably indicates that spawning takes place at intervals, as stated by Bhattacharya (*op. cit.*).

*Size and Age at Maturity.*—The smallest mature female specimen taken was 234 mm. long with the ovaries in the IV stage. In the Chetput Farm ponds, specimens 233.7 mm. to 317.5 mm. long which were only 9-10 months old after hatching from the egg were found to have the gonads in the IV stage. It is, therefore, clear that under natural conditions, *O. striatus* attains sexual maturity towards the end of the first year of its life. According

to Raj (*op. cit.*), Bhattacharya (*op. cit.*) and Mookerjee *et al.* (*op. cit.*) however, this murrel attains sexual maturity when two years old.

*Fecundity*.—According to Raj (*op. cit.*) the number of eggs varies from a few hundreds to a few thousands depending on the size of the fish; while young fry in each batch number 2,000 to 2,500 (Rahimullah, *op. cit.*). No definite account of the fecundity of the species thus appears to be available. Details of four female specimens collected from Azhicode, Cochin, and one from Serampore, West Bengal, are given in Table I.

TABLE I  
*Length-Weight-Fecundity data of O. striatus*

| No. | Date of collection | Total length (mm.) | Weight (gms.) | Stage of Maturity | Weight of Ovaries (gms.) | Volume of Ovaries (c.c.) | Total No. of Ova. | Average Diameter of Ovum (mm.) |
|-----|--------------------|--------------------|---------------|-------------------|--------------------------|--------------------------|-------------------|--------------------------------|
| 1   | 26-2-1951 ..       | 248.0              | 133.0         | V                 | 6.6                      | 6.7                      | 4,422             | 1.17                           |
| 2   | ..                 | 247.0              | 135.0         | IV                | 2.7                      | 2.7                      | 2,997             | 1.01                           |
| 3   | ..                 | 234.0              | 113.0         | IV                | 3.4                      | 3.3                      | 3,883             | 1.01                           |
| 4   | 22-2-1951 ..       | 386.0              | 534.0         | IV                | 22.6                     | 22.0                     | 11,811            | 1.11                           |
| 5   | 27-4-1949 ..       | 448.0              | 794.5         | IV                | 30.3                     | 30.0                     | 20,070            | ..                             |

Compared to carps the fecundity of murrels appears to be low. With increase in the size of murrels, however, the fecundity also increases. The mature egg does not vary in size in proportion to the size of the fish.

#### NOTES ON DEVELOPMENT

The average diameter of the laid eggs collected from the Chetput swamp, Madras, was 1.53 mm. In the early stages of embryonic differentiation the eggs are pale yellow or amber coloured, but with the formation of chromatophores on the advanced embryos they appear, to the naked eye, brownish in colour. The egg has a single large oil globule, and a narrow clean peri-vitelline space. No oil globule was found in the peri-vitelline space at any stage of embryonic development. The advanced embryo with the tail coiled over the head occupies almost the entire peri-vitelline space. It ruptures the egg membrane, hatches out with the tail foremost, and wriggles about with the head end still inside the egg, using the projecting tail portion as a paddle. The lashing movements of the tail help to cast off the half ruptured egg membrane covering the head portion.

The period of incubation in eggs even from the same nest ranges between 24 to 40 hours.

In the laboratory when artificial aeration was not provided mortality was heavy before hatching. When water is allowed to drip slowly in the aquaria, the mortality of eggs and larvæ could be controlled. This seems to indicate that even in the stagnant waters of the pond some little aeration of the egg may be brought about by the slow sinuous movements of the body of the parent to ensure satisfactory hatching.

The hatchling is 4.35 mm. long, considerably pigmented, and has a conspicuous oblong yolk sac from which the head hardly projects forward. It floats at the surface up side down at a slight angle. The eyes are not fully pigmented, and the pectoral buds and mouth have not yet appeared. On the second and third days it is 5.25 mm. and 5.73 mm. long respectively. The yolk sac is almost fully absorbed on the third day when with the well formed mouth the larva begins to feed. The pectoral fins are flap-like. Under natural conditions the growth and differentiation of structures are rapid. The mouth and the tip of the notochord are directed upwards by the 5th and 7th days respectively. The caudal fin has indications of 7-8 rudimentary rays. The colour of the body is reddish, with the eyes golden red and glistening. The characteristic yellow and dark lateral bands along both sides of the body are well indicated. A distinct bright yellow spot has appeared on the dorsum of the head postero-medially, over a spindle-shaped median patch of dark brown pigment extending upto the level of the eyes. On the 9th day the dorsal and anal fins are clearly indicated, almost separate from the caudal fin. Rudimentary rays are present in the dorsal and anal fins; and there are indications of ventral fin buds almost at the same level as pectorals. Pigmentation has become more pronounced. Within the next two days all the fins are fully formed excepting the ventrals which take two more days to be fully differentiated. Scales appear on the body by the 15th or 16th day.

#### POST-LARVAL GROWTH

(a) *In the Laboratory*.—Growth of fry in aquaria was slow. The growth in length of hatchlings fed on live plankton was on an average 8.04 mm. in 15 days, and 12.3 mm. in 36 days.

Growth of fingerlings in aquaria, fed regularly on an ample supply of young stages of forage fish, *Amblypharyngodon mola* and *Esomus danricus*, was as in Table II.

TABLE II

*Data on the growth of fingerlings of O. striatus in the laboratory aquaria (30"×15"×12") having a water content of 2.4 c.ft.*

| Date       | No. of specimens | Total length (mm.) |        | No. of days kept in aquaria | Growth during the period |       | Remarks                           |
|------------|------------------|--------------------|--------|-----------------------------|--------------------------|-------|-----------------------------------|
|            |                  | Range              | Aver.  |                             | Range                    | Aver. |                                   |
| 6-3-1946   | 4                | 112.0-123.0        | 119.0  | ..                          | ..                       | ..    |                                   |
| 6-5-1946   | 4                | 143.0-148.0        | 145.25 | 60                          | 24.0-31.0                | 26.25 |                                   |
| 10-6-1946  | 4                | 163.0-180.3        | 170.3  | 35                          | 20.0-32.3                | 25.08 |                                   |
| 16-8-1946  | only 2           | 181.0-203.0        | 192.0  | 66                          | 16.0-19.7                | 17.85 |                                   |
|            | added 2          | 148.0-160.0        | 154.0  | ..                          | ..                       | ..    |                                   |
| 11-9-1946  | 2                | 196.0-207.0        | 201.5  | 25                          | 4.0-15.0                 | 9.5   |                                   |
|            | 2                | 168.0-186.0        | 177.0  | 25                          | 20.0-26.0                | 23.0  | } poor growth<br>growth very poor |
| 9-10-1946  | 4                | 172.0-209.0        | 192.0  | 28                          | 2.0-4.0                  | 3.0   |                                   |
| 17-12-1946 | 4                | 175.0-215.0        | 194.5  | 69                          | nil -6.0                 | 2.5   |                                   |

During a period of over 9 months, the maximum growth recorded was only 92 mm. The largest specimen, 215 mm. long, was just about one year old after hatching.

(b) *In the Natural Pond.*—Samples of early fry (3rd day hatchlings) located in a natural pond were collected from a brood and preserved every alternate day for two weeks. The observations on the natural growth of fry under the protection of the parent fishes as seen from the size and weight of the above collection of fry are detailed in Table III.

The growth of fry under natural conditions is much more rapid than that under laboratory conditions. The period of relatively slow average growth in the first three days after hatching corresponds to the period of subsistence on yolk. The growth is, however particularly rapid from the middle of the second week to the beginning of the third week, when it begins to feed on plankton. By the middle of the third week, growth tends to slow down gradually. This growth in length corresponds to the steady gain in weight from the time the hatchling begins to feed. To begin with, the daily gain in weight is approximately half the weight of the fry at the beginning of the day, increasing to just as much as or even a little over the total weight of the body, by the middle of the second week (Table III, last column). There is a gradual decline after this and by the middle of the third week the daily

**TABLE III**  
*Initial growth of early fry of O. striatus in a natural pond at Azhicode, Cochin*

| Date      | No. of fry examined | Age (days) after hatching | Total length in mm. |      |       | Average growth (mm.)      |                 | Aver. wt. of fry (gms.) | Average increase in wt. (g.) |                 | Gain in wt. per day. |
|-----------|---------------------|---------------------------|---------------------|------|-------|---------------------------|-----------------|-------------------------|------------------------------|-----------------|----------------------|
|           |                     |                           | Max.                | Min. | Aver. | During intervening period | During 24 hours |                         | During intervening period    | During 24 hours |                      |
|           |                     |                           |                     |      |       |                           |                 |                         |                              |                 |                      |
| 14-3-1951 | 7                   | 3                         | 5.85                | 5.13 | 5.496 | 1.146*                    | 0.382           | 0.0014                  | ..†                          | ..              | ..                   |
| 16-3-1951 | 5                   | 5                         | 7.20                | 6.30 | 6.525 | 1.029                     | 0.514           | 0.0027                  | 0.0013                       | 0.00065         | 0.46                 |
| 18-3-1951 | 7                   | 7                         | 10.08               | 7.56 | 8.73  | 2.205                     | 1.102           | 0.0062                  | 0.0031                       | 0.00155         | 0.57                 |
| 20-3-1951 | 7                   | 9                         | 12.4                | 10.4 | 11.67 | 2.94                      | 1.47            | 0.0148                  | 0.0086                       | 0.0043          | 0.7                  |
| 22-3-1951 | 6                   | 11                        | 16.7                | 13.8 | 15.93 | 4.26                      | 2.13            | 0.0456                  | 0.0308                       | 0.0154          | 1.04                 |
| 27-3-1951 | 7                   | 16                        | 30.7                | 25.8 | 27.78 | 11.85                     | 2.37            | 0.2384                  | 0.1928                       | 0.03856         | 0.84                 |
| 29-3-1951 | 7                   | 18                        | 33.8                | 28.6 | 31.6  | 3.82                      | 1.91            | 0.3446                  | 0.1062                       | 0.0531          | 0.22                 |

\* The average length of hatchling is taken as 4.35 mm. † Weight of the hatchling was not taken.

gain in weight is only about one-fourth the weight of body. Thus, during the first 18 days of the life of the fish, the maximum growth in length and increase in weight are registered from the 11th to the 16th day (*vide* Table III). Though the average growth in length during these 18 days has been just over 6 times the length of the hatchling, the average increase in weight of the three-day old hatchling during the next 15 days has been about 24 times its initial weight. Zooplankton in the pond which consisted mainly of copepods, nauplii and rotifers, was only of very moderate density, and planktonic algæ were extremely rare.

In the natural environment the growth of the post-larvæ up to the fingerling stage is also rapid. Several broods of fry located in the Chetput Farm ponds were sampled at different intervals to ascertain their natural growth. The data gathered are given in Table IV.

TABLE IV

*Data on the growth of post-larval specimens of O. striatus to the fingerling stage in the Chetput Farm, Madras*

| Pond | Brood | Date       | Total length (mm.) |       | Intervening period (days) | Average growth (mm.)      |         | Remarks                 |
|------|-------|------------|--------------------|-------|---------------------------|---------------------------|---------|-------------------------|
|      |       |            | Range              | Aver. |                           | During intervening period | Per day |                         |
| I    | 1     | 3-1-1946   | 38.0-48.0          | 43.6  | ..                        | ..                        | ..      |                         |
|      |       | 29-1-1946  | 59.0-85.0          | 71.0  | 26                        | 27.0                      | 1.05    |                         |
|      |       | 6-3-1946   | 97.0-121.0         | 110.2 | 36                        | 39.2                      | 1.08    |                         |
|      | 2     | 24-10-1946 | 11.6-16.2          | 14.3  | ..                        | ..                        | ..      |                         |
|      |       | 29-11-1946 | 62.0-70.0          | 65.6  | 36                        | 51.3                      | 1.42    | Aver. wt.<br>1.8 gms.   |
| III  | 3     | 3-1-1946   | 28.0-32.0          | 30.3  | ..                        | ..                        | ..      |                         |
|      | 21    | 21-1-1946  | 38.0-46.0          | 42.5  | 18                        | 12.2                      | 0.68    | Infected by<br>Iernæids |
|      |       | 6-3-1946   | 80.0-89.0          | 85.2  | 43                        | 42.7                      | 1.0     |                         |
|      | 4     | 15-10-1946 | 12.6-16.8          | 15.1  | ..                        | ..                        | ..      |                         |
|      |       | 30-11-1946 | 78.0-99.0          | 90.8  | 45                        | 75.7                      | 1.68    | Aver. wt.<br>5.6 gm     |
|      |       | 17-12-1946 | 96.0-109.0         | 103.5 | 17                        | 12.7                      | 0.75    | Aver. wt.<br>7.2 mg     |

Growth in the different ponds varies probably with the availability of food. The daily increase in length ranging from 0.75 mm. to 1.68 mm. must be considered to be rapid though it is lower than that recorded in the

TABLE V  
Growth, fattening and maturity of fingerlings of *O. striatus* stocked in rearing ponds in the Chetput Farm, Madras

| Pond No.   | Brood | Date       | Total length (mm.)                                     |       | Aver. wt. per fish (g.) | Intervening period (days)                              | Aver. growth (mm.) |         | Sex | Stage of gonad | Remarks   |
|--|-------|------------|--|-------|-------------------------|--|--------------------|---------|-----|----------------|---|
|  |       |            | Range  | Aver. |                         |  | During the period  | Per day |     |                |   |
| I  | 2     | 24-10-1946 | 11.6-16.2  | 14.3  | ..                      | ..   | ..                 | ..      | ..  | ..             |   |
|  | "     | 29-11-1946 | 62.0-70.0  | 65.6  | 1.88                    | 36   | 51.3               | 1.42    | ..  | ..             |   |
| Fingerlings netted and released in rearing ponds on 29-11-1946 |       |            |  |       |                         |  |                    |         |     |                |   |
| Rearing Pond I   | "     | 21-4-1947  | 205.0-242.0  | 230.5 | 90.0                    | 142  | 164.9              | 1.16    | ♂ ♀ | Immature       | Only 2 specimens netted<br>43 specimens recovered |
|  | "     | 28-5-1947  | 195.0-273.0  | 238.7 | 117.5                   | 37   | 8.2                | 0.22    | ♂ ♀ | Immature       |   |
|  | "     | 3-7-1947   | 238.0-245.0  | 241.5 | ..                      | 36   | 2.8                | 0.09    | ♂ ♀ | IV             |   |
|  | "     | 20-11-1947 | 250.0-270.0  | ..    | ..                      | All fish emaciated, no forage fish present in the pond |                    |         | ♀   | V              |   |
| Rearing Pond II  | "     | 3-8-1947   | 233.7-317.5  | 266.2 | 138.0                   | 246  | 200.6              | 0.81    | ♂ ♀ | II-IV          |   |
|  | "     | 4-10-1947  | Fish had bred and fry have grown to 22.0 mm. in length |       |                         |  |                    |         |     |                |   |



post-larval stage. Fry infected by lernæids had their growth adversely affected.

When the fingerling stage is reached the herd instinct of the fry begins to wane and the brood gradually scatters all over the pond. To avoid the possibility of the stock getting mixed up with other broods of fingerlings, segregated rearing was resorted to and the growth followed in two rearing ponds. Pond I had only a limited population of carp minnows introduced along with the murrel fingerlings. In the other pond minnows were already thriving at the time of stocking murels. Growth of fingerlings was periodically observed by taking measurements and weight of samples. The data gathered are given in Table V.

As the forage fish and murrel fingerlings were introduced together in Pond I there was hardly any time for the former to breed and establish themselves in it. Though natural food such as forage fish was limited in quantity in the pond, it was sufficient to maintain the fairly rapid growth of the murels over a period of nearly 5 months, after which growth was slow as a result of the diminution in the number of forage fish. Though gonads were maturing in some specimens, there was distinct emaciation and undeveloped gonads in many. Only 66 out of the 300 fingerlings introduced in this pond survived.

As the forage conditions in Pond II were better the murels had attained a maximum length of 317.5 mm. and weight of half a pound in 8 months after stocking. In another 2 months when the fish were about 11 months old, they started breeding. It is thus clear that under natural conditions *O. striatus* attains sexual maturity and breeds at the end of the first year of its life.

#### FOOD AND FEEDING HABITS

The predatory habits of *O. striatus* is so well known that no further additions seem possible in respect of its food and feeding habits. Mookerjee *et al.* (*op. cit.*) reported that just after the mouth was formed the larvæ of *O. striatus* fed on protozoa and algæ, while early fry subsisted on planktonic crustacea. The 3-day old hatchlings from the Azhicode pond, however, had not begun feeding, even though the mouth was well formed and functional. On the 5th day the young ones had gorged themselves with eggs and nauplii of copepods, colonial rotifers and other zooplankters, and this was continued on the succeeding days also. The plankton in the pond consisted of predominantly animal forms as a collection made with a No. 21 bolting silk townet showed.

#### DISCUSSION AND SUMMARY

*O. striatus* breeds almost throughout the year, with a peak immediately preceding and during the monsoon months. Although known as a nest builder amidst weeds in the marginal shallows, it appears capable of breeding even in ponds devoid of all vegetation. Both the parents keep guard over the brood of fry, the larger female being more assiduous in brood care than the male. Under natural conditions sexual maturity is attained in about 11 months after hatching when it is 10" to 12" long. The observations of Raj (*op. cit.*), Bhattacharya (*op. cit.*) and Mookerjee *et al.* (*op. cit.*) that *O. striatus* attains sexual maturity when two years old, appear to refer to specimens grown under artificial or adverse conditions. The fecundity of the species seems to increase with the size of the fish. In the normally developing egg the single oil globule does not appear to undergo fragmentation, leaving the perivitelline space clear throughout, although Mookerjee *et al.*, report breaking up of the globule into smaller ones in the perivitelline space, which may happen in faulty preservation of eggs.

Under natural conditions, the larval development is much quicker than what has been recorded hitherto. The 16-20 days stage of Mookerjee *et al.*, which corresponds to the 40 days stage of Willey (*op. cit.*), is attained by the 9th day. The differentiation of structures is even more rapid than in *O. marulius* (Khan, *op. cit.*). Mookerjee *et al.*, state that it attains a maximum length of 320 mm. in two years. A brood of fry hatched in the Madras aquarium pond attained a length of 152.4 mm. in one year and about a foot (304.8 mm.) at the end of the second year (Raj, *op. cit.*). The present author's observations show that growth, during all stages of its life-history, is much more rapid, and that even under limited forage conditions a length of about 320 mm. is attained at the end of the first year. Even in aquaria one-year old specimens attain a maximum length of 215.0 mm. (*vide* Table II).

The observations recorded in the present paper on the feeding habits of the early larvæ of *O. striatus* do not seem to support those of Mookerjee *et al.*, who have concluded that the larvæ feed almost exclusively on algæ and protozoa. In the conditions prevailing in the pond under report there seems to be little possibility of the fry obtaining an exclusive diet of planktonic algæ or protozoans. Available evidence on the natural food of tender fry of the majority of fresh-water fishes shows that an algal diet, at the commencement of alimentation, is perhaps an exception rather than the rule. It has been recently shown (Alikunhi, 1952) in the major Indian carps that an algal diet is an emergency food for the tender fry, and what little algal

diet has been consumed remains undigested and that the fry thrive best on a natural diet of zooplankton. The murrel fry also appear to conform to this general rule.

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