

**STUDIES ON THE BIOLOGY OF *HEMIRHAMPHUS MARGINATUS*  
(FORSKAL) (HEMIRHAMPHIDAE—PISCES)**

By P. K. TALWAR,\*

*Central Marine Fisheries Research Institute, Mandapam Camp*

INTRODUCTION

INVESTIGATIONS on the biology of the common species of hemirhamphids in the Gulf of Mannar and Palk Bay was initiated in 1957. The biology of *Hyporhamphus georgii* (C.V.) has already been dealt with (Talwar, 1962b) and an account of the food and feeding habits of *Hemirhamphus marginatus* (Forsk.) has been discussed in a separate contribution (Talwar, 1962a). Observations on the biology of *H. marginatus* in the Mandapam area during the period January 1957 to January 1959 and the results obtained are presented in the following account.

The species contributes to a seasonal fishery in the Gulf of Mannar for about three months viz., November to January. The Appathivu and Baliyanathivu ('thivu' in Tamil means an island)—Lat. 9°5' N. Long. 78°, 45'-50' E.) are the main fish-landing centres. The shore seine accounts for most of the catches.

MATERIAL AND METHODS

The fishery of *Hemirhamphus marginatus* being seasonal, samples could be obtained only for a short period of about 3 months in a year viz., November to January. Weekly samples were collected from Kilakarai, the principal fish-landing centre. The techniques employed in this study were the same as those for *Hyporhamphus georgii* (Talwar, 1962b). The ova from twenty ovaries were measured with an ocular micrometer at a magnification giving a value of 92.64  $\mu$  to each micro-division. Frequency polygons were constructed from this data.

A cluster of eggs attached to *Sargassum* weeds collected by Dr. S. Jones from the Dhanushkodi beach on 7-2-1958 were brought to the laboratory in a porous mud-pot containing sea water for developmental studies. In the laboratory the cluster of eggs was separated from the sea-weeds and transferred to a series of glass troughs with sea water. In these rearing experiments the temperature was kept steady between 20° C. to 25°C. by the method suggested by Vijayaraghavan (1957). The larvae were supplied with fresh unsorted plankton and diatoms, as indicated by Lebour's (1918-20) researches.

SYSTEMATIC STATUS AND DISTRIBUTION

*Hemirhamphus marginatus* (Forsk.) was incorrectly treated as a synonym of *Hyporhamphus georgii* (C.V.) by Day (1878). Weber and de Beaufort (1922), how-

\* Present Address : Zoological Survey of India, Calcutta-13.

ever, treated *Hemirhamphus marginatus* as a distinct species. Further the author has shown that these two species are generically separate (Talwar, 1960).

This species is reported to occur in the Red Sea, through the East Indies and Philippines to the China coast, and in the Pacific to New Caledonia and Tongatabu.

#### OBSERVATIONS

##### *Length frequency distribution*

Percentage length frequency polygons were constructed for the 3149 specimens occurring in different lengths during different months of the 1957 to 1959 seasons and are presented in Fig. 1. The fishery was constituted of individuals ranging in size from 220-275 mm. L.C.F. The frequency polygons have a feature of considerable interest; they tend to be of the normal type, unimodal and often virtually symmetrical.

The fishery during 1957 commenced at the end of October when the modal size was at 235 mm. and remained stationary during the subsequent month. Thereafter the modal size was at 245 mm. during December, 1957 and January, 1958. A similar situation was observed during the following season.

From the above observations it is clear that the commercially exploited stock is composed only of a single year class. This year class has a growth rate of 10 mm. in the course of two months. No positive evidence is available regarding the age. A similar observation was made on the flying fish, *Cypselurus coromandelensis* Hornell by Arora and Banerji (1957) where the commercial catches also comprised of a single year class.

##### *Sex-ratio and fecundity*

The sex-ratio data of the fortnightly samples is presented in Table I. The sex ratio differs significantly from the expected 50 : 50 ratio, there being a predominance of males in the commercial catches.

TABLE I  
*Sex composition of the population of Hemirhamphus marginatus*

Period of sampling			Number of fish examined	Sex-ratio percentage
January	1957	..	573	69.45 : 30.55
October	1957	..	983	72.94 : 27.06
November	1957	..	2,519	71.73 : 33.27
December	1957	..	1,027	77.70 : 32.30
January	1958	..	1,007	63.75 : 36.25
November	1958	..	2,214	71.22 : 22.78
December	1958	..	2,110	59.08 : 40.02
January	1959	..	388	71.90 : 28.10

The fecundity, estimated by an actual count of the ripe ova from 25 ovaries of fish ranging in size 220 to 275 mm. S.L., varied between 4248 to 8930. The

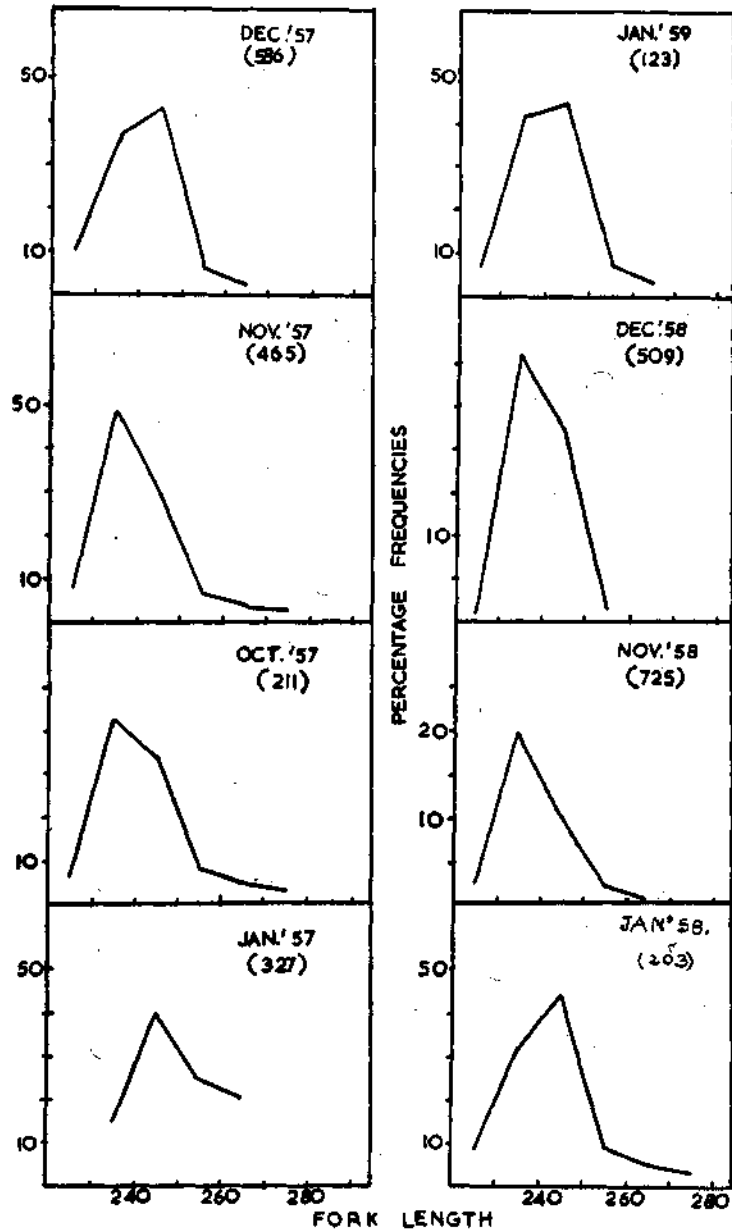


FIG. 1. Length frequency polygons of *Hemirhamphus marginatus* from January 1957 to January 1959

weight of matured ovaries was 2388 gms./1000 eggs in moist condition. The average number of eggs producible by a female of *Hemirhamphus marginatus* of a size 235 mm. was estimated to be 5250.

### *Maturity and spawning*

The study of the intraovarian eggs in the ovaries of penultimate stage of maturity was the basis to determine the frequency of spawning. When handling ripe females it was noticed that some contained tightly packed ovaries while others had ovaries still with many ripe ova present but much less turgid. This at once suggested that all ripe eggs may not be released in one batch (Ling, 1958).

Figure 2 represents the size frequency distribution of ova in V, VI and VII stages of sexual maturity. There is no apparent increase in the size of the ova from stage V to stage VI. They, however, only become transparent and are shed at stage VI.

From Fig. 2 (Stages V and VI) it could be seen that there are two modes 'a' and 'b', mode 'a' representing the mature stock of ova and mode 'b' the immature stock of ova. The fact that the maturing eggs are sharply differentiated from the immature stock of ova clearly indicates that the spawning in this species is restricted to a short and definite period viz., November-December and that it is not likely that this species spawns more than once a year. The occurrence of specimens in stages V and VI during November and December, and in stage VII at the end of December and January in the commercial catches confirms the above contention. Such a type of spawning is classified by Prabhu (1956) under category 'B' of his classification and is comparable to the type of spawning in *Cypsilurus oligolepis* (Blkr.).

As the commercial catches from the Appathivu and Baliyanathivu Islands comprised entirely of spawners, it may be concluded that the spawning grounds of this species lie in the coastal strips of these islands in rocky and weeded areas. Further it may be inferred that this species migrates to these islands during the winter months principally for spawning.

### *Eggs and larvae*

Our knowledge of the eggs and larvae of hemirhamphids is meagre. Bhattacharya (1916) described 13 young stages of *Hemirhamphus limbatus* C.V. from Chilka lake. The first four stages were later pointed out to be of some gobioid fish (Jones and Sujansinghani, 1954). Job and Jones (1938) and Nair (1952) described several larval stages of *H. gaimardi* C.V. from Madras waters. The eggs and larvae of *H. georgii* C.V. were described by Devanesan (1937), Chidambaram and Menon (1948) and Kuthalingam (1959). Vijayaraghavan (1957) made a study of the eggs and larvae of *H. far* (Forsk.) from Madras waters. Jones and Pantulu (1958) reported three post-larval stages of *Zenarchopterus buffoni* (C.V.) from Orissa waters. Recently Sudarsan (1966) has worked out the eggs and early larvae of *Hyporhamphus quoyi* (C.V.) from the Mandapam area.

In the following account the eggs collected from Dhanuskodi and larvae reared in the laboratory and provisionally identified to be *Hemirhamphus marginatus* are discussed.

**Egg (Fig. 3a)**—The fertilized eggs were transparent, pinkish and had an average diameter of 2.59 mm. From the zona radiata arose a number of long and also short silky filaments; these were arranged in tufts of 4 or 6 and about 8 to 12 such tufts were noticeable on each egg. The embryo which was in an advanced stage of

development formed a complete circle round the unsegmented yolk. The mouth was visible in the proportionately large head. Eyes with greyish iridescence were

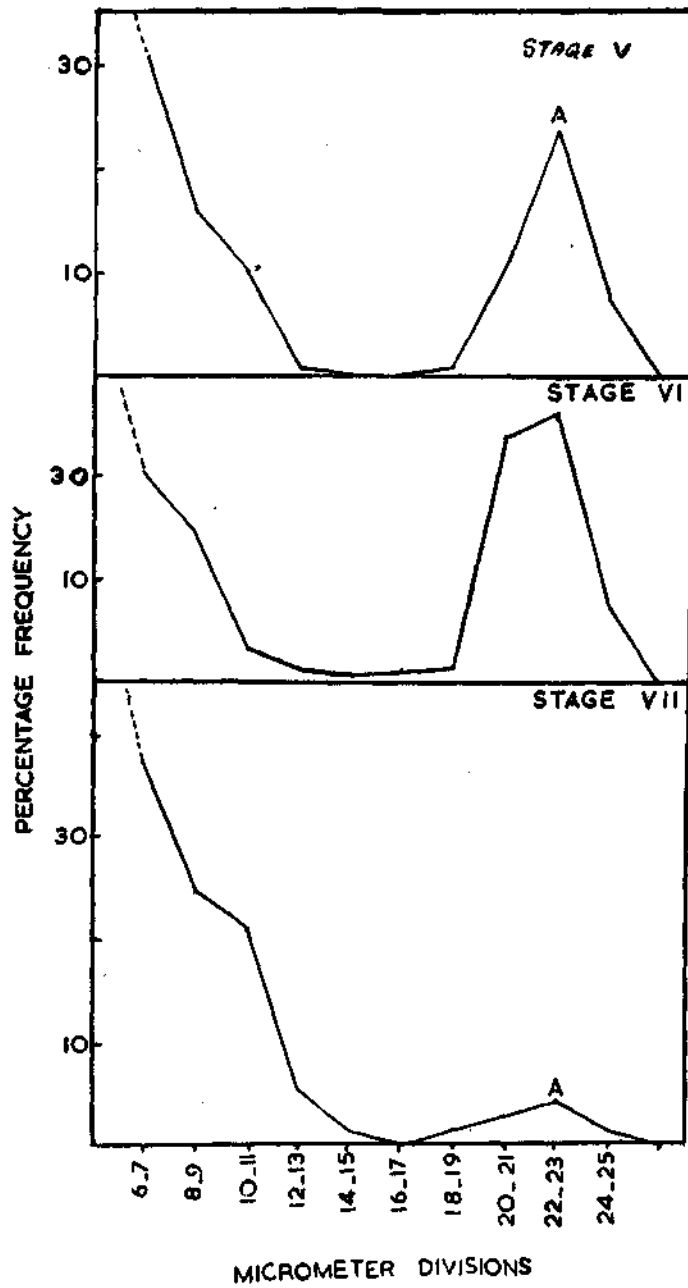


FIG. 2. Ovum diameter frequency of *Hemirhamphus marginatus* in Stages V, VI, and VII, (One m.d.=92.64 $\mu$ ).

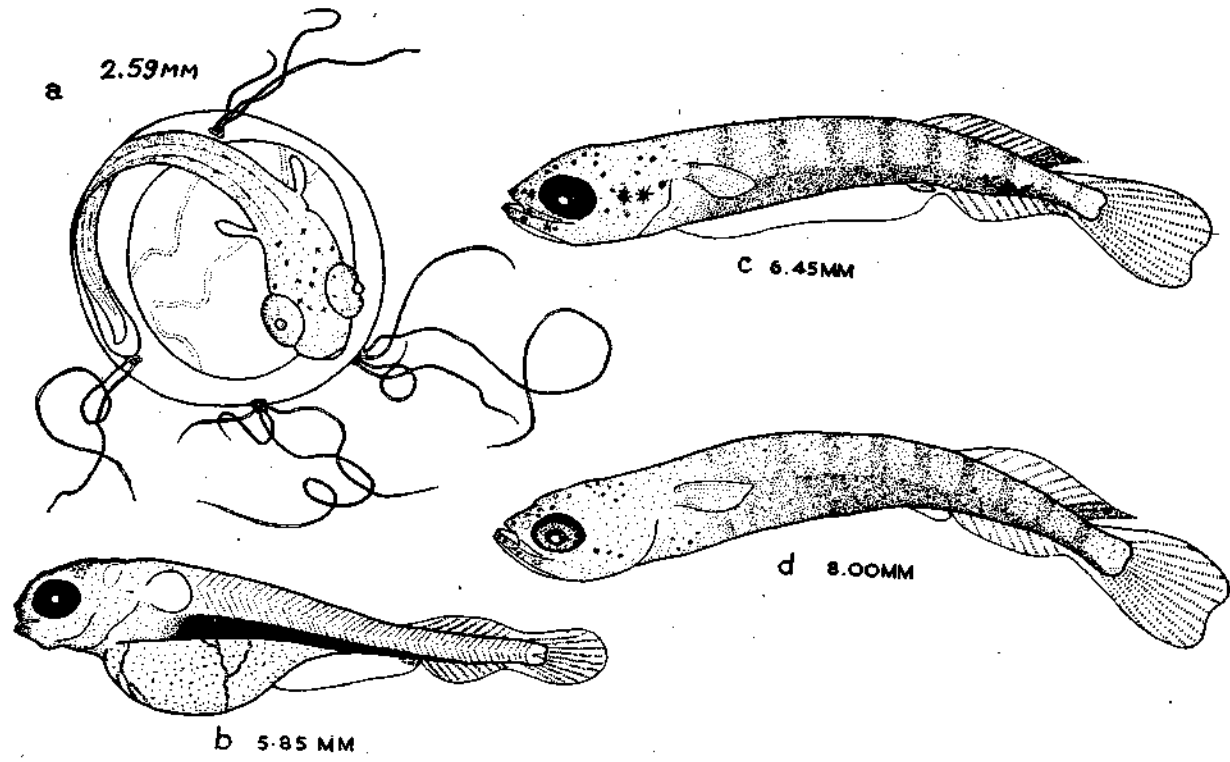


FIG. 3. *Hemirhamphus marginatus*—a. Egg. b, c, d. Larval stages.

developed. Numerous dark pigment spots were present all over the body of the embryo but the yolk-sac. The delicate membranes of the pectoral fins were clearly visible. The larvae emerged out of the egg membranes at different intervals varying from 2 to 6 days.

*Newly hatched larvae* (Fig. 3b)—The newly hatched larvae measured 5.85 mm. in average length. A very large quantity of yolk remained unabsorbed and the vitelline blood vessels were prominent. The eyes were brownish and prominent. Nasal pits and auditory vesicles were evident. The body segmentation in the middle region was quite clear but became less conspicuous both anteriorly and posteriorly. The entire body except the yolk-sac was pigmented. The constituent chromatophores lay along the myomeral septa. On the abdominal wall there was a heavy concentration of these pigment spots; on the cranium they were scattered while on the snout and the tip of the mandible they were grouped into specific spots. The median fin was continuous and the demarcations of the dorsal and anal fins were clear. The pectoral fin was fairly large, transparent, rounded and arose immediately behind the auditory vesicle. No pigment spots were noticed on the embryonic fin membranes. The anus opened under the 38th myotome and had 16 post-anal myotomes. The heart lay in the cardiac coelome just below the head. Kupfer's vesicle had become evident. According to Sumner (1900) this vesicle is a post-anal gut.

*Pro-larvae: 28 hours after hatching*—The larvae had grown to 6.22 mm. in length. The yolk-sac was considerably reduced. The auditory vesicle was clearly visible. The vitelline blood vessels were still prominent. The liver was distinguishable and in some larvae a bright green gall bladder could be seen.

*Post-larvae: 130 hours after hatching* (Fig. 3c)—The larvae had grown to 6.45 mm. The yolk was completely used up. The vitelline circulation lost its contact with the body surface and had come to lie among the organs of the alimentary tract to form a vermiculate pattern over the liver. The eyes acquired a metallic sheen and the iris was black. The rays in the anal, dorsal and pectoral fins were distinct. The body pigmentation was characteristic, the black chromatophores were distributed all over the body surface of the larvae giving rise to a series of vertical bars which were visible even to the naked eye when the larvae were alive. On preservation these vertical bars were not distinguishable. The last rays of the dorsal fin were elongated and pigmented.

*Post-larvae: 216 hours old* (Fig. 3d)—The larvae at this stage were 8.00 mm. in length with practically no changes in the nature of the pigmentation. The caudal fin, till now symmetrical, became slightly asymmetrical. An interesting feature at this stage was the slight protuberance of the maxillary plate. The number of pre-anal myotomes continued to be 38. They were not as clear as in the earlier stages. The pelvic fin was distinguishable at this stage.

The shape, morphological characters, size, nature of the eggs and the number of myotomes in the larvae readily signify that they belong to the family Hemirhamphidae.

Of the nine species of half-beaks in the Mandapam area there are only five species which have 54 myotomes (Talwar, 1960) but of these three species viz., *Hyporhamphus cantori* (Blkr.), *H. quoyi* (C.V.) and *H. dussumieri* (C.V.), have more than seventeen haemal vertebrae, thus differing from the present larvae which have

only sixteen post-anal myotomes. Of the other two species viz., *Hemirhamphus marginatus* and *Hyporhamphus georgii*, only the former is spawning during early February, the latter species' spawning season being March-April (Talwar, 1962a). Further the eggs of *H. georgii* are very much smaller being 1.5 mm. in diameter (Devanesan, 1937). Chidambaram and Menon (1948) gave the diameter of the egg of *H. georgii* as 2.5 mm. which in all probability is a mistake. The number of filaments and tufts are fewer. Chidambaram and Menon (1948) observed only six knobs of filaments each having two to six individual filaments in *H. georgii* whereas in the material under study there are 8 to 12 tufts having 4 to 6 filaments each.

Munro (1955) has referred to the presence of dark vertical bars in the young of *H. marginatus*. These bars are clearly seen in the 216 hours larvae. From the foregoing discussion it could be inferred that the eggs and larvae belong to *Hemirhamphus marginatus* (Forsk.).

#### SUMMARY

The spawning population of *Hemirhamphus marginatus* (Forsk.) constitutes a highly seasonal fishery in the Gulf of Mannar (Mandapam area) from November to January. Observations on the length frequency, duration of spawning, sex-ratio, fecundity and eggs and larvae are discussed.

#### ACKNOWLEDGEMENTS

The author is deeply indebted to Dr. S. Jones for his guidance and encouragement and to Dr. N. K. Panikkar for suggesting the problem and for the initial guidance.

#### REFERENCES

- ARORA, H. L. AND BANERJI, S. K. 1957. Flying-fish fishery along the Coromandal coast. *Indian J. Fish.*, 4 (1) : 80-91.
- BHATTACHARYA, D. R. 1916. Stages in the life-history of *Gobius*, *Petrosciartes* and *Hemirhamphus*. Fauna of Chilka Lake. *Mem. Indian Mus.*, 5 (4) : 383-392.
- CHIDAMBARAM, K. AND MENON, M. D. 1948. Notes on the development of *Megalops cyprioides* and *Hemirhamphus georgii*. *Proc. zool. Soc., Lond.*, 117 (4) : 756-763.
- DAY, F. 1875-1888. *Fishes of India*. London. Vol. I.
- DEVANESAN, D. W. 1937. On the spawning habits and the hatching experiments with the eggs of *Hemirhamphus georgii* (C.V.) *Proc. 12th Intern. Congr. Zool., Lisbon, 1935* : 2175-2181.
- JOB, T. J. AND JONES, S. 1938. Studies on the development of the Indian garfish, *Tylosurus strongylurus* (van Hass.) with notes on the younger stages of *Hemirhamphus gaimardi* (C.V.) *Rec. Indian Mus.*, 49 (3) : 245-253.
- JONES, S. AND SUJANSINGHANI, K. H. 1954. Fish and Fisheries of the Chilka Lake with statistics of the fish catches for the years 1948-50. *Indian J. Fish.*, 1 (1 & 2) : 256-344.
- JONES, S. AND PANTULU, V. R. 1958. On some larvae and juvenile fishes from the Bengal and Orissa coasts. *Ibid.*, 5 (1) : 118-143.
- KUTHALINGAM, M. D. K. 1959. Observations on the food and feeding habits of post-larvae, juveniles and adults of some Madras fishes. *J. Madras Univ.*, B. 29 (2) : 139-150.



- LEBOUR, M. V. 1918. The food of the post-larval fish. *J. Mar. biol. Ass. U.K.*, **11** (4) : 433-469.
- . 1919a. Feeding habits of some young fish. *Ibid.*, **12** (1) : 9-21.
- . 1919b. The food of post-larval fishes. *Ibid.*, **12** (1) : 22-47.
- . 1920. The food of young fish. *Ibid.*, **12** (2) : 261-324.
- LING, J. K. 1958. The sea garfish, *Reporhamphus melanochir* (C.V.) (Hemiramphidae), in South Australia : Breeding, Age determination and Growth rate. *Aust. J. Mar. Freshw. Res.*, **9** (1) : 60-110.
- MUNRO, I. S. R. 1955. *The Marine and Freshwater Fishes of Ceylon*. Canberra.
- NAIR, R. V. 1952. Studies on some post-larval fishes of the Madras plankton. *Proc. Indian Acad. Sci.*, **35** (B) : 203.
- PRABHU, M. S. 1956. Maturation of intraovarian eggs and spawning periodicities in some fishes. *Indian J. Fish.*, **3** (1) : 59-90.
- SUDARSAN, D. 1967. Eggs and larvae of a hemiramphidae fish from Mandapam. *Jour. Mar. biol. Ass. India*, **8** (2) : 342-346.
- SUMNER, F. B. 1900. Kupfer's vesicle and its relation to gastrulation and concrescence. *Mem. N.Y. Acad. Sci.*, **2** (2) : 47-84.
- TALWAR, P. K. 1960. The Biology and Fishery of *Hemirhamphus Cuvier* in the Gulf of Mannar and Palk Bay. Ph. D. Thesis of the University of Rajasthan.
- . 1962a. Studies on the food and feeding relationships of the halfbeak fishes (Hemiramphidae) from the Gulf of Mannar and Palk Bay. *Indian J. Fish.* **9A** : 1-9.
- . 1962b. A contribution to the biology of the halfbeak, *Hyporhamphus georgii* (C.V.) (Hemiramphidae). *Indian J. Fish.*, **9A** : 168-196.
- VIJAYARAGHAVAN, P. 1957. *Studies on fish-eggs and larvae of Madras coast*. University of Madras.
- WEBER, M. AND de BEAUFORT, L. F. 1922. *The Fishes of the Indo-Australian Archipelago*. Leiden, Vol. 4.