

STUDIES ON SOME POST-LARVAL FISHES OF THE MADRAS PLANKTON

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INTRODUCTION

TILL now no detailed systematic work on the common post-larval fishes occurring along the Madras Coast has been attempted. Raj (1916) while dealing with the fresh-water fishes of Madras has described some post-larval stages of estuarine fishes collected from the backwaters of the Cooum and Adyar. Rao (1934, Abstract) made a statistical study of the growth in *Therapon jarbua* found at Adyar. From the same locality Job and Jones

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(1938) collected the post-larval stages of *Hemirhamphus gaimardi* and supplemented the account of the post-larval stages of the same species by Bhattacharya (1916) from the Chilka Lake. Panikkar and Aiyar (1937) in their account of the brackish-water fauna of Madras record the occurrence of the post-larval stages of mullets, clupeoids and other forms in the plankton collections made from Adyar. Recently John (1944, Abstract) described the larval stages of *Elops indicus*, *Megalops cyprinoides*, *Opisthopterus tartoor*, *Arnoglossus tapeinosoma*, *Psettodes erumei*, *Plagusia marmorata*, *Sciæna aneus*, *Leiognathus insidiator*, *L. lineolatus*, *L. ruconius*, *Triacanthus brevirostris*, *Plottosus anguillaris* and *Amphisile scutata* collected by him from the Madras Coast. The full paper has not so far been published.*

With a view to study the larval and post-larval stages of the common fishes occurring along the Madras Coast, regular plankton collections were made from the Sea and from the backwaters of the Cooum and Adyar throughout the period of study. These collections contained post-larval forms of fourteen Genera belonging to thirteen Families and a general account of the characters of the post-larvæ is given in this paper with special reference to pigmentation which is one of the important diagnostic features of the larvæ of fishes. The following post-larval fishes have been collected from the Madras Coast:—

Family Elopidae.

Elops saurus Linnæus.

Family Engraulidae.

Anchoviella sp.

Family Belonidae.

Tylosurus strongylurus (van Hasselt).

Family Hemirhamphidae.

Hemirhamphus gaimardi Cuvier and Valenciennes.

Family Mugilidae.

Mugil sp.

Family Trichiuridae.

Trichiurus haumela (Forskål).

Family Cynoglossidae.

Cynoglossus sp.

Family Centropomidae.

Ambassis miops Günther.

* John's paper was published in the *Journ. Zool. Soc. India*, Vol. 3, No. 1, June 1951, when the present paper was in the course of publication.

Family Theraponidæ.

Therapon jarbua (Forskål).

Family Lactariidæ.

Lactarius lactarius (Bloch and Schneider).

Family Leiognathidæ.

Leiognathus ruconius Hamilton Buchanan.

Gerres lucidus Cuvier and Valenciennes.

Family Scatophagidæ.

Scatophagus argus (Bloch).

Family Sciænidæ.

Pseudosciæna sp.

Family Elopidaë

Elops saurus Linnæus* (Fig. 1)

D 21, A 14, C 20

The larval and post-larval stages of *Elops saurus* have been recorded by Raj (1916), Panikkar and Aiyar (1939) and John (1944) from the Madras Coast and by Gopinath (1946) from the Trivandrum Coast.

The plankton collections made from the Sea on the 22nd September 1944 and on the 11th April 1945 contained one and three larvæ of *Elops saurus* respectively. It may be mentioned that the latter collection also contained swarms of the leptocephalus of *Muraenesox cinereus* (Nair, 1947).

The larvæ of *Elops saurus* are transparent and ribbon-shaped like the leptocephalus of eels. The smallest larva in the collection measures 32 mm. in total length. The head is very small with a sharply pointed snout. The jaws are of about the same length and are provided with small teeth. Sixty-three myotomes are present in the larvæ. The alimentary canal is long and straight and the vent is situated below the fifty-eighth myotome. The dorsal fin has twenty-one rays. The anal fin which originates opposite the termination of the dorsal fin, possesses fourteen rays. The caudal fin is deeply forked and has twenty rays.

The pigmentation of the larva is feeble. Along the dorsal aspect of the alimentary canal and throughout its length, black stellate chromatophores are arranged in a line. These chromatophores, particularly those in the anterior region of the alimentary canal, have a tendency to be regular in their disposition, one being found in each of the myotomes. The last

* Syn. *Elops indicus* Swainson (vide Misra, K. S., *Rec. Ind. Mus.*, 1947, 45, 382).

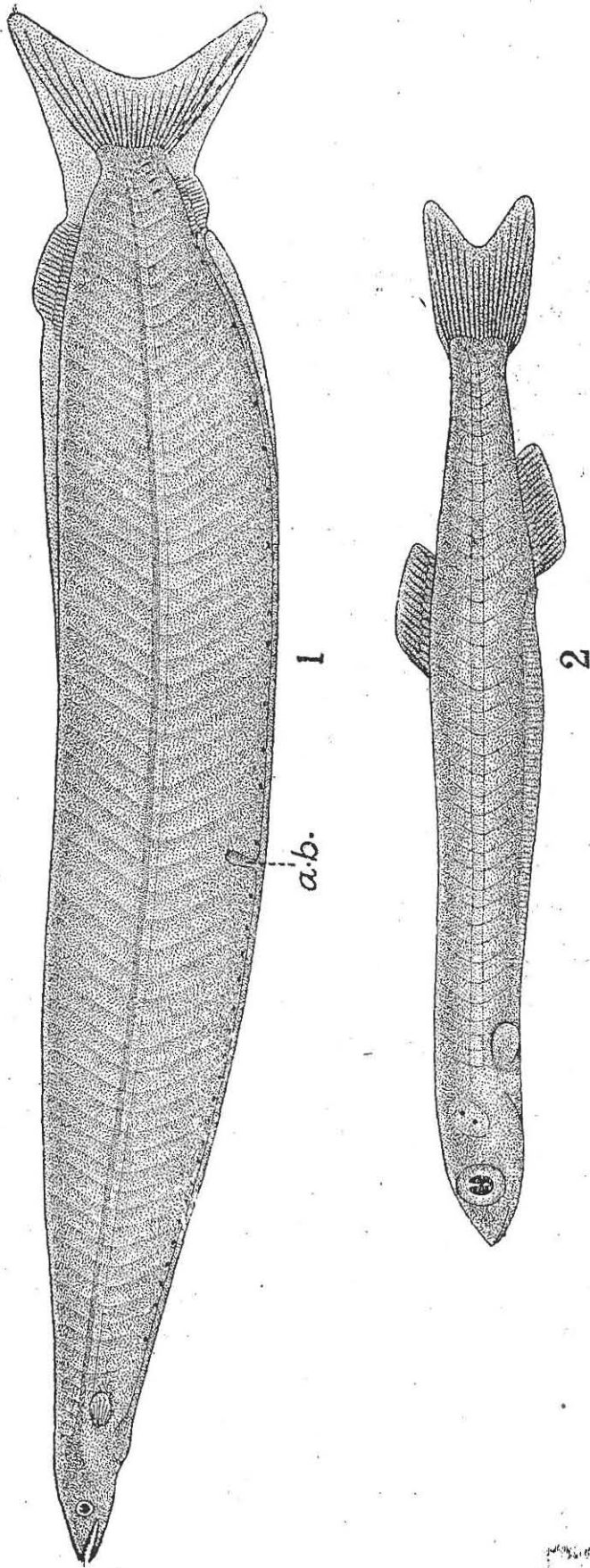


FIG. 1. Post-larva of *Elops saurtis*, \times ca. 6.
FIG. 2. Post-larva of *Anchoviella* sp., \times ca. 8.

four myocommas have each a similar elongated chromatophore. Pigment cells are also present in a line along the two ventral caudal fin rays.

Family Engraulidæ

Anchoviella sp. (Fig. 2)

D I/14, A 19, C 19

Anchoviella is the common whitebait found along the Madras Coast and forms an important food fish in both the fresh and the dried conditions. Panikkar and Aiyar (1939) have recorded the occurrence of larval and post-larval stages of *Anchoviella* in the backwaters of Adyar. Post-larval stages of *Anchoviella* were frequently encountered in the plankton collections made from the mouths of the Cooum and Adyar and from the Sea during the months November to January. Enormous numbers of the fry are trapped in the fishing nets used by fishermen and are generally discarded on account of their small size. Specific identification of the post-larvæ collected has not been made since the diagnostic characters are not sufficiently clear in the stages collected. However, it may be mentioned that *Anchoviella commersonii* is the commonest species on the Madras Coast.

The smallest post-larva measures 16 mm. in total length. The snout is pointed. The mouth is wide and the jaws are provided with small teeth. The auditory vesicles are large and prominent. The alimentary canal is long and straight and shows the transverse folds clearly. Forty myotomes are present in the post-larva and the vent is below the twenty-fourth myotome. The dorsal fin has one spine and fourteen rays. The anal and the caudal fins have nineteen rays each. The pectoral fins show indistinct rays only.

The post-larvæ are transparent in the living condition and are free from chromatophores.

Family Belonidæ

Tylosurus strongylurus (van Hasselt) (Fig. 3)

D 13, P 11, A 16, C 15

Tylosurus strongylurus is one of the common garfishes of the Madras Coast frequenting estuaries and backwaters. Job and Jones (1938) have described the eggs and the very early larval stages. Larval and post-larval stages of *Tylosurus strongylurus* have been noticed to be very common during September and October in the backwaters of Adyar and are generally found amidst the filamentous alga, *Chaetomorpha*.

The smallest post-larva collected measures 14 mm. in total length including the beak. The lower jaw is longer than the upper jaw. Both the

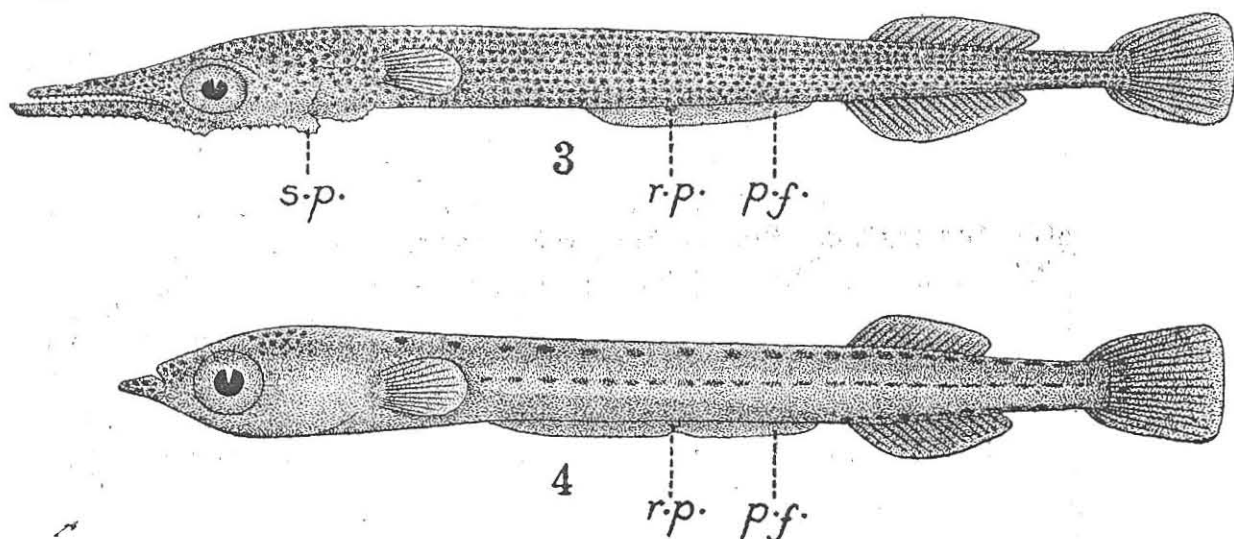


FIG. 3. Post-larva of *Tylosurus strongylurus*, \times ca. 10.

FIG. 4. Post-larva of *Hemirhamphus gaimardi*, \times ca. 10.

jaws are provided with minute teeth. The single dorsal fin has thirteen rays. The pectoral fin is well developed, with eleven rays. The anal fin is composed of sixteen rays and the caudal of fifteen rays. The pelvic fins have appeared as small lobes. The pre-anal fin-fold could be seen in this stage. Symmetrically arranged dermal projections are present on the head, which are transparent with serrated edges.

The larvæ are pigmented prominently and uniformly with extensively branched black pigment cells. These chromatophores are larger in the anterior region and become smaller towards the posterior region. The chromatophores are arranged in longitudinal rows and about eight such rows could be made out in the post-larva. The chromatophores of the first row and of the posterior ends of the last row and the row along the lateral line are closely arranged occasionally forming lines. The fins are devoid of pigment cells.

In the post-larvæ of 22 mm. size the beak has elongated and measures 4 mm. in length. The pelvic fins are well developed, with six rays. The pre-anal fin-fold has completely disappeared. The mouth in this stage assumes the typical form of garfishes. There is no change in the colouration.

Family Hemirhamphidæ

Hemirhamphus gaimardi Cuvier and Valenciennes (Fig. 4)

D 13, P 10, A 13, C 14

Hemirhamphus gaimardi is another common garfish found along the Madras Coast, It is known to enter brackish and even fresh water.

Bhattacharya (1916) and Job and Jones (1938) have described several stages of this species leading to the establishment of the adult characters. Post-larval stages of this species are common in the townet collections made from Adyar during the months September and October. These post-larvæ too have a tendency to move amidst the alga *Chaetomorpha* along with the young ones of *Tylosurus strongylurus*.

The smallest post-larva collected measures 12 mm. in length. The characteristic beak of the larva has begun to develop. All the fins are well developed, with distinct rays, except the pelvic fins which are indicated only by bud-like projections. The dorsal and anal fins have thirteen distinct fin rays. The pectoral and the caudal fins have ten and fourteen distinct rays respectively. The pre-anal fin-fold is present as a transparent fringe interrupted in the region of the pelvic fins.

The post-larvæ are pigmented in a very characteristic manner by deep black chromatophores. The tips of both the jaws are pigmented. A few black chromatophores are present on the dorsal side of the head. On the body, the chromatophores are arranged in three regular horizontal rows on each side. The chromatophores of the dorsal row are large in size and are very prominent. The chromatophores of the posterior ends of the dorsal and ventral rows and of the lateral row are elongate and form a dotted line. Chromatophores, in very small numbers, have been noticed at the bases of the caudal fin rays.

In the post-larva of 20 mm. length, the beak is long and measures 3 mm. in length. The pectoral fins have grown to the normal size with six distinct fin rays. The ventral fin-fold has completely disappeared. There is no change in the pigmentation.

Family Mugilidæ

Mugil sp. (Fig. 5)

D IV I/8, P. 15, A III/9, C 15

The mullets are an economically important group contributing substantially to the fish supply of the Madras City. Of the several species inhabiting the Indian Seas, *Mugil oligolepis*, *Mugil speigleri*, *Mugil cephalus*, *Mugil troscheli* and *Mugil cunnesius* are the common species of the Madras Coast (Moses, 1923).

The breeding season of *Mugil* is generally after the commencement of the rains when adults with ripe gonads are very common in the catches along the Madras Coast. During this period when the bars of the Cooum and

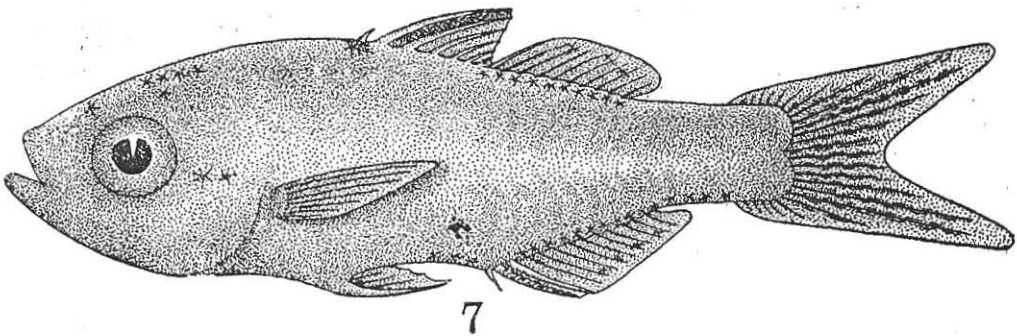
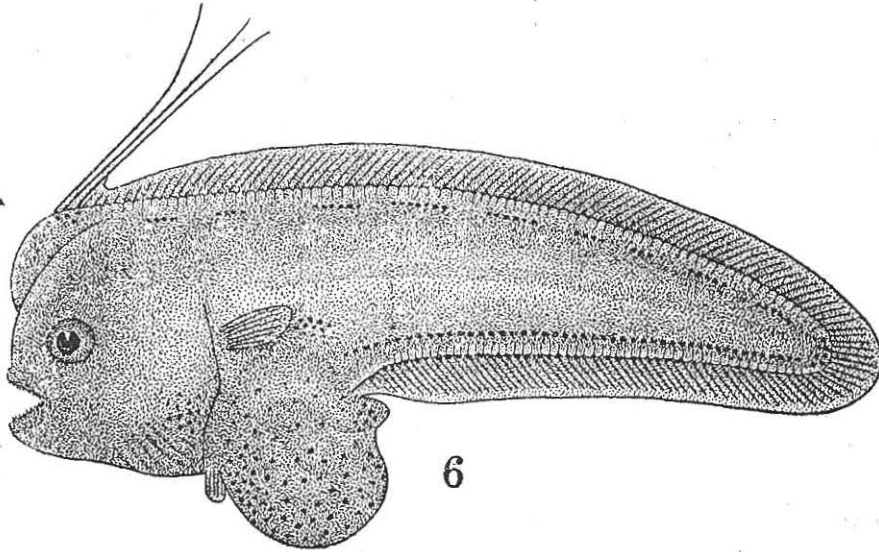
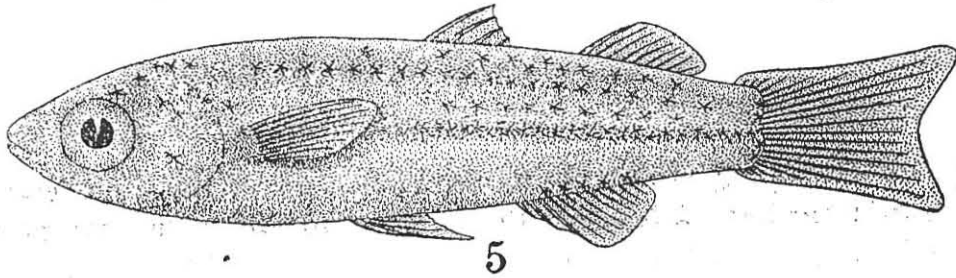


FIG. 5. Post-larva of *Mugil* sp., \times ca. 9.

FIG. 6. Post-larva of *Cynoglossus* sp., \times ca. 16.

FIG. 7. Post-larva of *Ambassis miops*, \times ca. 11.

Adyar are open, the sexually mature mullets migrate into these backwaters in enormous numbers for breeding purposes, when they are extensively netted by the fishermen. The colder months of the year, namely November to January, are the breeding period of the mullets. Every tonet collection made during these months from the Cooum and Adyar and sometimes also

from the Sea contains post-larval stages of mullets which are easily distinguished by their cylindrical silvery body. Specific identification of the post-larvæ is extremely difficult because of the slight differences between the various adult species and their absence in the post-larval stages.

The smallest post-larva collected measures 12 mm. in total length. Four spines are present in the first dorsal fin of which the first is the longest and best developed. The second dorsal fin has a single spine and eight rays and the pectoral fin about fifteen rays. The anal fin has nine rays and three spines of which the first is the shortest and the third the longest. About fifteen rays occur in the caudal fin.

In the living condition the post-larva is silvery in colour. The black chromatophores present on the body become prominent only after fixation. The fins are free from chromatophores. Pigment cells are found on the dorsal side of the head, the opercles and the dorsal half of the body where they are roughly arranged in four longitudinal rows. There is an intensification of the chromatophores of the row along the lateral line. Chromatophores are also present at the bases of the anal and caudal fins.

The stomach contents of most of the specimens showed large numbers of copepods while diatoms were also noticed in a few specimens.

Family Trichiuridæ

Trichiurus haumela (Forskål) (Photo. 1)

D 130, P 11, A 80

Trichiurus is another important food fish occurring in very large numbers along the Madras Coast during the months September to January. The maximum catches are made during October and November, when enormous numbers are brought to the local markets every day though the major part of the catches is sun-dried. It is interesting to note that though this fish occurs in huge swarms, the post-larval stages are extremely rare in the Madras plankton and so far, only two specimens have been obtained from the plankton collections made from the Sea on the 22nd September 1944 and on the 9th December 1944. The extreme rarity of the post-larval forms may be due to their oceanic habitat.

Of the two specimens, the one collected on the 9th December 1944 is the smallest and measures 67 mm. in total length. The dorsal fin, which is as broad as the height of the fish, is composed of a hundred and thirty rays. The rays at the anterior and posterior ends of this fin, particularly the latter, are short. The pectoral fin has eleven rays. The anal fin is represented only by spines which are short and blunt and number eighty.

The post-larvæ are bright silvery in colour and black chromatophores are present only on the jaws. The body is free from chromatophores.

Family Cynoglossidæ

Cynoglossus sp. (Fig. 6)

D 98, P 8, A 80, C 14

The flat-fishes form an important constituent of the fish supply of the Madras Coast and are generally caught in large numbers during the months August and September. These are much esteemed as food. They generally live on the sandy and muddy bottoms of the Coast and some species ascend rivers. Post-larvæ of *Cynoglossus* occur in the plankton collections made from the Sea during the months August and September and they are easily distinguished by the large and bulging belly and the long and slender tentacle at the commencement of the dorsal fin.

The smallest post-larva in the collection measures 6 mm. in total length. The post-larvæ are perfectly symmetrical and laterally compressed. The jaws are provided with very minute teeth. As is usual with most of the larvæ of flat-fishes, the belly bulges out ventrally as an oval mass containing inside it the alimentary tract which forms a coil. In some specimens the anal opening projects out from this mass posteriorly. The fins are well developed, with the rays clearly differentiated. The median fins are continuous. The anterior part of the base of the dorsal fin is continued forward over the head as a finger-shaped process, the tip of which is free in some specimens particularly in the older ones. The first three rays of the dorsal fin are very long and constitute the tentacle. The other rays are of moderate length except a few anterior ones succeeding the three long rays which are somewhat short. About ninety-eight rays are present in the dorsal fin. The anal fin rays are also of the same length as those of the dorsal fin and about eighty such rays are present of which a few of the anterior ones are short. The caudal fin has about fourteen rays which are of the same size as those of the vertical fins. The pectoral fin is well developed with eight rays. The pelvic fin is very small and is hidden partially by the bulging abdominal region and possesses four faint rays.

The larvæ are transparent with a characteristic colouration. Black chromatophores are arranged in three prominent horizontal rows. The first row, situated below the base of the dorsal fin, is interrupted in places to form nine groups of chromatophores. Similarly the second row is situated on the ventral side above the insertion of the anal fin and the pigment cells are arranged regularly in a line. The third row of chromatophores is located

along the bases of the anal fin rays and is similar to the middle row in the arrangement of the pigment cells but does not extend posteriorly as far as the latter. Groups of black chromatophores are present at the bases of the elongated dorsal fin rays and the caudal fin rays and on the opercle. The abdominal bulge is pigmented more or less uniformly over the entire surface. The pigment cells of the air bladder are clearly seen in the living larvæ above the coil of the alimentary canal and behind the pectoral fins.

The post-larvæ feed mainly on copepods and small crustacean larvæ.

Family Centropomidæ

Ambassis miops Günther (Fig. 7)

D VII I/9, P 12, A III/9-10, C 17

Of the glass-fishes, *Ambassis miops* is the common species occurring along the Madras Coast. The breeding season ranges from October to December when adult fishes with ripe gonads have been collected in large numbers both from the Sea and from the Cooum and Adyar. During these months the plankton collections from the backwaters invariably contained numerous post-larval stages.

The smallest post-larva collected measures 10 mm. in total length. The first dorsal fin has seven spines of which the first one is very short while the second is stronger and longer than the rest. The second dorsal fin has a single spine and nine rays, the former being about half the length of the second spine of the first dorsal fin. The anal fin is composed of three spines and nine or ten rays. The first spine of the anal fin is small, but longer than the first dorsal spine. The second spine is stronger and shorter than the third spine. The forked caudal fin has about seventeen rays.

The post-larvæ are transparent with a light golden yellow tinge. The abdomen and opercles are somewhat silvery in colour. A few black stellate chromatophores are present on the dorsal side of the head. The base of the first dorsal spine and the interspinous membrane between the second and third dorsal spines of the first dorsal fin are black owing to the accumulation of black stellate chromatophores. Large black and highly branched chromatophores are present in a line below the origin of the rays of the second dorsal fin. The membrane of this fin may possess a few chromatophores without any regularity in their arrangement. The pectoral and pelvic fins are devoid of chromatophores. The hind edge of the second anal spine is bordered by chromatophores. A large chromatophore is present at the base of each of the rays of the anal fin. The membrane of the anal fin also has irregularly arranged chromatophores. The rays of the caudal fin are

bordered on either side by small chromatophores. The ventral border of the body, anterior and posterior to the anal fin, also has a row of black pigment cells. In the living condition the two rows of pigment cells arranged along the dorsal and ventral sides of the vertebral column could be made out easily.

The post-larvæ feed mainly on copepods as revealed by the examination of the stomach contents. While under captivity in the Laboratory, the post-larvæ as well as the adults have been observed to feed very readily without discrimination on the micro-organisms of the plankton given.

Attempts were made to fertilise the eggs artificially and also to rear the adults with ripe gonads in the Laboratory for studying the developmental stages, but these efforts were not successful.

Family Theraponidæ

Therapon jarbua (Forskål) (Fig. 8)

D XI/10, P 15, A III/9, C 17

Therapon jarbua is a widely distributed species and is mainly marine but specimens are often found in brackish waters within tidal influence. Species of the genus are not much esteemed as food since they are supposed to feed on carrion. Ripe individuals of *Therapon jarbua* have been collected from November to January. Post-larval and young forms of *Therapon jarbua* are very common during these months in the backwaters of Cooum and Adyar when they are in communication with the Sea. These young ones are indiscriminately and extensively caught by the fishermen with small meshed nets. The smaller ones are generally thrown out. A study of the growth rate in this species collected from the Madras Coast has been made by Rao (1934).

The smallest post-larva collected measures 12 mm. in total length. The opercle is provided with about six spines of which the dorsal one is the longest and the strongest. The single dorsal fin has eleven rather slender spines and ten rays. The pectoral fin has fifteen rays. The anal fin is composed of nine rays and three well-developed spines of which the second spine is the strongest. The caudal fin has about seventeen rays.

The colouration of the young ones is liable to variation. The middle of the spinous portion of the dorsal fin is deeply pigmented and is jet black in colour. The anterior basal region of the soft portion of the dorsal fin is also black in colour. All the other fins are transparent and unpigmented. Black stellate chromatophores are uniformly spread over the head and the body. The opercle and the abdomen have only a few chromatophores,

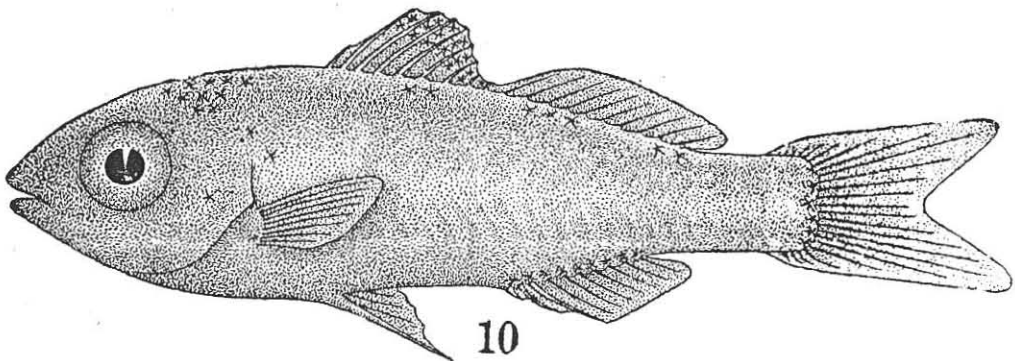
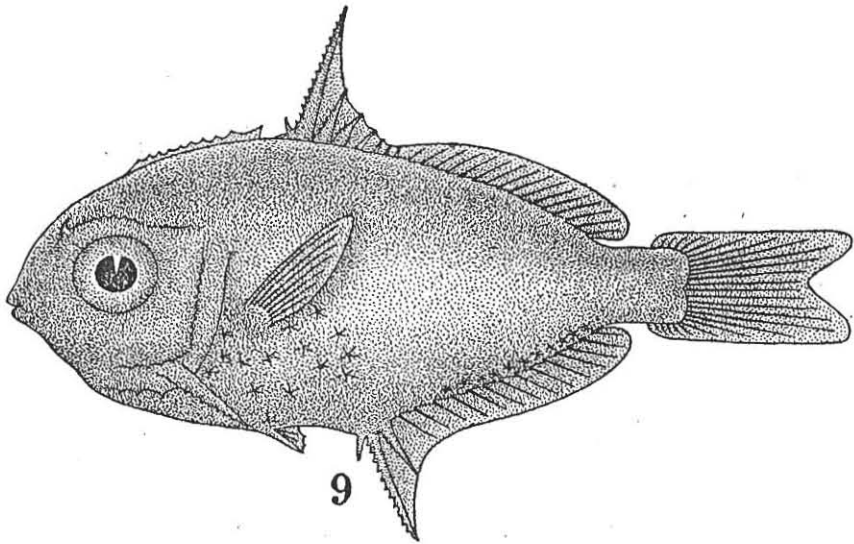
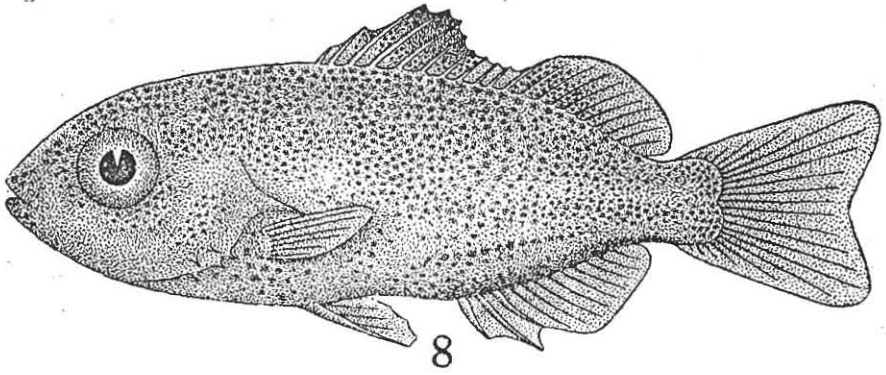


FIG. 8. Post-larva of *Therapon jarbua*, \times ca. 8.

FIG. 9. Post-larva of *Leiognathus ruconius*, \times ca. 11.

FIG. 10. Post-larva of *Gerres lucidus*, \times ca. 9.

The chromatophores are aggregated on the postero-dorsal region of the head, on the dorso-lateral side of the body on a level with the posterior half of the spinous region of the dorsal fin, along the bases of the soft

portion of the dorsal fin and the anal fin and along the lateral line. The lateral curved bands of the adult fish are produced partly by the reorientation of the chromatophores of the post-larva and partly by the formation of new chromatophores.

Copepods, Crustacean larvæ and Polychæte larvæ have been noted in the stomach contents of the post-larvæ of this species.

Family Lactariidæ

Lactarius lactarius (Bloch and Schneider) (Photo. 2)

D VII 17, A III/25, C 17

This is another important food fish caught in enormous numbers and sold in the fresh as well as in the salted condition. The breeding season extends from October to December during which period large numbers of ripe adults and post-larval forms have been collected from the fishing nets.

The smallest post-larva measures 21 mm. in total length. The body is oblong and compressed. The mouth is oblique with a prominent lower jaw. The first dorsal fin is composed of seven feeble spines of which the third is the longest. The second dorsal fin is composed of seventeen rays. Anal fin has three spines and twenty-five rays. The caudal fin is composed of seventeen rays.

The post-larvæ are pigmented in a characteristic manner. An extensively branched black chromatophore is present behind the eye on a level with its centre. A few small chromatophores are present above the posterior border of the eye. At the base of each of the rays of the anal fin, except a few anterior ones, there is a prominent black chromatophore. Similar chromatophores are present at the bases of some of the caudal fin rays forming a vertical line at the base of the fin.

Family Leiognathidæ

Leiognathus ruconius Hamilton Buchanan (Fig. 9)

D VIII/16, P 18, A III/14, C 17

In the Madras Coast the silver-bellies are represented only by a few species which occur in enormous numbers from August to November. They form an important group of food fishes and are extensively sun-dried. Even in this group there is much wasteful fishing owing to the use of small meshed nets by fishermen. Enormous numbers of the fry of *Leiognathus* are trapped in the nets and are thrown out on the beach because of their small size. The post-larvæ generally occur during the months September to December.

Plankton collections made from the Sea and from the Cooum and Adyar, when they are in communication with the Sea, also contain post-larval forms in small numbers. Taking into consideration the occurrence of ripe adults and the fry during September to December, it can be concluded that this is the breeding period—of the silver-bellies.

The smallest post-larva of *Leiognathus ruconius* collected so far measures 9 mm. in total length. These larvæ are easily distinguished by their laterally compressed body, large head and the small protrusible mouth. The supra-orbital and pre-opercular edges are serrated with a curved spine in the former and a long well-developed serrated spine in the latter. The median occipital blade is transparent and serrated. The fins are well differentiated. The single dorsal fin consists of eight spines and sixteen rays. The second spine is the longest and best developed. The entire anterior margin of the second and the anterior basal margins of the third and the fourth spines are serrated. The pectoral fin consists of eighteen rays. The anal fin consists of three spines and fourteen rays. Of the three spines of the anal fin, the first is small, but larger than that of the dorsal fin. The second spine is long and well developed. The entire anterior margin of the second and the anterior basal margin of the third spines are serrated. The caudal fin has seventeen rays.

The colouration is very feeble. Large black stellate chromatophores are present on the abdomen without any regular arrangement and similar chromatophores are present in a line at the bases of the rays of the anal fin, excluding the first few rays.

Gerres lucidus Cuvier and Valenciennes (Fig. 10)

D IX 10, P 15, A III/7, C 17

This is a very common fish of the Madras Coast occurring in enormous numbers during the months February to July. *Gerres filamentosus* is also a common species of the Madras Coast but not so abundant as the present species. These fishes are generally eaten by the poorer classes. They are mostly salted and dried since they are not esteemed in the fresh condition. The breeding season of *Gerres lucidus* appears to be from October to December, when ripe adults have been collected in fair numbers. Further evidence is given by the occurrence in enormous numbers of the post-larvæ of this species in the plankton collections from the Sea and from the Cooum and Adyar made during these months.

The smallest post-larva collected measures 12 mm. in total length. The post-larvæ are somewhat opaque without any prominent colouration. The

first dorsal fin has nine moderately strong spines of which the first one is very short. The third spine is the longest. The second dorsal fin has ten rays. The pectoral fin has about fifteen rays. Three spines and seven rays are present in the anal fin. The first spine is short, the second though stronger than the third is only half the length of the latter spine. The caudal fin has about seventeen rays.

Pigmentation is not very prominent. A few large black chromatophores are present on the dorsal side of the head and in some larvæ one or two chromatophores are also present on the opercles. The outer border of the membrane of the first dorsal fin is dark due to the presence of a fair number of spreading chromatophores. The second dorsal, the pectoral and the pelvic fins are unpigmented. At the bases of the spines and rays of the anal fin, black stellate chromatophores are present arranged in a line. At the place of insertion of the rays of the caudal fin with the hypural bones about five to six chromatophores are present in a vertical line. Though the silvery colouration is not present in the post-larvæ, indications of the adult vertically banded colouration could be made out. On the nape, at the base of the first dorsal fin and at the bases of the anterior and posterior ends of the second dorsal fin black chromatophores have begun to appear which by increase in number form the indistinct vertical bands of the adult.

An examination of the stomach contents revealed the presence of a few partially digested copepods and other digested matter the components of which could not be made out satisfactorily.

Family Scatophagidæ

Scatophagus argus (Bloch) (Fig. 11)

DX 17, P 20, A IV/14, C 16

This fish has a fairly wide distribution and enters brackish waters and even rivers withstanding great salinity changes. In Madras the fish is not very common in the fishermen's catches and is very rarely brought to the local markets. A single *Tholichthys* stage was obtained from the plankton collection made from the Cooum on the 11th November 1944, and three more slightly older stages from the same place the next day.

The smallest *Tholichthys* larva measures 11 mm. in total length. The body is rounded and very much compressed with a relatively large head protected by the bony plates and the strong supra-scapular spine. Ten moderately strong spines are present in the first dorsal fin of which the fourth spine is the longest. The second dorsal fin has seventeen rays. About twenty rays are present in the pectoral fin. The anal fin has four spines

of about the same length and fourteen rays. The caudal fin has sixteen rays.

The first dorsal fin is of a bright purple colour with a brownish tinge posteriorly. All the other fins are completely transparent and are free from chromatophores. Though the body of the post-larvæ is uniformly dark, there is a grouping of chromatophores in certain regions particularly along the back, indicating the formation of the black patches of the adult. Amidst these black chromatophores red pigment cell groups are also present forming a beautiful pattern in the post-larval colouration.

Family Sciaenidæ

Pseudosciæna sp. (Fig. 12)

DXI/28, P 17, A II/7, C 17

The jew-fishes are represented by many species along the Indian Coast of which quite a few are common on the Madras Coast. The post-larval forms of *Pseudosciæna* are very common along the Madras Coast during July to September.

The smallest specimen collected measures 12 mm. in total length. The large head and the relatively small body with the long and pointed caudal fin give a characteristic shape and appearance to the post-larvæ. The mouth is oblique and a few spines are present on the preopercle. All the fins of the post-larvæ are well developed with distinct rays. There are two dorsal fins. The spinous dorsal is composed of ten slender spines of which the first is very small and the third and the fourth are the longest. The soft dorsal has one spine and twenty-eight rays. The two dorsal fins are connected at the base by the membrane. The pectoral fins possess seventeen rays. The anal fin is short and is composed of two spines and seven rays of which the second spine is the best developed. The caudal fin is long and pointed with seventeen rays. The pelvic fins show one spine and five rays.

Pigmentation of the post-larva is feeble and the chromatophores are few. On the dorsal side of the head an extensively branched black chromatophore is present. Similar chromatophores are present behind the pelvic fins, near the termination of the anal fin and near the lower basal region of the caudal fin.

As the genus is represented along the Madras Coast by numerous species which can be identified only by the slight differences in the adults, it is not possible to refer the post-larvæ to any particular species,

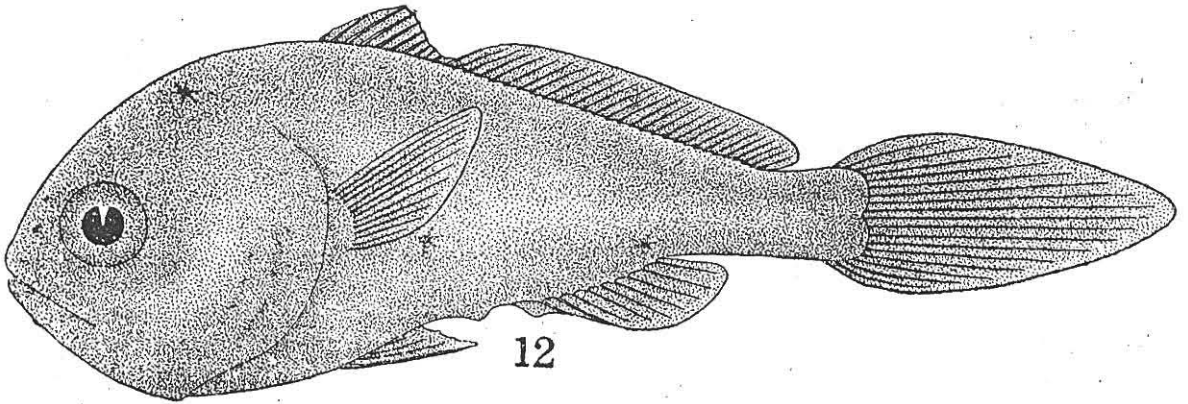
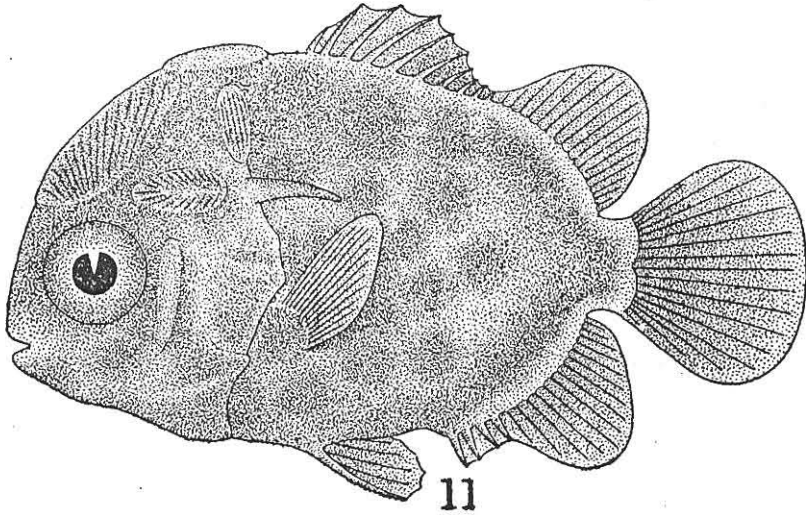


FIG. 11. *Tholichthys* stage of *Scatophagus argus*, \times ca. 8.
 FIG. 12. Post-larva of *Pseudosciana* sp., \times ca. 11.

GENERAL REMARKS

Based on this study it is possible to draw certain general conclusions about the migratory movements and breeding habits of some of the common fishes of the Madras Coast. Most of the fishes of this Coast show intense breeding activity only during the cold season as shown conclusively by the presence of large numbers of fish eggs and larvæ in the plankton collections made during this period. This aspect has been briefly dealt with in another paper (Nair, 1952).

The marine fishes dealt with in this paper can be grouped under four main categories according to their breeding habits and the migratory movements of the adults and the post-larvæ. Firstly, fishes like *Tylosurus strongylurus* can grow and breed equally well in the Sea and in the backwaters. Secondly, some fishes like *Mugil* migrate from the Sea into the

backwaters in enormous numbers for spawning and return to the Sea. The post-larvæ feed and grow in the backwaters and go back to the Sea where they attain sexual maturity. Eggs of *Mugil* have not so far been collected from the plankton and it is probable that they lay demersal eggs. Under the third category come fishes like *Therapon jarbua* which spawn in the Sea, the post-larval stages alone migrating into the backwaters. Here they feed and grow and go back to the Sea where they become sexually mature. Lastly come the fishes which spend their whole lifetime in the Sea, under which group comes the majority of the fishes. Even under this group two types of fishes could be observed, namely, the coastal breeders and the oceanic breeders as shown by *Anchoviella* and *Trichiurus haumela* respectively. The eggs, post-larvæ and adults of *Anchoviella* are very common during the months November to January showing conclusively that the fish is a coastal breeder. On the contrary, though enormous numbers of *Trichiurus haumela* occur along the Madras Coast during October and November, the post-larvæ are extremely rare in the coastal plankton probably on account of the off-shore breeding habits of the adults or the preference of the post-larvæ for an off-shore habitat.

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Note.—The important references alone are given, particularly those mentioned in the paper.

KEY TO LETTERING

<i>a.b.</i>	air bladder.	<i>r.p.</i>	rudiment of pelvic fin.
<i>p.f.</i>	pre-anal fin-fold.	<i>s.p.</i>	spiny projection.