

ON SOME LARVAL AND JUVENILE FISHES FROM THE BENGAL AND ORISSA COASTS

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INTRODUCTION

THE present account deals with a number of larval and juvenile fishes collected from the Bengal and Orissa coasts (Fig. 1) in 1952 and 1953 respectively. The collection from the Bengal Coast was made by the first author in 1952, while on a visit to the Sundarban areas of the 24 Parganas on board the M.F.V. *Kerala* of the West Bengal Fisheries Department and that from the Orissa Coast was made by the second author and Dr. V. G. Jhingran in 1953 on board the I.N.S. *Investigator* during one of its survey operations at the mouth of the Mahanadi. Our thanks are due to the West Bengal Fisheries Directorate and to the Indian Naval authorities for the facilities given aboard their vessels and for the co-operation extended by their officers. We also thank Dr. V. G. Jhingran who was in charge of making the collections on board the I.N.S. *Investigator*.

The following are dealt with in this account:—

Family HEMIRHAMPHIDÆ

1. *Zenarchopterus buffoni* (Valenciennes) = *Hemirhamphus buffoni* of Day.

Family BREGMACEROTIDÆ

2. *Bregmaceros maccllellandi* Thompson = *Bregmaceros atripinnis* of Day.

Family CALLIONYMIDÆ

3. *Callionymus melanopterus* Bleeker = *Callionymus fluviatilis* of Day.

Family PSETTODIDÆ

4. *Psettodes erumei* (Bloch & Schneider).

Family BOTHIDÆ

5. *Pseudorhombus arsius* (Hamilton).
6. *Pseudorhombus oligodon* (Bleeker).

7. *Arnoglossus tapeinosoma* Bleeker.

8. *Bothus* sp.

Family SAMARIDÆ

9. *Samaris macrolepis* Norman.

Family SOLEIDÆ

10. *Solea ovata* Richardson.

11. *Heteromycteris oculus* (Alcock).

Family CYNOGLOSSIDÆ

12. *Cynoglossus* sp. I.

13. *Cynoglossus* sp. II.

14. *Cynoglossus* sp. III.

Family TRIACANTHIDÆ

15. *Triacanthus brevirostris* Temminck & Schlegel.

Family PEGASIDÆ

16. *Parapegasmus natans* (Linnæus).

In addition to the above 16 species there were a few larval Clupeids and Leiognathids which were partially damaged making identification difficult. Some juvenile specimens of *Therapon jarbua*, *Rattabora rattaborua* and Carangids from the collections are left out in view of their large size. Two specimens of Ophichthyid larvæ from the *Investigator* collection have already been described elsewhere (Jones and Pantulu, 1955).

DESCRIPTIONS OF LARVAL AND JUVENILE FISHES

Zenarchopterus buffoni (Valenciennes)

Three larval specimens and one juvenile of *Zenarchopterus buffoni* = (*Hemirhamphus buffoni*) forming a fairly connected series, were collected in a townet on the 8th December 1952, from Frasergunj, near the mouth of the Bhagirathi, during high tide. The juvenile specimen was sufficiently large to enable fixing the identity of the species concerned. A number of adult specimens from the *Behundijals* (fixed bag nets) operated in the neighbourhood were also available for comparison.

The stages given are arbitrary and are only in relation to the specimens dealt with in this account. The measurements of the stages described are given in Table I.

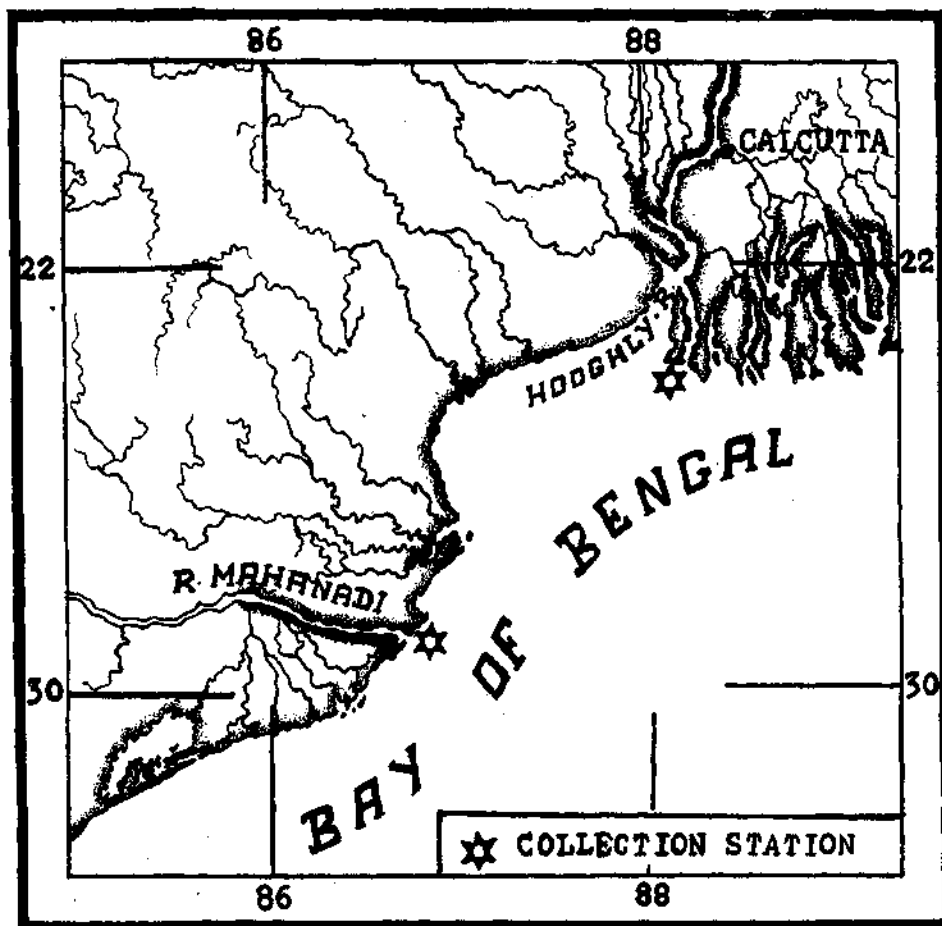


FIG. 1

Stage I (Fig. 2).—The total length is 9.25 mm. The lower jaw projects only very little beyond the upper. Both the upper and lower jaws bear 6 to 7 minute teeth on each side. There are no teeth near the angle of the jaw. Ventrals are absent and rays on the dorsal and anal are not distinct.

The general colour of the specimen is brown in formalin and the pattern of distribution of chromatophores is as shown in the figure. The body chromatophores are stellate and are closely arranged in more or less irregular longitudinal rows. Of these the two uppermost rows on each side are fairly distinct. There is a 3rd row immediately above the lateral line and a narrow, rather indistinct row along the lateral line. Below the lateral line there are 4 to 5 irregular rows. The upper and lower rows of chromatophores

TABLE I
Measurements of *Zenarchopterus buffoni* in mm.

Stages	I	II	III	IV
Total length	9.25	11.25	14.85	33.5
Head	2.51	3.83	4.96	13.70
Eye .. ..	.63	.80	.86	1.48
Snout .. ..	.74	1.71	2.80	10.62
"Beak"* .. ..	.53	1.2	2.28	9.14
Snout to anal	6.28	7.94	10.39	25.62
Snout to dorsal	5.82	7.54	10.11	24.94

* The term "beak" is used here to denote the portion of the lower jaw that extends beyond the upper jaw.

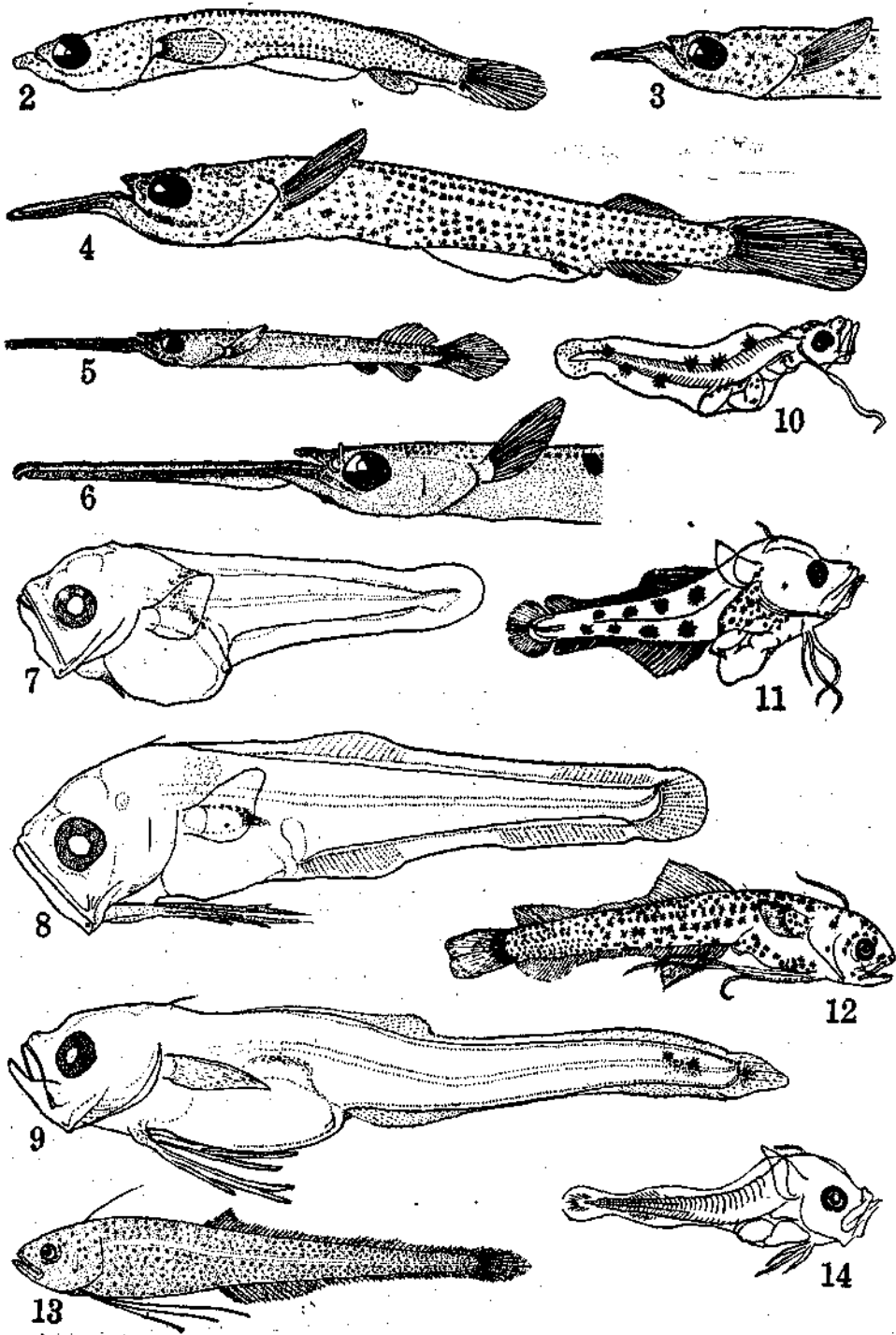
do not show any definite pattern towards the pectoral and caudal ends. The dendritic chromatophores on the head appear somewhat connected together. The fins are devoid of chromatophores.

Stage II (Fig. 3).—The specimen is 11.25 mm. long. The general features are as in the previous stage, except for a slight elongation of the snout. The ventral fins are seen as small buds a little in advance of the vent. The nature and distribution of the chromatophores are as in the previous stage.

Stage III (Fig. 4).—The specimen is 14.85 mm. long. The snout is longer and the ventral fins are more conspicuous. The chromatophores appear darker and more diffused, giving an overall deeper coloration.

Stage IV (Figs. 5 and 6).—This is a juvenile fish 33.5 mm. long. The preanal median finfold is not discernible and the ventrals extend to the vent. The rays of the anal are longer than those of the dorsal. Except on the dorsal side the chromatophores have faded considerably giving a deep brown colour to the body. The chromatophores below the lateral line are indistinct.

The larval stages of two Indian Hemirhamphids are known. They are *Hemirhamphus gaimardi* and *Hemirhamphus georgii* but of these the oldest stage of the latter (Devanesan, 1937) is only 12 hours old and measures about 6 mm. and therefore comparison is not possible. Descriptions of larval stages of the former from 6 to 12 mm. are given by Bhattacharya (1916)



FIGS. 2-14

and from 12 to 24.8 mm. by Job and Jones (1938). Two post-larvæ of the same species measuring 12 and 20 mm. have also been described by Nair (1952). The larvæ of *Z. buffoni* could be distinguished from those of *Hemirhamphus gaimardi* by the distribution of chromatophores. In the latter there are only three rows of chromatophores on each side, one on the dorso-lateral aspect, another along the mid-lateral line and the third along the latero-ventral aspect from the vent to the caudal base. In addition to this, the larger and stouter beak, the presence of nasal tendrils, the rounded nature of the caudal fin, the comparatively longer and stouter rostrum, posterior origin of the dorsal in relation to the anal, the greater length of the anal fin rays, the proximity of the ventrals to the vent and the greater length of the pectoral help to distinguish the larvæ of *Z. buffoni* from those of *H. gaimardi*.

TABLE II

Total lengths and snout lengths (in mm.) of three comparable larval stages of H. gaimardi and Z. buffoni

Species	Total length	Snout	Total length	Snout	Total length	Snout
<i>H. gaimardi</i>	10	0.24	12	0.35	15.5	0.9
<i>Z. buffoni</i>	9.25	0.74	11.25	1.71	14.55	2.8

The number of vertebræ in *Z. buffoni* is 42 of which 29 are preanal. The above is the only species of Hemirhamphid in the Indian waters with 13 caudal vertebræ whereas in other species the number varies from 16 to 20. The vertebral counts of larval and juvenile specimens dealt with in this account tally with the above, thereby helping to confirm this identity beyond any reasonable doubt.

It may incidentally be mentioned here that the egg and larval stages described by Delsman (1924) as of some Hemirhamphid appear to be of *Oxyporhamphus* as explained by Breder (1938) and Hubbs & Kampa (1946). Examination by one of us (S. J.) of some larval synentognathi collected by the Dana Expedition from the Indian Ocean has helped to confirm the above. *Bregmaceros macclellandi* Thompson.

Bregmaceros macclellandi, which is the only species related to the Cod family available in Indian waters, is said to be an important food of the Bombay Duck, *Harpodon nehereus*. Eleven post-larvæ were collected from the Orissa Coast off the mouth of the Mahanadi on 19-1-1953 from which

three typical stages are described here. The various body measurements of the larvæ are given in Table III.

Stage I (Fig. 7).—This is a very early larva, 3.60 mm. in length. It is white in colour in formalin. The eyes are large and the median fins are continuous and devoid of fin rays. A small conical projection on the dorsal side of the head marks the position of the single occipital ray which is yet to develop. The pectorals are large and the ventrals are seen as short projections below the head. There is a patch of chromatophores immediately behind the pectorals and a stellate one below the angle of the jaw.

TABLE III
Measurements of Bregmaceros maclellandi in mm.

Sl. No.	Total length	Max. depth	Head	Snout	Eye	Ventrals
*1	3.60	1.31	.86	.31	.29	.23
2	4.8	1.26	1.09	.37	.39	1.03
3	5.1	1.43	1.20	.37	.37	.57
4	5.48	1.37	1.31	.39	.37	1.54
*5	5.82	1.43	1.20	.34	.34	1.26
6	5.88	1.37	1.31	.37	.39	1.60
7	6.11	1.43	1.26	.46	.41	1.20
8	6.22	1.37	1.26	.39	.39	1.37
9	6.56	1.43	1.31	.41	.39	1.83
10	7.48	1.60	1.37	.41	.41	2.11
*11	7.66	1.49	1.37	.37	.37	1.66

* Denotes those described and figured.

Stage II (Fig. 8).—This measures 5.82 mm. in length and shows more advanced features than the previous one. The occipital ray on the dorsal side is present. The long second dorsal, the anal and the caudal show the rudiments of fin rays in their broader portions. The ventrals are long and extend a little beyond the vent. Chromatophores are as in the previous stage.

Stage III (Fig. 9).—The larva is 7.66 mm. long and the body measurements are given in Table III. The increase in length appears to be out of proportion to the increase in depth. The preanal portion has considerably elongated. The ventrals do not reach the vent in this particular specimen though in the preceding stages they do. The fin rays in the dorsal, anal and caudal fin are better developed. The chromatophores near the pectorals are not discernible but there are two or three large, dark brown, dendritic chromatophores on the caudal peduncle and one on the caudal fin.

Bal and Pradhan (1947) have recorded the collection of a larval *B. maccllellandi* 10 mm. in length from Bombay in January 1945 but no description of this is available. Munro (1950) has described from Australian waters the larval and juvenile stages of a number of species of *Bregmaceros* including 5 larval *B. maccllellandi*, ranging from 5.8 mm. to 13.6 mm. Adults of the above species are unknown from the Australian waters and the identification is based on the nature of pigmentation and body proportions. The differences between the Australian and the Indian larvæ of *B. maccllellandi* of the same size are very marked and therefore some of Munro's figures are reproduced here for comparison along with the figure of a 15 mm. larva collected from the Indonesian region by the Challenger Expedition (Günther, 1889). The latter, reproduced here as figure 13, bears appreciable resemblance to the larvæ of *Bregmaceros japonicus* Tanaka, described by Munro (*op. cit.*).

Bregmaceros maccllellandi is the only member of the genus so far known from the Indian waters and the identity of the larval specimens from the Orissa Coast described in this account is beyond any reasonable doubt. These measure from 3.6 to 7.6 mm. (Table III) and only the first two Australian larvæ [*i.e.*, the one measuring 5.8 mm. (Fig. 10) and the other measuring 6.6 mm. (Fig. 11)] come within the above range for comparison. The 5.8 mm. specimen described by Munro (*op. cit.*) differs from the Indian specimen of the same size not only in the nature and distribution of chromatophores but in the body proportions, shape of the head and fin characters also. It is said to be a pro-larva whereas the 3.6 mm. Indian specimen is a post-larva as also the 3.9 mm. larva of *B. nectabamus* Whitley (Munro, *op. cit.*) reproduced in Fig. 14, which possesses the typical *Bregmaceros* features. In the larva described by Munro the distance from snout to vent is greater than that of the caudal portion and the ventral fins are represented by a single process without differentiation into fin rays whereas at no stage in any *Bregmaceros* is the preanal portion greater than the caudal portion. By the time the larva reaches 4 mm. in length, the ventral rays are differentiated, the nuchal appendage is visible and the median fins show some rudimentary

rays. The marked differences in the 5.8 mm. Australian larva therefore remain to be explained.

Callionymus melanopterus Bleeker

There are 7 specimens in the collection obtained on 17-1-1953 from the Orissa Coast. The measurements are given in Table IV. The smallest specimen is 5.08 mm. In this, chromatophores are much fewer and the lateral spine much smaller than in the 5.7 mm. specimen described and figured by Jones and Menon (1954).

TABLE IV

Measurements of Callionymus melanopterus in mm.

Sl. No.	Total length	Head	Snout	Eye	Snout to Dorsal	Snout to Anal
1	5.08	1.71	.40	.63	2.80	2.86
2	5.82	1.99	.40	.74	2.31	3.25
3	6.89	2.28	.46	.77	3.03	3.54
4	7.19	2.46	.51	.80	3.14	3.65
5	7.77	2.57	.46	.80	3.18	3.65
6	7.85	2.68	.49	.83	3.18	3.77
7	9.36	3.20	.63	.86	3.37	4.39

Psettodes erumei (Bloch & Schneider)

This is the only known Indo-Pacific species of the genus *Psettodes* and is distributed from the east coast of Africa to Japan and Australia. It is quite common on the coasts of India. An early juvenile of this species was described by John (1951).

Two early larval stages of this species measuring 3.99 mm. and 4.77 mm. collected on 17-1-1953 from the Orissa Coast are described here. The nature of the fin, of not extending forward on the head, helps to place the larvæ as that of *Psettodes*. Since *P. erumei* is the only known species from the Indian waters the specimens are assigned to this species.

Stage I (Fig. 15).—The total length of the specimen is 3.99 mm. and it is a bilaterally symmetrical post-larva. The median fins are continuous and the fin rays have not yet formed except a few at the caudal end. The dorsal fin does not extend forward on the head but stops far behind the eyes. Mouth is anterior with a slight upward inclination. The pectoral fin is very small. Air bladder is present. Chromatophores are mainly in two rows along the base of the dorsal and anal fins. There is a cluster of chromatophores on the ventral side of the abdomen and another over the air bladder and a few scattered ones on the head.

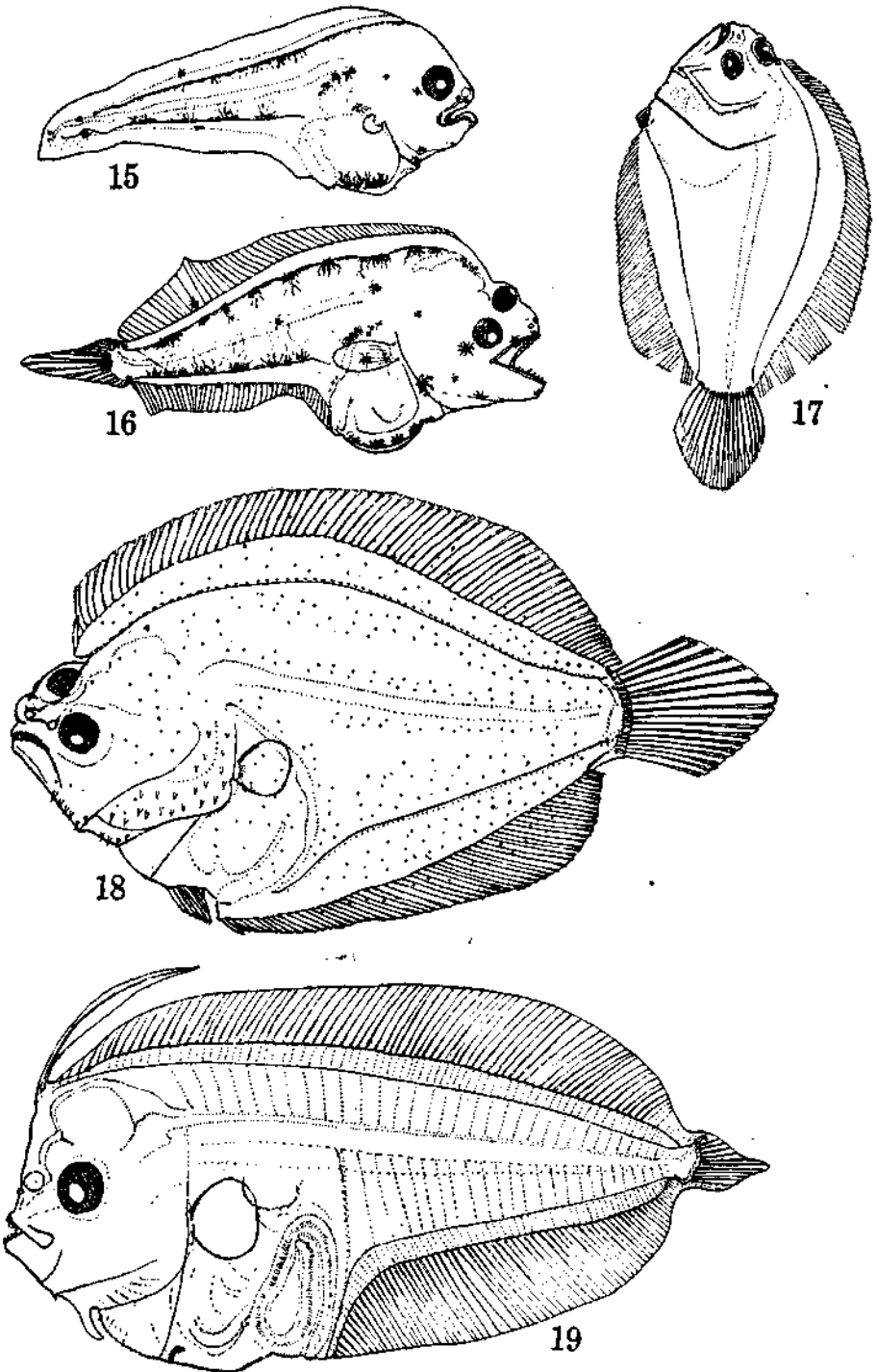
Stage II (Fig. 16).—The total length is 4.77 mm. It is a bilaterally asymmetrical larva. The median fins are discontinuous and fin rays are distinct. The mouth is obliquely directed upwards and teeth are present in the jaws. The left eye is in the process of shifting to the right side and is close to the dorsal edge. The general distribution of the chromatophores is as in the previous stage and, in addition, there is a row of chromatophores along the base of the anal fin.

Pseudorhombus arsius (Hamilton)

There are 19 specimens belonging to this species, ranging in length from 10.28 to 13.53 mm., collected on 19-1-1953 from the Orissa Coast. All are more or less of the same stage of development with the right eye at the dorsal edge showing early the disposition towards the asymmetrical condition (Fig. 17). The body measurements are given in Table V. The chromatophores on the body have faded out due to faulty preservation and therefore they are not indicated in the figure.

TABLE V
Measurements of some typical stages of Pseudorhombus arsius in mm.

Sl. No.	Total length	Max. depth	Head	Snout	Left Eye
1	10.28	6.85	2.80	.66	.59
2	11.49	7.02	3.26	.69	.60
3	11.99	7.08	3.37	.77	.66
4	12.50	7.14	3.43	.77	.66
5	12.85	7.31	3.43	.80	.66
6	13.53	7.37	3.48	.86	.71



FIGS. 15-19

The extension of the dorsal fin to above the eyes, the absence of spinous rays and the possession of free opercular margin and prominent lower jaw place the fish under the Bothidæ. The general body proportions and the dorsal and anal fin ray counts which are 71 to 72 and 50 to 54 respectively, tally with those of *Pseudorhombus arsius* which is one of the commonest flat fishes on the Bengal-Orissa Coast.

Gopinath (1946) has described from the Trivandrum Coast *Pseudorhombus arsius* larva of about this size which differs appreciably from the Orissa Coast specimens in body proportions.

Pseudorhombus oligodon (Bleeker)*

A single asymmetrical larva of this fish measuring 10.56 mm. wa. collected on 17-1-1953 (Fig. 18).

The specimen is white in formalin. The general measurements are given in Table VI. Though the right eye still faces the right side, it has shifted

TABLE VI

Measurements of *Pseudorhombus oligodon*, *Arnoglossus tapeinosoma*, *Bothus sp.*, *Samaris macrolepis*, *Solea ovata* and *Heteromycteris oculus* in mm.

Species	Total length	Head	Eye	Max. depth	Fin rays	
					Dorsal	Anal
<i>P. oligodon</i>	10.56	3.14	.51	5.71	71	57
<i>A. tapeinosoma</i>	6.42	1.88	.57	3.11	79	66
<i>Bothus sp.</i> I	22.38	4.80	.91	12.05	91	71
.. II	24.15	4.97	.91	12.91	88	68
.. III	25.02	5.08	.94	13.08	89	72
<i>S. macrolepis</i>	4.85	1.43	.34	2.11	..	..
..	5.35	1.60	.34	3.43	..	..
<i>S. ovata</i> I	4.68	1.20	.31	..	..	..
.. II	6.28	1.71	.37	2.34	63	45
<i>H. oculus</i>	11.31	3.53	.51	5.71	94	69

* = *Pseudorhombus malayanus* Bleeker, of Norman (1927).

to an almost dorsal position on the head. Teeth are present on both the jaws. The chromatophores consist of very small brown spots which are fairly uniformly distributed all over, except along the distal portion of the fins. Scales have begun to form and those on the blind side are ctenoid, a character which distinguishes the species from the related *P. arsius*.

Gopinath (1946) has described a specimen of *Pseudorhombus arsius* measuring 9.5 mm. from the Trivandrum Coast in which the right eye has already shifted to the left side. The larva of *P. oligodon* differs from the above in the absence of dendritic chromatophores along the side, by its greater depth, presence of pectoral fins and proportionately deeper body and longer head.

Arnoglossus tapeinosoma Bleeker

A single symmetrical larva (Fig. 19) of this fish measuring 6.4 mm. was collected from the Orissa Coast off the mouth of Mahanadi on 29-1-1953. The body measurements are given in Table VI. It has a whitish colour in formalin and is translucent except for the eyes which are black. No chromatophores are present on the body. There are four teeth on either side on each jaw. The first dorsal ray is conspicuously prolonged and there is a ventral hook-like projection behind the lower jaw. Air bladder and pectoral fins are present but the ventrals are very rudimentary. The median fins are united partially by a very narrow portion of the larval fin-fold, which still persists.

John (1951) has described an advanced larva of *Arnoglossus macrolophus* Alcock (= *A. tapeinosoma*) of 22 mm. in length from the Madras Coast. At this stage the median fins are separate, the ventrals are well developed and the hook seen in the earlier stage is absent. The urohyal is emarginate whereas in the earlier stage under report this is not so prominent.

Weber and de Beaufort (1929) have described two similar larval flatfishes, 10.6 and 11.6 mm. in length which they have provisionally assigned to *Bothus*.* Of these the first one collected from the Flores Sea appears to belong to some other species in view of the presence of a ventral armature and fewer dorsal rays. The second one collected from the Banda Sea resembles *Arnoglossus tapeinosoma* very much. The absence of hook behind the lower jaw and the presence of well-developed ventral fins could probably be attributed to the fact that it is older than the Orissa Coast specimen. The absence of pectoral fins in the Banda specimen cannot be explained easily

* Weber and de Beaufort (1929) treat *Arnoglossus* only as a subgenus under *Bothus* whereas Norman (1927), whose classification is followed here, has given it a generic status.

unless it is assumed that the fins being very thin and transparent have either been damaged or overlooked. The above is most likely since there are no Bothinæ in the Indo-Australian waters which have no pectoral fins. Another difference in the Banda Sea specimen is that the anal has only 63 fin rays whereas *A. tapeinosoma* has 65-72 rays.

Bothus sp.

Three specimens measuring 22.38, 24.15 and 25.02 mm. were collected from the sea off the mouth of Mahanadi, Orissa, on 17-1-1953. Of these one (Fig. 20) is a late symmetrical larva with the right eye close to the dorsal fin which shows a slight dent at its extremity where the shifting of the eye takes place. In the other two specimens, one half of the right eye has shifted to a dorsal position indicating that the specimens were collected at the time of shifting of the eye (Fig. 21). The specimens are white in formalin and the body is devoid of chromatophores. The measurements are given in Table VI.

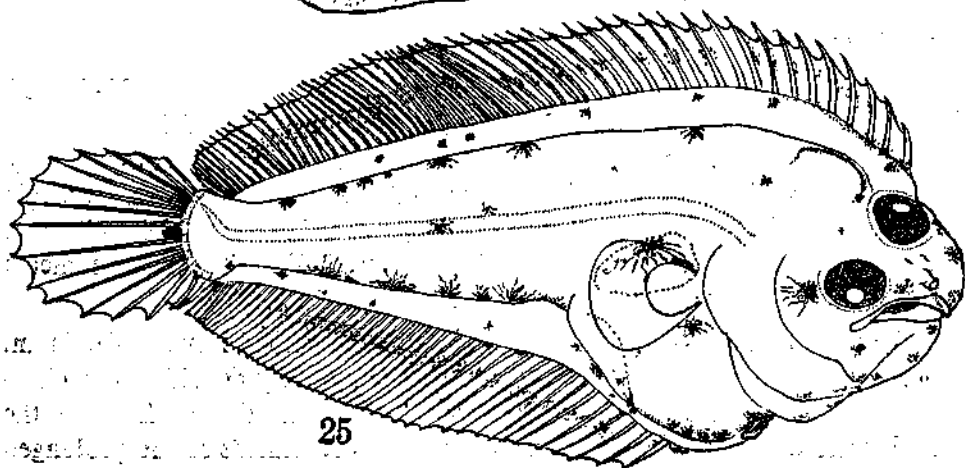
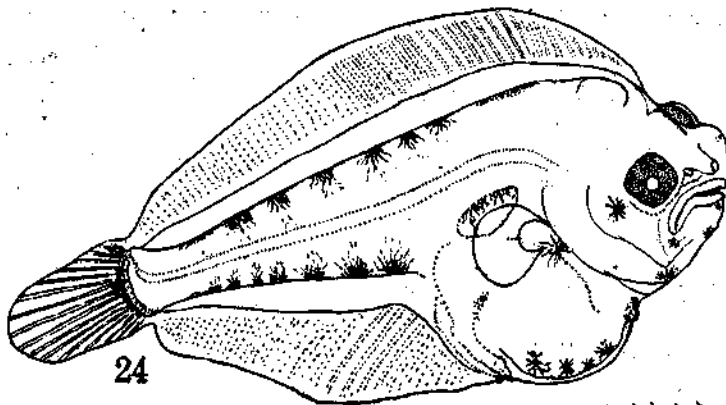
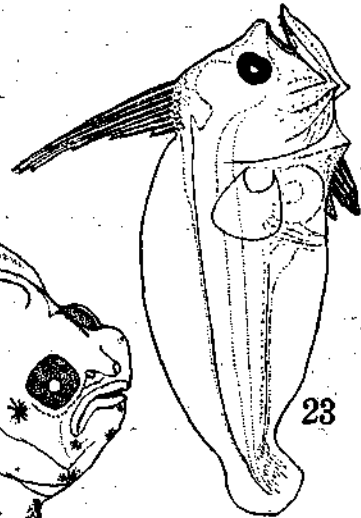
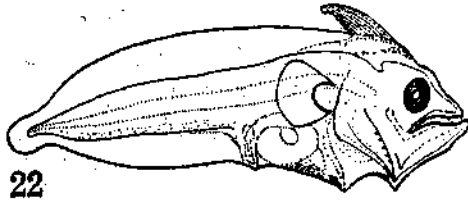
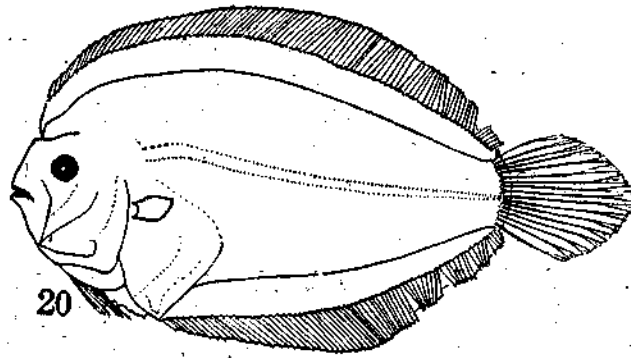
The characters enumerated for Bothidæ under *Pseudorhombus arsius* hold good for the above specimens. The median position of the left pelvic fin with the base longer than the right one and the gill opening ending a short distance above the pectoral fin show that they belong to the genus *Bothus*. Identification of the species is not possible with the available material. It is well known that in some of the *Bothus* of tropical waters the metamorphosis is considerably delayed.

A 17 mm. larva of *Bothus (Platophrys) pantherinus* from the Trivandrum Coast has been figured and described by Gopinath (1946). The Orissa Coast specimens differ so markedly from the above that they evidently belong to some other species.

Samaris macrolepis Norman

The larval stages of this interesting flat-fish were obtained on 29-1-1953 from the sea off the mouth of Mahanadi. The presence of 8 moderately prolonged fin rays at the anterior end of the dorsal fin helps to fix the identity of the species. The only previous record of *S. macrolepis* is from a single male type specimen, 45 mm. in total length, from the gulf of Martaban on the eastern section of the Bay of Bengal (Norman 1927). The measurements of the specimens are given in Table VI.

Stage I (Fig. 22).—This is a transparent, symmetrical larva of 4.85 mm. in length. The eyes are dark but the body is completely devoid of any chromatophores. The median fins are continuous but the dorsal shows at the anterior end a triangular projection, thus showing rudiments of the prolonged



FIGS. 20-25

rays which form the most characteristic feature of the species concerned. No other fin rays are present. Pectorals are of the same size and pelvics are absent.

Stage II (Fig. 23).—This is 5.35 mm. long and is a little more advanced than the previous stage, though still symmetrical and devoid of any chromatophores on the body. The anterior 8 rays are well defined and conspicuously prolonged. All the median fins are continuous but the caudal is thickened at the base showing a few rudimentary rays. Fin rays are not distinguishable in the pectorals.

Solea ovata Richardson

Two specimens of *Solea ovata* Richardson, 4.68 mm. and 6.28 mm. in length, were collected from the Orissa Coast on 17-1-1953. The general measurements are given in Table VI.

Stage I (Fig. 24).—The larva is light brown in formalin. The left eye which has partially shifted towards the dorsal aspect of the head still faces the left side. The dorsal and anal are connected to the caudal by a narrow finfold. Except in the caudal the fin rays are not quite distinct. The pectoral is well formed but the ventrals are very rudimentary. Chromatophores are all dendritic and in addition to a few on the head and one below each pectoral fin, there are two distinct rows along the dorsal and ventral sides of the body as far as the caudal fin which has two groups at its base.

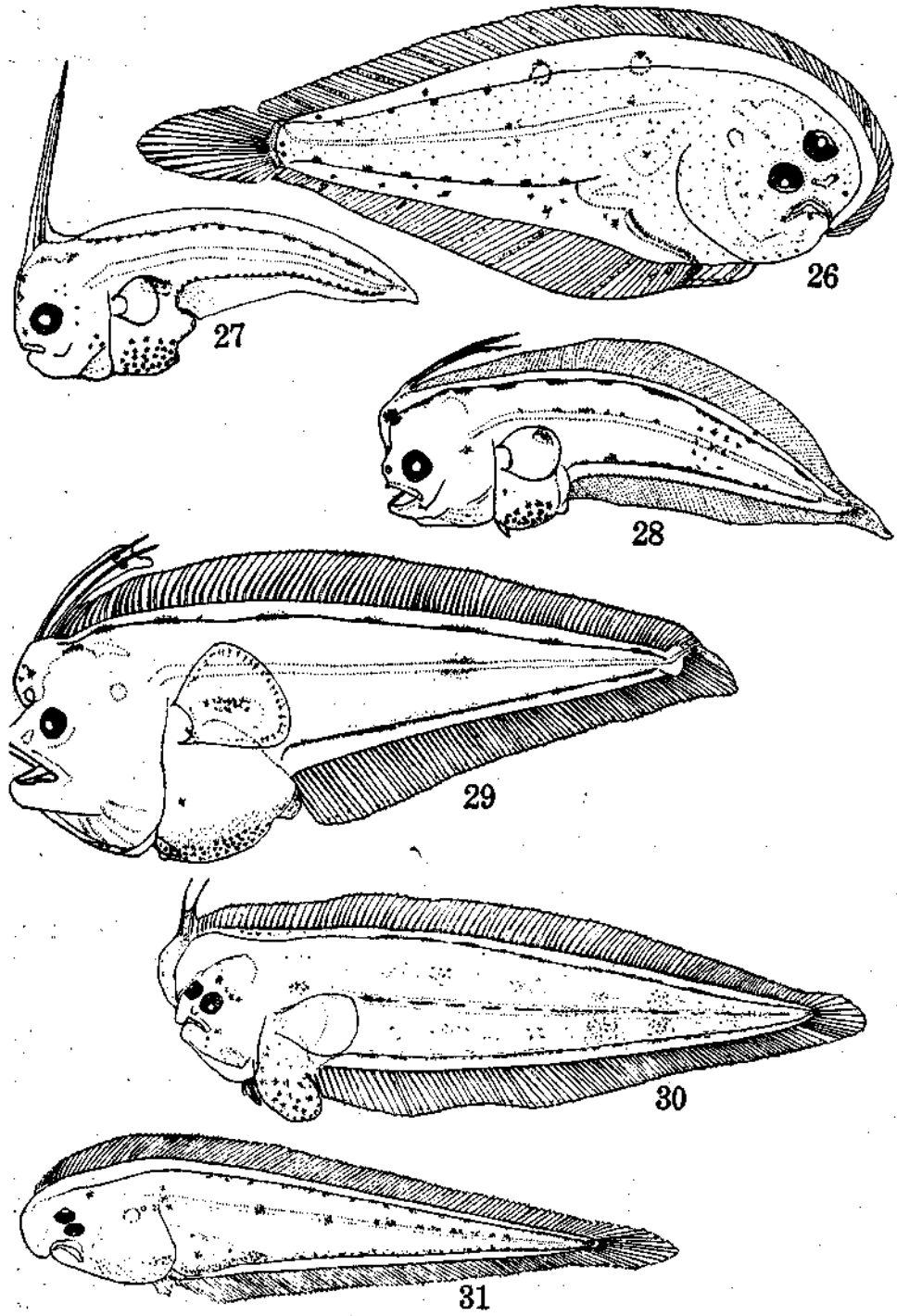
Stage II (Fig. 25).—This is a more advanced stage than the previous one. The left eye has come over to the right side and the median fins are separate and the fin rays in them are distinct.

Heteromycteris oculus (Alcock)

A single late post-larva (Fig. 26) of this species measuring 11.31 mm. was collected on 17-1-1953 from the Orissa Coast. The general body measurements are given in Table VI.

The median fins are separate. The dorsal extends as far as the tip of the snout and the ventral is united with the anal. Pectorals are absent. There is a large number of minute chromatophores spread all over the body, a few irregular patches on the fins and two conspicuous rows along the dorsal and ventral sides. The two anteriormost of the dorsal row are in the form of circles presumably indicating the beginning of oculi-like marks which are characteristic of the adult.

The union of the pelvic fin to the anal, the absence of pectoral fins and the characteristic extension of the dorsal fin rays up to the tip of the snout



FIGS. 26-31

help to place this in *H. oculus*, the only recorded species of this genus from Indian waters.

Cynoglossus sp. I

There are four specimens of *Cynoglossus* larvæ measuring from 4.34 to 16.27 mm. which were collected on different dates from 19-1-1953 to 30-1-1953. Though it is not possible to say with certainty that all the stages belong to the same species the first 3 stages appear to form a connected series while the 4th one which is a more advanced stage shows some abrupt differences from Stage III. However, they are described in one series. The relative body measurements are given in Table VII.

TABLE VII
Measurements of *Cynoglossus* spp. in mm.

Species	Stage	Total length	Head length	Eye	Dorsal fin rays	Anal fin rays
Sp. I	.. I	4.34	1.02	.31	?	?
Sp. I	.. II	5.25	1.26	.29	94+?	68+?
Sp. I	.. III	7.45	1.77	.29	103+?	75+?
Sp. I	.. IV	16.27	2.74	.46	117+?	96+?
Sp. II	.. I	9.65	2.46	.33	116	95
Sp. II	.. II	9.76	2.46	.33	117	96
Sp. II	.. III	9.99	2.57	.35	115	98
Sp. II	.. IV	18.73	4.23	.49	116	96
Sp. III	.. I	10.50	2.57	.35	104	76+?

Stage I (Fig. 27).—This is an early post-larva measuring 4.34 mm. A very characteristic feature is the presence of two elongated rays at the anterior extremity of the dorsal fin. Median fins are continuous and devoid of fin rays. Chromatophores are arranged in two rows below the dorsal and anal fins. There is a patch on the ventral side of the abdomen and another over the air bladder. There are a few scattered chromatophores on the head.

Stage II (Fig. 28).—This is 5.25 mm. long. The rudiments of the ventral fins are seen. Indications of fin rays are seen in the median fins. In addition to the dorsal and ventral rows of chromatophores there is an additional row along the sides.

Stage III (Fig. 29).—The general features are as shown in the figure. The specimen is comparatively broader than in the previous stage. Fin rays have developed, though they are not quite clear towards the caudal end. Though the larva is symmetrical the ridge in front of the dorsal fin has formed into a hook with an opening below through which the shifting of the eye from the right to the left eventually takes place. The pectoral fins are conspicuously large whereas the ventrals are still very small.

Stage IV (Fig. 30).—Total length is 16.27 mm. The eye has shifted to the dorsal side and the hook in front of the dorsal fin is very prominent. The abdomen is large and conspicuous. The elongated anterior rays of the dorsal fin are shorter than in the previous stages. All fin rays are distinct in the median fins and the ventrals are well developed.

The larval flat-fishes described from the Madras Coast by John (1951), which were provisionally assigned by him to the Soleidæ, resemble very much the *Cynoglossus* sp. collected by Nair (1952) from the same area subsequently. The above differ appreciably from specimens described here.

Cynoglossus sp. II

Four specimens of *Cynoglossus* collected on 17-1-1953 form a connected post-larval series. The identification of the species is not definite. The body measurements are given in Table VII. Stage No. II is shown in Fig. 31.

Cynoglossus sp. III

A post-larval *Cynoglossus* of 10.50 mm. in length collected on 17-1-1953 from the sea off the mouth of Mahanadi is identical with the specimen collected from the Burhabalong Estuary and described by Jones and Menon (1951) as *Cynoglossus* II. The above specimen was collected on 18-5-1950 which shows that the species has a fairly extended breeding season.

Triacanthus brevirostris Temminck & Schlegel

Two specimens of *Triacanthus brevirostris* measuring 5.76 and 8.11 mm. were collected from the Orissa Coast off the mouth of Mahanadi on 17-1-1953. A specimen 5.35 mm. in length obtained in 1950 from Chandipore, Balasore (Orissa), is described here as Stage I, as it is younger than the other two.

TABLE VIII
Measurements of *T. brevirostris* in mm.

Stage	Total length	Max. depth	Head length	Eye	Snout	Snout to dorsal	Snout to ventral
I	5.35	2.87	1.29	.69	.50	1.69	2.87
II	5.76	3.31	1.77	.86	.52	1.99	3.20
III	8.11	4.91	2.74	1.26	.80	3.02	4.17

Stage I.—The body measurements are given in Table VIII. The larva is short but broad with large eyes. All the median fins are connected by a narrow finfold. There are conspicuous patches of chromatophores on the body. There is a large cluster on each side between the pectoral and ventral fins, a few internally along the dorsal wall of the abdominal cavity and a dense row, each along the base of the dorsal and the anal fins. The ventral fins are dark and the spine is covered by a thin layer of epidermis.

Stage II.—The specimen is cream-coloured in formalin and measures 5.76 mm. The body measurements are given in Table VIII. There is an appreciable increase in the depth of the body. A narrow finfold is still present between the two dorsals. Spine bearing sclera have developed over a greater portion of the body and except a few chromatophores along the base of the dorsal fin, rest of the larger groups have disappeared and very minute dot-like ones have appeared fairly uniformly over the upper half of the body.

Stage III.—This is an advanced post-larva measuring 8.11 mm. in length and showing many of the unmistakable characters of the adult fish, though still short and broad with conspicuously large eyes in comparison to the adult. The dorsal fins are separate. The body measurements are given in Table VIII. The two dorsals are separate and dorsal and ventral spines could be seen outside. The ventral edge of the abdomen between the ventrals and the anal is dark brown in colour. The spots on the upper half of the body are densely distributed.

Gopinath (1946) has described a 5 mm. larva of *T. brevirostris* from the Trivandrum Coast, which shows much earlier larval characters than the *Stage I* described here. There are two species of *Triacanthus*, viz., *T. brevirostris* and *T. strigilifer* in Indian waters. The fin ray counts of the Orissa Coast specimens agree with those of the former which is the more common of the two species.

Parapegasis natans (Linnæus)

Pegasus draconis Linnæus is the only species of Pegasidæ recorded by Day (1889). Johnstone (1904) has listed a specimen of *Parapegasis natans* from Aripu reef, Ceylon, and this is probably the only record of this fish from the Indian waters. Amongst other characters the presence of 12 segments in the caudal region in *P. natans* distinguishes the fish very easily from *P. draconis* which has only 8 segments. According to Herre (1951) the distribution of *Parapegasis natans* which he considers synonymous with *P. volitans* is confined to "The Philippines, East Indies, West of India, South from New Guinea to Australia" but Smith's (1948) record of the fish from South Africa, and Johnstone's (*op. cit.*) record from off the coast of Ceylon extend its distribution over a very wide range.

Twenty-three post-larval stages of *Parapegasis natans* were obtained in the tow-net collection made on 17-1-1953 from the Orissa Coast near the mouth of Mahanadi. In the earliest stage both the upper and lower jaws are of the same length, whereas the oldest stage is almost a juvenile with a fairly well-developed "beak". The relative measurements of the specimens are given below:—

TABLE IX

Measurements of some typical stages of Parapegasis natans in mm.

Sl. No.	Total length	Head	Snout	Eye	Snout to dorsal	Snout to ventral
*1	7.88	2.0	.63	.63	4.40	4.23
2	10.05	2.63	.74	.86	5.48	4.11
3	10.68	2.57	.80	.91	5.65	4.05
4	11.13	2.86	.86	1.08	5.99	4.63
5	11.19	2.86	.80	.91	5.70	4.45
*6	11.76	2.97	.91	1.03	5.60	4.74
7	12.05	3.03	1.09	.97	6.22	4.91
8	13.42	3.48	1.20	1.09	6.85	5.08
9	14.85	4.17	1.71	1.14	7.59	7.42
*10	25.12	7.14	3.60	1.66	12.56	12.45
11	27.18	7.7	4.05	1.77	14.10	11.14
*12	30.72	8.17	4.57	1.71	14.56	14.45

* Denotes those described and figured.

Of the above numbers 1, 6, 10, and 12 are selected as typical stages and are described below.

Stage I (Fig. 32).—Specimen is 7·88 mm. long. The two jaws which are edentulous are of equal length and the mouth is at the tip of the snout. There is a small bony frill immediately behind the eyes. The gill openings could be seen as small depressions on either side immediately anterior to the pectoral fin base. Compared to the later stages the specimen looks short and stumpy. The 12 caudal segments are distinct but are short. The dorsal takes its origin from the 3rd segment. The ventral fins are two simple curved structures with 3 fin rays of which the anterior two are long whereas the posterior one is short and feeble.

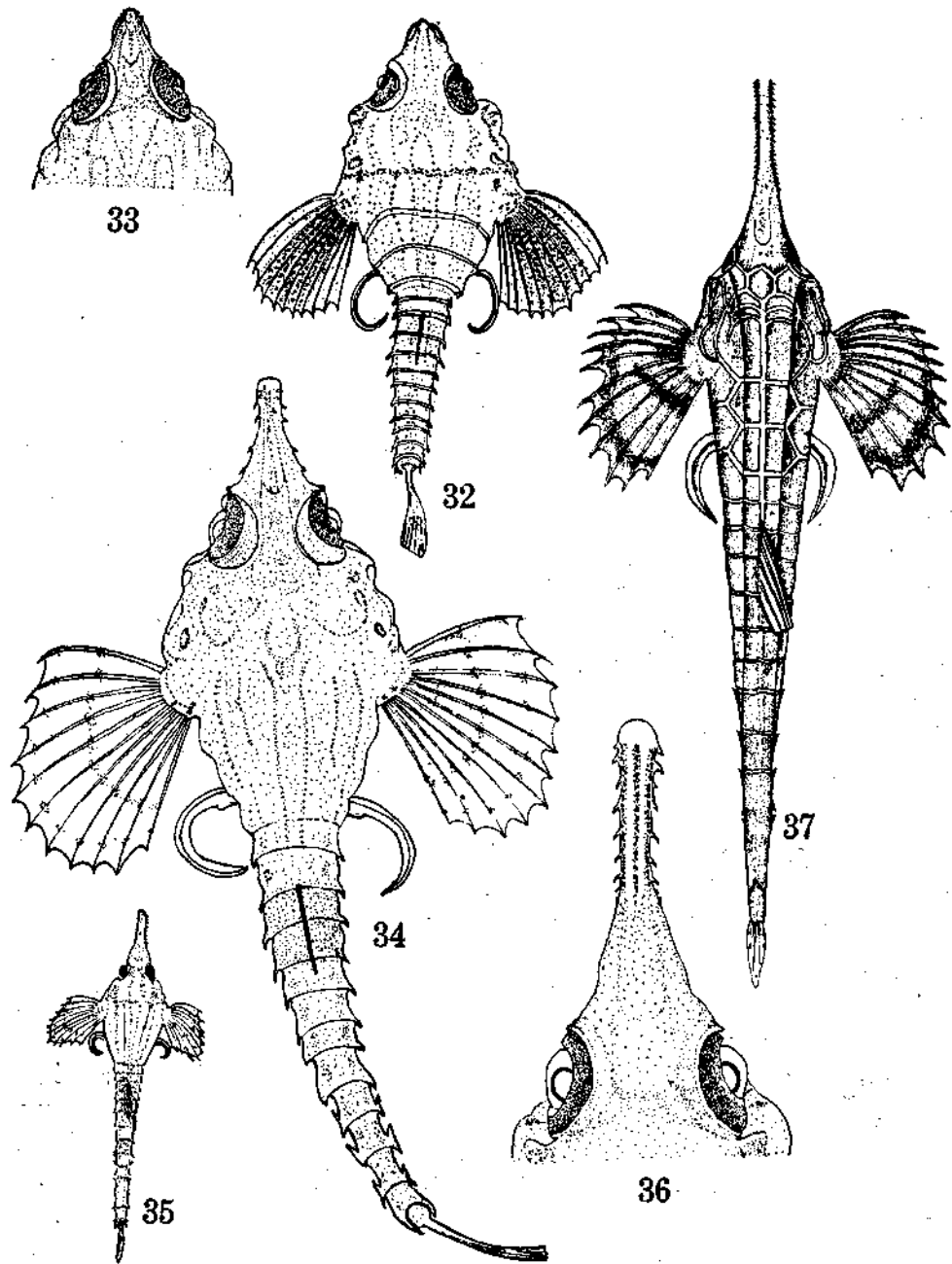
The general colour of the specimen in formalin is light brown. There are six irregular rows of chromatophores on the dorsal side, of which only two lines are clear in the caudal region. There is a dark brown cluster of chromatophores along the middle of the pectoral fins. Scattered chromatophores are present on the dorsal and caudal fin. The ventral side including the fins is devoid of any pigment.

Stage II (Fig. 33).—The specimen is 11·76 mm. long. The snout has begun to elongate showing the rudiments of the first and second pairs of spines, but it does not extend appreciably beyond the lower lip. The colouration is more or less similar to that in the previous stage except for a slightly deeper shade of the body. The pigmentation in the pectoral fins appears less dense.

Stage III.—The specimen is 14·85 mm. long. The snout has elongated a little, showing spines on either side. The caudal portion also is comparatively long. Anteriorly pointed spines are present on the 10th, 11th and 12th segments. The general arrangement of the chromatophores is the same as in the previous stage except for a general deepening of colour and for the dense patch on the pectoral fins, giving place to a series of isolated ones.

Stage IV (Fig. 34).—This is 25·12 mm. long. The ‘beak’ shows 5 spines on each side. Unlike in the previous stages the caudal segments have elongated considerably giving a narrow appearance to the fish. The ridges on the back and the anteriorly directed spines of the last three segments are very conspicuous.

Though the general arrangement of chromatophores on the dorsal side is as in the previous stages, concentration of chromatophores could be seen as dark patches on the 3rd and 4th segments and on the 8th segment.



Figs. 32-37

Stage V (Figs. 35 and 36).—The specimen is 30.72 mm. long and the various body measurements are given in Table IX. It is practically a juvenile at this stage except that the "beak" has not grown to the full proportionate length. There are spines on the beak. The ridges on the body are more conspicuous and the brown patches on the body appear as interrupted bands.

Adult stages of the species are not available for comparison. Since there appears to be no sketch of this fish in any of the Indian publications to facilitate reference, its figure from Smith (1949) is reproduced here (Fig. 37). *Parapegasmus natans* is easily distinguished from *Pegasus draconis* by the presence of 12 tail-rings and the long narrow body with elongated snout as against the 8 tail segments and the stout body with short snout in the latter.

SUMMARY

The account deals with 16 species of larval and juvenile fishes from the Bengal and Orissa Coasts collected on board M. F. V. Kerala and I. N. S. Investigator. Stages of *Zenarchopterus buffoni* (Valenciennes), *Bregmaceros macclellandi* Thompson, *Callionymus melanopterus* Bleeker, *Psettodes erumei* (Bloch and Schneider), *Pseudorhombus arsius* (Hamilton), *P. oligodon* (Bleeker), *Arnoglossus tapeinosoma* Bleeker, *Bothus* sp., *Samaris macrolepis* Norman, *Solea ovata* Richardson, *Heteromycteris oculus* (Alcock), *Cynoglossus* spp., *Triacanthus brevirostris* Temminck and Schlegel, and *Parapegasmus natans* (Linnæus) are described and figured. Of these the larval and juvenile stages of *Zenarchopterus buffoni* and *Parapegasmus natans* form connected series and are dealt with in detail. The figure of an adult of the latter is reproduced. *Samaris macrolepis* which was formerly known only from a single specimen from the Southern Burma Coast is recorded from the Indian Coast for the first time. Early larval stages of *Bregmaceros macclellandi* are compared with the descriptions of larvæ of the above species from the Australian waters and the significant differences are pointed out.

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EXPLANATION OF FIGURES

FIG. 1. Map of Bengal and Orissa coasts showing the collection centres.

FIGS. 2-14. Figs. 2-6. *Zenarchopterus buffoni* (Valenciennes): 2: 9.25 mm. stage; 3: Head of 11.25 mm. stage; 4: 14.85 mm. stage; 5: 33.5 mm. stage; 6: Head of 33.5 mm. stage. Figs. 7-13. *Bregmaceros maclellandi* Thompson: 7: 3.60 mm. stage; 8: 5.82 mm. stage; 9: 7.66 mm. stage; 10: 5.8 mm. prolarva (after Munro); 11: 6.6 mm. post-larva (after Munro); 12: 13.6 mm. post-larva (after Munro); 13: 15 mm. larva (after Günther). Fig. 14. *Bregmaceros nectabanus* Whitley: 3.9 mm. larva (after Munro).

FIGS. 15-19. Figs. 15 and 16. *Psettodes erumei* (Bloch & Schneider): 15: 3.99 mm. stage. 16: 4.77 mm. stage. Fig. 17. 12.16 mm. stage of *Pseudorhombus arsius* (Hamilton). Fig. 18. 10.56 mm. stage of *P. oligodon* (Bleeker). Fig. 19. 6.4 mm. stage of *Arnoglossus tapinosoma* Bleeker.

FIGS. 20-25. Figs. 20 and 21. *Bothus* sp. 20: 24.15 mm. stage; 21: Head of 25.02 mm. stage. Figs. 22 and 23. *Samaris macrolepis* Norman. 22. 4.85 mm. stage; 23. 5.35 mm. stage. Figs. 24 and 25. *Solea ovata* Richardson. 24: 4.68 mm. stage; 25: 6.28 mm. stage.

FIGS. 26-31. Fig. 26. 11.31 mm. stage of *Heteromycteris oculus* (Alcock). Figs. 27-30. *Cynoglossus* sp. I. 27: 4.34 mm. stage; 28: 5.25 mm. stage; 29: 7.45 mm. stage; 30: 16.27 mm. stage. Fig. 31. 9.76 mm. stage of *Cynoglossus* sp. II.

FIGS. 32-37. *Parapegasmus natans* (Linnæus). 32: 7.88 mm. stage; 33: Head of 11.76 mm. stage; 34: 25.12 mm. stage; 35: 30.72 mm. stage; 36: Head of 30.72 mm. stage; 37: Adult *P. natans* (after J. L. B. Smith).