



STUDIES ON THE LEPTOCEPHALI OF BOMBAY WATERS

V. A Few Other Leptocephali*

BY R. VELAPPAN NAIR AND K. H. MOHAMED
(Central Marine Fisheries Research Station, Mandapam Camp)

Received September 1, 1960

(Communicated by Dr. N. K. Panikkar, F.A.Sc.)

LEPTOCEPHALUS IV

(Text-Fig. 1 and Photograph 1)

Total length	..	68.5
Maximum height	..	10.3 (15.0)
Predorsal distance	..	39.0 (56.9)
Preanal distance	..	50.5 (73.7)
Length of head	..	4.3 (6.3)
Length of snout	..	1.3 (30.2)
Diameter of eye	..	1.2 (27.9)
Total myotomes	..	164
Preanal myotomes	..	105

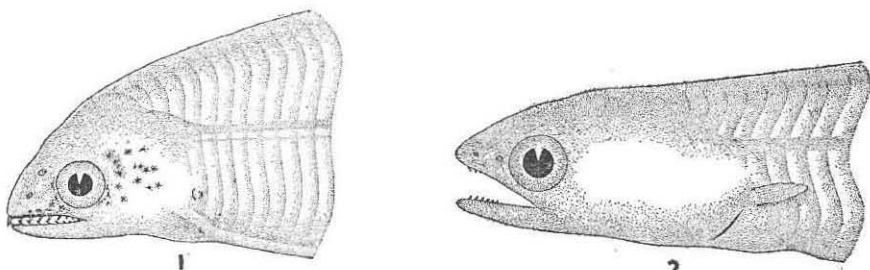
A single specimen of this murænid leptocephalus was obtained from the 'dol' net catches made at Versova on the 9th January 1956 (*vide* Introduction, Nair and Mohamed, 1960 a).

The larva is translucent and short and measures only 68.5 mm. in total length. The body is moderately thick and very high and shows the typical leaf-like appearance. The maximum height of 10.3 mm. is slightly in front of the anus and it is 6.7 times in length. The body tapers moderately at the extremities and terminates posteriorly in a rounded caudal fin.

The head which measures 4.3 mm. is 15.9 times in length. It is roughly conical in shape with a blunt snout which is 3.3 times in head. The eye is

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

perfectly circular and it is 3.6 times in head. Both the jaws are of equal length and the cleft of the mouth extends to a level with the centre of the eye. Jaws are provided with strong and pointed teeth and the dental formula is $1 + 5 + 3/1 + 5 + 4$. Each half of the upper jaw carries a short grasping tooth, 5 strong and pointed teeth which gradually decrease in length backwards and another set of 3 short, conical and uniformly sized teeth. The lower jaw also carries in each half, teeth of the same size, shape and arrangement but they number 10 since an additional tooth is present in the last group. The nostrils are distinctly seen and the anterior one is midway between the tip of the snout and the front border of the eye while the posterior one is above and slightly behind the anterior nostril.



TEXT-FIGS. 1-2. Fig. 1. Head region of *Leptocephalus* IV, $\times ca.$ 5.5. Fig. 2. Head region of *Leptocephalus* V, $\times ca.$ 6.

The myotomes are very narrow and compactly arranged. There are 164 myotomes in the larva and a distinct diaphanous zone where the myotomes do not extend is present on the dorsal side throughout the length of the leptocephalus. A similar zone is seen on the ventral side also, but it begins only from the middle of the larva and extends up to the tail. These transparent zones are relatively wide in the caudal region. The dorsal fin originates slightly behind the middle of the larva opposite the 77th myotome. The predorsal distance is 1.8 times in length. The vent is below the 105th myotome and the preanal distance is 1.4 times in length.

The dorsal and anal fins are continuous with the caudal fin and the posteriormost rays of these two fins are double the length of the other rays and equal in length to those of the caudal fin. The rudiments of the pectoral fin is seen as a frilled fold near the gill opening.

The colouration of this larva differs from that of the other murænid larvæ recorded so far from Indian waters and it is conspicuously pigmented in the head region and it serves as a distinguishing feature of the leptocephalus. Head pigmentation of diagnostic importance is rare in

Indian leptocephalids and so far it has been observed only in the case of *Uroconger lepturus* (Nair, 1946) and in a few other murænid leptocephali (Nair, 1947 and 1948; Jones and Pantulu, 1952). A group of large highly branching chromatophores is present in the snout in the form of a dark patch extending from the middle of the snout along the border of the upper jaw up to the front edge of the eye. A large group of several similar pigment cells occurs behind the eye. The roof of the mouth is also black owing to the dense accumulation of black branching chromatophores. These patches of chromatophores on either side of the eye together with the buccal pigmentation give a conspicuous dark colouration to the head of the leptocephalus.

A row of small unbranched pigment cells is seen on the dorsal side of the posterior half of the alimentary canal and these chromatophores are regularly arranged in the post-aortic region.

A row of closely arranged small black chromatophores is seen at the base of the anal fin and the pigment cells are generally found at the base of the fin rays. Dorsal fin shows a row of black pigment cells, but they are arranged far apart tending to become closer in the caudal region. In front of the dorsal fin minute chromatophores are present along the mid-dorsal line and this row extends anteriorly up to the middle of the predorsal distance. A few scattered black chromatophores are present at the base of the caudal fin.

REMARKS

Leptocephali belonging to the family Murænidæ are very common in Indian coastal waters as judged by the relatively large number of varieties recorded so far. Including the present form 14 varieties of murænid leptocephali and 1 murænid preleptocephaline stage have been recorded from both the coasts of India. *Leptocephalus dussumieri* described by Kaup (1856), *Leptocephalus milnei* recorded by Southwell and Prashad (1919) from the estuaries of the Gangetic Delta and *Leptocephalus E* collected by Gopinath (1950) from the Trivandrum coast have been identified as murænid leptocephali (Nair, 1960). Kaup's description of *L. dussumieri* is based on 3 specimens of which one was sent by Dussumier from Malabar and according to Bertin (1935) this specimen is not found in the Paris Museum. However, for comparison the additional characters given by Bertin in his re-description of the species are also included in Table I which gives the salient features of all the murænid leptocephali recorded so far from the Indian waters. Larva I collected by Nair and Bhimachar (1950) measures 7.7 mm.

TABLE I
Measurements of murænid leptocephali

	<i>Leptocephalus dussumieri</i> (Kaup, 1856; Bertin, 1935)	<i>Leptocephalus minnet</i> (Southwell and Prashad, 1919)	Larva VIII (Deraniyagala 1934)	Larva IX (Deraniyagala, 1934)	Leptocephalus of <i>Muræna</i> <i>macrura</i> (Nair, 1947)	<i>Muræna</i> sp. (Nair, 1948)	Leptocephalus E. (Gopinath, 1950)	Leptocephalus I (Jones and Pantulu, 1952)	Leptocephalus II (Jones and Pantulu, 1952)	Leptocephalus III (Jones and Pantulu, 1952)	Leptocephalus of <i>Muræna tile</i> (Pantulu and Jones, 1954)	<i>Muræna</i> II (Pantulu and Jones, 1954)	<i>Muræna</i> III (Pantulu and Jones, 1954)	Leptocephalus IV
Total length	66.0	55.4	66.0	69.0	93.0	66.0	68.0	74.0	81.0	100.0	62.5	68.0	55.5	68.5
Maximum height	8.0 (12.1)	8.3 (15.0)	6.8 (10.3)	9.0 (13.0)	13.0 (14.0)	9.0 (13.6)	13.0 (19.1)	9.8† (13.2)	7.7† (9.5)	10.1† (10.1)	11.6 (18.6)	9.9 (14.6)	7.5 (13.5)	10.3 (15.0)
Predorsal distance	..	18.7* (33.8)	..	..	50.5 (53.8)	38.0 (57.6)	..	34.0 (45.9)	41.0 (50.6)	49.0 (49.0)	25.0 (40.0)	24.0 (35.3)	18.0 (32.4)	39.0 (56.9)
Preal anal distance	..	42.2† (76.2)	38.9* (58.9)	39.6* (57.4)	62.0 (66.7)	47.0 (71.2)	46.0 (67.6)	50.0 (67.6)	56.0 (69.1)	63.0 (63.0)	51.5 (82.4)	57.0 (83.8)	45.5 (82.0)	50.5 (73.7)
Length of head	..	4.0 (7.2)	5.1† (7.7)	5.8† (8.4)	4.0 (4.3)	4.0 (6.1)	3.0 (4.4)	5.0 (6.8)	4.1 (5.1)	4.9 (4.9)	4.2 (6.7)	3.5 (5.1)	3.3 (5.9)	4.3 (6.3)
Length of snout	..	1.3 (32.5)	..	..	1.2* (30.0)	1.5* (37.5)	..	0.9 (18.0)	1.1 (26.8)	1.3 (26.5)	1.0 (23.8)	0.9 (25.7)	0.7 (21.2)	1.3 (30.2)
Diameter of eye	..	1.1 (27.5)	..	..	0.9* (22.5)	1.0* (25.0)	..	0.5 (10.0)	1.0 (24.4)	0.9 (18.4)	0.9 (21.4)	0.9 (25.7)	0.9 (27.3)	1.2 (27.9)
Total myotomes	..	190	120	122	101	210	132	205	209	211	124	126	125	164
Preal anal myotomes	..	110	79	69	55	120	79	116	123	119	97	98	93	105
Teeth	..	nil	?	nil	6/5	11/12*	nil	26/22	nil	nil	12/10	17/12	17/12	9/10

* Calculated from the Text-Figures. † Calculated from the description. ‡ Excluding fins.

and possesses 146 myotomes of which 84 are preanal in position. This larva is referred to the murænid group by Nair and Dharma-mba (1960), but it is not considered here since it is an early preleptocephaline stage.

Jones and Pantulu (1952) described 4 varieties of leptocephali and provisionally assigned Leptocephali I to III collected from the Burhabulong estuary in Orissa to the family Murænidæ and doubtfully referred Leptocephalus IV which shows a striking resemblance to *Leptocephalus milnei* (Southwell and Prashad, 1919) and which was collected from the Hooghly estuary to *Muræna tile*. The identification of the leptocephalus of *M. tile* was later provisionally confirmed by them when they collected more murænid leptocephali from the Burhabulong estuary (Pantulu and Jones, 1954). They supplemented the description of the larva with an account of the stages in its metamorphosis and also described two more murænid leptocephali collected from the same place.

These authors have altogether described 6 larvæ murænid from the Burhabulong estuary out of the 14 recorded so far from Indian waters, but the diagnostic features or the significant differences between the larvæ are not given by them. A critical perusal of their papers shows that in addition to the myotome number, they have given importance to the body proportions also for creating the different varieties and consequently failed to recognise the presence of distinct species in the larval collection which showed a high variation from 180–216 myotomes. Further, they observed a constant myotome number in the leptocephalus and all the metamorphosing stages and the same vertebral number excluding the urostyle in the elver. It is well known that the myotome number is the chief character for comparing leptocephali and that the myotome and vertebral number varies in different individuals of the same species.

It is seen from Table I which gives the morphometric and other characters of all the murænid leptocephali recorded so far, that there is close similarity between some of the larvæ described by them in external characters, body proportions and myotome number. In Leptocephali II and III (Jones and Pantulu, 1952) the myotomes vary only by 2 segments which is only an intra-specific variation. According to their description, the height and head in both the larvæ are 10 and 20 times respectively in length, and there is almost perfect agreement in the other body proportions as well, which show that they belong to the same species. Leptocephalus I described by them differs from these two larvæ in myotome number, relatively higher body, very small size of the eye and snout and longer head.

In regard to the larva of *Muræna tile*, Muræna II and Muræna III, there is very close similarity in the myotome number as well as in body proportions (Table I) and the differences which they point out in these 3 larvæ are not of taxonomic significance. The difference in the myotome number by 2 muscle segments in *M. tile* and Muræna II and by 1 segment in Muræna II and Muræna III has, as pointed out earlier, no specific importance. The number of larval teeth is a variable character depending on the stage of growth of the leptocephalus. Referring to Muræna III they (1954) state that it "is distinct from the other two, described earlier in its characteristic notched constriction above the tip of the snout, the larger size of the eye in relation to that of the snout and in the number of the larval teeth". It may be pointed out here that the snout tends to become distorted due to improper fixation and such specimens are also present in the Bombay collection. In regard to the number of teeth, there is no difference between Muræna II and Muræna III and both have 17 teeth in the upper jaw and 12 teeth in the lower jaw, since the median tooth noted by them in Muræna II could only be one of the paired grasping tooth. It may also be pointed out here that all these murænid larvæ were collected from the same place on the same days. It is, therefore, necessary to consider both Muræna II and Muræna III as the larvæ of *Muræna tile* only.

Out of the 14 murænid larvæ recorded so far from Indian waters, only 11 are valid species. Leptocephalus III of Jones and Pantulu (1952) is considered synonymous with Leptocephalus II of the same authors while Muræna II and Muræna III (Pantulu and Jones, 1954) are only the leptocephalus of *Muræna tile* (Jones and Pantulu, 1952; Pantulu and Jones, 1954). A perusal of Table I which gives the salient features of all the murænid larvæ shows clearly the divergence in the characters seen among the different species. In regard to size, the longest larva is Leptocephalus II (Leptocephalus III) of Jones and Pantulu (1952) and it measures 100 mm. while *Leptocephalus milnei* (Southwell and Prashad, 1919) measures only 55.4 mm. in length. Compared with the leptocephalus of other families, those of Murænidæ possess the maximum height giving them the characteristic leaf-like appearance. Leptocephalus E of Gopinath (1950) shows the maximum height of 19.1% while the minimum height of 9.5% is recorded for Leptocephalus II of Jones and Pantulu (1952), the latter of which has begun to metamorphose as shown by the loss of the larval teeth.

In regard to the length of the head, marked difference is seen among these larvæ and the longest head of 8.4% is seen in Larva IX of Deraniyagala (1934) while the smallest head of 4.3% is seen in the leptocephalus of *Muræna macrura* (Nair, 1947).

The length of the snout and the diameter of the eye do not show any appreciable difference among the different murænid leptocephali except in the case of *Leptocephalus* I (Jones and Pantulu, 1952) where the eye is very small and about half the size of the eye of other larvæ. In regard to the number of teeth, the highest number is seen in *M. tile* with 17/12 teeth (Muræna II and Muræna III of Pantulu and Jones, 1954). As pointed out earlier (Nair and Mohamed, 1960 *b*), Gopinath's account of 26/22 teeth for *Leptocephalus* E could only be the total number of teeth in each jaw.

The predorsal distance which is more or less uniform in the different species shows only minor variations. The maximum predorsal distance of 57.6% is seen in *Muræna* sp. (Nair, 1948) while the minimum distance of 32.4% is seen in the leptocephalus of *M. tile* (Muræna III of Pantulu and Jones, 1954). On the other hand, the longest preanal distance is seen in *M. tile* (Muræna II of Pantulu and Jones, 1954) where it forms 83.8%. Larva IX of Deraniyagala (1934) shows the shortest preanal distance of 57.4%.

In regard to the myotome number, considerable difference is seen among the different larvæ and *Leptocephalus* II (*Leptocephalus* III) of Jones and Pantulu (1952) shows the maximum number of 211 muscle segments while the number is as low as 101 in Larva IX of Deraniyagala (1934). A similar variation in the number of preanal myotomes is seen among the different murænid leptocephali and *Leptocephalus* II (Jones and Pantulu, 1952) shows the maximum number of 123 preanal myotomes while Larva IX of Deraniyagala (1934) shows only 55 preanal myotomes.

It is well known that the adults of the family Murænidæ do not possess pectoral fins. But rudimentary fins have been observed to be present in a few forms like *Muræna macrura*, *M. tile*, etc. The pectoral fin atrophies and disappears during the process of metamorphosis as observed in the case of *M. macrura*.

The pigmentation of the murænid leptocephali shows certain distinctive features which are characteristic of the family. The head pigmentation has been observed to show variation in the different species and most of the murænid larvæ show the normal pigmentation while in some like *Leptocephalus* I (Jones and Pantulu, 1952) the head is completely free from pigment cells. The eye is distinctly pigmented in some larvæ like *M. macrura* and *Muræna* sp. (Nair, 1947 and 1948). In both the species the eye is golden yellow in colour with 8 large stellate black chromatophores arranged equidistant from one another round the pupil of the eye. In addition to this characteristic pigmentation of the eye, golden yellow patches are found in

the anterior and posterior regions of the eye of the leptocephalus of *M. macrura*. Similar conspicuous stellate chromatophores round the pupil of the eye have been observed by Jones and Pantulu (1952) in *Leptocephalus* II (*Leptocephali* II and III) which they thought "is not of any special diagnostic importance" since they disappear after preservation. The black pigment cells found in leptocephali do not disappear after fixation or even under long storage. It is likely that they become indistinguishable when the silvery colouration of the eye disappears during storage. The murænid larva collected from Bombay waters shows a distinctive colouration of the head in having black patches of pigment cells on either side of the eye closely resembling the pigmentation of the head of *Leptocephalus fuliginosus* (Stromman, 1896).

The body pigmentation is very faint in all the larvæ and the mid-lateral row of chromatophores is absent in the murænid larvæ which indicates that this is a family character. The alimentary canal shows pigmentation in a few larvæ only, like those of *M. macrura* and *M. tile*.

The anal fin is provided with chromatophores at the bases of the fin rays in all the leptocephali while the pigmentation of the dorsal fin is confined to the posterior region only as in the leptocephalus of *M. macrura*, *Leptocephalus* E of Gopinath (1950) and *Leptocephalus* I of Jones and Pantulu (1952).

LEPTOCEPHALUS V

(Text-Fig. 2 and Photograph 2)

Total length	..	83.5
Maximum height	..	5.2 (6.2)
Predorsal distance	..	33.0 (39.5)
Preanal distance	..	40.0 (47.9)
Length of head	..	6.2 (7.4)
Length of snout	..	1.3 (21.0)
Diameter of eye	..	1.4 (22.6)
Total myotomes	..	123
Preanal myotomes	..	51

A single specimen of this leptocephalus was collected from the 'dol' net catches landed at Sassoon Dock on the 21st April 1954 (*vide* Introduction, Nair and Mohamed, 1960 a). The larva is in a fairly advanced stage

of metamorphosis and it is described here in view of its extreme rarity in the Bombay waters.

The leptocephalus is translucent, thick and measures 83.5 mm. in length. The height is almost uniform throughout its length except in the caudal portion which is bluntly pointed. The maximum height is 5.2 mm. which is 16.1 times in length.

The head is long and measures 6.2 mm. and it is 13.5 times in length. The snout is very short, obtusely pointed and much shorter than the diameter of the eye. The snout is 4.8 times in head. The eye is perfectly circular, large and measures 1.4 mm. in diameter which is 4.4 times in head. The nostrils are distinctly seen as small openings, and the posterior nostril is in front of the eye while the anterior one is midway between the tip of the snout and the posterior nostril. The cleft of the mouth is very short and extends up to the middle of the eye only. The larval set of teeth has fallen off and the permanent adult teeth are in the course of formation and they are seen clearly in the lower jaw, as short, pointed, inwardly directed teeth.

Due to the commencement of metamorphosis, the posterior myotomes are not clearly seen and about 123 muscle segments are present in the specimen. The alimentary canal is of moderate length and the vent opens to the outside below the 51st myotome and it is situated slightly in front of the middle of the larva with the preanal distance 2.1 times in length. The origin of the dorsal fin is in advance of the anus and is above the 42nd myotome with the predorsal distance 2.5 times in length.

The fins are well developed and the rays are distinctly seen in the anal and caudal fins while they are distinct only in the posterior portion of the dorsal fin. The pectoral fin is moderately long and pointed and shows indistinct rays. About 40 rays are present in the well-developed portion of the dorsal fin. The anteriormost rays of this fin are indistinct and could be made out only with difficulty. The posteriormost rays of the dorsal and anal fins, barring the last few ones, show a zig-zag curvature at their tips, similar to the condition observed in *Leptocephalus* III (Nair and Mohamed, 1960 *b*). The anal and caudal fins possess 110 and 6 distinct rays respectively.

The pigmentation of the leptocephalus is interesting and both the head and the body are completely devoid of chromatophores. The vertical fins, on the other hand, show somewhat prominent pigmentation and each of the fin rays of the anal and caudal fins and the well-developed posterior portion of the dorsal fin is pigmented at its base by a group of two to three

highly branching black chromatophores. These pigment cells surround the base of the rays to give a conspicuous colouration to the vertical fins.

REMARKS

This leptocephalus is completely different from any of the larvæ recorded so far from Indian waters and exhibits interesting peculiarities. The larva is in a fairly advanced stage of metamorphosis and judging from the morphometric characters, it corresponds to Stage III of *Muraenesox cinereus* (Nair, 1947). The snout of the larva is very short and less than the diameter of the eye and in this respect approaches the condition found in some muraenid leptocephali. The eye is very large and the larva possesses the largest eye so far observed in Indian leptocephali. The zig-zag curvature of the posteriormost rays of the dorsal and anal fins, excluding the last few ones, is similar to the condition found in the ophichthyid *Leptocephalus* III, but the presence of the well-developed caudal fin excludes it from the family Ophichthyidæ. The pigmentation also shows peculiarities and the head pigmentation normally found in other leptocephali is absent in this larva. Similarly, the mid-lateral pigmentation is also absent and in this respect resembles muraenid larvæ. The pigmentation is confined to the base of the vertical fins only.

It was found difficult to assign this leptocephalus to any of the families of eels and the extreme rarity makes the identification very difficult and this can be attempted only at a later stage when more specimens become available for study.

REFERENCES

- Bertin, L. .. "Les types de Kaup dans la collection des leptocephales du Museum," *Bull. Mus.*, 1935, Tome 7, No. 2, 99-106.
- Deraniyagala, P. E. P. .. "Some apodal larvæ from Ceylon," *Cey. Journ. Sci.*, 1934, **19 B**, Part I, 89-96.
- Gopinath, K. .. "On a few leptocephali from the Trivandrum coast," *Rec. Ind. Mus.*, 1950, **47**, Part I, 87-98.
- Jones, S. and Pantulu, V. R. .. "On the metamorphosing stages of the telabon eel, *Muraenesox talabon* (Cantor) with descriptions of some leptocephali from the estuaries of Bengal and Orissa," *Jour. Asiatic Soc. (Science)*, 1952, **18** (2), 129-40.
- Kaup, J. J. .. *Catalogue of Apodal Fish in the Collection of the British Museum*, London, 1856, pp. 163.
- Nair, R. V. .. "On the leptocephalus of *Uroconger lepturus* (Richardson) from the Madras plankton," *Curr. Sci.*, 1946, **15** (11), 318-19.

*R. Velappan Nair and
K. H. Mohamed*

Proc. Ind. Acad. Sci., B, Vol. LII, Pl. X



PHOTO. 1

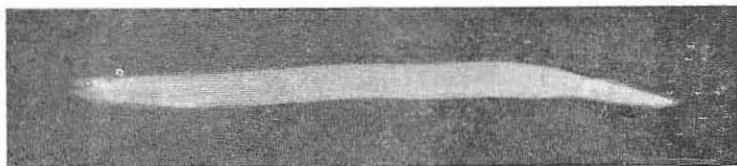


PHOTO. 2

CENTRAL MARINE FISHERIES
RESEARCH STATION; LIBRARY