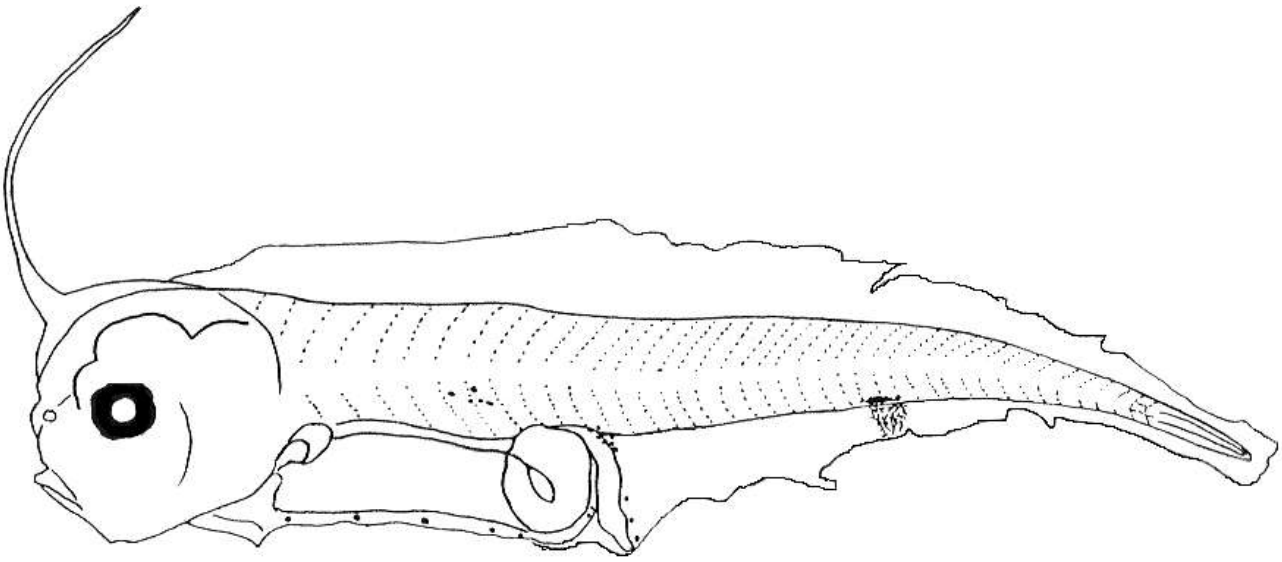

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Fish Larvae of Pakistan Based on "Dr. Fridtjof Nansen" Cruises 1 and 2, 1977

Identification, distribution and abundance

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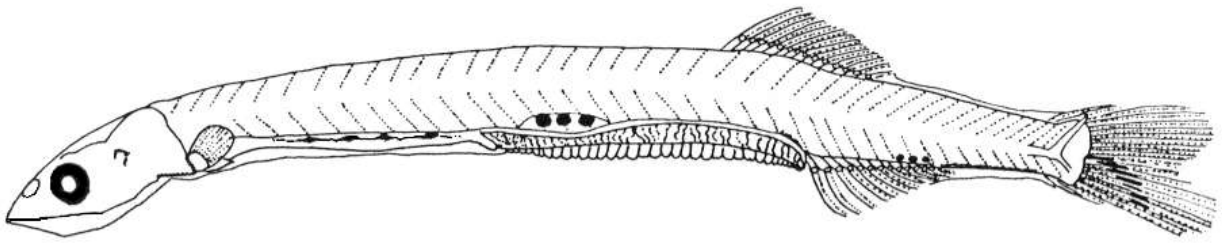

This research work submitted in 1990 to the University of Karachi, Pakistan in partial fulfillment of the requirements for the Degree of Master of Philosophy (M. Phil.) in Marine Biology.

The research was conducted at the Centre of Excellence in Marine Biology, University of Karachi-Pakistan.

1. ABSTRACT

The present study based on the zooplankton samples collected during "Dr. Fridtjof Nansen" Cruises 1 and 2, January – February, 1977 as a part of the Indian Ocean Fishery and Development Programme – Pelagic Fish Assessment Survey, North Arabian Sea (FAO / NORAD / PAKISTAN). Standard Bongo net (60 cm diameter) of 500 µ mesh size was used to collect these samples. The samples were preserved in formalin and brought to Institute of Marine Biology (now as Centre of Excellence in Marine Biology, University of Karachi). The oblique hauls of zooplankton samples from 50 M - 0 M were used for the study of fish larvae.

A total number of 1557 fish larvae from 23 stations have been analyzed. They belonged to 28 fish families and an order Angulliformes. A sum of 12 species and 23 genera could be identified. Generally, the higher number of fish larvae was found in the area south of Karachi. Larvae belong to the families Myctophidae, Bregmacerotidae, Nomeidae, and Pomadasyidae together constituted 78.0 % of the total. *Benthosema pterotum* larvae (44.24 %) dominated in abundance. The other abundant larvae belonged to *Bregmaceros nectabanus* (22.9 %), *Psenes* sp. (3.4 %) and *Pomadasys* sp. (3.3 %). Information on distribution and relative abundance of larvae of "Principal", "Common", and "Rare" families is given in detail. For *Benthosema pterotum*, *Bregmaceros nectabanus*, *Callionymus* sp. *Champsodon* sp. and *Diaphus splendidus*, a dynamic approach of tracing the development of characters sequentially has been attempted to study the life history.

Distribution maps and tables are prepared. The identified fish larvae have been described and drawn using camera Lucida. Drawings are reproduced using HP Scanjet G3110 for this publication.

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Distribution maps and tables are prepared. The identified fish larvae have been described and drawn using camera Lucida. Drawings are reproduced using HP Scanjet G3110 for this publication.

2. INTRODUCTION

In the late 19th century, the International Indian Ocean Expedition (IIOE) has revealed that the western side of the Arabian Sea is a region of high basic production (KABANOVA, 1964; RYTHER et al., 1966). WOOSTER et al., (1967) stated that the entire Western part of the Arabian Sea as the region of "high primary and secondary production". They restated that the primary productivity of this region is as large as or larger than that noted in upwelling areas along the coast of Peru, or off -West Africa. CUSHING (1973) interpreted mathematically the secondary production as fairly high in this region. Based on the analyses of physical, chemical and biological data of the IIOE, SCHAEFER (1969) speculated as "the most promising areas for the development of new, large scale commercial fisheries, which promise to be similar in productivity to those of the south-west Pacific off Peru and northern Chile --------".

WOOSTER et al., (1967) found large numbers of pelagic fish schools, along the Arabian and Somalian coasts during the R. V. Discovery II" surveys. HIDA and PEREYRA (1966) indicated highest bottom fish catch rates at 40-70 m along the eastern coast of Arabia, Gulf of Oman, Gulf of Kutch and along the coast of Pakistan. FISCHER and BIANCHI (1984) assumed that like most other tropical and sub-tropical areas, the western Indian Ocean is also very rich in bony fish fauna.

The fisheries research in the Arabian Sea carried out by the F.R.V."Dr. Fridtjof Nansen" during the years 1975 – 1976, showed that the mesopelagic fishes were far more abundant than any other fish groups (ANON, 1977). The latter cruises from January to June 1977 (ANON, 1978) also showed large seasonal fluctuations in the fish biomass in Pakistan waters to the extent that it dropped from 1.3 million tonnes in January to 0.3 million tonnes in June 1977. This reduction was attributed to the reduction in the pelagic fish biomass, including anchovies, and other herring like fishes, while thread fin bream, hair tails, catfish and croakers contributed to the major portion of the demersal fish biomass. The largest fish resource within the area is the stocks of mesopelagic fish (lantern fish) which was estimated at 13 million tonnes in January 1977.

It is difficult to comment on the number of species found in the Indo-Pacific region, Indian Ocean or in the Arabian Sea because such information in the existing published literature is scarce.

About 2,200 species of fishes are likely to occur in the Indian Ocean (DAY, 1889; MUNRU, 1955; QURAISHI, 1955; KOTTHAUS, 1967; JALEEL and KHALILLUDIN, 1972; FISCHFR and BIANCHI, 1984; SMITH and HEEMSTRA, 1986). These studies are based on fishes from different areas, regions and seas of the Indian Ocean.

A century back, descriptive aspects of larval fish development were exciting the biological sciences. Now, although developmental series have still not been made for most fish species, but the interest in larval fish study is continuing.

The larval fish studies are considered to be very important in Fishery Science. The published literature on the taxonomical aspects of larval fishes from the Indian Ocean is scattered and insufficient. AHLSTROM (1968) was the first, who analyzed larval fish families from the zooplankton samples collected during the International Indian Ocean Expedition. Latter, such studies on larval fish species from the Arabian Sea were strengthened by NELLEN (1973), ALI-KHAN (1972, 1976, 1985 b, 1989), ALI-KHAN and WAQAR (1985 a).

The present study on the fish larvae is based on the zooplankton samples collected during Fish Assessment Survey in Pakistan waters by F. R. V. "Dr. Fridtjof Nansen" during January 19th to February 9th 1977. It is believed that this study will provide important information with regard to the larval fish species, their abundance and distribution during the sampling period. In addition, it has also been attempting to describe taxonomically the individuals of various fish taxa found in the region of investigation. The identified fish larvae were drawn using camera Lucida and are reproduced using HP Scanjet G3110.

3. MATERIAL AND METHODS

The material used for this investigation was collected during the Cruises 1 and 2 (19th January – 9th February, 1977) by Fishery Research Vessel "Dr. Fridtjof Nansen" from the Pakistan waters, under the JOINT PAKISTAN / NORAD / FAO Fisheries Research Project.

In all, twenty three stations were covered between latitudes 22.6500° and 25.1666° N, and longitudes 61.5833° and 67.9166° E (Figure 1). A Bongo net of 60 cm diameter (500 µ mesh size) was towed oblique to collect the zooplankton samples from 50 meter depth to sea surface for 5 minutes at each station following the standard procedures. A flow-meter was also used. The collected samples were immediately transferred to plankton sample bottles and were preserved in using 4% buffered formalin solution. All the recommended precautions were taken at the time of collection, preservation and handling on board the ship and in the laboratory of the Centre of Excellence in Marine Biology at the University of Karachi. These samples were given proper curatory attention during the course of time.

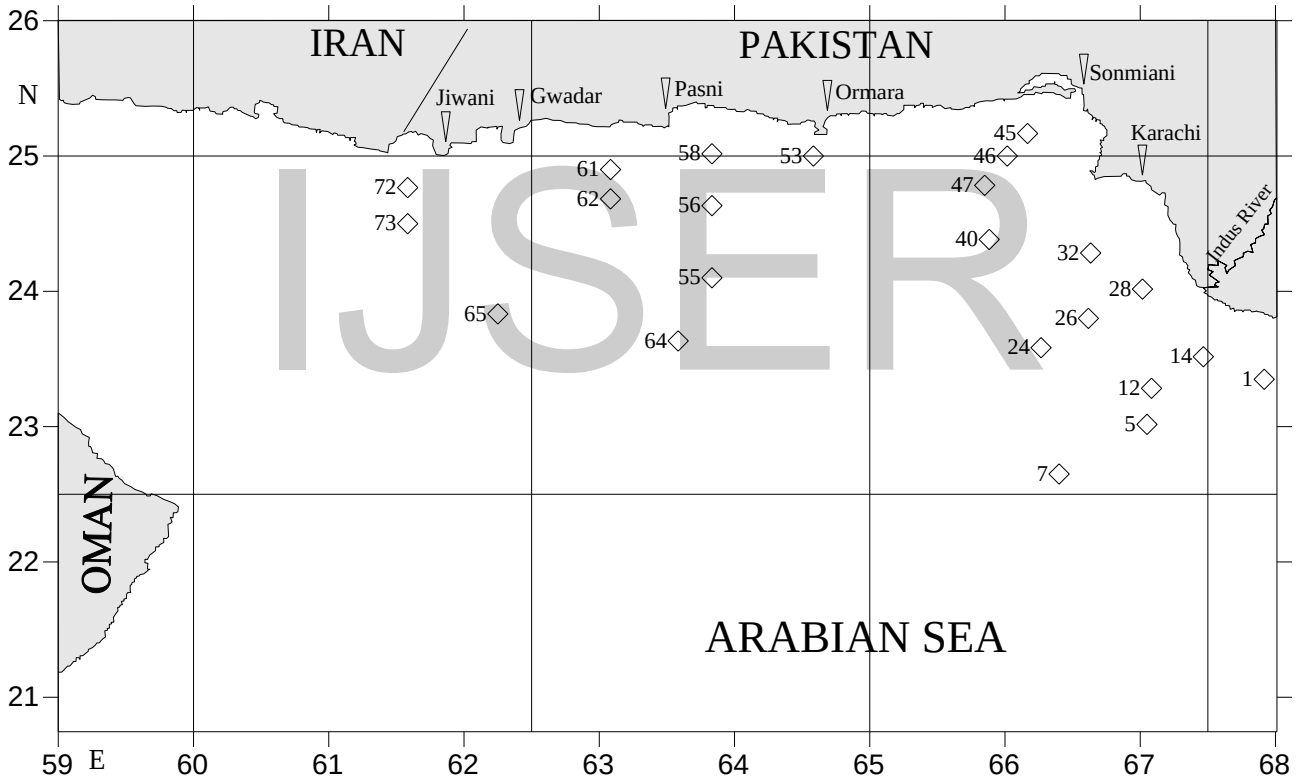


Figure 1. Stations grid of F. R. V. "Dr. Fridtjof Nansen" Cruises 1 and 2 (19th January - 9th February, 1977).

The fish larvae from each sample of zooplankton were sorted out by the present worker using a simple binocular in the laboratory for the following study. A total of 22 samples were found positive for fish larvae. It is therefore worthwhile to present the results quantitatively.

Identification of fish larvae was mainly based on meristic counts, body proportions, and

morphological characteristics.

The existing literature on fish larvae from the tropical waters of the Indian Ocean and of other oceans was found useful in classifying the larvae to family level and in some cases to generic and species levels. Occasionally, descriptions of adult fish were also referred. The previously identified fish larvae from the Indian Ocean by ALl-KHAN (1972) and NELLEN (1973) available by Dr. J. ALI-KHAN were used as comparative material for the present study.

For *Benthosema pterotum*, *Bregmaceros nectabanus*, *Callionymus* sp. *Champsodon* sp. and *Diaphus splendidus* larvae, a dynamic approach of tracing the development of characters sequentially from the newly hatched larvae up to the juvenile stage has been attempted to study the life history.

The body measurements of each larva were made using the stage ocular micrometers. All drawings were made initially using a binocular with fixed camera Lucida and are reproduced using HP Scanjet G3110.

The description of the fish larvae belonging to various taxa is based on the morphological differentiations, body proportions and meristic counts. When mentioned, vertebrae = preanal + postanal.

The number of fish larvae taken at each station has been calculated to the number of larvae per meter square.

The terms "Principal, Common, and Rare" have been adapted and frequently used in the text.

Principal = more than 50 larvae per family.
Common = larval number between 20 – 50 per family
Rare = number of larvae less than 20 per family.

In addition mark of interrogation has been used occasionally for uncertain counts or uncertain taxa.

The terminologies used in larval measurements by MOSER and AHLSTROM (1970) have been adapted for the present works which are as follows:

Body length: In early stage larvae and in those larvae undergoing notochord flexion the body length is defined as "the distance from tip of the snout to the tip of 'the notochord". When the notochord is fully flexed and caudal fin is formed, the usual standard length (SL) measurement is made, i.e. "the distance from the tip of the snout to the posterior margin of the hypural elements".

Snout to anus distance: Distance along midline of body from tip of snout to a vertical from the anus.

Head length: Distance from tip of snout to posterior margin of cleithrum.

Head width: Maximum width of posterior region of head.

Interorbital width: Width of fleshy tissue dorsal to the eyes.

Body depth at base of pectoral fin: Usually the maximum body depth.

Eye length: Maximum length of pigmented region of eye.

Eye width: Maximum width of pigmented region of eye.

Length of ventral eye tissue: Maximum length of choroid tissue found at the ventral surface of the eye in some species of *Benthosema*, *Diaphus*, and *Hygophum* etc.

4. GENERAL ABUNDANCE OF UNCLASSIFIED FISH LARVAE

A total of 23 zooplankton samples were collected in the course of survey by the F. R. V. "Dr. Fridtjof Nansen" in the waters of Pakistan in late winter (January – February 1977). Twenty two hauls were positive which contained a sum of 1557 fish larvae (Table I). An average number of 70.8 larvae per positive haul were collected. The number of fish larvae per positive haul varied from 3 - 471 (both off Sindh coast). At 5 stations (station nos. 24, 28, 32, 47, and 61) the larvae counts were remarkably high, ranging from 119 (station no. 47) to 471 (station no. 24) larvae/ haul. The total depth observed in this region varied between 15 M and 500 M.

Out of 22 stations, 10 stations were located on the slope area and the remaining 12 stations on the shelf area. About 62.5 % larvae (97.3 larvae/ haul) were collected from the former area and 37.5 % larvae (48.7 larvae/ haul) from the latter.

A total of 948 larvae were collected in 10 hauls from the area south of Karachi from 19 – 31 January, with an average to 94.8 larvae/ haul. The highest number (471 larvae) was taken at station no. 24. The observed depth of this station was 230 m.

Out of 10 stations in Sindh, 2 stations were located on the slope area and the remaining 8 stations in the shelf area. About 50.1 % larvae (237.5 larvae/ haul) were collected from the former area and 49.9 % larvae (59.1 larvae/ haul) from the latter area.

A sum of 609 fish larvae were collected in 12 hauls from the area west of Karachi from 1 – 9 February. These larvae were estimated at an average of 50.8 larvae/ haul. The number of fish larvae per haul ranged from 7 to 155. The maximum number (155 larvae) in the area was taken on station no. 61. The depth observed at this station was 500 m.

Off the Balochistan coast, out of 12 stations, 8 stations were situated on the slope area and remaining 4 stations in the shelf area. About 81.8 % larvae (62.25 larvae/ haul) were collected from the former area and 18.2% larvae (27.8 larvae/ haul) from the latter area.

TABLE 1

Position of stations, date, year, time, depth observation and number of fish larvae per haul.

Station Number	Date	Time Hours	Location		Observation Depth (M)	No. of larvae per Haul
			Latitude	Longitude		
1	19-Jan-77	23:00	23° 21' N	67° 55' E	15	3
5	20-Jan-77	17:00	23° 01' N	67° 03' E	125	4
7	21-Jan-77	0:00	22° 39' N	66° 24' E	500	4
12	22-Jan-77	0:00	23° 17' N	67° 05' E	95	8
14	22-Jan-77	7:00	23° 31' N	67° 28' E	30	41
24	24-Jan-77	13:00	23° 35' N	66° 16' E	230	471
26	24-Jan-77	17:00	23° 48' N	66° 37' E	75	63
28	24-Jan-77	21:00	24° 01' N	67° 01' E	60	141
32	26-Jan-77	17:00	24° 17' N	66° 38' E	75	171
40	31-Jan-77	2:00	24° 23' N	65° 53' E	125	42
45	1-Feb-77	21:00	25° 10' N	66° 10' E	65	7
46	1-Feb-77	0:00	25° 00' N	66° 01' E	115	14
47	2-Feb-77	2:00	24° 47' N	65° 51' E	500	119
53	4-Feb-77	0:00	25° 00' N	64° 35' E	75	43
55	4-Feb-77	22:00	24° 06' N	63° 50' E	500	32
56	5-Feb-77	3:00	24°38' N	63° 50' E	500	67
58	5-Feb-77	8:00	25° 01' N	63° 50' E	45	47
61	6-Feb-77	21:00	24° 54' N	63° 05' E	500	155
62	6-Feb-77	0:00	24° 41' N	63° 05' E	500	33
64	7-Feb-77	9:00	23° 38' N	63° 35' E	500	19
65	7-Feb-77	16:00	23° 50' N	62° 15' E	500	Nil
72	9-Feb-77	1:00	24° 46' N	61° 35' E	225	23
73	9-Feb-77	3:00	24° 30' N	61° 35' E	500	50

5. RELATIVE ABUNDANCE OF LARVAL FISH FAMILIES

As stated earlier, a total of 1557 fish larvae obtained from the study region (22 positive hauls averaging 71 larvae/ haul). Out of which a sum of 1513 larvae could be identified. They belong to 28 fish families and an order Angulliformes. A small number of 44 larvae could not be identified, either because of the lack of taxonomic literature, or because of the larvae were found in disintegrated condition. The numbers, percentages, and ranks of the identified fish larvae families based on the collection from our region during 19th January to 9th February 1977 are computed in Table 2.

The larvae of first four ranking fish families are named as "Principal" (>50 larvae per family). They were found to be Myctophidae, Bregmacerotidae, Nomeidae and Pomadasyidae respectively. Altogether they contributed 78 % to the number of larvae obtained during the entire survey period.

The larvae of Myctophidae dominated in abundance and alone constituted 48.2 % of the total number. The second abundant larvae in our collections belonged to family Bregmacerotidae which constituted 23.1 % of the total number of larvae collected. Nomeidae larvae were found to be third in abundance during the present study programme. These larvae contributed 3.4 %, while Pomadasyidae ranked 4th in abundance and contributed 3.27 % of the total number of larvae.

The seven fish families ranked from 5th to 10th. Their larvae were considered as the “Common” (20 – 50 larvae per family) fish larvae and are tabulated in Table 2. These families together constituted 12.7 % of the total number of larvae. The “Common” fish families in the present work included Clupeidae (2.6 %), Gobiidae (2 %), Gonostomidae (1.9 %), Champsodontidae (1.7 %), Apogonidae and Engraulidae showed equal abundance (1.61 %) each, and Carangidae (1.4).

The larvae of the remaining 17 fish families and order Angulliformes were considered as “Rare” (less than 20 larvae per family) during the period of present investigation. The larvae of these fish families ranked from 11 to 19 (Table 2).

These families together contributed 6.5 % to the total number of larvae. Their individual percentage ranged from 0.06 % to 1.03 %. The larvae belonging to these fish families include: Callionymidae and Sciaenidae (1.03 % each family), Priacanthidae (0.96 %), Synodontidae (0.83 %.), Pomacentridae (0.57 %), Paralepididae (0.51 %), Sphyraenidae (0.31 %), Bothidae, Cynoglossidae, and Scombridae (0.19 % each), eel larvae, Platycephalidae and Trichiuridae (0.13 % each), Blenniidae, Lutjanidae, Sillaginidae, Soleidae, and Triglidae (0.06 % each).

TABLE 2

Fish families and their number of larvae collected from Pakistan waters on board the F.R. V. "Dr. Fridtjof Nansen" (Cruise 1 and 2) during January and February, 1977. Fish families are written in alphabetical order.

Series Number	Order*/ Families	Absolute Number of Larvae	Percent (%)	Rank (R)
1	Angulliformes*	2	0.13	18th
2	Apogonidae	25	1.61	9th
3	Blenniidae	1	0.06	19th
4	Bothidae	3	0.19	17th
5	Bregmacerotidae	360	23.1	2nd
6	Callionymidae	16	1.03	11th
7	Carangidae	21	1.35	10th
8	Champsodontidae	26	1.67	8th
9	Clupeidae	40	2.57	5th
10	Cynoglossidae	3	0.19	17th
11	Engraulidae	25	1.61	9th
12	Gobiidae	31	1.99	6th
13	Gonostomidae	30	1.92	7th
14	Lutjanidae	1	0.06	19th
15	Myctophidae	750	48.21	1st
16	Nomeidae	53	3.4	3rd
17	Paralepididae	8	0.51	15th
18	Platycephalidae	2	0.13	18th
19	Pomacentridae	9	0.57	14th
20	Pomadasyidae	51	3.27	4th
21	Priacanthidae	15	0.96	12th
22	Sciaenidae	16	1.03	11th
23	Scombridae	3	0.19	17th

Continued….

TABLE 2 Continued….

Series Number	Order*/ Families	Absolute Number of Larvae	Percent (%)	Rank (R)
24	Sillaginidae	1	0.06	19th
25	Soleidae	1	0.06	19th
26	Sphyraenidae	4	0.3	16th
27	Synodontidae	13	0.83	13th
28	Trichiuridae	2	0.13	18th
29	Triglidae	1	0.06	19th
	Number of identifying larvae			1513
	Number of unidentified larvae			44
	Total number of larvae			1557

6. RELATIVE ABUNDANCE OF FISH LARVAE

From the 22 samples used for this study, a total of 1557 fish larvae were sorted out. Out of these collected larvae, a sum of 1513 larvae could be identified to various taxonomic levels. These larvae belonged to 28 fish families and an order Angulliformes, which could not be identified even to the family level because of the scarcity of literature on eel fish larvae at that time. Twenty three genera and 12 species have been identified from a total of 20 families. The larvae belonged to 8 families could not be identified even to their genera.

6.1 "PRINCIPAL" FISH LARVAE

A sum of 1214 larvae belonged to four fish families have been considered as "Principal", since each of this family was represented by more than 50 fish larvae. These fish families included: Myctophidae, Bregmacerotidae, Nomeidae and Pomadasyidae. The larvae of these four families together contributed 78 % of the total number of fish larvae. Their absolute abundance varied between 3.3 % (51 larvae) and 48.2 % (750 larvae) as shown in Table 3.

The larvae of Myctophidae were the most abundant among the "Principal" fish family group. These larvae constituted 48.2 % of the total number of larvae. The family Myctophidae, in the present study material was consisted of three identified genera: *Benthosema*, *Diaphus*, *Hygophum*, and three undetermined genera. Each of this identified genus was represented by one species.

The large numbers of myctophid larvae identified as *Benthosema pterotum* ranked first among all taxa, alone constituted 44.24 % of the total number of larvae and dominated in this region during January - February, 1977. The larvae of *Diaphus splendidus* constituted about 2 % of the total number. The total contribution of the remaining myctophid larvae was about 2 % included *Diaphus* sp. (0.45 %), *Hygophum* sp. (0.45 %) and the three undetermined genera of Myctophidae (1.08 %).

The larvae of Bregmacerotidae were second highest in abundance in the group of "Principal" fish families. They contributed 23.1 % to the total number of larvae. This family was represented by a single genus, *Bregmaceros macclellandi*, *B. nectabanus*, and *B. rarisquamosus*. *Bregmaceros nectabanus* larvae dominated the other species of Bregmacerotidae and ranked second among all the taxa listed in Table 3. This species constituted 22.9 % of the total number of larvae collected in January, February, 1977. The other 2 species constituted 0.12 % to the total number of larvae.

The third ranked larvae of Nomeidae were found in fairly good number and contributed 3.4 % to the total larvae. This family was represented by a single genus *Psenes*. The species of this genus could not be identified.

The larvae of Pomadasyidae were found in considerable number (51 larvae). This family ranked 4th in abundance among the "Principal" families. The larvae of this family represented by a single genus, Pomadasys and contributed about 3.3 % of the total number. The species of this genus could not be determined.

TABLE 3

"Principal" fish families and their relative abundance. Taxa are listed in alphabetical order.

Families / Genus /Species	**Absolute Number of Larvae**	**Percent (%)**
MYCTOPHIDAE		
Benthosema pterotum	688	44.24
Diaphus splendidus	31	1.99
Diaphus sp.	7	0.45
Hygophum sp.	7	0.45
3 undetermined genera	17	1.08
Sub Total	**750**	
		48.21
BREGMACEROTIDAE		
Bregmaceros macclellandi	1	0.06
Bregmaceros nectabanus	358	22.99
Bregmaceros rarisquamosus	1	0.06
Sub Total	**360**	**23.1**
NOMEIDAE		
Psenes sp.	53	3.4
POMADASYIDAE		
Pomadasys sp.	51	3.27

6.2 "COMMON" FISH LARVAE

Out of 1513 identified larvae, a sum of 198 fish larvae belonged to seven fish families. Their numbers varied between 21 and 50 per family. These families have been mentioned as "Common". These fish families were Clupeidae, Gobiidae, Gonostomidae, Champsodontidae, Apogonidae, Engraulidae and Carangidae (Table 4). The larvae of the 7 fish families together contributed 12.7 % to the total number of larvae. Their actual numerical abundance, ranged from 21 larvae (1.35 %) to 40 larvae (2.57 %).

Clupeidae dominated the other larvae of this group of families. These larvae constituted about 2.6 % of the total number of larvae. The family Clupeidae consisted of 2 genera: one was *Sardinella* with a single species of it, i.e., *S. sindensis*, another genus could not be identified. Out of 40 larvae of Clupeidae, a small number of 10 larvae were represented by *S. sindensis*.

The larvae of Gobiidae were second highest in abundance in the group of "Common" fish families. This family was represented by a single genus Gobius. Species of this genus could not be identified because of its smaller size as well as the unavailability of enough literature on this genus during study time. Although a variant type of pigmentation on the body was noted to differentiate the species. On the bases of pigmentation pattern, these larvae have been drawn and categorized into I to IX types to assist future workers in terms of their identification up to the specific level. Gobiidae larvae contributed 2.0 % to the total number of larvae.

Gonostomid larvae were the third highest in abundance among the **"Common"** fish families. This family was represented by a single genus and a single species, *Vinciguerria lucetia*. The larvae of *Vinciguerria lucetia* ranked sixth among all the taxa identified from the region of the present study. This species constituted 1.92 % of the total.

The fourth highest fish family, in this group was Champsodontidae. This family contributed about 1.7 % to the total number of larvae. Champsodontidae was represented by a single genus *Champsodon*. The species of this genus could not be determined.

Family Apogonidae and Engraulidae both ranked fifth among the group of "**Common"** fish families as each of these families contained 25 larvae (1.61 % each). Family Apogonidae was represented by *Apogon* with undetermined species. Family Engraulidae was represented by *Stolephorus zollingeri*. These two families together constituted 3.2 % of the total number of larvae.

Family Carangidae was last among "Common" fish families. This family was also represented by a single genus and a single species, *Decapterus macarellus*. The larvae of this species contributed about 1.35 % to the total.

TABLE 4

"Common" fish families and their relative abundance.

Families/ Genus /Species	**Absolute Number of Larvae**	**Percent (%)**
CLUPEIDAE		
Sardinella sindensis	10	0.64
undetermined genus	30	1.93
Sub Total	**40**	**2.57**
GOBIIDAE		
Gobius spp. (9 types)	31	1.99
GONOSTOMIDAE		
Vinciguerria lucetia	30	1.92
CHAMPSODONTIDAE		
Champsodon sp.	26	1.67
APOGONIDAE		
Apogon sp.	25	1.61
ENGRAULIDAE		
Stolephorus /Amentum zollingeri	25	1.61
CARANGIDAE		
Decapterus macarellus	21	1.35

6.3 "RARE" FISH LARVAE

The larvae of the 17 identified fish families and an order Angulliformes were found in lesser number (< 20 larvae per family). These fish families and order were treated as **"Rare"**. These families composed of a sum of 101 larvae, as shown in Table 5. Their relative abundance varied between 0.06 % and 1.03 %. Altogether they contributed 6.49 % to the total number of larvae.

The larvae belonged to this group included: *Callionymus* sp. and Sciaenidae larvae (1.03 % each), *Priacanthus* sp. (0.96 %), *Trachinocephalus myops* (0.83 %), Pomacentridae larvae (0.57 %), *Lestidiops jayakari* (0.51 %), *Sphyraena* sp. (0.3 %), *Arnoglossus* sp. and *Pseudorhombus* sp. together contributed (0.19 %) to the total. The contributions of other taxa were as follows; *Cynoglossus* sp. and Scombridae larvae (0.19 %) each, eel larvae, *Platycephalus* sp. and *Lepidopus caudatus* (0.13 %) each. The other families like Blenniidae, Lutjanidae, Sillaginidae, Soleidae, and Triglidae together contributed 0.3 % to the total number of larvae.

TABLE 5

"Rare" fish families and their relative abundance.

Order*/ Families/ Genus /Species	**Absolute Number of Larvae**	**Percent (%)**
CALLIONYMIDAE		
Callionymus sp.	16	1.03
SCIAENIDAE	16	1.03
PRIACANTHIDAE		
Priacanthus sp.	15	0.96
SYNODONTIDAE		
Trachinocephalus myops	13	0.83
POMACENTRIDAE		
3 undetermined genera	9	0.57
PARALEPIDIDAE		
Lestidiops jayakari	8	0.51
SPHYRAENIDAE		
Sphyraena sp.	4	0.3
BOTHIDAE		
Arnoglossus sp.	1	0.06
Pseudorhombus sp.	2	0.13
Sub Total	3	0.19
CYNOGLOSSIDAE		
Cynoglossus sp.	3	0.19
SCOMBRIDAE	3	0.19
ANGULLIFORMES*	2	0.13
PLATYCEPHALIDAE		
Platycephalus sp.	2	0.13
TRICHIURIDAE		
Lepidopus caudatus	2	0.13
BLENNIIDAE	1	0.06
LUTJANIDAE	1	0.06
SILLAGINIDAE	1	0.06
SOLEIDAE	1	0.06
TRIGLIDAE	1	0.06

7. DISTRIBUTION OF FISH LARVAE

The material used for the study of the distribution and abundance of fish larvae in Pakistani waters was obtained from the region between latitudes 22.6500° and 25.1666° N, and longitudes 61.5833° and 67.9166° E. A total of 23 stations was covered by F. R. V. "Dr. Fridtjof Nansen" during the period 19th January – 9th February, 1977. Out of 23 zooplankton samples 22 samples were found positive for fish larvae which contained a total of 1557 larvae.

The region of investigation divided into two main areas to study the differences in numbers of larvae, number of occurrences, and distribution pattern of various taxa. The two main areas are:

a) Sindh coast (area south of Karachi)
b) Makran coast (area west of Karachi)

The plankton stations marked in the South of Karachi were 1, 5, 7, 12, 14, 24, 26, 28, 32 and 40. Whereas the remaining plankton stations such as 45, 46, 47, 53, 55, 56, 58, 61, 62, 64, 65, 72 and 73 were situated in the area west of Karachi (Figure 1).

The numbers of fish larvae taken at each station were calculated to larvae per meter square and are presented as such in this section. These calculated values would facilitate the other workers in and outside the country to compare their results for the better understanding of the larval fish studies from the region.

The distribution of larval fish taxa of the "**Principal**" and "**Common**" fish families is mentioned in some detail, while those of the "Rare" fish families is briefly described.

7.1 LARVAE OF THE "PRINCIPAL" FISH FAMILY GROUP

The "Principal" fish families and the abundance of their taxa have been discussed in sections 5 and 6.1.

7.1.1 FAMILY: MYCTOPHIDAE

As mentioned earlier (in section 6.1), this first ranked family was represented by six genera (3 genera identified and other 3 remained unidentified). Genus *Benthosema* was represented by one species, *Benthosema pterotum* and genus *Diaphus* by the species *Diaphus splendidus*. The species of *Hygophum* could not be identified. However, the distribution of six taxa of this family is being presented under this section.

Benthosema pterotum

Benthosema pterotum larvae were found widely distributed off the Sindh coast as well as off the Makran coast. They were frequently obtained and ranked first in frequency of occurrence (91.3 % of station).

About 57 % of *Benthosema pterotum* larvae were obtained from the former area (9 occupancies) remaining 43 % larvae were taken on 12 occupancies in the latter area.

The calculated number of larvae ranged from 4 larvae / M^2 (station 5 and 12) to 973 larvae / M^2 (station 24) as shown in Figure 2. More than 101 larvae / M^2 were taken at each of the occupancy i.e., station Nos. 24, 32, 40, 47, 56, and 61.

The size of the larvae taken ranged from 1.75 mm to 10.8 mm. In general, the larvae measured in 2 - 3 mm, rarely 4 - 6 mm and more. A single larva of 10.8 mm was found at station 28, south of Karachi, near the Indus Delta.

Diaphus splendidus

The larvae *Diaphus splendidus* were occurred on ten stations: 4 stations located in the west of Karachi, and 6 stations in the south of Karachi.

The calculated number of larvae ranged from 4 larvae / M^2 to 35 larvae / M^2. The highest number of larvae / M^2 was found at station 73 in February (Figure 2).

The size range of these larvae varied between 2.0 mm and 7.425 mm in the investigation area. Comparatively larger size larvae (4.7 mm - 7.4 mm) occurred in the former area, whereas the smaller sized larvae (1.825 mm - 4.5 mm) occurred in the latter area.

***Diaphus* sp.**

The larvae of undetermined species of genus *Diaphus* were confined to the shelf area off the Sindh coast during the present study programme (Figure 2). They have been estimated at 4 larvae / M^2 to 14 larvae / M^2. The highest number was taken at station 28 in January.

***Hygophum* sp.**

These larvae occurred on 3 stations (Figure 2). Two stations (24 and 40) were located in the former area where they were estimated at 4 larvae / M^2 in January. While on station 73 they were estimated 18 larvae / M^2 in the latter area.

The remaining 3 undetermined genera of myctophid (not shown in Figure) were found on 4 different stations in the study areas.

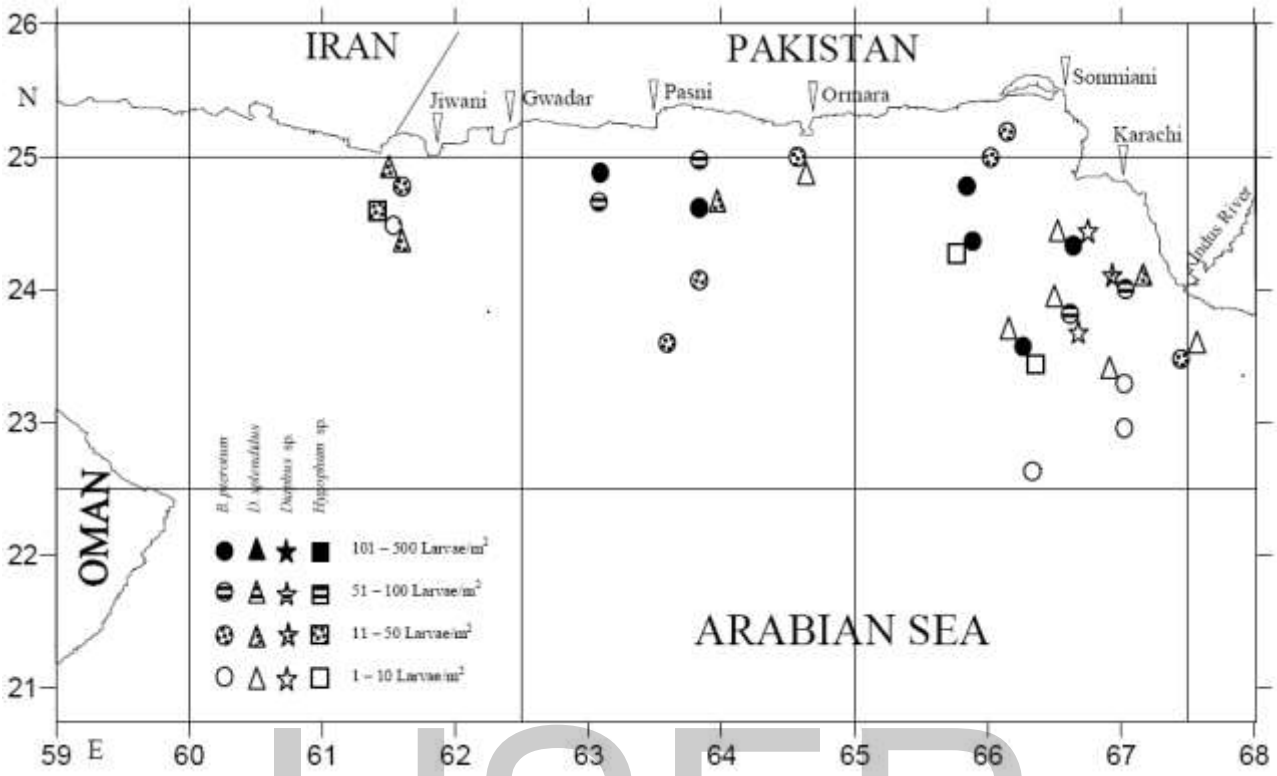


Figure 2. Distribution and abundance (per M^2) of *Benthosema pterotum*, *Diaphus splendidus*, *Diaphus* sp. and *Hygophum* sp.

7.1.2 **FAMILY:** BREGMACEROTIDAE

This family ranked second in abundance of larvae as described earlier in section 5. All the larvae of this family belonged to a single genus, *Bregmaceros*. This genus was represented by 3 species: *Bregmaceros macclellandi*, *B. nectabanus* and *B. rarisquamosus*. However, the distribution of these 3 species of this family is being discussed below.

Bregmaceros macclellandi

Only 4 larvae / M^2 were taken from the shelf area (station 58), west of Karachi.

Bregmaceros nectabanus

In the study region, the distribution pattern of these larvae was more or less similar to that of the distribution of *Benthosema pterotum*. The larvae were taken frequently and ranked second in abundance as well as in the frequency of occurrence (78.3 % of the total station).

About 85 % *Bregmaceros nectabanus* were found off the Sindh coast (8 occupancies), remaining 15 % were taken on 10 occupancies from the Makran coast.

The calculated number of larvae ranged from 4 larvae / M^2 (station 5, 45 and 61) to 513 larvae / M^2 (station 24) as shown in Figure 3. More than 212 larvae / M^2 were found on station 24, 28 and 32.

Mostly the larvae measured in 2-3 mm, rarely 4-5 mm and above. A single larva of (11.9 mm) was taken at station 26 (off the Sindh coast) in January.

Bregmaceros rarisquamosus

Only 4 larvae / M^2 were taken at station 26 (shelf area) off the Sindh coast (area) off the Sindh coast (Figure 3).

7.1.3. FAMILY: NOMEIDAE

Nomeidae was the third ranked family in relative abundance (see section 5). This family represented by an unidentified species of genus *Psenes* in this region. The distribution of Psenes larvae was as follows:

***Psenes* sp.**

Psenes larvae were widely distributed off the coast of Sindh and Makran. They ranked fourth in the frequency of occurrence. They were found on 47.8 % occupancy.

About 70 % of these larvae (7 occupancies) were caught along the Makran coast and remaining 30 % larvae were obtained from 4 stations off the Sindh coast.

The estimated numbers of larvae ranged from 4 larvae / M^2 (Station 26, 47, and 64) to 35 larvae / M^2 (station 62) as shown in Figure 4. More than 32 larvae / M^2 m were found at station 24, 56, and 62.

Larval size ranged from 1.7 mm - 5.5 mm in our study region (January/February, 1977). The larger size-group larvae (3.0 mm - 5.5 mm) were found along the Sindh coast, whereas the smaller size group larvae (1.8 - 3.0 mm) were found higher in numbers along the Makran coast.

7.1.4 FAMILY: POMADASYIDAE

As previously mentioned (section 5) this family ranked fourth in the relative abundance. Pomadasyidae larvae were represented by a single genus *Pomadasys* with an unidentified species.

The distribution pattern of these larvae in Pakistan waters is being discussed below.

***Pomadasys* sp.**

Pomadasys larvae were present on 2 stations only. The higher number of 177 larvae / M^2 were found on the continental slope area, west of Karachi (station 51), whereas the lower number of 4 larvae / M^2 were taken at shallow water station 32 (South of Karachi) as shown in Figure 5.

The larval size ranged from 2.3 mm to 5.9 mm. Most of the larvae belonged to the size group 2.25 mm – 3.5 mm.

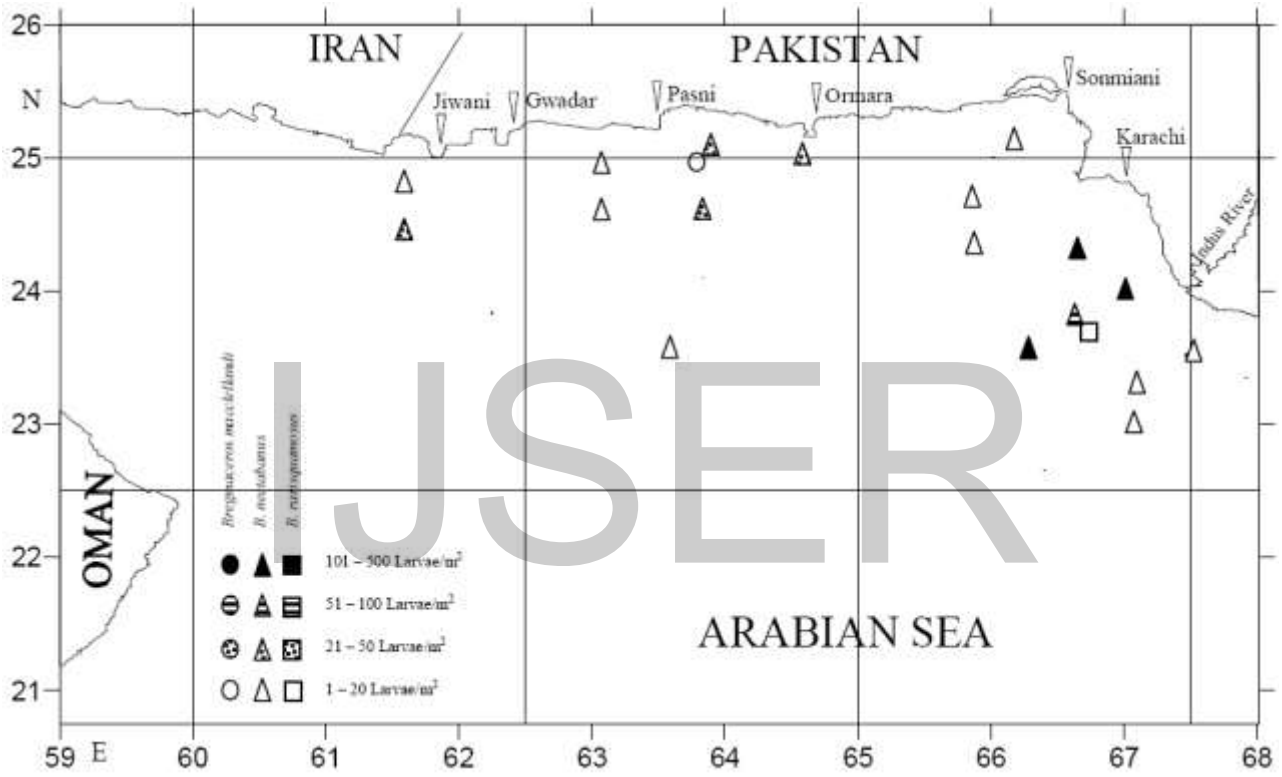


Figure 3. Distribution and abundance (per M^2) of *Bregmaceros macclellandi*, *B. nectabanus*, and *B. rarisquamosus*.

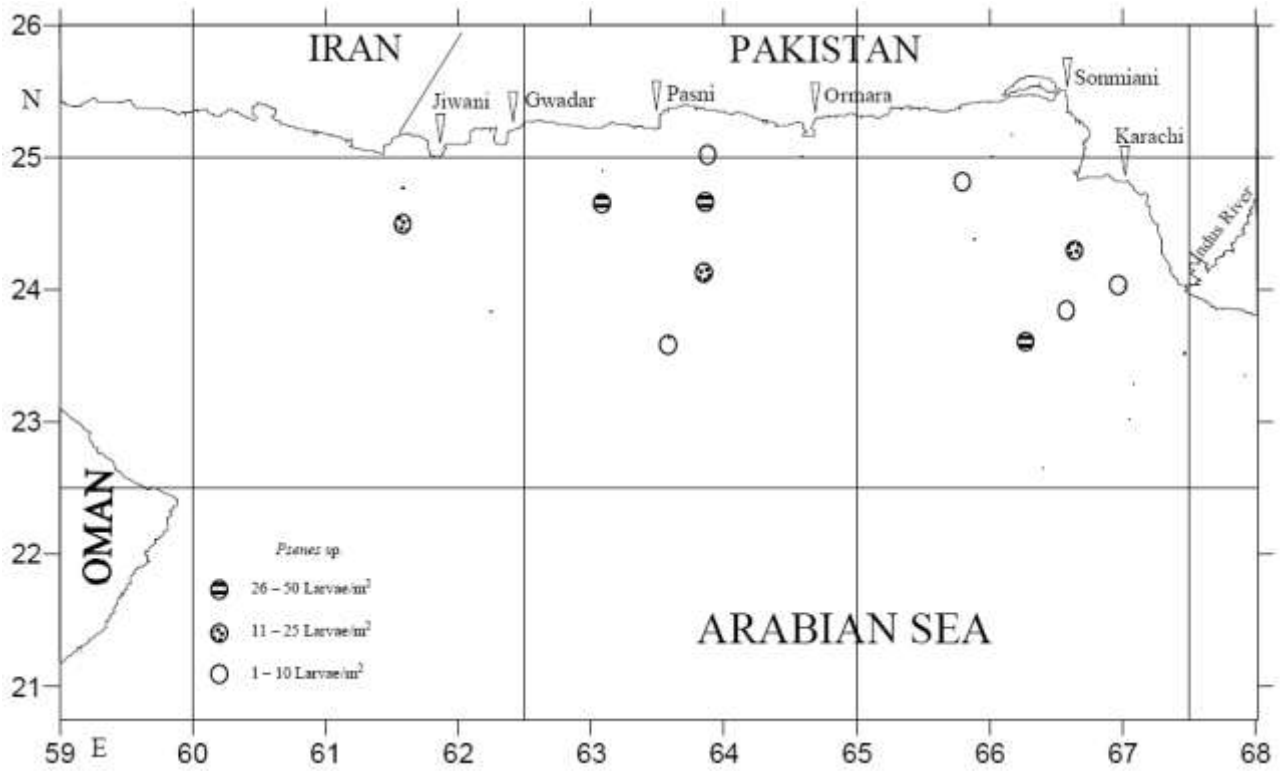


Figure 4. Distribution and abundance (per m^2) of *Psenes* sp.

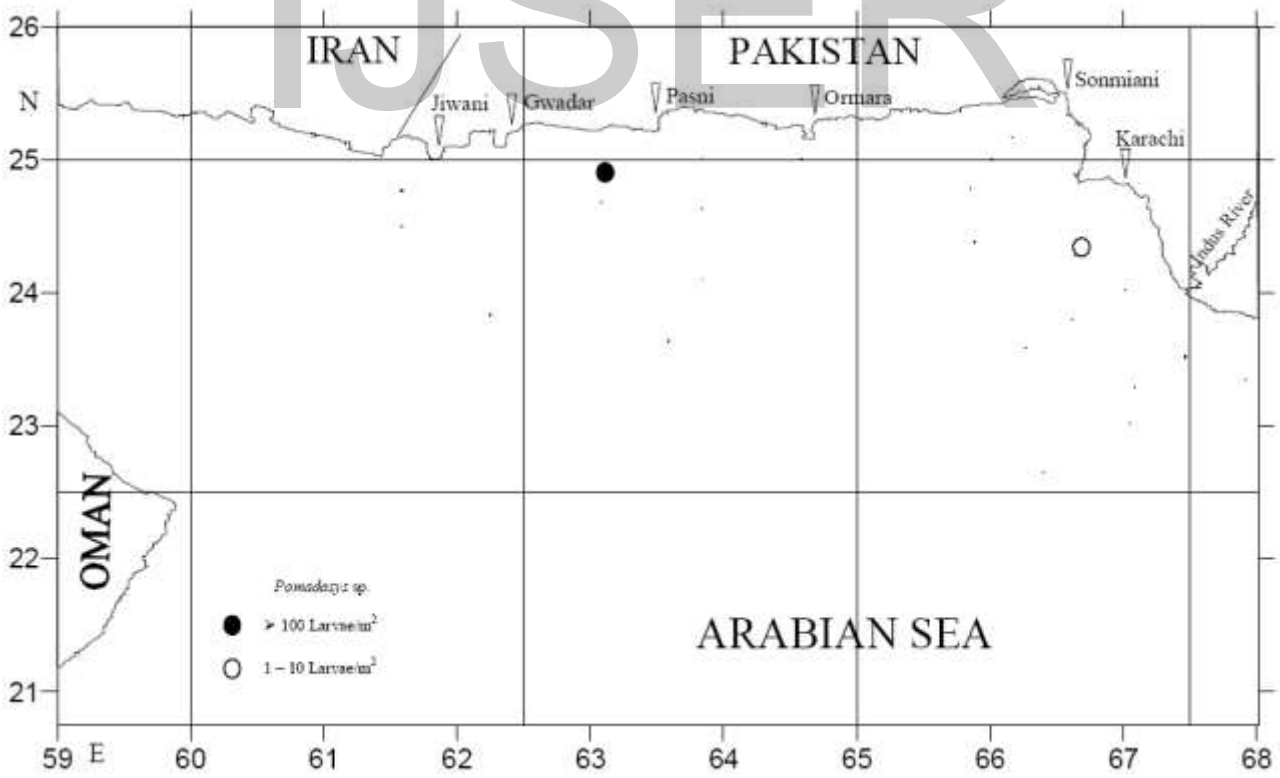


Figure 5. Distribution and abundance (per m^2) of *Pomadasys* sp.

7.2 LARVAE OF THE "COMMON" FISH FAMILY GROUP

The “Common” fish families and the abundance of their taxa have been mentioned in sections 5 and 6.2.

7.2. 1 FAMILY: CLUPEIDAE

In section 5, the family Clupeidae was ranked 5th in abundance and was represented by 2 genera in our investigation region. Genus *Sardinella* was represented by a single species, *Sardinella sindensis*. The other genus could not be identified. The larvae of both genera were found off Makran coast. The distribution of clupeid larvae is being mentioned below.

Sardinella sindensis

Sardinella sindensis larvae were taken from station 55 and 61 (Figure 6). Their calculated numbers were 14 larvae / M^2 (station 61) and 21 larvae / M^2 (station 55). The larval size ranged from 4.25 mm to 14.6 mm in the month of February.

The larvae of the undetermined genus of Clupeidae were found at 2 stations (Figure 6). They were estimated at 7 larvae / M^2 (station 53) in shallow water and 99 larvae / M^2 (station 61) in the continental slope area. The size range of these larvae of Clupeidae was 2.6 mm - 6.3 mm in February.

7.2.2 FAMILY: GOBIIDAE

This family ranked 6th in abundance as mentioned earlier in section 5 and 6.2. A single genus *Gobius* was determined. The larvae of this genus showed marked variations in pigmentations (Species I to Species IX). The distribution pattern of this genus in Pakistan waters was as follows.

***Gobius* sp.**

These larvae were collected at station 28 (41 larvae / M^2) and at 32 (40 larvae / M^2) along the Sindh coast and from 5 occupancies (stations 46, 53, 56, 61 and 62) along the Makran coast.

The calculated number along the latter area ranged from 4 larvae / M^2 (station 46 and 62) to 40 larvae / M^2 (station 61) as shown in Figure 7. There were 8 larvae / M^2 at station 53 and 14 larvae / M^2 at station 56.

Most of the larvae size measured 2 - 3 mm, a few 5 - 6 mm and above. The biggest larva of 7.6 mm was collected from the shelf area (station 32) south of Karachi in late January.

7.2.3 FAMILY: GONOSTOMIDAE

Gonostomidae ranked seventh in abundance. This family was represented by *Vinciguerria lucetia* in the study area. The distribution pattern of these larvae was as below.

Vinciguerria lucetia

Vinciguerria lucetia larvae found distributed in scattered form in Sindh and Makran waters. They were frequently obtained and ranked third in frequency of occurrence, (69.6% of stations): 9 occurrences in the former area and 7 occurrences in the latter area.

Their estimated number ranged from 4 larvae / M^2 (stations 5, 12, 14, 32, 46, 53, 55, 64 and 72) to 28 larvae / M^2 (station no. 73) as shown in Figure 8.

The larval size measured 2.8 mm – 13 mm, generally 5 mm, in January/February.

7.2.4 FAMILY: CHAMPSODONTIDAE

This was the 8th ranked family in abundance. This family represented by a single genus *Champsodon* with undetermined species. Distribution of this genus was as below.

***Champsodon* sp.**

Champsodon larvae were widely distributed in the study area. They ranked fourth in the frequency of occurrence as that of the *Psenes* (Nomeidae) larvae with 47.8 % occupancy (on 11 stations). Three stations were situated in the former area and 8 in the latter.

The calculated number of larvae ranged from 4 larvae / M^2 (station nos. 53, 55, 56 and 62) to 18 larvae / M^2 (station 24 and 58) as shown in Figure 9.

The larval size ranged from 2.4 mm - 8.6 mm, mostly (2 mm – 4 mm). The largest larva (8.6 mm) was obtained from shelf area, along the Makran coast.

7.2.5 FAMILY: APOGONIDAE

This family ranked 9th in abundance (Table 2). Apogonidae was represented by a single genus *Apogon*. The species of this genus could not be identified. The distribution pattern of these larvae is given below.

***Apogon* sp.**

Apogon larvae were found distributed between longitudes 63° and 68° and taken at eight stations (Figure 10). Five stations were situated off the coast of Sindh and the other three stations along the Makran coast.

The highest calculated number of 57 larvae / M^2 was obtained at station 32 whereas on the other stations there were only 4 larvae / M^2 respectively.

The size of the larvae taken ranged from 1.65 mm to 8.5 mm. Most larvae grouped between 1.65 mm and 2.5 mm. The largest specimen of *Apogon* was taken from the slope area along the Makran coast at station 55 in February.

7.2.6 FAMILY: ENGRAULIDAE

In abundance, the 10th ranked family was Engraulidae. This family was represented by *Stolephorus zollingeri*. The distribution of this species was as follows.

Stolephorus zollingeri

The larvae of this neritic species were taken on station 14, 28, 32, 40 and 61. Larvae were distributed more in Sindh waters (4 stations) in contrast to Makran waters (1 station).

The calculated number ranged from 4 larvae / M^2 to 35 larvae / M^2 (Figure 11). The highest number of larvae obtained at station 14.

The size of larvae measured from 2.5 mm to 13.55 mm, mostly grouped between 3 and 5 mm.

7.2.7 FAMILY: CARANGIDAE

This family was represented by *Decapterus macarellus*. The distribution of these larvae in Pakistani waters was as follows.

Decapterus macarellus

Decapterus macarellus larvae were confined to the waters off the Sindh coast. These larvae were taken from 5 stations. Their calculated number ranged from 4 larvae / M^2 (station 24 and 26) to 35 larvae / M^2 (station 32) as shown in Figure 12. Their larval size varied between 2.3 mm and 8.7 mm. The largest specimen was obtained from station 26.

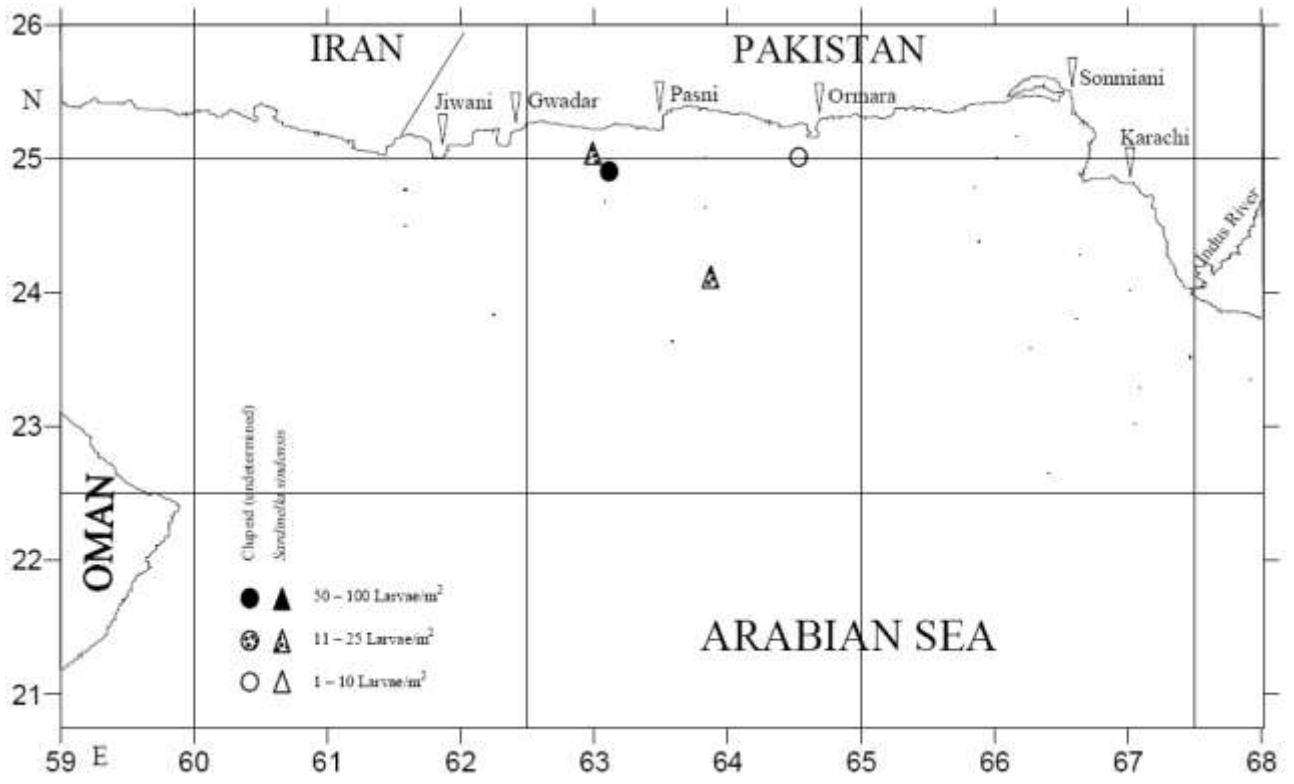


Figure 6. Distribution and abundance (per m^2) of *Sardinella sindensis* and undetermined clupeid larvae.

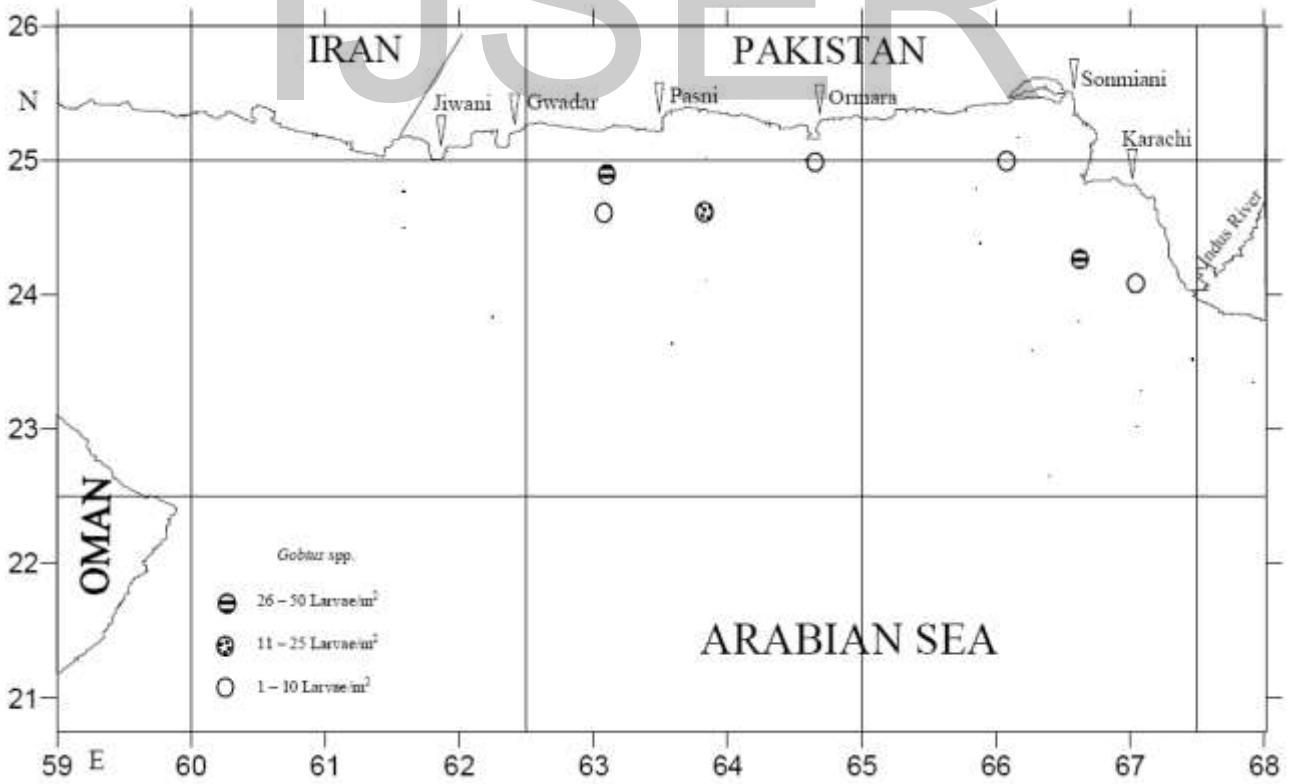


Figure 7. Distribution and abundance (per m^2) of *Gobius* spp.

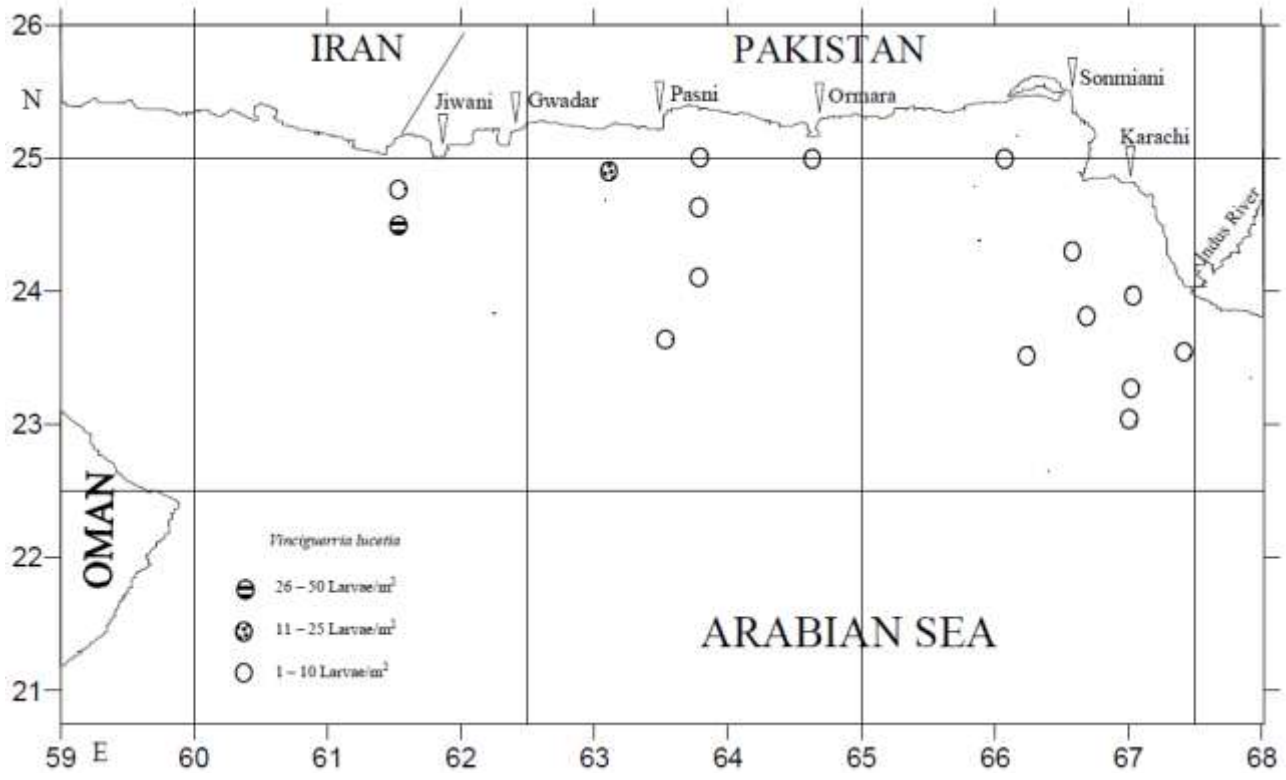


Figure 8. Distribution and abundance (per m^2) of *Vinciguerria lucetia*.

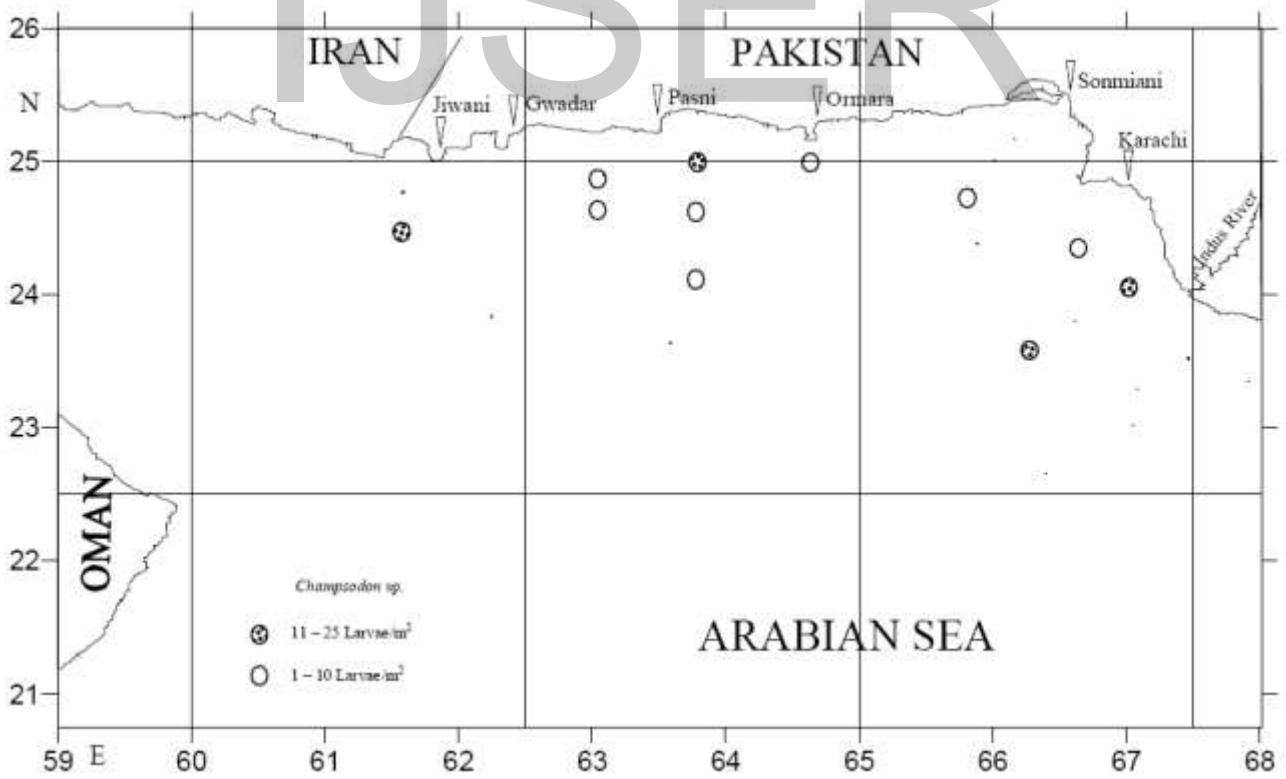


Figure 9. Distribution and abundance (per m^2) of *Champsodon* sp.

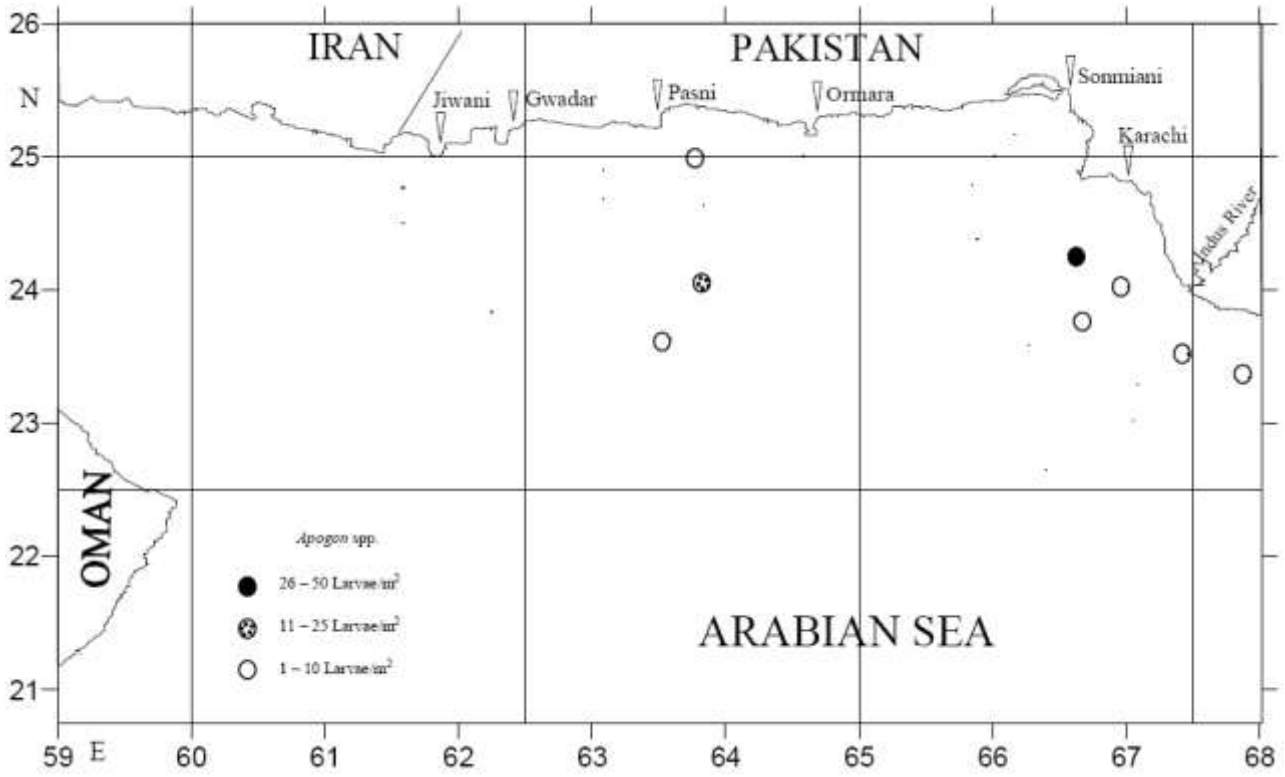


Figure 10. Distribution and abundance (per m^2) of *Apogon* spp.

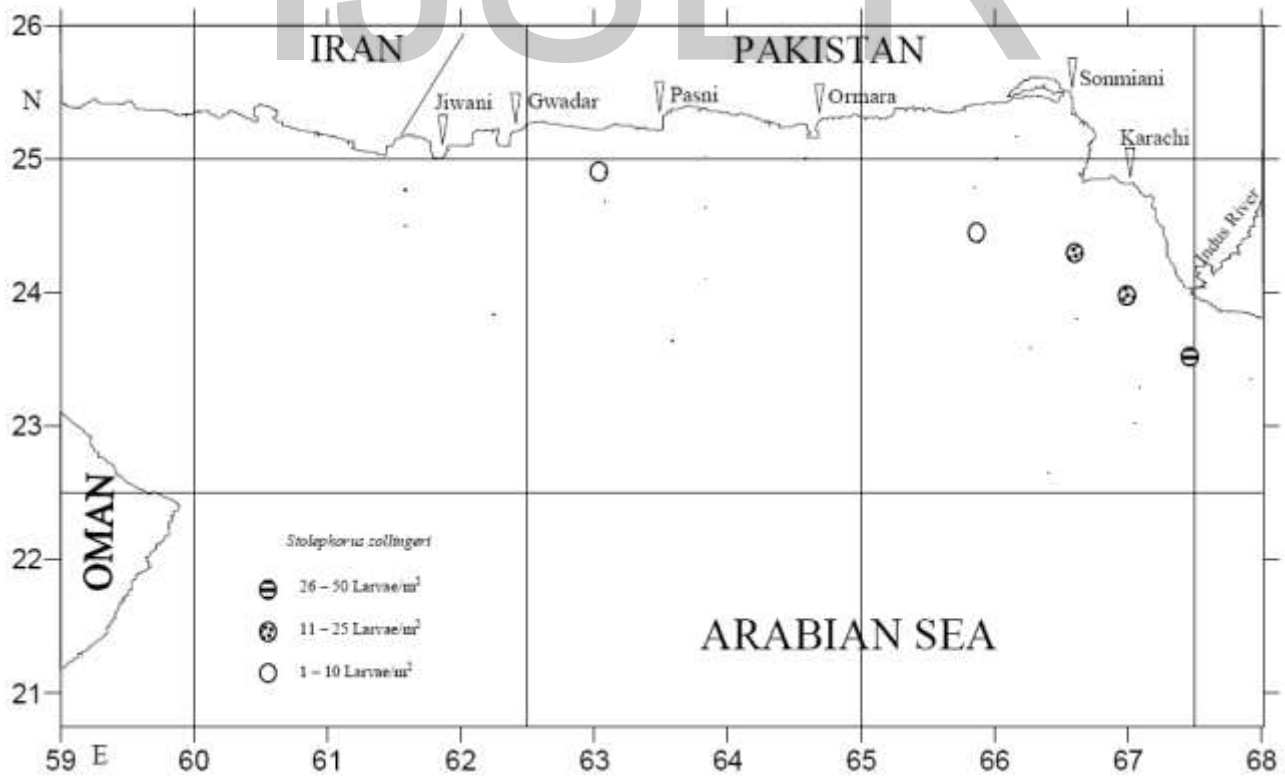


Figure 11. Distribution and abundance (per m^2) of *Stolephorus zollingeri*.

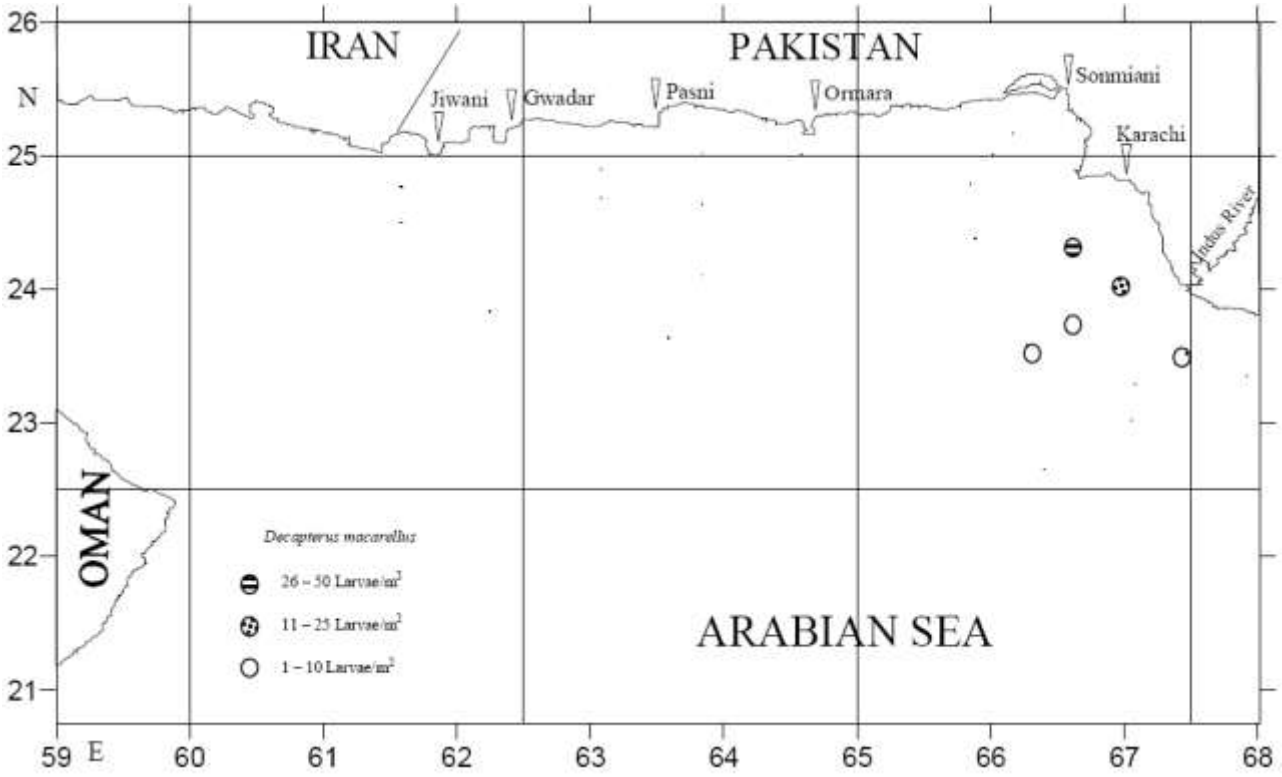


Figure 12. Distribution and abundance (per m^2) of *Decapterus macarellus*.

7.3 LARVAE OF THE "RARE" FISH FAMILY GROUP

The "Rare" fish families are mentioned in section 5. The distribution of various taxa and their number per M^2 belonging to these families is shown in Table 6. Remarks with regard to their distribution are given very briefly since some of these larvae belonged to some very important commercial fishes.

Callionymus larvae (Callionymidae) were taken from 6 stations in each area off the Sindh and Makran coast. The highest number of 18 larvae / M^2 was found at station 28 and 61. The distribution of *Priacanthus* larvae found restricted to the Sindh coast (shelf area, 5 stations). The maximum number (18 larvae / M^2) was collected at station 28. While the larvae of *Lestidiops jayakari* (Paralepididae) were confined to the Makran coast (at 5 stations) being the highest number (11 larvae / M^2) at station 56. The sciaenid larvae (Sciaenidae) were caught from the Sindh waters (3 stations) as well as from the Makran waters (2 stations). The maximum number of 42 larvae / M^2 of these larvae were obtained at station 28.

The larvae of *Trachinocephalus myops* were found at 3 stations off the Sindh coast and on 1 station off Makran coast. Their higher numbers were found in the former area being the highest (21 larvae / M^2) at station 32.

The distribution of the larvae of Bothidae, Cynoglossidae, and Pomacentridae as noted on 3 stations is being shown in Table 6. Pomacentrid larvae were taken only from the waters off the Sindh coast. The highest number of 25 larvae / M^2 was noted at station 24.

Those larvae found on two occupancies (Table 6) includes Platycephalidae, Scombridae, Trichiuridae and eel larvae.

Those larvae taken only once during the entire period of study include: Blenniidae, Soleidae, Triglidae, Sillaginidae, Lutjanidae and *Sphyraena* sp. (Sphyraenidae) are shown in Table 6.

TABLE 6 Distribution and abundance (per M^2) of the fish larvae belonged to the "RARE" Fish Families at various stations**.**

Order*/ Family/ Genus/Species	Station Number																						
	1	5	7	12	14	24	26	28	32	40	45	46	47	53	55	56	58	61	62	64	65	72	73
ANGULLIFORMES*	–	4	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–
BLENNIIDAE	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–
BOTHIDAE																							
Arnoglossus sp.	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pseudorhombus sp.	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–
CALLIONYMIDAE																							
Callionymus sp.	–	–	–	–	11	–	–	18	4	–	–	–	–	4	4	–	–	18	–	–	–	–	–
CYNOGLOSSIDAE																							
Cynoglossus sp.	4	–	–	–	4	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–
LUTJANIDAE	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PARALEPIDIDAE																							
Lestidiops jayakari	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	11	–	7	–	4	–	–	–
PLATYCEPHALIDAE																							
Platycephalus sp.	–	–	–	–	–	–	4	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
POMACENTRIDAE	–	–	–	–	–	25	–	4	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE 6 Continued…….

Order*/ Family/ Genus/Species	Station Number																						
	1	5	7	12	14	24	26	28	32	40	45	46	47	53	55	56	58	61	62	64	65	72	73
PRIACANTHIDAE																							
Priacanthus sp.	–	–	–	4	18	–	–	25	4	4	–	–	–	–	–	–	–	–	–	–	–	–	–
SCIAENIDAE	–	–	–	–	–	–	–	42	4	4	–	–	–	–	–	–	4	4	–	–	–	–	–
SCOMBRIDAE	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	7	
SILLAGINIDAE	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SOLEIDAE	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SPHYRAENIDAE																							
Sphyraena sp.	–	–	–	–	–	–	–	–	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SYNODONTIDAE																							
Trachinocephalus myops	–	–	–	–	–	14	7	–	21	–	–	–	–	–	–	–	–	4	–	–	–	–	–
TRICHIURIDAE																							
Lestidiops jayakari	–	–	–	–	–	–	4	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–
TRIGLIDAE	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–

8. DESCRIPTION OF FISH LARVAE

FAMILY APOGONIDAE

(Cardinal fishes)

Occurrences: Station number 01, 14, 26, 28, 32, 55, 58, and 64
Size range 1.65 mm – 8.5 mm
Genus *Apogon*
Species Undetermined

Description of Larvae

Body oblong. Dorsal and ventral line of the body is more or less equally convex. Snout-anus distance is more than 50 percent of the body length in larva of 6.375 mm which decreases to 44 percent with larval growth. Posterior portion of the gut narrower than the anterior portion. Terminal end of the intestine deflected obliquely from the ventral side of the body. Head large, dorsal profile of the head with a notch in front of the eyes and smooth in larger sized larva of 8.5 mm. Mouth terminal, small with thick lips. Tip of the snout blunt. Eyes moderately large, round and symmetrical. Two separated dorsal fins. Spinous dorsal fin with five feeble spines, first spine smallest, other reaching to second dorsal fin origin. Origin of the soft dorsal fin is opposite to the anal fin. Anal and pelvic fins having spine. Pectoral fin round but slightly elongate in 8.5 mm larva with developed rays. Caudal fin forked with countable rays. Notochord moving upward in 6.375 mm and flexion has completed in 8.5 mm.

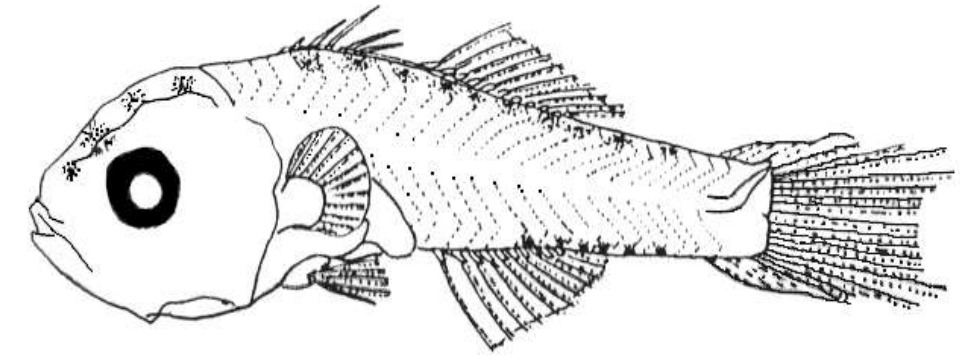
Vertebrae 10 + 14 = 24

Pigmentation

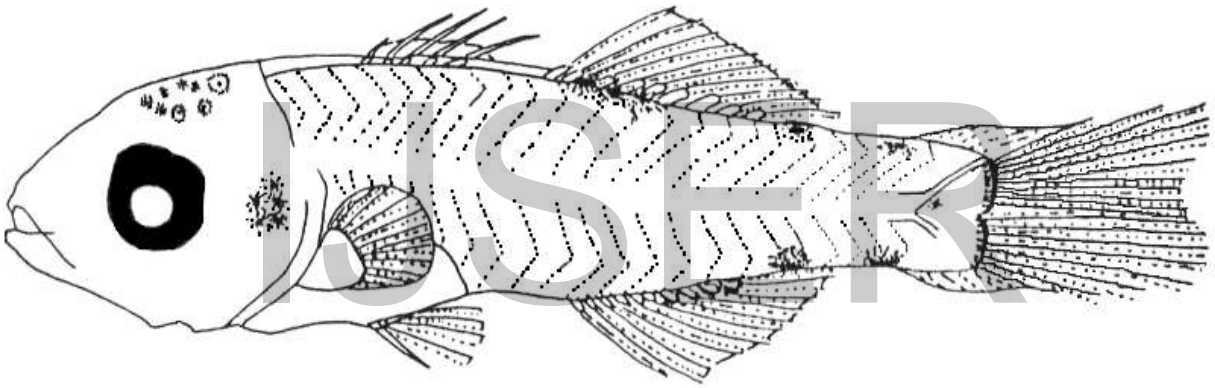
In 6.375 mm larva, a row of large stellate chromatophores on dorsal mid line of the body below dorsal fin bases and on mid ventral side of the tail, starting from posterior side of anal fin base. Few large stellate chromatophores on the dorsal side of the head. In 8.5 mm larva the numbers of stellate chromatophores increases on dorsal side of the head, and decreases on the mid dorsal region, only three stellate chromatophores remain below the second dorsal fin. An opposite pair of stellate chromatophores develop on the caudal peduncle. Posterior anal fin bases found pigmented. Base of caudal fin also pigmented. A short bunch of stellate chromatophores on operculum behind eyes.

Colour of the body

The larva of 6.3 mm is darker (brown) than the larva of 8.5 mm and also more pigmented with reddish brown pigments.



A



B

Figure 13. Larvae of *Apogon* sp., A) 6.375 mm; B) 8.5 mm.

FAMILY BLENNIIDAE

(Combtooth and saber tooth blennies)

Occurrence: Station number 61
Size range Single, 3.625 mm
Genus undetermined
Species undetermined

Description of Larva

Body elongate, narrowing towards the posterior end. Stomach bag shaped, with small protruding rectal portion reflecting obliquely downward from the ventral side of the body. PreanaI region is about 1/3rd of the body length. Head large, more or less round. Dorsal margin of the head convex. Lower jaw slightly longer than the upper jaw. Tip of the snout blunt. Eyes large, more or less round. Finfold continuous from nape around the tail to the posterior side of the gut region. No sign of dorsal and anal fin rays. Only embryonic caudal rays, appearing. Pectoral fin round with developing rays. Notochord slightly bent upward.

Vertebrae 8 + 26 - 28(?) - 34 - 36(?)

Pigmentation

One chromatophore on posterio-dorsal side of the head and on the dorsal side of operculum respectively. Concentrated pigmentation at the dorsal side of gut junction to the body. A prominent chromatophore at the vent side of rectal end and a number of small pigment spots on the lateral side of the gut. A row of small chromatophores on the mid ventral side of the tail region.

Colour of the body

Light brown, with comparatively darker gut region.

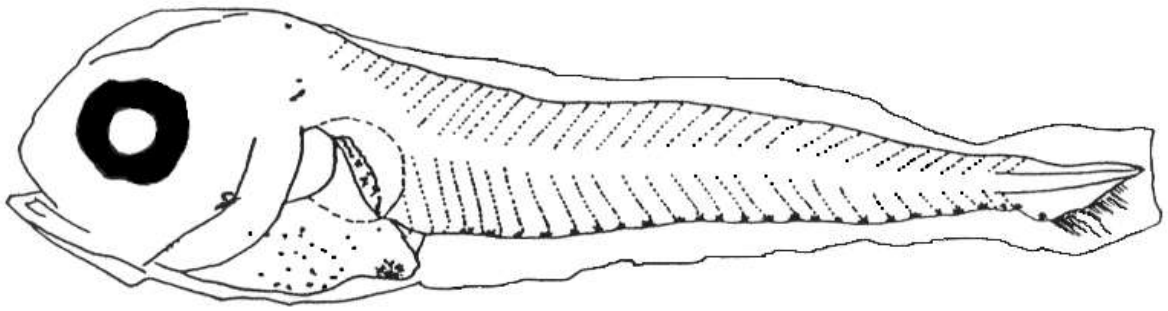


Figure 14. Larva of Blenniidae, 3.625 mm.

FAMILY BOTHIDAE

(Left-eye flounders)

Occurrence: Station No. 32
Size range Single, 4.65 mm
Genus *Arnoglossus*
Species undetermined

Description of Larva

Body, elongate and flat. From mid position the body evenly tapering posteriorly. Alimentary canal in the first half of the body. Two-third of alimentary canal broader and long, 1/3rd consists of a single circular coil with rectal portion directed angularly downward. Head more or less round with a single elongated dorsal fin ray at the upper part of the eyes. Head length 18.3 per cent of the body length. Dorsal profile of the head convex with a small notch infront of eyes, near nostrils. Lower jaw slightly larger than the upper jaw. Mouth opening small and oblique. Eyes small, symmetrical, black and more or less round. Median fin-fold continuous. Dorsal fin-fold originates infront of the eyes. Pectoral fin short and below the mid line of the body with indistinct rays. Notochord straight.

Vertebrae 13 + 30 = 43

Pigmentation

Body scantly pigmented if compared with larvae of *Pseudorhombus*. Five reddish brown pigment spots in a row on the ventral side of intestinal straight portion and few on the body near air vesicle. A Few black pigment spots at rectal junction to the body. Prominent pigment streaks on mid ventral part of fin-fold.

Colour of the body

Light brown.

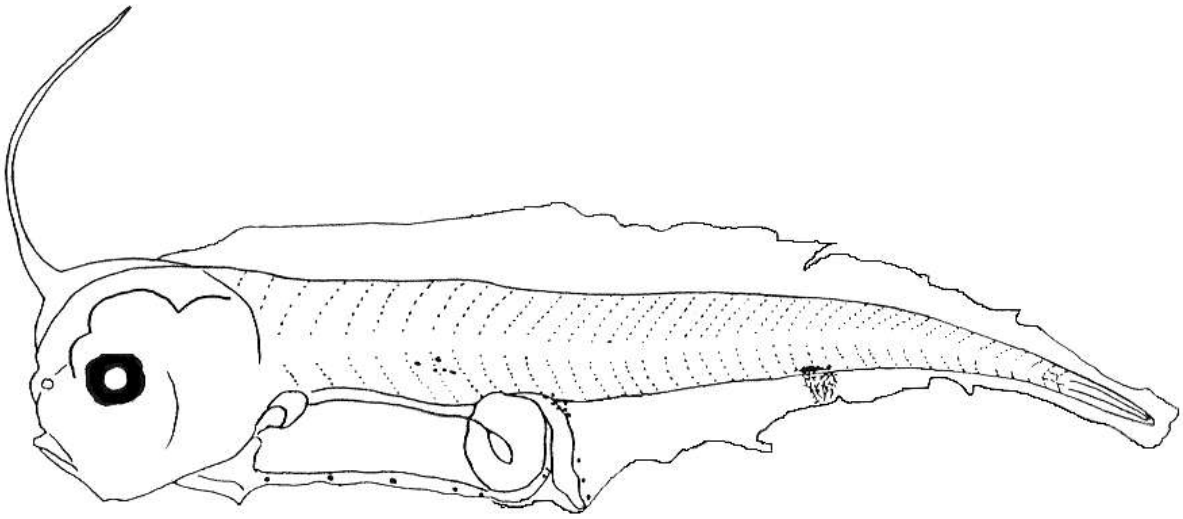


Figure 15. Larva of *Arnoglossus* sp., 4.65 mm.

FAMILY BOTHIDAE

(Left-eye flounders)

Occurrences: Station No. 24, 62.
Size range 4.1 mm – 5.6 mm
Genus *Pseudorhombus*
Species Undetermined

Description of Larvae

Body elongate and flat, tapering towards the tail (4.1 mm larva), nearly evenly broaden (5.6 mm larva). Alimentary canal consists of a single circular coil with rectal portion directed obliquely forward. In larger size the abdomen bulges out more at the ventral profile of the body, rectal portion of the intestine directed vertically down. Head broad, dorsal profile of head more or less straight, notched in-front of eyes. In smaller size larva, lower jaw slightly larger than upper jaw. Tip of the snout blunt. Mouth small, opening oblique. Eyes large, round and symmetrical, nearer to the upper jaw.

In 4.1 mm larva, the median fin-fold continuous. In 5.6 mm larva, the median fins separated from the caudal fin. Dorsal fin with 71 developed rays, originates in-front of the eyes. Anal fin with 44 developed rays. Pectoral fin present with large fin base, having no fin rays. Pelvic fin not developed. Caudal fin wedge-shaped and free from dorsal and anal fins. Notochord deflected upward posteriorly in 5.6 mm larva.

Vertebrae 10 + 23 - 25(?) = 33 – 35 (?)

Pigmentation

In 4.1 mm larva, few pigment streaks on dorsal side of head, and around nostrils. Posterior rectal end dark pigmented. Three large brown vertical bands (blotches) in the tail region. Two large pigmented streak on the mid ventral side of the body in tail region. One-third portion of fin-fold in tail region also darkly pigmented. Embryonic rays in caudal fin with few streaks of pigments.

In 5.6 mm larva, pigmented spots spread all over the body, concentrated on the dorsal side of head and operculum, on the pectoral fin base, and in between mid-ventral and lateral line of the tail portion. Three prominent vertical brown blotches on the body. Complete pigmented streaks on few anterior, mid and posterior dorsal fin rays, and partially (half the length of the rays) on few posterior anal fin rays.

Colour of the body

Dark reddish brown.

Remarks

The identification of the present specimens is based on the number of dorsal fin rays, and vertebral counts etc. DEVI (1969) noted 11+23 vertebral segments, 66-69 dorsal, 50-55 anal, 17 caudal rays in 7.76 mm larva of *Pseudorhombus elevatus* Ogilby from the south west coast of India. She placed this larva in the *Paralichthys – Pseudorhombus* group of bothid flat-fish. Whereas, 33 vertebrae, 72 - 80 dorsal rays, found in the adult of *Pseudorhombus arsius* from Pakistani waters by HUSSAIN and ALl-KHAN (1980).

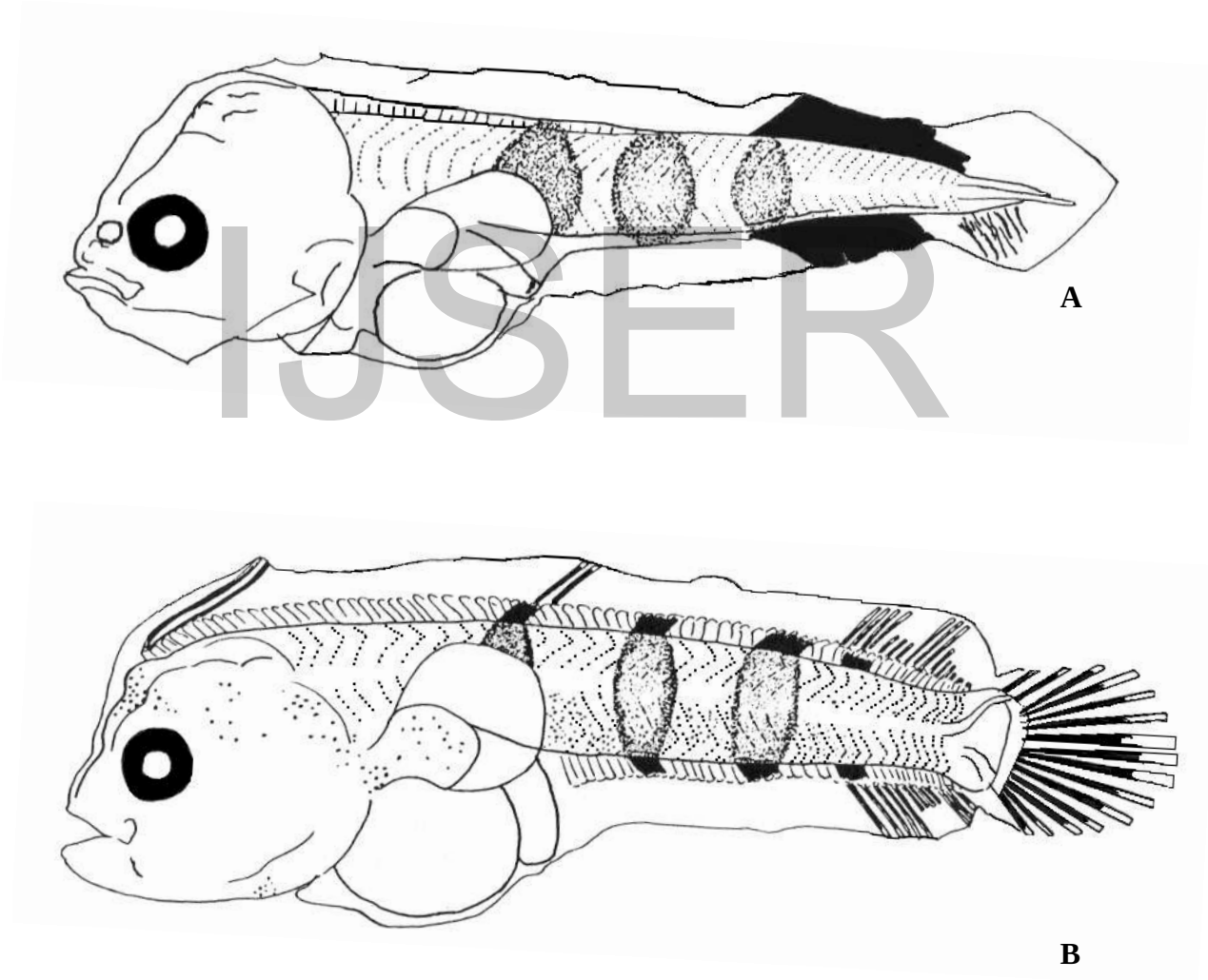


Figure 16 Larvae of *Pseudorhombus* sp., A) 4.1 mm; B) 5.6 mm.

FAMILY BREGMACEROTIDAE

(Codlets, codlings)

Occurrence: Station No. 58
Size range Single, 2.75 mm
Genus *Bregmaceros*
Species *macclellandi* THOMPSON, 1840

Description of larva

Body elongate, Head broad, dorsal profile wavy. Mouth opening small, oblique and terminal in position. Eyes large, more or less square. Lower jaw slightly larger and pointed, upper jaw shorter and anteriorly blunt. Abdominal portion closer to head with folding of intestine and bulging out of the ventral profile of the body. Rectal end along the ventral side of the body. Fin-fold covering the dorsal side of the body from nape continuing around the tail to the ventral side of the body up to the posterior side of the abdomen region. No sign of dorsal and anal fin origin. Pectoral fin present, lateral in position with indistinct rays. Caudal fin with embryonic rays. Notochord straight.

Vertebrae 10 + 40 – (?) = 50 – (?)

Pigmentation

Scattered large chromatophores on the head region and on the lower jaw and concentrated chromatophores in the gut region. Pectoral fin base also with chromatophores. A large oblong coloured pigment patch on the ventro-lateral side of the tail region.

Colour of the body

First half of the body darker than the second half.

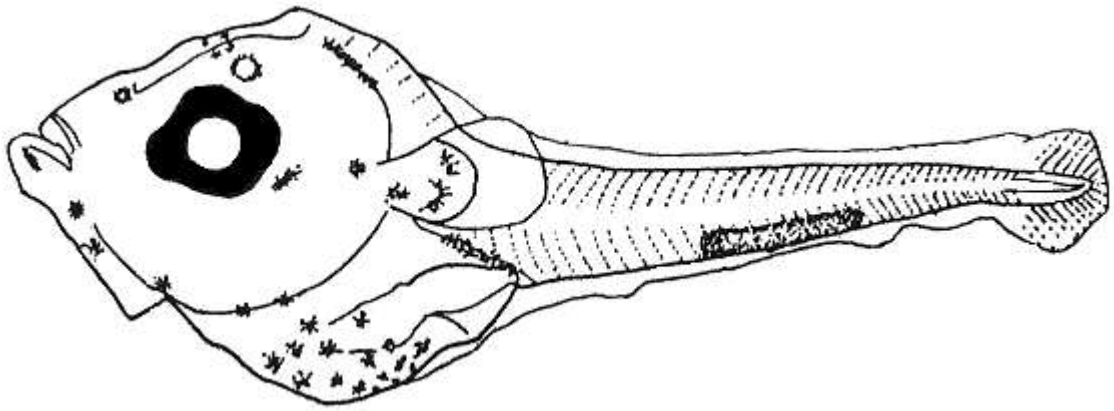


Figure 17. Larva of *Bregmaceros macclellandi*, 2.75 mm.

FAMILY BREGMACEROTIDAE

(Codlets, codlings)

Occurrences: Station No. 05, 12, 14, 24, 26, 28, 32. 40, 45, 47, 53, 56, 58, 61, 62, 64, 72, and 73

Size range 1.75 mm - 11.9 mm

Genus *Bregmaceros*

Species *nectabanus* WHITLEY, 1941

Description of larvae

Body moderately elongate with relatively short head. Abdominal portion consists of folds of intestine closer to head with. Snout- anus distance 38-41 percent of the body length in larvae ranging from 3.375 mm to 11.9 mm in size. Rectal end facing obliquely downward. Dorsa1 profi1e of the head, notched above and in front of the eyes in larvae of 3.375 mm and 5.35 mm, whereas in larva of 11.9 mm, it is smooth, strong, and makes slope. Mouth terminal in position opening oblique and. Eyes more or less round, symmetrical and large. Lower jaw slightly larger and pointed, upper jaw blunt at its anterior end. Fin-fold covering the dorsal side of the body from nape, continuous around the tail to the ventral side of the body up to posterior end of the abdominal portion in 3.375 mm larvae. In 5.35 mm larva signs of developing rays appear with long based dorsal and anal fins, round caudal fin with embryonic rays. In 11.9 mm larva, distinct 2 dorsal fins present, Occipital ray on head lacks which is the 1st dorsal fin, second dorsal fin long based with middle rays much shorter emerging just above the beginning of the long based anal fin which also has middle rays much shorter.

Caudal fin round, separated from the dorsal and anal fin with developing rays. Pelvic fin inserted under the rear part of the head, with long thick rays extends beyond the beginning of the anal fin. Notochord straight in 3.375 mm larva, slightly flexed in 5.35 mm flexion has been completed in 11.9 mm larva.

Vertebrae 10 + 40-42 = 50 - 52

Pigmentation

In larva of 3.375 mm, a single chromatophore at angle of jaw. A large pigmented patch on the posterior part of the body. Few small chromatophores on ventral side of abdomen, and dark pigmentation at junction of abdomen to the body.

In larva of 5.35 mm, similar pattern of pigmentation as in 3.375 mm larva. In addition, a short row of chromatophores-spots on the hinder part of the body in caudal region.

In larva of 11.9 mm, a number of chromatophores on head surface, dark pigments in a curved line on the body just above the gut region. Few chromatophore spots in a row on caudal vertebrae, two chromatophores just in the middle of the body length.

Colour of the Body

Light brown in 3.375 mm and 5.35 mm larva. In 11.9 mm larva, first half of the body, comparatively darker, a dark patch on anterior side of abdomen.

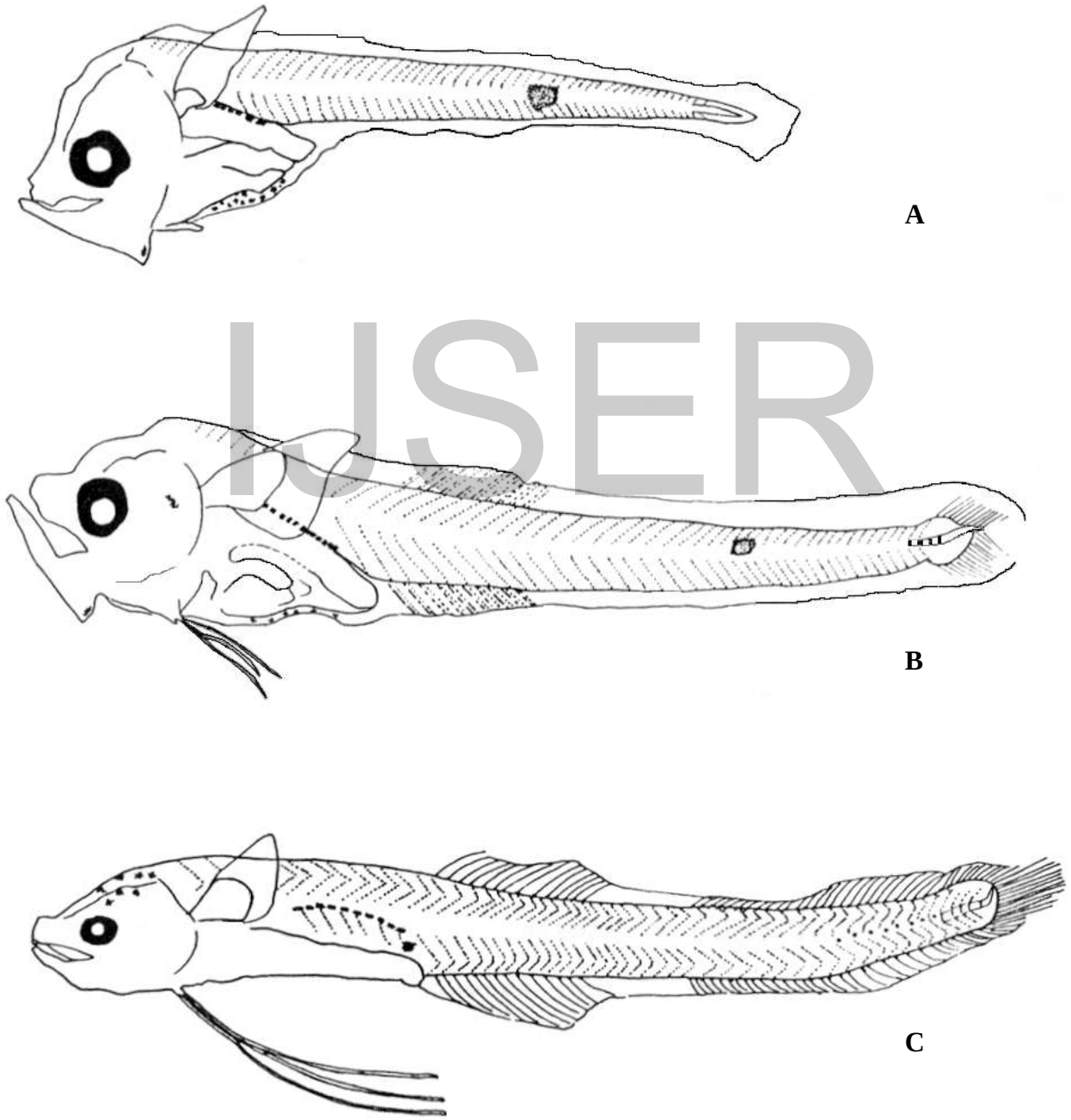


Figure 18. Larvae of *Bregmaceros nectabanus*, A) 3.375 mm; B) 5.35 mm; C) 11.9 mm.

FAMILY BREGMACEROTIDAE

(Codlets, codlings)

Occurrence: Station No. 26
Size range 5.025 mm
Genus *Bregmaceros*
Species *rarisquamosus* MUNRO, 1950

Description of larva

Body moderately elongate with broad head. Abdominal portion closer to head with folded intestine. Snout-anus distance 49.75 percent of the body length. Rectal opening facing obliquely downward to the ventral side of the body. Dorsal profile of the head sloped in-front of eyes. A well developed occipital ray on top of head. Mouth opening oblique and terminal in position. Eyes large, more or less square in shape. Lower jaw slightly larger and pointed, upper jaw blunt at its anterior end. First dorsal fin in the form of occipital ray, second dorsal fin long based with sign of 35 developing rays, starts in parallel line above the beginning of the long based anal fin with 37 developing rays. Caudal fin round with developing rays. Pelvic fin inserted under the rear part of head, 2 knobs, each with 3 long rays, not reaching beyond rectal end. Notochord Flexed upward.

Vertebrae 13 - 14(?) + 30 - 31(?) = 43 - 45(?)

Pigmentation

A small pigment streak on the posterior-dorsal side of the operculum. A bunch of pigments on dorsal side of intestine to the body. An expanded pigment on the mid lateral line at the last 1/3rd part of the tail region.

Colour of the body

Light brown except that of the expanded darker patch at rectal end.

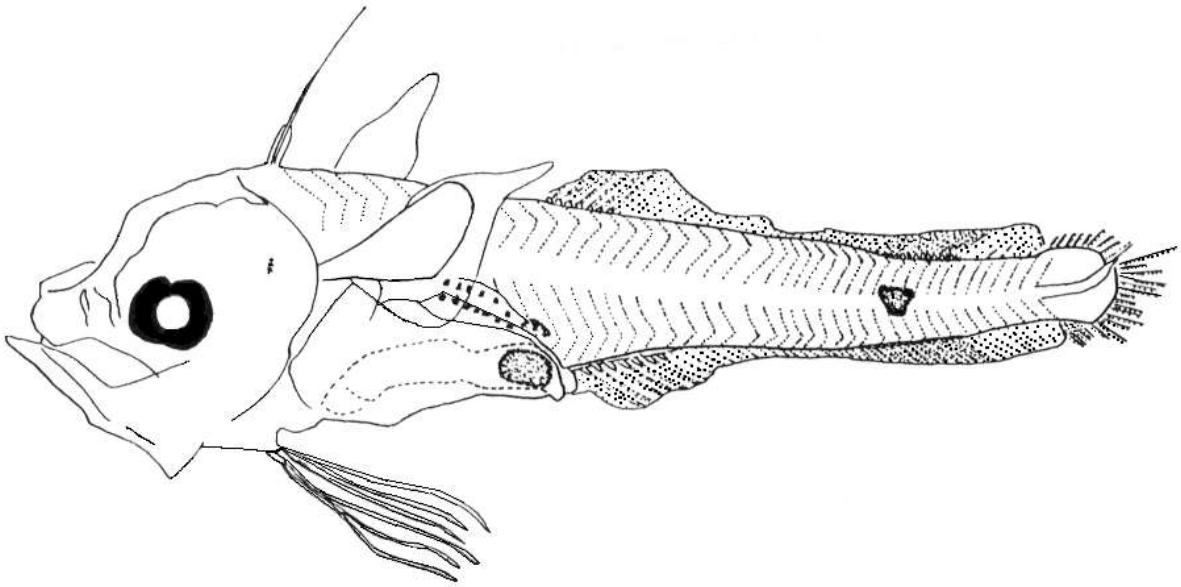


Figure 19. Larva of *Bregmaceros rarisquamosus*, 5.025 mm.

FAMILY CALLIONYMIDAE

(Dregonets)

Occurrences: Station No. 14, 28, 32, 53, 55, and 61
Size range 1.225 mm - 3.95 mm
Genus *Callionymus*
Species undetermined

Description of larvae

Body fusiform with large head. Gut moderate in length, more or less straight but later folded in a triangular shaped structure with short protruding intestine, appears as a triangular bag shaped in 3.95 mm larva. Snout-anus distance remains between 50-60 percent of the body length during growth. Dorsal profile of head shows a gradual slope towards mouth. Mouth opening small and terminal. Jaws with thick lips. Tip of the snout blunt. Eyes large, round and symmetrical. Smaller larvae possess transparent fin fold. Signs of dorsal and anal fin rays appear in 3.0 mm and 3.95 mm. Caudal fin with few developed rays. Pectoral fin with indistinct rays, lateral in position. Notochord straight in 2.125 mm, diverging upward in 3.0 mm and 3.95 mm.

Vertebrae 7 + 14 = 21

Pigmentation

In 2.125 mm larva, small pigment spots spread nearly all over the body, concentrated over dorsal and ventral profile of the body, also over posterio-dorsal side of the head, and over the anterio-ventral side of the gut. Few large stellate chromatophores on the dorsal side of head. A pigmented dash-line on upper jaw. A broken pigmented streak on the mid lateral line of the body.

In 3 mm larva, pigment spots much localized. The spots of the ventral side of the gut region condensed into larger chromatophores. Anal fin fold with developing anal fin rays also pigmented.

In 3.95 mm larva, ventral side of the stomach with large sized concentrated stellate chromatophores. Two large stellate chromatophores on the dorsal mid line of the body. Pigmented streaks on lateral mid line of the body with large stellate chromatophores. Ventral mid line of the body with concentrated pigment spots in a row from where it spread along the developing anal rays. Small pigment spots on tip of lower and upper jaw, also having pigment streaks at junction of lower and upper jaw. Ventral side of the lower jaw with dash-pigments in row. Three stellate pigments in the posterior side of the operculum.

Colour of the body

Dark brown.

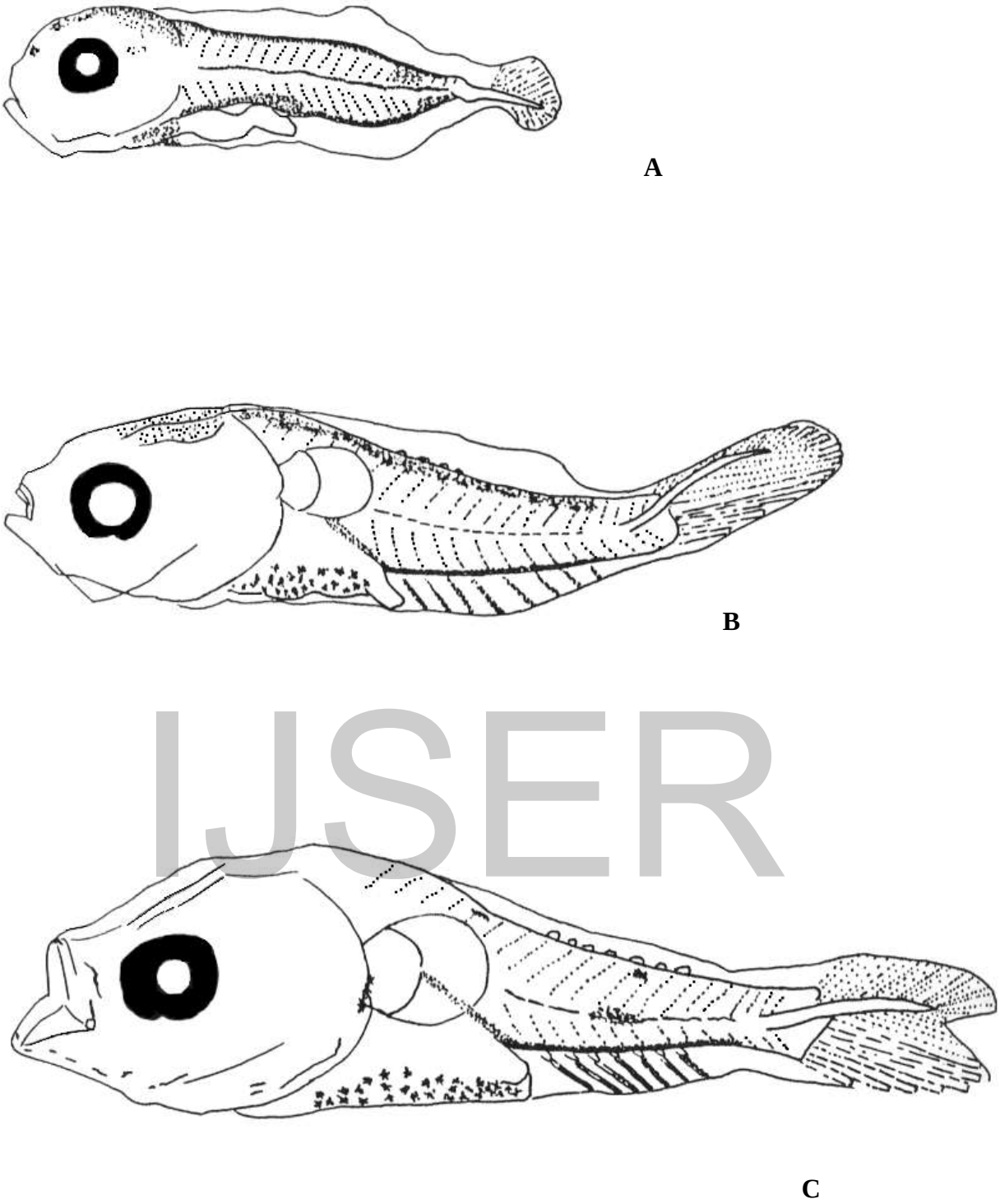


Figure 20. Larvae of *Callionymus* sp., A) 2.125 mm; B) 3.0 mm; C) 3.95 mm.

FAMILY CARANGIDAE

(Jacks, trevallies, bludgers, scads, queenfishes, etc.)

Occurrences: Station No. 14, 24, 26, 28, and 32
Size range 2.275 mm – 8.675 mm
Genus *Decapterus*
Species *macarellus* CUVIER, 1833

Description of larvae

Body elongate, slender, tapering towards the tail in smaller size larvae, strongly compressed and deep in larger sizes. Dorsal and ventral contour of the body equally convex. Gut region moderate in length. Snout to anus distance noted 54 - 64 percent of the body length. Stomach more or less triangular, intestine short and uniform in diameter from dorsal side of stomach, deflected obliquely in smaller sizes but vertically downward in larger size. Head broad and compressed with strong concavity in dorsal profile of head in larvae of 2.4 - 3.0 mm. Concavity decreases with larval growth and remains slightly in larva of 8.675 mm. Comparatively, large sized spines present on operculum in smaller sized larvae than in the larger sized larvae. Mouth opening large, less oblique. Lower jaw slightly larger than the upper jaw. Tip of snout blunt. Eyes large, round, symmetrical, and brown. Thin membranous structure on nape. The fin-fold complete and extends from the nape round the tail and forward to the abdomen. Rays development start in larvae of 4.5 mm and above it. Two dorsal fins, more or less separated. Spinous dorsal fin with shorter fin bases and soft dorsal fin with long bases. In larva of 8.675 mm, first dorsal fin with 8 flexible spines, middle spines longer. Whereas, 36 rays have been developed in the second dorsal fin. Anal fin with long fin base, comparatively shorter than dorsal fin base with 32 developed rays. Caudal fin starts bifurcation but lobes still round. Position of pectoral fin base and pelvic fin base on the same axis if an imaginary line drawn between them. Pectoral fin base paddle-shaped with fan-shaped fin. Pectoral, pelvic and caudal fin rays are also countable in 8.675 mm larva. Notochord straight in smaller size larvae, starts bending upward in 4 mm and found flexed in 8.675 mm larva.

Vertebrae 11 + 13 – 14 (?) = 24 – 25 (?)

Pigmentation

In smaller sizes (2-3 mm), dark chromatophores on the dorsal and ventral edges of the body in the tail region, also on the median line of the body. In larger than 3.0 mm larvae, few Chromatophores develop on head, on tip of jaws and on ventral side of the gut region.

In 8.675 mm larva, dark chromatophores increases in numbers on the dorsal and ventral ridges of the body, also on the median line of the body. Few stellate chromatophores near the base of tail. Dark concentration of these stellate chromatophores on the dorsal side of the head. Few

small pigment spots on sides of lower jaw, also on the spiny dorsal fin membrane.

Colour of the body

Brown.

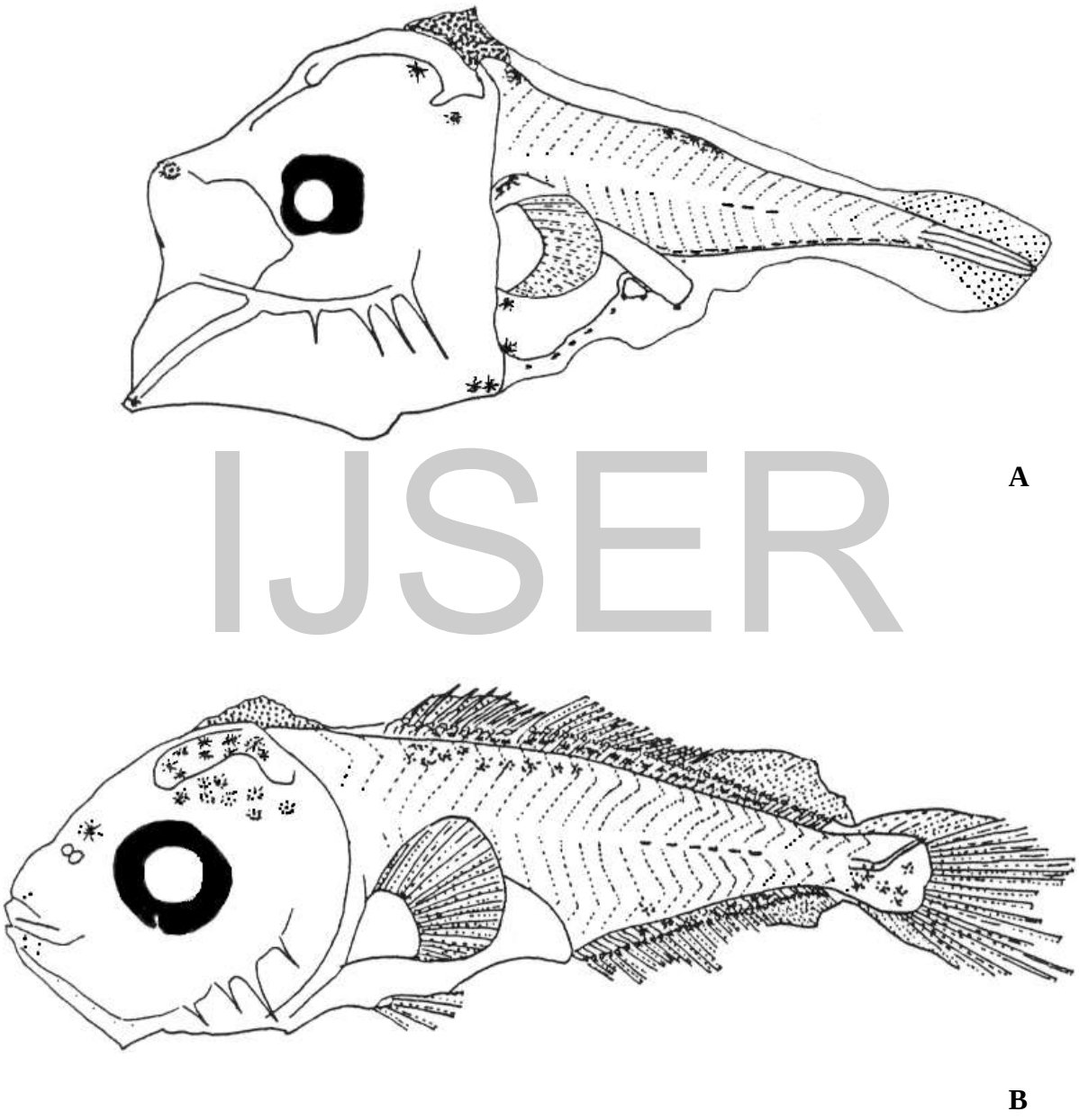


Figure 21. Larvae of *Decapterus macarel1us,* A) 3.275 mm; B) 8.675 mm.

FAMILY CHAMPSODONTIDAE

(Gapers)

Occurrences: Station No. 24, 28, 32, 47, 53, 55, 56, 58, 61, 62, and 73
Size range 2.375 mm – 8.6 mm
Genus *Champsodon*
Species undetermined

Description of larvae

Body elongate but body depth increases with larval growth. Gut length moderate, cylindrical in shape with one coil in smaller larvae, later converted into a large triangular sac-like stomach with short intestine in 8.6 mm larva. In larva of 8.6 mm head large, broad with bony crest above it. A pair of long appendage located at the upper posterior part of the operculum. Mouth opening very large with pointed teeth in the upper and lower jaw. Tip of the snout blunt. Eyes round and large. Two dorsal fins, first with 3-4 weak spines, second with 19 soft rays. Anal fin similar to 2nd dorsal fin with 17 soft rays. Pectoral fin short with 13 soft rays, while pelvic fin ray comparatively larger than pectoral fin rays with 6 rays and inserted slightly in-front of pectoral fin. Caudal fin forked with 16 rays. Notochord straight in smaller larvae, start moving upward in larvae above 4 mm and found flexed in 8.6 mm larva.

Vertebrae 10 - 11 + 20 = 30 - 31

Pigmentation

A prominent, large persistent pigment on the mid ventral region of the tail. Few stellate chromatophores on the dorsal profile of head, and at the joint of upper and lower jaw. Following larval growth dark pigmentation appears in between the digestive sac and the body. Later it spreads all over the digestive sac and on dorsa-lateral portion below the 1st dorsal fin and a few in row below the 2nd dorsal fin. The number of stellate chromatophores also increased on the dorsal side of the head. A prominent stellate chromatophore at the upper posterior part of the operculum, where the base of long appendage is situated.

Colour of the body

Pale brown to darker.

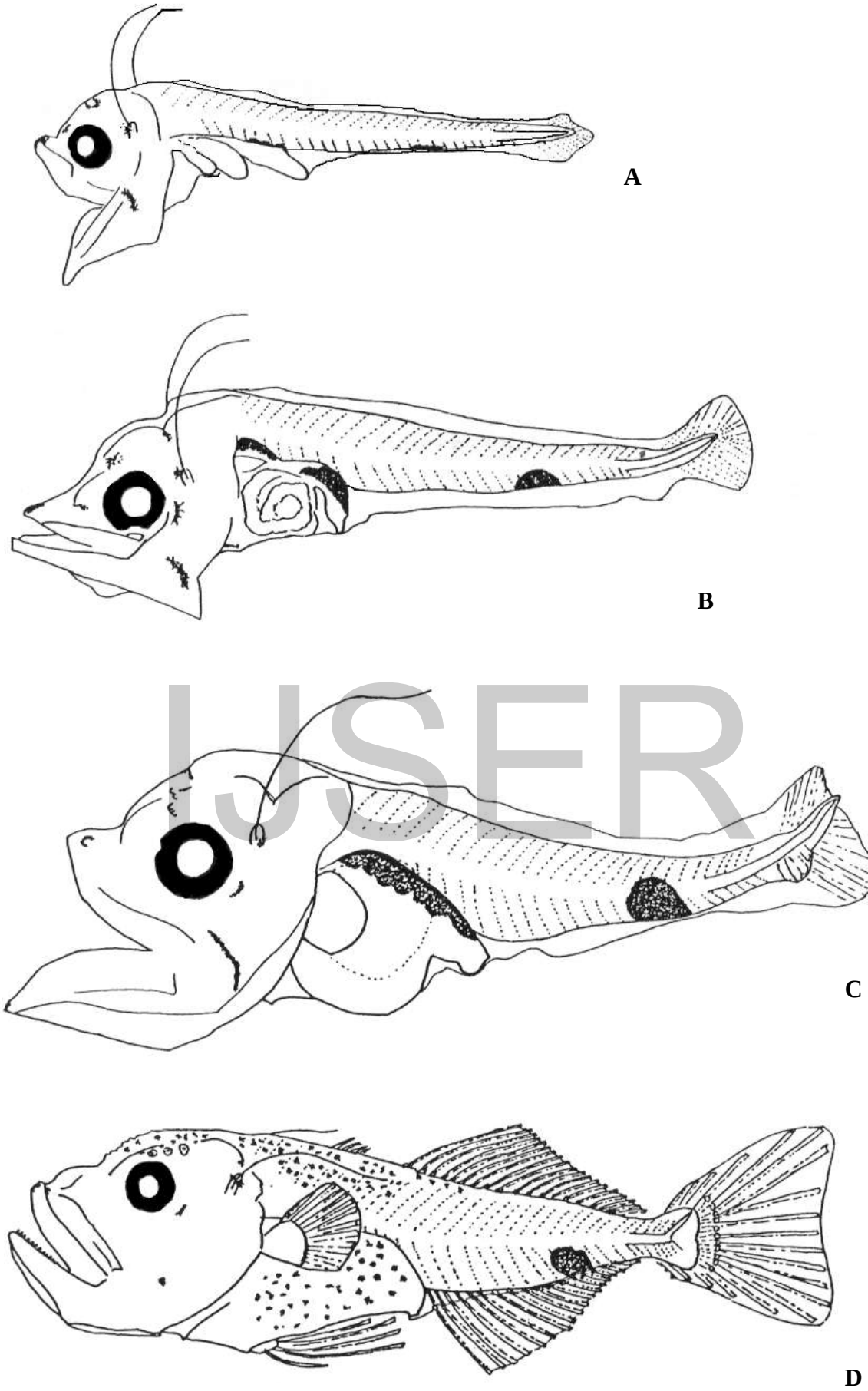


Figure 22. Larvae of *Champsodon* sp. A) 2.6 mm; B) 3.425 mm; C) 4 mm; D) 8.6 mm.

FAMILY CLUPEIDAE

(Herrings, shads, sardinellas, sprats, sardines)

Occurrences: Station No. 55 and 61
Size range 4.25 mm – 14.6 mm
Genus *Sardinella*
Species *sindensis* (DAY, 1878)

Description of larvae

Shape of the body slender, elongate and slightly compressed laterally. Smaller larvae with delicate cross muscles, larger with firmly attached harder muscles. Body evenly broaden except in tail region. Alimentary canal long and straight. First part smooth whereas second part with visible rings. Anus situated at extreme part of the body. Head moderately elongate. Head-length greater than tail length. Tip of the snout pointed and slightly bent upward in the smaller larvae. Mouth terminal with small, oblique opening. Eyes large, round and towards dorsal side of head. Single dorsal fin without spiny rays. Dorsal fin base longer, develop in the 2nd half of the body. Anal fin base relatively shorter than dorsal fin base. Pectoral fin base paddle-shaped and on low side of the body. Pelvic fin not developed. Caudal fin deeply forked with countable rays. Notochord straight in larvae up to 6.25 mm and flexion noted in larvae from 10.875 mm to 14.6 mm.

Vertebrae 39 + 6-7 (?) = 45 – 46 (?)
40 + 5-6 (?) = 45 - 46 (?)

Pigmentation

In 14.6 mm larva two stellate chromatophores on the lower side of the tip of lower jaw, two prominent chromatophores on operculum. V-shaped streaks of pigment at posterior side of operculum. A stellate chromatophore beyond eye and dorsal side of the head and at the posterior part of the dorsal fin base respectively. A small pigmented area near the posterior end of notochord. A pigmented line of small spots at junction of first intestinal part of the body and a row of pigmented streaks on ventral side of the 2nd part. An expanded stellate chromatophore at the posterio-dorsal side of the anus persistent from smaller larval size. Streaks of pigments on the caudal fin rays.

In 6.25 mm larva V -shaped pigmented streak on posterior free part of operculum, a row of pigment-dashes at junction of intestine to the body. A row of streak pigments at the ventral side of the 2nd intestinal half. A spread streak pigment on the hypural side of the caudal fin fold.

Colour of the body

Whitish with cross-muscles, brown to dark brown in larger sizes.

Remarks

Comparative material of *Sardinella sindensis* was available (with DR. JAFFER ALl-KHAN) in the Department of Zoology, University of Karachi was used for the present identification.

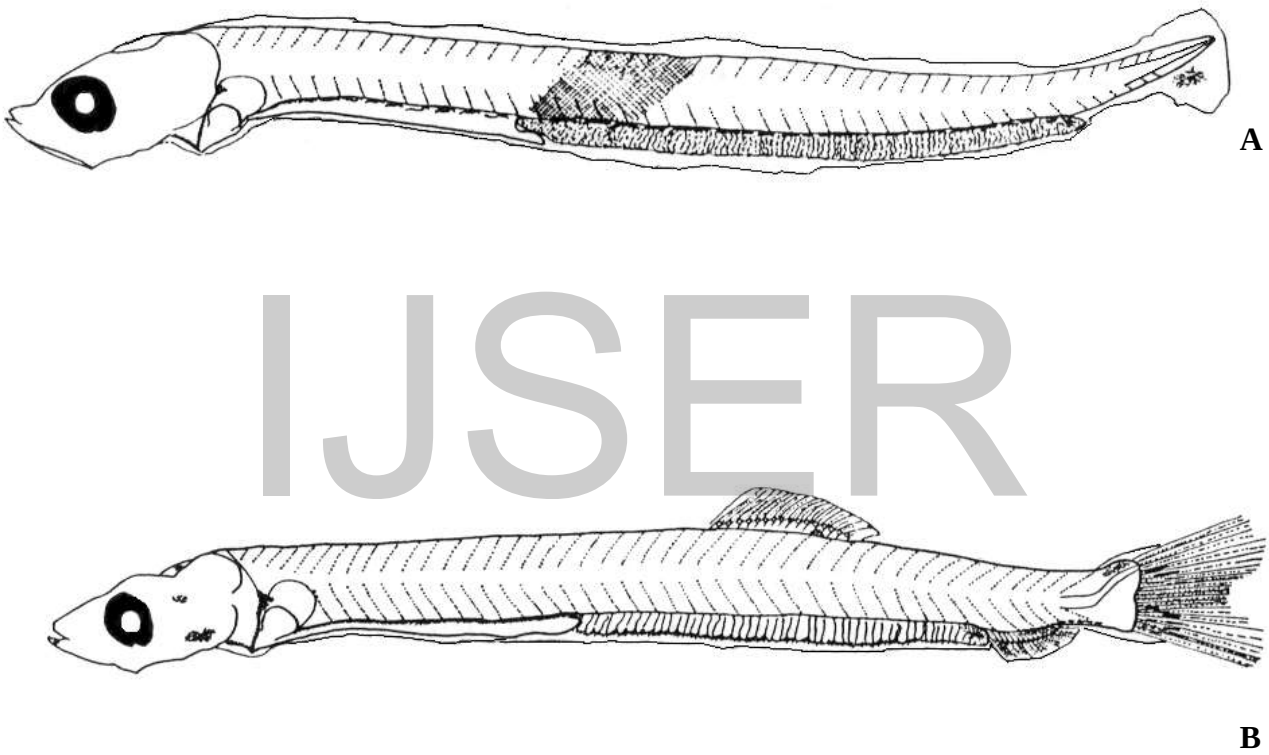


Figure 23. Larvae of *Sardinella sindensis,* A) 6.25 mm; B) 14.6 mm.

FAMILY CLUPEIDAE

(Herrings, shads, sardinellas, sprats, sardines)

Occurrences Station No. 53 and 61
Size range 2.625 mm – 6.275 mm
Genus undetermined
Species undetermined

Remarks

An undetermined genus of clupeid larvae was also noted. The morphological differences found with that of *Sardinella sindensis* were the presence of an air sac visible in the first half the body, vertebral count were 30 + 13 = 43 and the intestinal part was comparatively less pigmented.

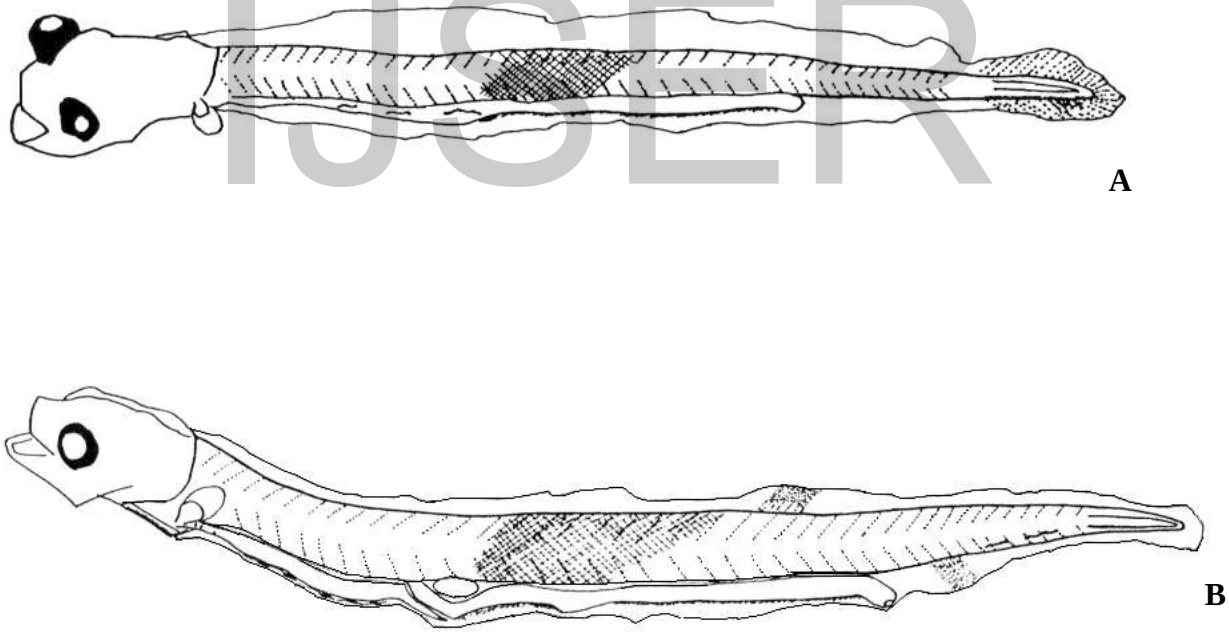


Figure 23. Larvae of Clupeidae undetermined genus A) 4.0 mm; B) 6.275 mm.

FAMILY CYNOGLOSSIDAE

(Tongue sole)

Occurrences: Station No. 01, 14 and 56
Size range 2.125 mm – 2.975 mm
Genus *Cynoglossus*
Species undetermined

Description of larvae

Body elongate, narrow tapering towards the tail and very delicate. Alimentary canal with a single circular coil bulges out of the ventral profile of the body. Rectal portion directed obliquely downward and situated in one third part of the body length. Head small, dorsal profile of the head slops towards snout. Mouth opening small, oblique and terminal in position. Tip of the snout blunt. Eyes more or less square in shape, black, present near the upper jaw. At the level of the eyes a tentacular process and a pair of elongated rays present. Dorsal fin fold commences from the level of eye and continuous with the caudal and anal fin fold. Pectoral fin short but prominent. Notochord straight. Vertebrae not clear and counts uncertain.

Vertebrae 10 - 12 (?) + 40 – 42 = 50 - 54 (?)

Pigmentation

In 2.975 mm larva, few pigment spots concentrated in 2 areas near dorsal margin in tail region, and a few in row on the ventral side of the body. Concentrated small pigment spots on the ventral side of the coiled intestinal portion.

In 2.7 mm larva, dorsal and ventral mid line of the body with a row of reddish brown pigment spots. Ventral side of the intestinal coil with a few splashing pigment spots.

The larva 2.125 mm possess two pairs of concentrated pigmented areas in tail region. Ventral side of the circular intestine having very small pigment spots. Few pigments at the membranous edge which connect the coiled intestine with that of head.

Colour of the body

Light to dark brown.

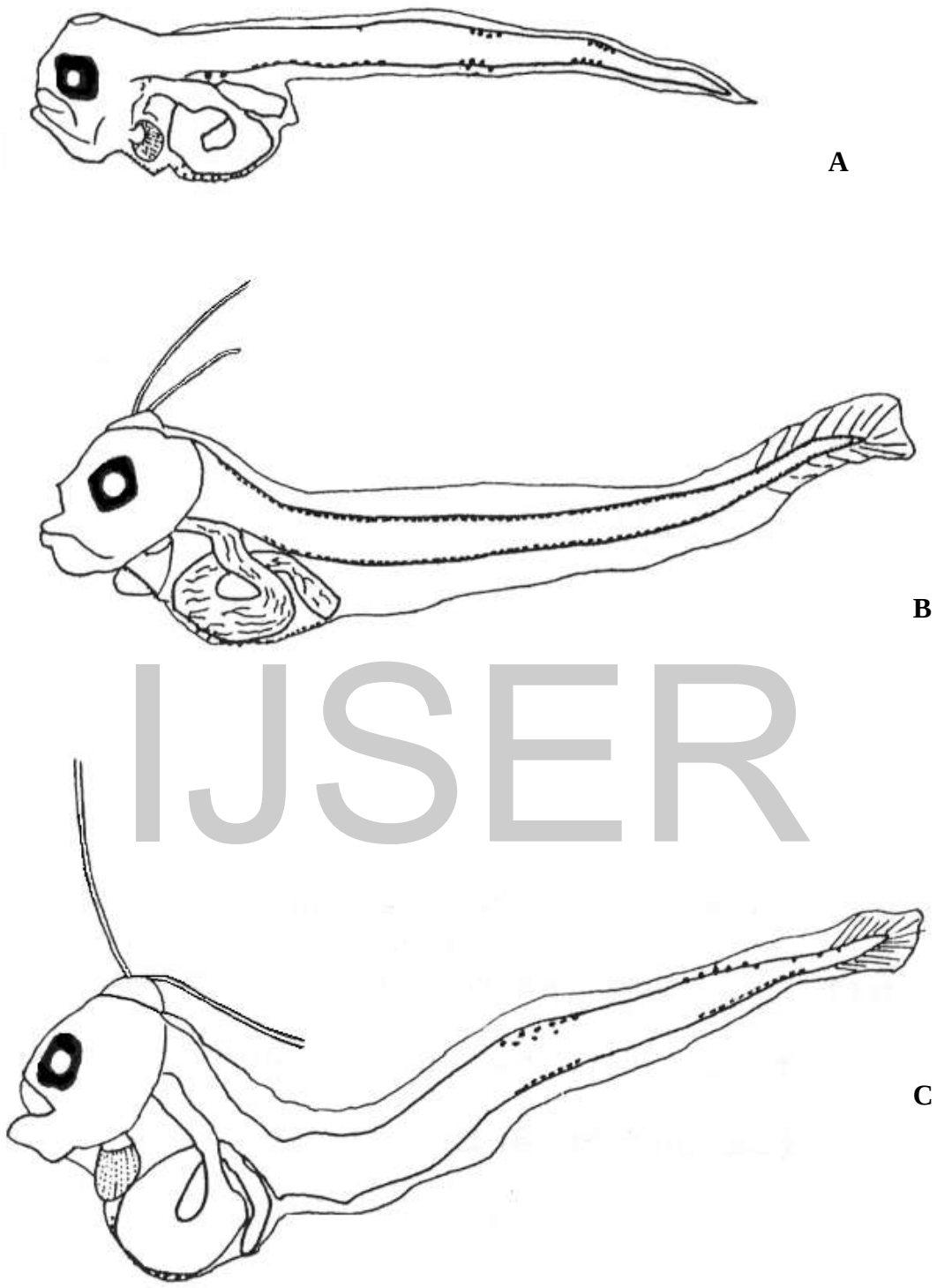


Figure 25. Larvae of *Cynoglossus* sp. A) 2.125 mm; B) 2.7 mm; C) 2.975 mm.

FAMILY ENGRAULIDAE

(Anchovies)

Occurrences: Station No. 14, 28, 32, 40 and 61
Size range 3.4 mm – 13.55 mm
Genus *Stolephorus* / (*Amentum*)
Species *zollingeri* BLEEKER

Description of larvae

Body elongate, moderately compressed from lateral side, with a long straight digestive tract differentiated into two halves. First half comparatively thinner and smoother in structure, while the second half wider in diameter with prominent annular rings. Very short portion of its posterior end deflected obliquely from the ventral side of the body. A vesicle present at mid part of body length and appear in larvae of 6.2 mm and more. Head elongate, dorsal profile of head sloped anteriorly in larger sized larvae and slightly concave in smaller sized larvae. Tip of the snout pointed in larvae larger than 6 mm, but slightly blunt in smaller larvae. Mouth opening small, oblique and terminal in position. Eyes moderately large, round and symmetrical. Anal fin origin beneath the basal end of dorsal fin. Fourteen developed rays noted each in dorsal and anal fin rays in 13.55 mm larva. Caudal fin deeply forked with countable rays. Pectoral fin short, round and on low side of the body. Notochord starts moving upward in larvae longer than 6.2 mm and remained flexed in 13.55 mm.

Vertebrae 28 + 14 = 42

Pigmentation

Four to five chromatophores in row on dorsal side of intestinal first half, few larger pigment spots concentrated at the place of air vesicle. A row of small pigment spots on the ventral side of the annular rings of intestinal second half, few more pigment spots in row from posterior part of anal fin end to the mid ventral side of the tail region. Streaks of pigment line on caudal fin rays of hypural side. In larvae smaller than 6 mm in size, a row of chromatophores on the dorsal side of the first intestinal half up to the ventral mid line of the tail region. A row of thin wavy pigment streaks on the ventral side of the second half of the intestine. Three small pigment spots in caudal fin region in smaller sizes, 8-10 pigment streaks on caudal fin rays in larger sized larvae.

Colour of the body

White to pale brown in larvae smaller than 8 mm. In larvae of 8 mm and above, the muscles become stronger, thicker and darker but the head remains pale.

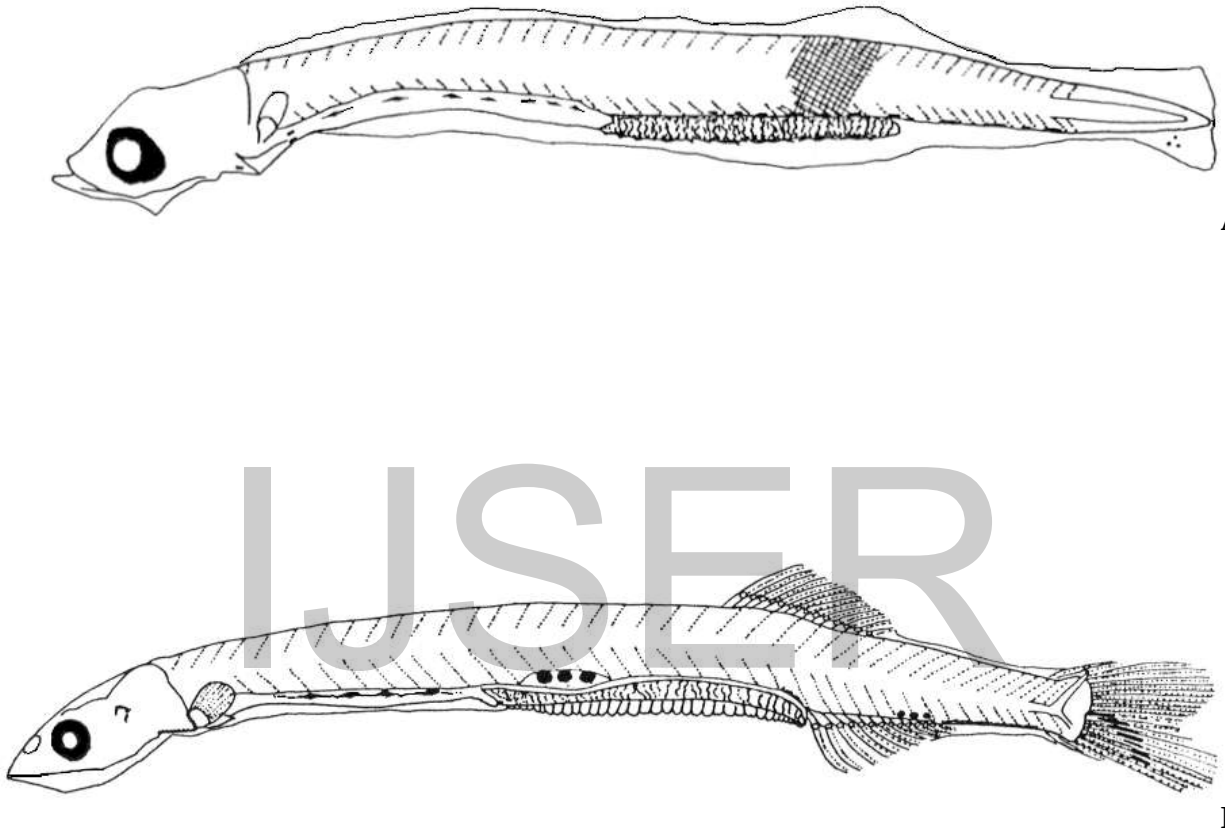


Figure 26. Larvae of *Stolephorus zollingeri* A) 4.425 mm; B) 13.55 mm.

FAMILY GOBIIDAE

(Gobies)

Occurrences: Station No. 28, 32, 46, 53, 56, 61 and 62
Size range 1.05 mm – 7.6 mm
Genus *Gobius*
Species undetermined

Description of larvae

Body elongate, broad and thick anteriorly, narrowing towards tail. Dorsal edge of the body convex whereas the ventral edge of the body more or less straight. Intestine moderate in length. Terminal end of the intestine deflecting obliquely against the body. An air vesicle present in between the lateral line of the body and the dorsal side of the intestine. Head large and smooth. Mouth terminal, opening oblique. lips thick and fleshy. Lower jaw slightly larger and pointed in smaller larvae. Tip of the snout blunt, in larger larvae. Eyes large, round, black and symmetrical from very early larval stage. Dorsal fin two, separated. First dorsal fin with 5 feeble spines. Second dorsal fin and anal fin with 10 soft rays in each. Lobes of spinal dorsal fin much shorter than that of the lobes of soft dorsal fin. Length of the anal fin base equal to the length of the soft dorsal fin. Rays of the dorsal and anal fins long and narrow. Caudal fin round with long rays. Pectoral fin on mid lateral position of the body. Pelvic fin short.

Vertebrae 10 + 16 = 26
11 + 15 = 26

Pigmentation

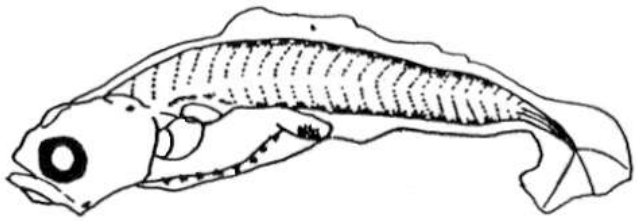
The identification of species, though attempted, was not possible because the literature on these larvae was not enough during this research work. However, different species (types) of gobies larvae are sketched and recognized on the basis of pigment pattern.

Gobius sp. I

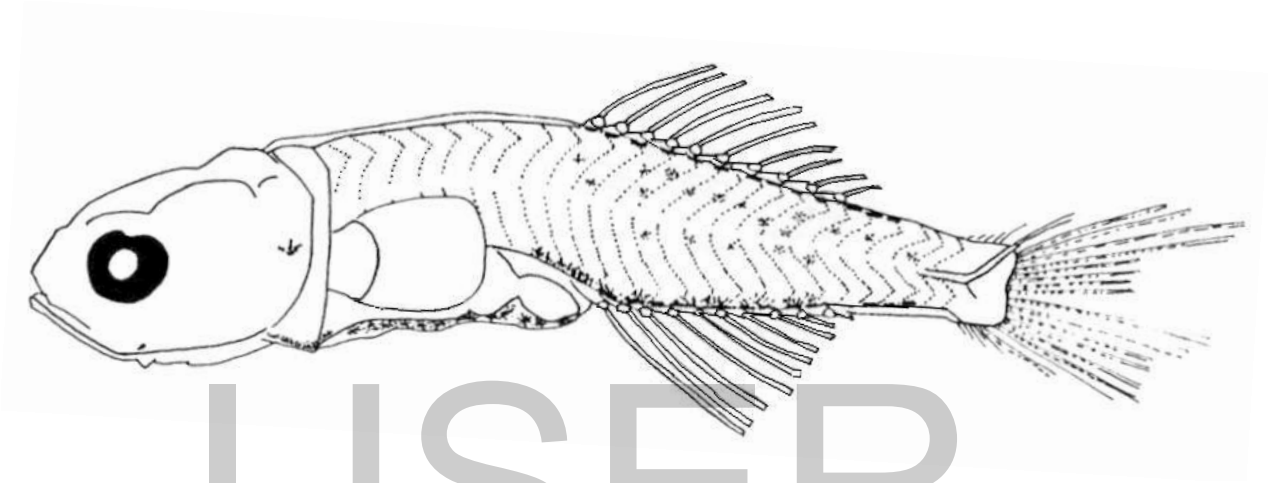
A row of stellate chromatophores on the dorsal and ventral mid ridge of the body, on the dorsal side of the air vesicle and a row on the ventral side of the intestine from its anterior to posterior end. A chromatophore on the articulation of the mandible and on the upper posterior side of the operculum respectively. In addition to this pattern in larger sizes, number of stellate chromatophores appear on the lateral side of the body and pigment dashes appear on somites of tail region. A large arrow-shaped chromatophore on the upper posterior side of operculum and a pigment line at junction of head to remaining part of body.

Colour of the body

Brown.



A



B

Figure 27. Larvae of *Gobius* sp. I A) 2.2 mm; B) 4.2 mm.

***Gobius* sp. II**

A row of pigment dashes on the ventral side of the body. A patch of streaks pigmented lines in the last three fourth part of the body from ventral side as well as from dorsal side. Dorsal side of the air vesicle also pigmented. Ventral side of the intestine with a row of stellate chromatophores, whereas the dorso- and ventro-posterior end of gut darkly pigmented with few wavy pigment streaks moving upward on somites from ventral side above anal end. A v-shaped chromatophore at junction of head to intestine on ventral side, a chromatophore on the articulation of the mandible. On the hypural side of caudal fin origin an expanded chromatophore present.

Colour of the body

Brown.

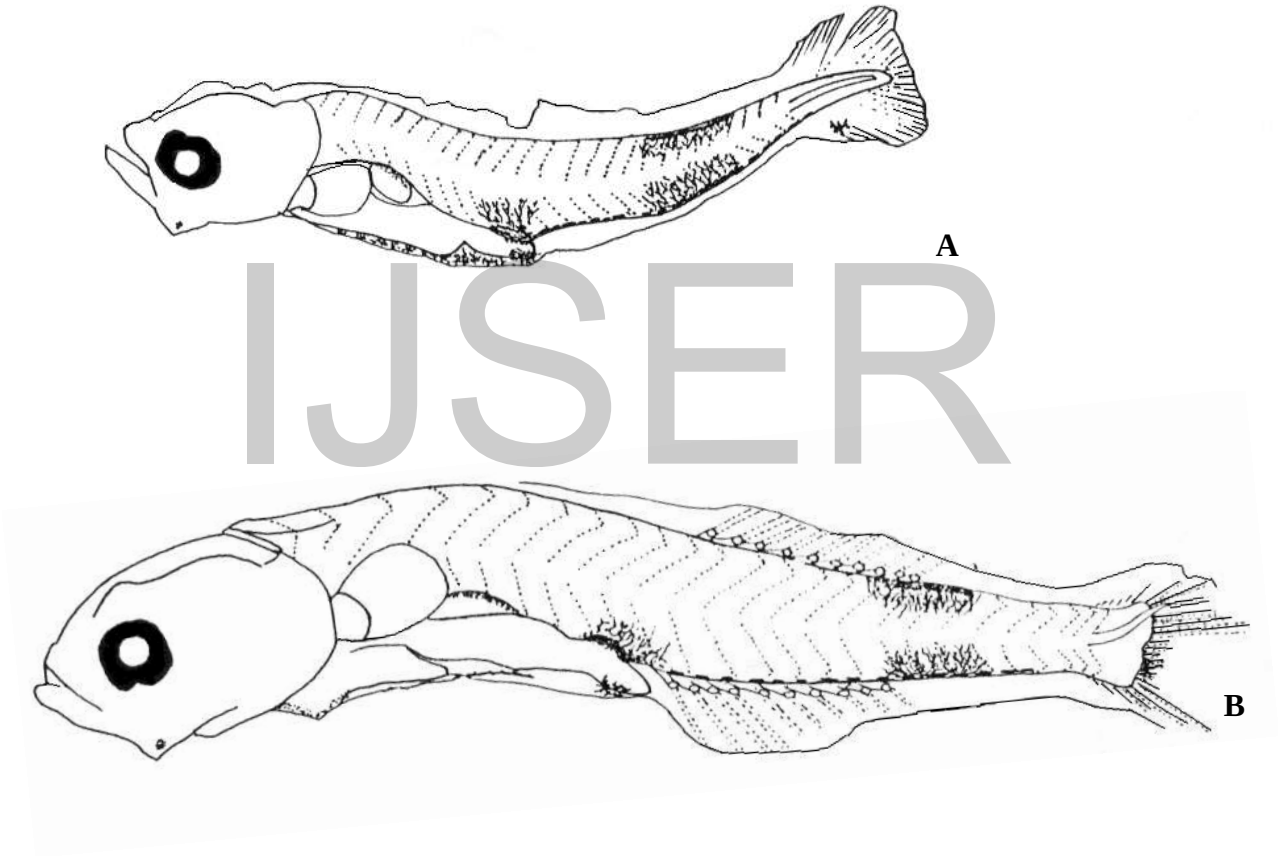


Figure 27 Conti……. Larvae of *Gobius* sp. II A) 3.15 mm; B) 4.4 mm.

***Gobius* sp. III**

A remnant stellate chromatophore on ventral side of the body, above anal fin base, and a dark big wavy patch slightly away from anal fin base. These large expanded stellate chromatophores on ventral side of the intestine, one at antero-ventral and two at its mid ventral portion. Similarly one large stellate chromatophore at the posterio-dorsal side of intestine and one on mid dorsal side of intestine.

Colour of the body

Body light brown, intestine comparatively darker.

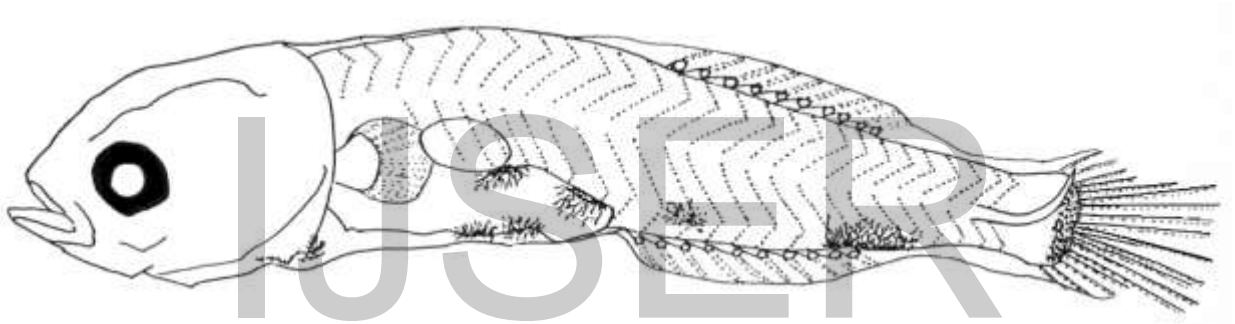


Figure 27 Conti……. Larva of *Gobius* sp. III. 4.425 mm.

***Gobius* sp. IV**

A large patch of stellate chromatophore on the ventral side of the tail away from anal fin with pigment streaks on the somites of tail region. A row of stellate chromatophores on dorsal mid ridge of the body below the dorsal fin base. A dark stellate chromatophore at the dorso-posterior end of the intestine and a few small pigment dashes below its anterio-ventral side. A small chromatophore on the articulation of the mandible.

Colour of the body

Light brown.

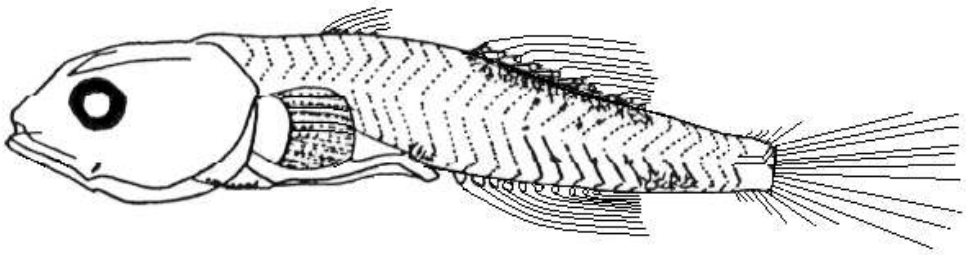


Figure 27 Conti……. Larva of *Gobius* sp. IV 6.175 mm.

***Gobius* sp. V**

No pigment on the body except a row of dash pigments on the mid ventral side of the tail.

Colour of the body

Dark brown.

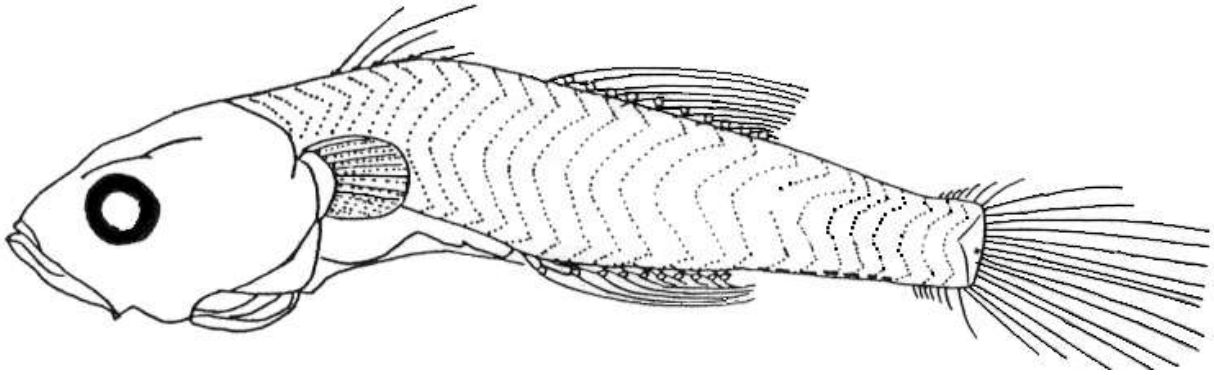


Figure 27 Conti……. Larva of *Gobius* sp. V 7.6 mm.

***Gobius* sp. VI**

A pair of chromatophore on the mid portion of the body i.e. one on the mid dorsal and the other on mid ventral ridge of the body. Pigmentation on dorsal side of air vesicle and a pigment line in between the intestinal connection with that of body.

Colour of the body

Light brown.

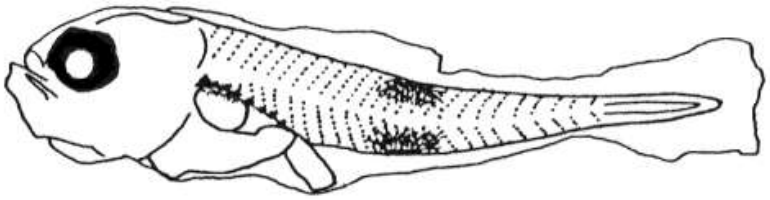


Figure 27 Conti……. Larvae of *Gobius* sp. VI 2.325 mm.

***Gobius* sp. VII**

A row of prominent pigment dashes on the mid ventral side of the tail and a few on dorsal side of air vesicle.

Colour of the body

Brown.

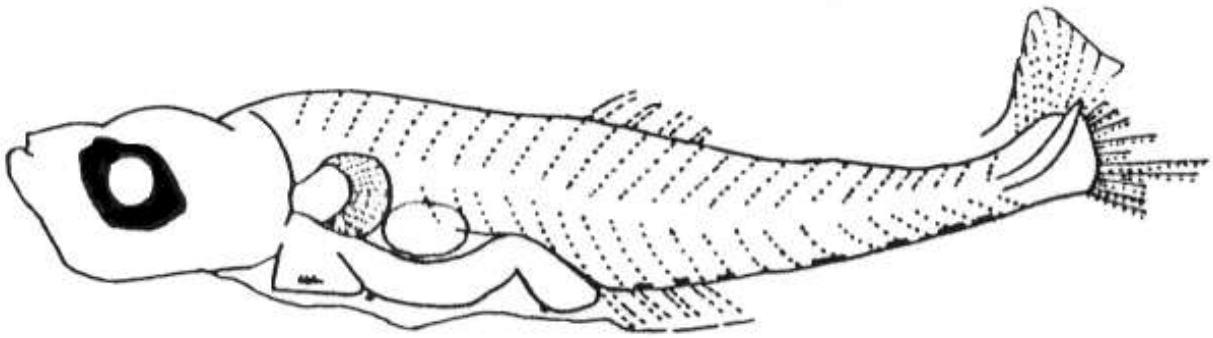


Figure 27 Conti……. Larvae of *Gobius* sp. VII 2.925 mm.

***Gobius* sp. VIII**

Large spread chromatophore on ventral side of the body away from anus. Few pigment dashes in a row on the antero-ventral side of intestine. A pigment line on the dorsal side of the air vesicle and runs posteriorly along the connection of intestine to the body.

Colour of the body

Light brown.

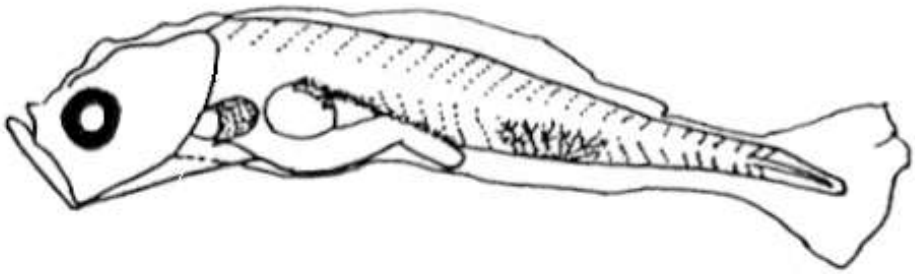


Figure 27 Conti……. Larvae of *Gobius* sp. VIII 2.05 mm.

***Gobius* sp. IX**

Streaks of chromatophores from ventral side of the tail towards myotomes, on the ventral side of intestine and on posterio-dorsal and on ventral end of anus. Pigmentation on the dorsal side of the air vesicle.

Colour of the body

Light brown.

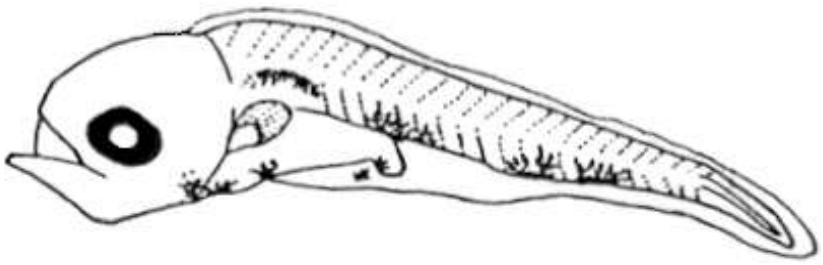


Figure 27 Conti……. Larvae of *Gobius* sp. IX 2.0 mm.

FAMILY GONOSTOMIDAE

(Bristle mouths)

Occurrences: Station No. 05, 12, 14, 24, 26, 28, 32, 46, 53, 55, 56, 58, 61, 64, 72 and 73

Size range 2.7 mm – 12.75 mm

Genus *Vinciguerria*

Species *lucetia* GARMAN, 1899

Description of larvae

Body elongate, slightly compressed laterally, with elongated straight intestine. Intestine cylindrical in shape, smooth and with larval growth the posterior portion deflected obliquely downward from the ventral side of the body. Anus opening present at the extreme posterior end of intestine. Average snout to anus distance about 73.82 % before flexion, which increases to about 79.65 % of the body length during flexion. Head elongate, dorsal profile of the head slightly depressed and concavely sloping anteriorly. Snout prolonged, tip of the snout pointed to slightly blunt. Mouth large, opening oblique and terminal in position. Pointed teeth present in jaws. Eyes large, slightly tubular, inter-orbital width narrow. Origin of the anal fin beneath the end of dorsal fin. Pectoral fin low on the body. Caudal fin forked. Rays of caudal fin are comparatively larger than dorsal and anal fin rays. Pelvic fin originates in the second half of the body length. Notochord starts moving upward in larva of 5.075 mm. Flexion found completed in larva of 13 mm.

Vertebrae 24 + 15 +39

Pigmentation

In 3.375 mm larva, a few pigment spots in a row above intestine on lateral side of the body.

In 12.7 mm larva, a few stellate chromatophores on the posterior side of anal fin and a large, persistent stellate chromatophore on the mid ventral side of the tail near caudal fin origin. Few pigment streaks at caudal fin origin.

Photophore development

In larvae of 12.7 mm, following paired photophores were also found developed.

Lateral series	=	OA	19 – 20 (?)
Ventral series posterior to anal fin origin	=	AC	15
Operculum Photophores	=	OP	2
Close to orbit	=	ORBS	2

Colour of the Photophores

Pale golden-yellowish.

Colour of the body

Pale brown to dark-brown.

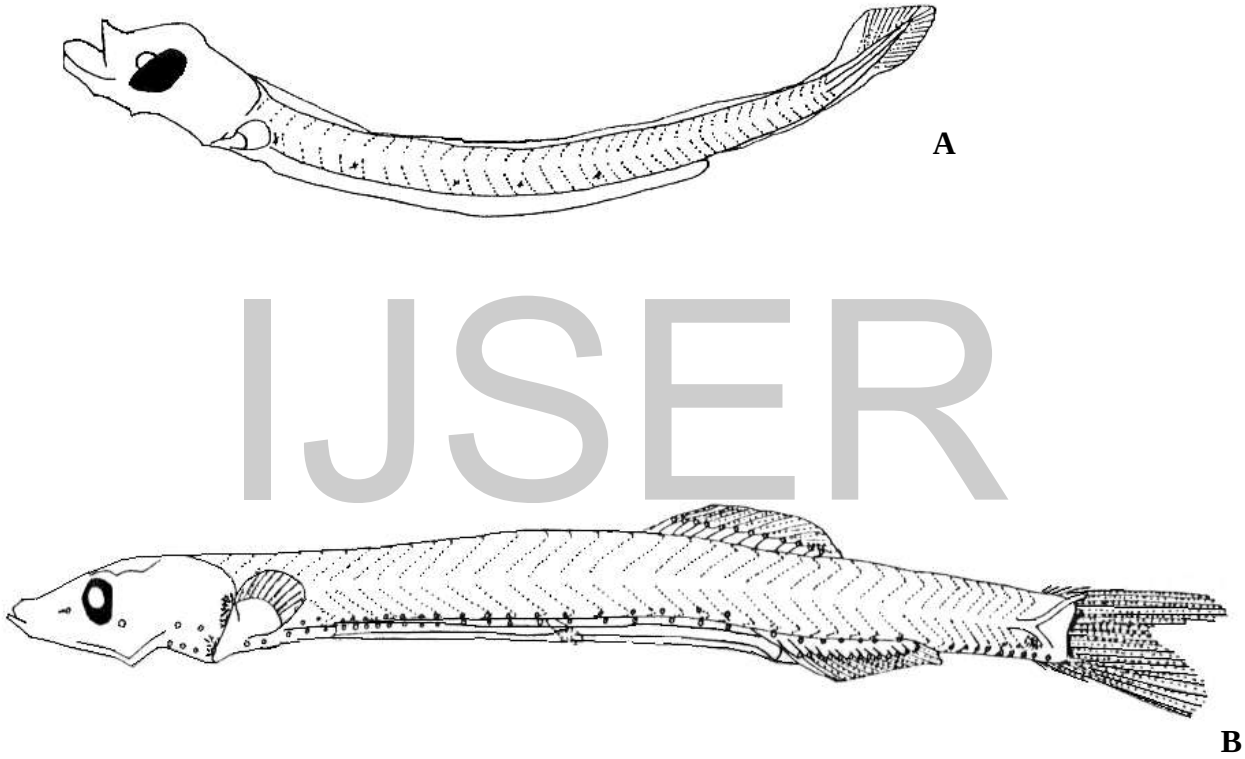


Figure 28. Larvae of *Vinciguerria lucetia* A) 3.375; B) 12.7 mm.

FAMILY LUTJANIDAE

(Snappers, jobfishes)

Occurrence: Station No. 28
Size range Single, 5.06 mm
Genus Undetermined
Species Undetermined

Description of larva

Body oblong, moderately elongate, evenly decreasing in breath posteriorly. Snout-anus distance 51 percent of the body length. Stomach bag-shaped with a short protruding intestine reflecting obliquely downward from the ventral side of the body. Head broad, dorsal profile of head convex. Mouth small, terminal with thick lips. Tip of the snout blunt. Operculum with fine and hard spines. Eyes large, round and symmetrical in the middle of the head. Fin-fold transparent, continuous, from nape, around the tail to the posterior end of the intestine. Signs of long-based dorsal fin with 20 developing rays and short-based anal fin with 10 developing rays. Caudal fin with 14 developing rays from two lobes of the tail. Pectoral fin large, round, with 8 developed rays. Notochord moving upward at its posterior side.

Vertebrae 9 – 10 (?) + 15 = 24 - 25 (?)

Pigmentation

Three pigment spots on the dorsal side of the head. Three small pigment spots on the ventral side of body on anal fin base and three beyond its on caudal peduncle. Dark pigmentation in between the gut junction with the body.

Colour of the body

Brown.

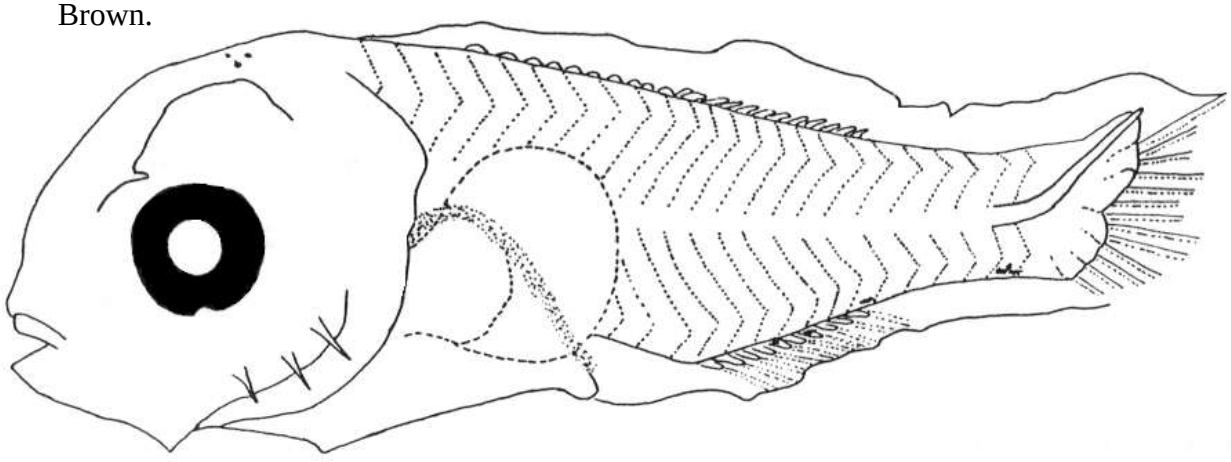


Figure 29. Larva of Lutjanidae 5.06 mm.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 05, 07, 12, 14, 24, 26, 28. 32, 40, 45, 46, 47, 53, 55, 56, 58, 61, 62, 64, 72 and 73

Size range 1.70 mm - 10.8 mm

Genus *Benthosema*

Species *pterotum* ALCOCK, 1891

Description of larvae

Body slender during early development, but stubbier later as the body depth increases steadily during and after notochord flexion. Gut length moderate throughout the larval period. Intestinal diameter uniform in smaller larvae, later the anterior part of it enlarges, while posterior short portion changes little and deflected obliquely downward from the ventral side of the body. Head round, but appears wedge-shaped from lateral view after the completion of notochord flexion. The dorsal profile of the snout slightly concave in early larval stages, but become straight to slightly convex in larvae larger than 5.0 mm. Lower jaw slightly larger than upper jaw in smaller larvae, but in larger size larvae the tip of the snout blunt. Eyes elliptical during early larval stages and nearly round during late larval stages. Eye-drop development start at the time of upward movement of posterior part of notochord, but at transformation stage, there is no choroid tissue on the ventral side of the eye. The development of the anal fin rays starts first than the dorsal fin rays. Anal fin base distinctly longer than the dorsal fin base. Depressions are found at the origin of fin and at the adipose fin origin. At transformation stage there are 10 superior and 9 interior principal caudal rays. Notochord flexion begins in larvae of about 4 mm and completed in 6 mm.

Vertebrae 11 - 12 + 20 - 21 = 31 - 33

Pigmentation

A pigmented spot on the symphysis of lower jaw. Four pairs of chromatophores along the gut present, a ventero-lateral pair at the cleithrum, a dorso-ventral pair on the free terminal section of the gut, and two pairs on the free terminal section of the gut and two pairs on the lateral surface. A series of chromatophores on the ventral mid line of the tail. Larger specimens having only a single chromatophore midway along the tail.

Photophores developments

In transformation stage (10.8 mm) following photophores were found:-

Anterior orbital organ = Ant 1

Anal organ	=	AO	6
Branchiostegal organs	=	Br	2
Operculum organs	=	OP	2
Supra pectoral organ	=	PLO	1
Pectoral organ	=	PO	4
Sub pectoral organ	=	PVO	1
Supra anal organ	=	SAO	2
Supra ventral organ	=	VLO	1
Ventral organ	=	VO	2

Colour of the body

Pale brown to brown.

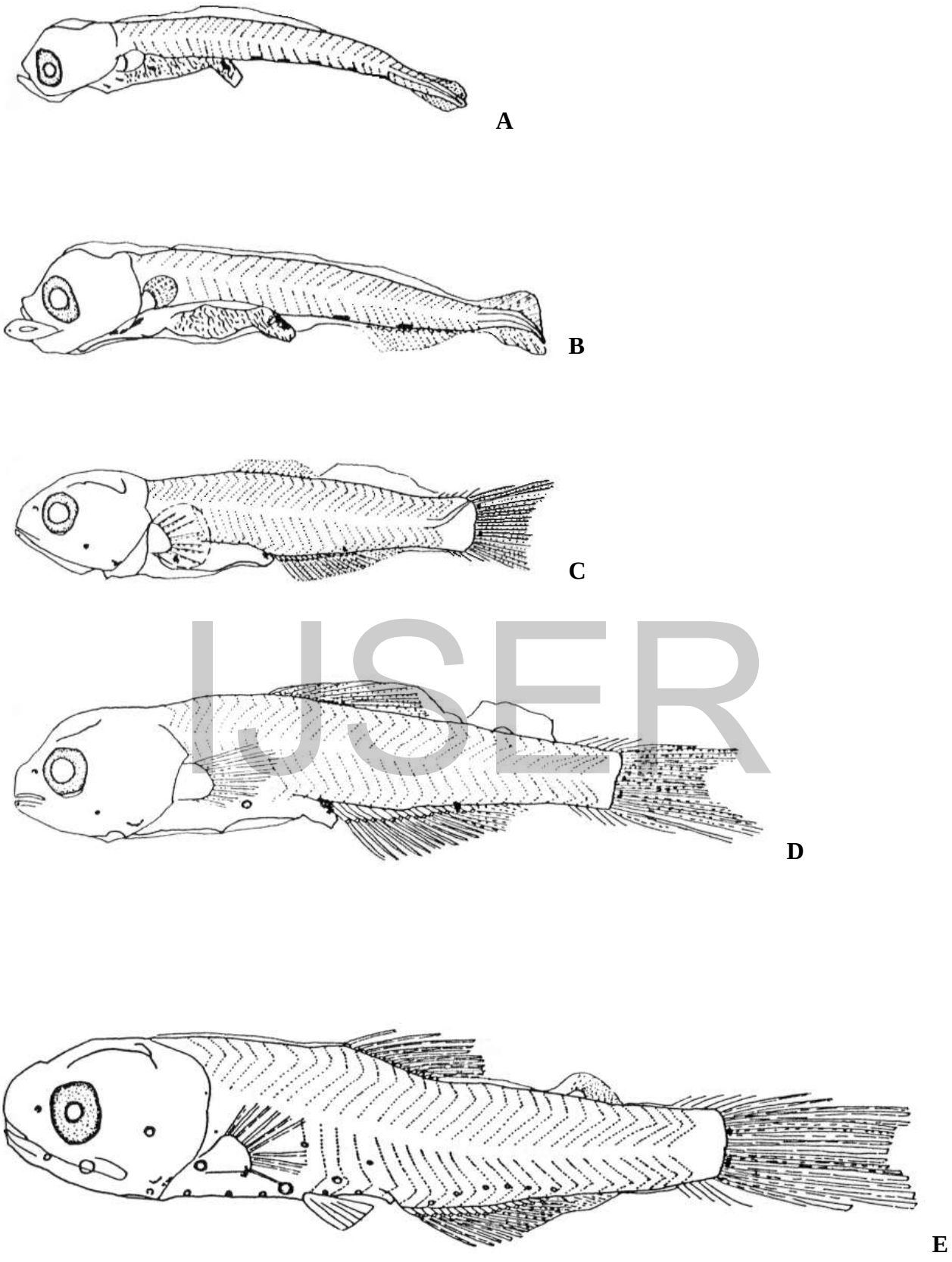


Figure 30. Larvae of *Benthosema pterotum*, A) 2.475 mm; B) 2.875 mm; C) 5.725 mm; D) 7.538 mm; E) 10.8 mm.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 12 14, 24, 26, 28, 32, 53. 56, 72, and 73
Size range 1.825 mm - 7.425 mm
Genus *Diaphus*
Species *splendidus* BRAUER, 1904

Description of larvae

Body slender but depth of the body, increasing steadily during and after notochord flexion. Snout-anus distance 49-50 percent in 3-4 mm larvae, 52-56 percent in 4-5 mm, 56-61 percent in 5-6 mm, 59.3 percent in 6-7 mm, and 61-62 percent in larvae ranging in between 7-8 mm. Gut cylindrical in shape, intermediate in length and increases relative to standard length during larval development, making a slight curve in its mid-part. Whereas the short end of the intestine deflected obliquely downward from the ventral side of the body. Head short and ovoid to oval in shape. Snout short, tip of the snout slightly pointed in smaller size, but blunt in developed larvae. Length of the snout shorter than the eye diameter. Eyes large, slightly elliptical in smaller size, and rounded in larvae of 3.0 mm and above, carrying short choroid tissue on ventral side of the eyes.

The photophores on the dorsonasal organ (Dn) supra orbital organ (Suo) and ventronasal organ (Vn) completely developed in 7.425 mm larva. Dn short, Suo elongated, reaching above the Dn, and Vn starting from the anterior side of the eye. Dn is smaller than the size of nasal rosette. Gill rakers 16 - 17. The development of the first caudal fin rays starts in larvae above 4.0 mm. Dorsal fin rays develop first at size above 4.5 mm, while the anal fin rays appear away from anus at this size. In 7.425 mm larva, anal fin originates closer to anus. Base of the pectoral fin paddle-shaped with large fin rays. Pectoral fin rays not correctly countable.

Vertebrae 16 + 16 - 18 = 32 - 34

Pigmentation

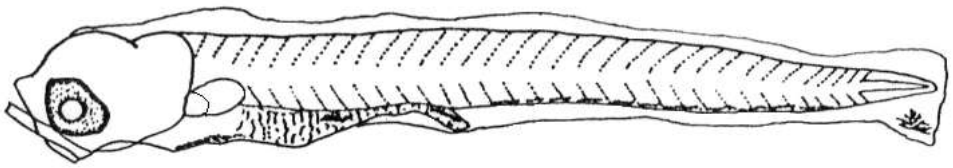
In smaller larvae the anterior, mid, and posterior part of the gut is pigmented with streaks of pigmented lines. Later cohescent with larval development. Terminal gut pigment remains dark throughout larval development. Dash-pigments in a row on the ventral side of the body which looks as remnant pigments on the body in larger size larvae. In ventral view of body a single pigmented line is visible.

In larva of 7.425 mm, 4 prominent chromatophores on gut region and 4 on anal fin region. The: photophores on the posterior anal organ (AOP) not developed, but is heavily pigmented in

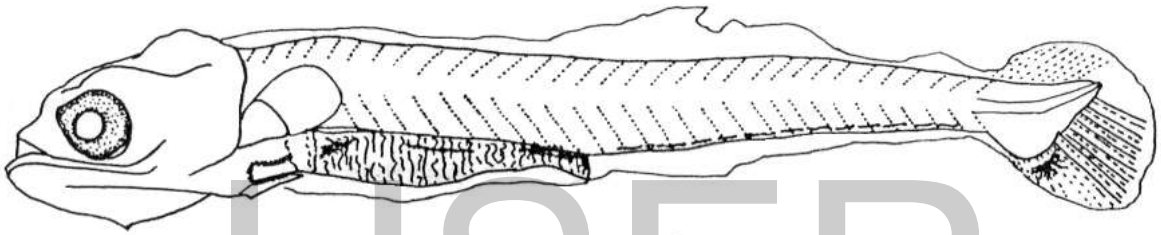
ventral view. A persistent pigment in the caudal region on hypural side of the tail remains throughout the larval growth. Streaks of pigment on caudal fin rays in 7.425 mm larva.

Colour of the body

Light brown to dark brown.



A



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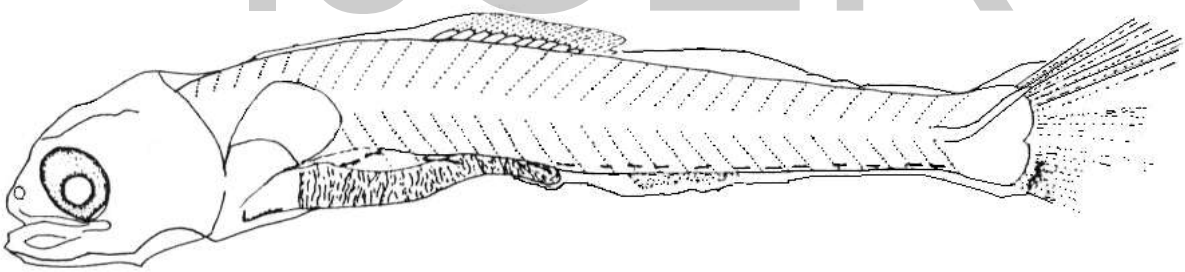

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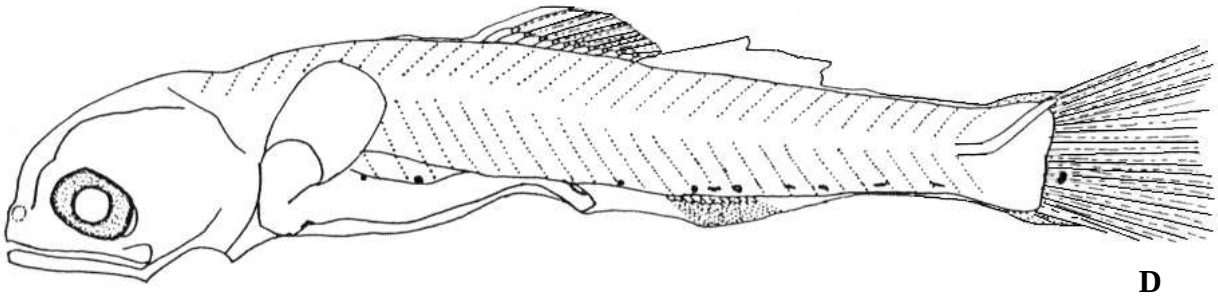
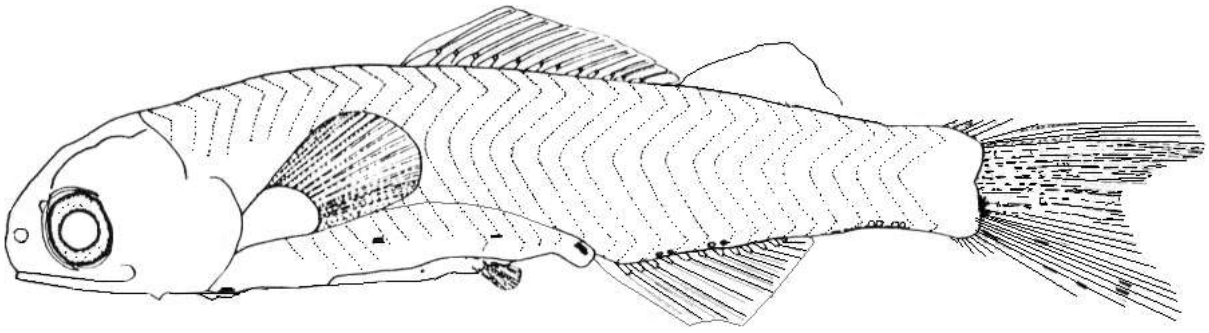


D



E

Figure 31. Larvae of *Diaphus splendidus*, A) 3.425 mm; B) 4.05 mm; C) 4.525 mm; D) 75 mm; E) 7.425 mm.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 26, 28 and 32
Size range 3.75 mm - 7.875 mm
Genus *Diaphus*
Species undetermined

Description of larvae

Body stubby type and deeper. Smaller larvae tapering evenly towards tail region. Body depth increases from 20 to 25 percent of the body length during notochord flexion and upto 28 percent in the largest larva of 7.875 mm. Gut moderate in length, and has two distinct parts: anterior part has large diameter which constitute about two - third of the intestine, posterior part with uniform diameter makes up the remaining one - third. Posterior intestinal end slight oblique deflecting at the ventral side of the body. Head large, bulbous. Head -length 29-30 percent of the body length during and after flexion. Tip of the snout blunt. Eyes large, round, carrying short choroid tissue on ventral side of the eyes. Eye diameter greater than the snout length. Gill rakers 16, counted with slight doubt. Dorsal and anal fin rays nearly completely developed in larvae of 5.4 mm. Pectoral fin large and fan shaped. Pelvic fin rays countable in 7.875 mm.

Vertebrae 16 + 17 - 18 = 33- 34

Pigmentation

Scantly pigmented larvae. Smaller sized larvae with 2 pigment spots in the gut region. One persistent on the anterio-ventral part of intestine and one on its posterio- dorsal part. In larger size, 2 additional pigment spots on the mid part of the gut. In tail region, a single persistent chromatophore on the posterior end of anal fin base and another at caudal fin origin on hypural, later one more appears on the epiural side.

Colour of the body

Pale to dark brown.

Remarks

Our larvae agree totally, when compared with the published drawings of *Myctophum* by SPARTA (1952) and *Diaphus* by MOSER and AHLSTROM (1974). The former author's identification is based only on the body shape, position of dorsal and anal fins and the pigment

pattern. On the contrary MOSER and AHLSTROM (1974) studied the larvae in detail and had sufficient amount of comparative material from all oceans. According to them there are two basic larval types in *Diaphus*. One has slender body, small head, and a series of persistent melanophores on the ventral mid line of the tail. Other type has a deeper body, bulbous head and a single persistent ventral tail melanophore, or none. Our specimen are more closer to the later authors for having round eyes with short choroid tissue on ventral side of the eyes, and 16 gill rakers. One of the most important characters of *Myctophum* larvae include narrowed eyes with long prominent eye drop, and the eye diameter greater than snout-length which lack in *Diaphus*. It is strongly believed that SPARTA's (1952) identification may not be very correct.

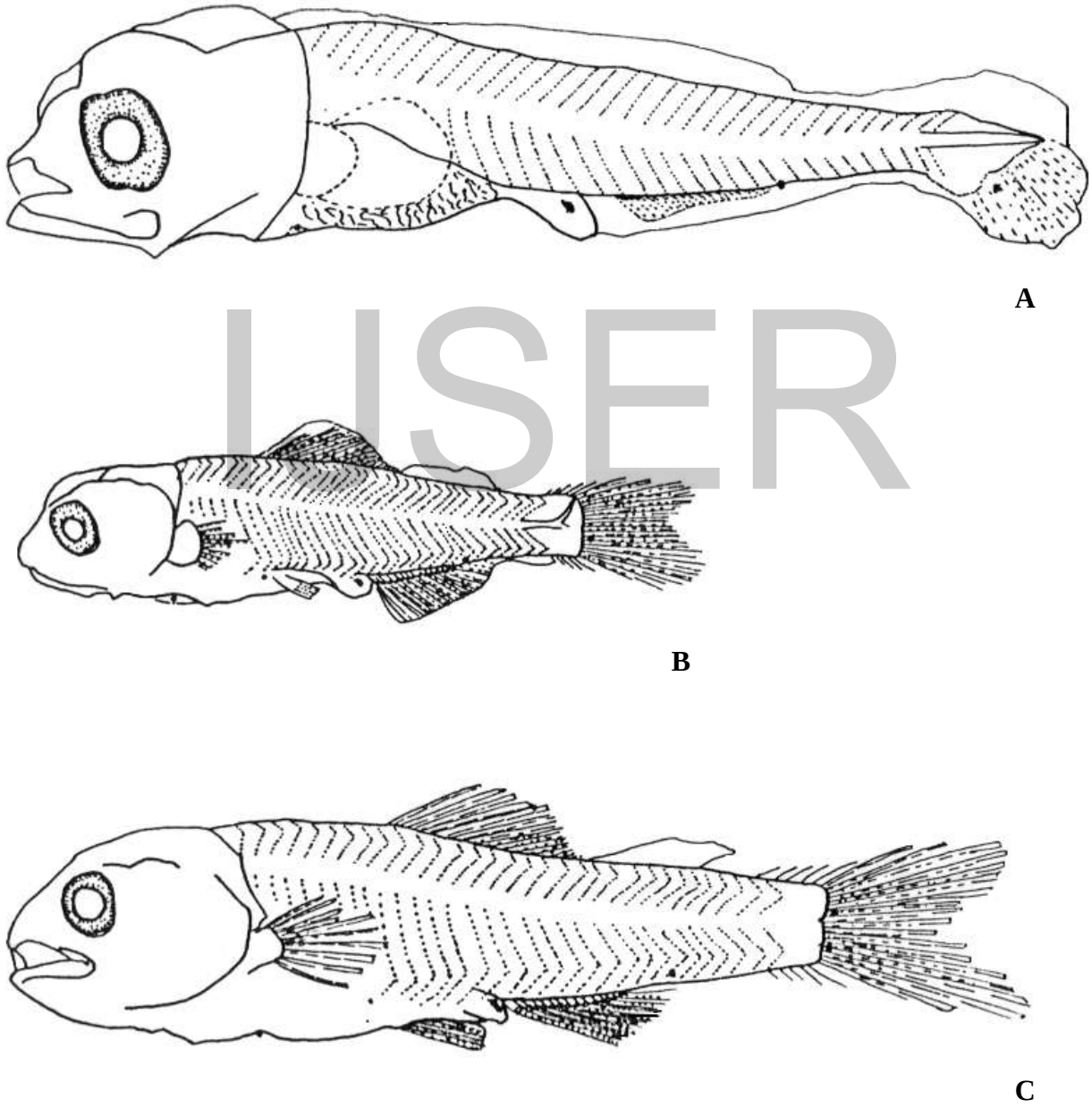


Figure 32. Larvae of *Diaphus* sp. A) 3.975 mm; B) 5.425 mm; C) 7.875.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 24, 40 and 73
Size range 2.375 mm - 5.24 mm
Genus *Hygophum*
Species undetermined

Description of larvae

Body slender with elongate gut. In larvae between 2.5 - 5.24 mm, snout-anus distance 59-62 percent of the body length. Gut straight, cylindrical in shape, except that the short free terminal end making an arch. Head slightly elongate, oval in shape. Snout short and pointed. Eyes small and elliptical, carrying prominent choroid tissue on ventral side of the eyes. Only sign of anal fin development appears with 10 rays in larva of 5.24 mm. Remaining body still with dorsal and anal fin fold. Pectoral fin with paddle like base and 6 developed rays. Caudal fin also with developing rays. Notochord flexion starts at the same size.

Vertebrae 16 - 18 + 18 = 34 – 36

Pigmentation

Smaller larvae more pigmented. Wavy pigmented lines on anterior mid and posterior side of the gut. In tail region the pigmented streaks on myotomes from ventral to dorsal side of body, at a later stage, a single stellate chromatophore appears at the anal fin base. Two to three prominent stellate chromatophores found in smaller larvae on the edge of dorsal finfold, which are not reported elsewhere before, in *Hygophum*. An stellate chromatophore on the tip of the lower jaw, another on the hypural side of the caudal fin base and a few pigment streaks on the developing caudal rays in the larva of 5.24 mm.

Colour of the body

Brown.

Remarks

These specimens resembling to the larvae of *Hygophum reinhardtii* (MOSER and AHLSTROM, 1970) in morphology, pigmented bars in tail region, and the ratios of snout-anus distance to the standard length except that the presence of 3 chromatophores at dorsal fin fold edge, not seen in the available literature on *Hygophum* larvae.

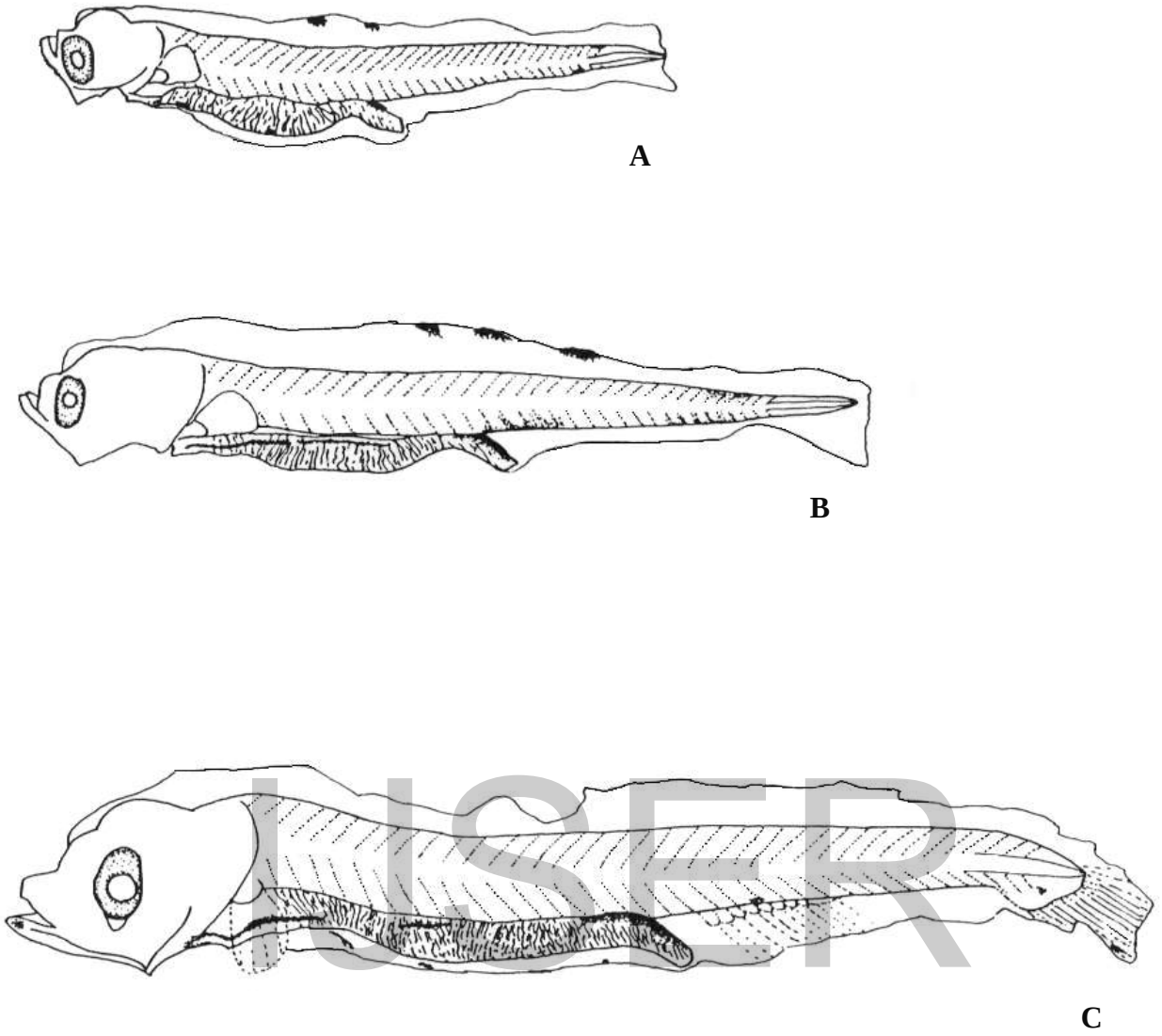


Figure 33. Larvae of *Hygophum* sp. A) 2.45 mm; B) 3.2 mm; C) 5.24 mm.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 24, 53 and 72
Size range 1.85 mm - 3.2 mm
Genus Undetermined (I)
Species undetermined

Description of larvae

Body slender, elongate, tapering towards tail. Larvae thinner, not much broadened, enclosed in a thin membranous sheet. Anus opening reaching nearly to the mid part of the body. Anterior part of the gut slightly swollen than the posterior cylindrical part. Head small, round, with small oblique mouth opening. Tip of the snout blunt. Eye diameter greater than snout length.

Vertebrae 12 + 21 =33

Pigmentation

Four pairs of pigment spots in the gut region. One on the anterio-ventral side, another on the posterio-dorsal side of the gut, remaining two in the mid part of the gut. A series of small dash pigment spot in a row on the mid ventral side of the tail.

Colour of the body

White to light brown.

Remarks

The larvae are in bad condition, identification uncertain.

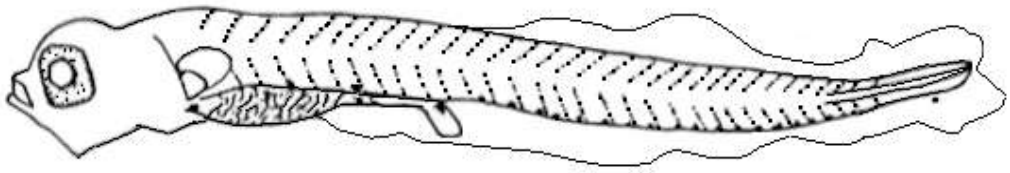


Figure 34. Larva of Myctophidae type I. 2.625 mm.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 24
Size range 2.125 mm - 4.57 mm
Genus Undetermined (II)
Species undetermined

Description of larvae

Body elongate and compressed laterally, tapering towards the posterior side of tail. Body depth increases from 11 - 16 % of the body length before notochord flexion. Gut moderate in length, 2/3rd part of it swollen remaining 1/3rd cylindrical. Posterior short end of it reflected obliquely downward from the ventral side of the body. Head broad. Tip of the snout slightly pointed. Eyes large and round. Mouth opening small, oblique and terminal in position. Pectoral fin fan-shaped without rays. Caudal fin with embryonic rays. No sign of dorsal and anal fin origin.

Vertebrae 13 + 20 =33

Pigmentation

Two pairs of pigment spots, one on anterio-ventral side and the other on posterio-dorsal side of the gut respectively. A series of round pigment spots on the ventral side of the tail region.

Colour of the body

Brown.

Remarks

The identification is very uncertain because the larvae are in bad condition.

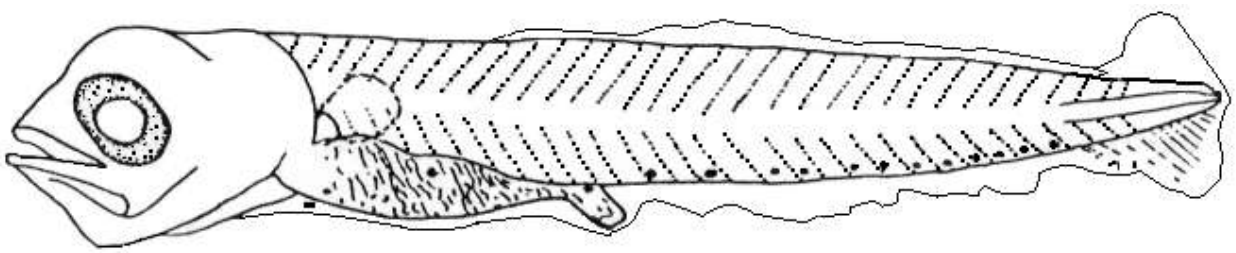


Figure 35. Larva of Myctophidae type II. 3.175 mm.

FAMILY MYCTOPHIDAE

(Lantern fishes)

Occurrences: Station No. 64
Size range Single 3.075 mm
Genus Undetermined (III)
Species undetermined

Remarks

Morphologically (body shape, gut region and head structure etc.) resembling to *Benthosema* larvae but pigment pattern is quite different. Due to the unavailability of comparative material and literature, this larva could not be identified even up to the generic level.

Vertebrae 14 + 20 =34

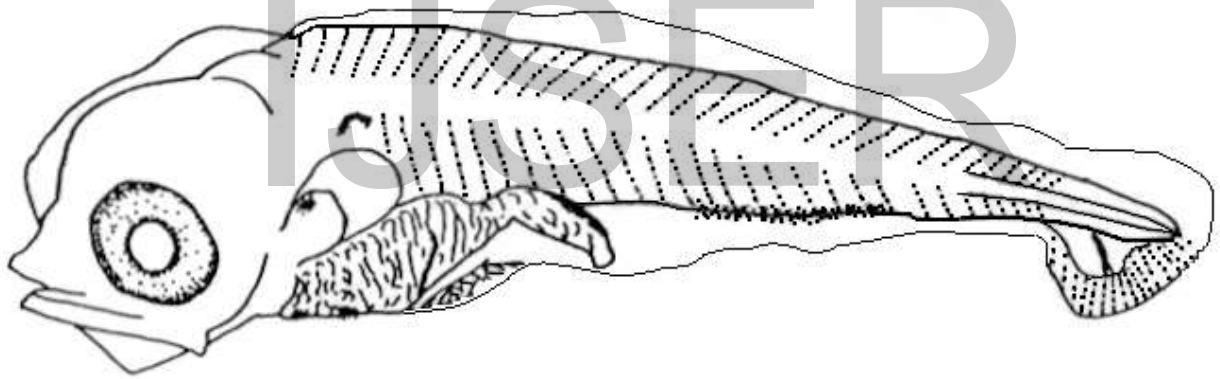


Figure 36. Larva of Myctophidae type III. 3.075 mm.

FAMILY NOMEIDAE

(Bristle mouths)

Occurrences: Station No. 24, 26, 28, 32, 47, 55, 56, 58, 62, 64 and 73

Size range 1.7 mm – 5.5 mm

Genus *Psenes*

Species undetermined

Description of larvae

Body slender, quite deeper and compressed. Intestine terminates in the first half of the body. Snout - anus distance above 50 percent of the body length in the largest larva of 5.5 mm. Stomach round with short protruding intestine, deflecting obliquely against the body in smaller sized larvae later becomes triangular, deeper and closer to head in large size larvae. Head broad and compressed. Dorsal profile of head convex. Mouth opening small, slightly oblique. Lower jaw pointed in smaller larvae. Tip of the snout blunt. Eyes prominent, squarish in smaller sizes but round, large and symmetrical in larger size larvae. Transparent fin fold remains complete and extends from the nape, around the tail and forwarded to the abdomen in smaller sizes. Development of the fin rays starts in larvae above 3.5 mm. Two dorsal fins, first with shorter fin base and lobes with slender spines, second with longer fin base and lobes with soft fin rays. Anal fin with long base more or less equal to 2nd dorsal fin base. Caudal fin starts bifurcation with two lobes in larvae above 4 mm. Pectoral fin large, fan-shaped, rays originating from the knobs. Pelvic fin attached to abdomen with a thin membrane, and greatly extended, originating directly under posterior end of pectoral fin base and reaching to anus. Notochord straight, start deflecting upward at its posterior end in larvae above 3.8 mm and found flexed in largest size larva of 5.5 mm.

Vertebrae $8 + 22 - 23 = 30 - 31$

Pigmentation

Larvae smaller than 2 mm having no pigment dots over head. But the pigmentation noted on the dorsal side of digestive system with that of body. Few stellate chromatophores on the ventral side of the stomach and a row of prominent pigment dashes close together on the mid ventral line of the tail.

In larva of 2.025 mm, these dashes are completely separated into prominent round dots, whereas in 3 mm larvae few dots appear on head, few on ventral side of stomach, a row of 17-20 dots on ventral mid line, and 3 dots near ventral side of cauda1 fin fold. With increase in size (i.e., above 5 mm) concentration of stellate chromatophores increase in numbers on the dorsal side of the

head and operculum. Few at the base of pelvic fin. Row of remnant pigment dots present in between mid lateral line and the mid ventral side of the tail. Two stellate chromatophores develop on the mid line, and two near caudal lobes.

Colour of the Body

Light brown body . Mid lateral site of the body comparatively paler than dorsal and ventral sides.

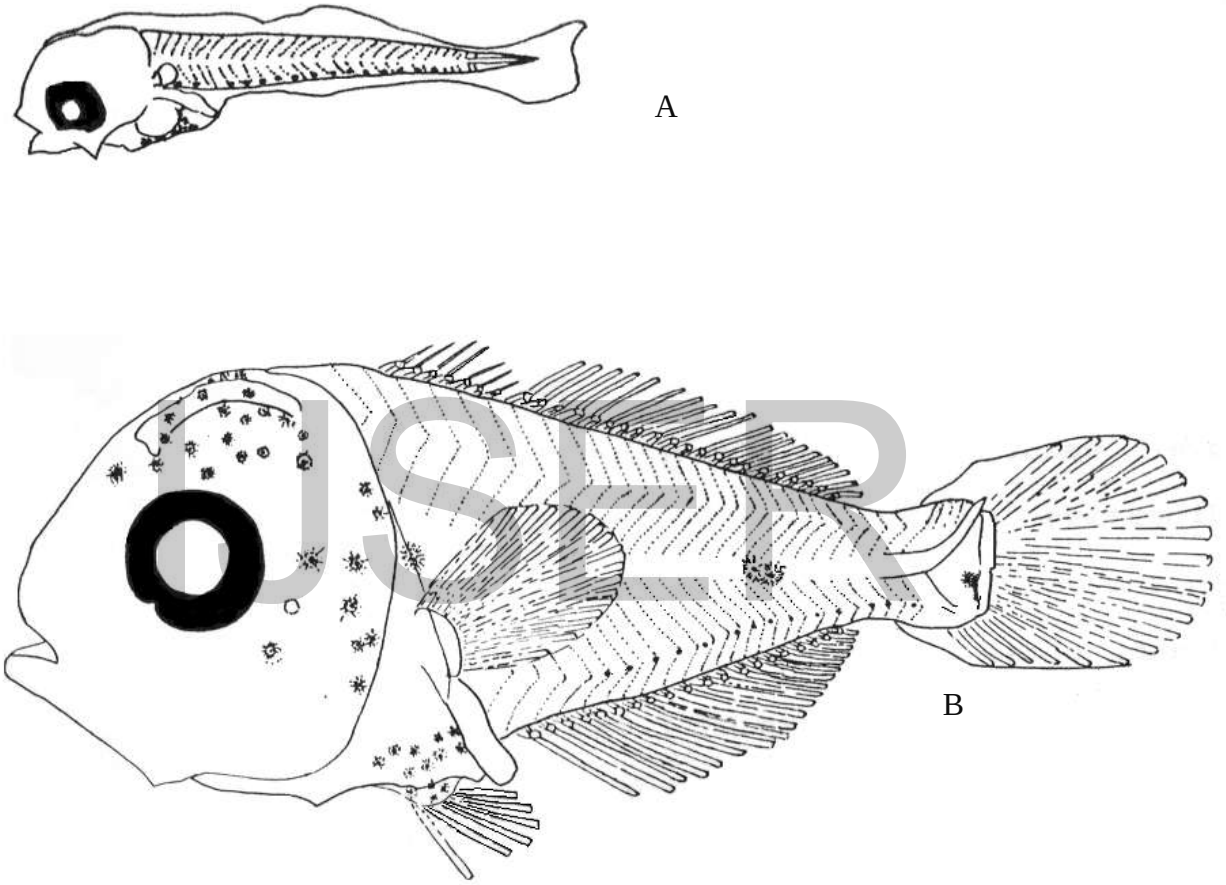


Figure 37. Larvae of *Psenes* sp. A) 2.025 mm; B) 5.5 mm.

FAMILY PARALEPIDIDAE

(Barracudinas)

Occurrences: Station No. 53, 55, 56, 61, and 64
Size range 2.57 mm – 6.775 mm
Genus *Lestidiops*
Species *Jayakari* (BOULENGER, 1889)

Description of larvae

Body extremely elongate, cylindrical, slightly compressed and tapering towards the posterior end. Gut much shorter than the body length. Gut with two distinct regions. Anteriorly with large diameter which gradually decreases in diameter posteriorly. Last short posterior part deflecting obliquely from the ventral side of the body. Head large with pointed snout. Snout bent upward. Lower jaw projecting slightly beyond the upper jaw. Mouth opening large, oblique, reaching beyond anterior margin of the eyes. Eyes large and oval. Smaller larvae enclosed in transparent sheath. In larger larvae, long based anal fin starts developing beyond the mid of the body which is posteriorly in continuation with the developing caudal fin rays. No sign of dorsal or pelvic fin origin. Pectoral fin short, low on the body with indistinct rays. Notochord straight.

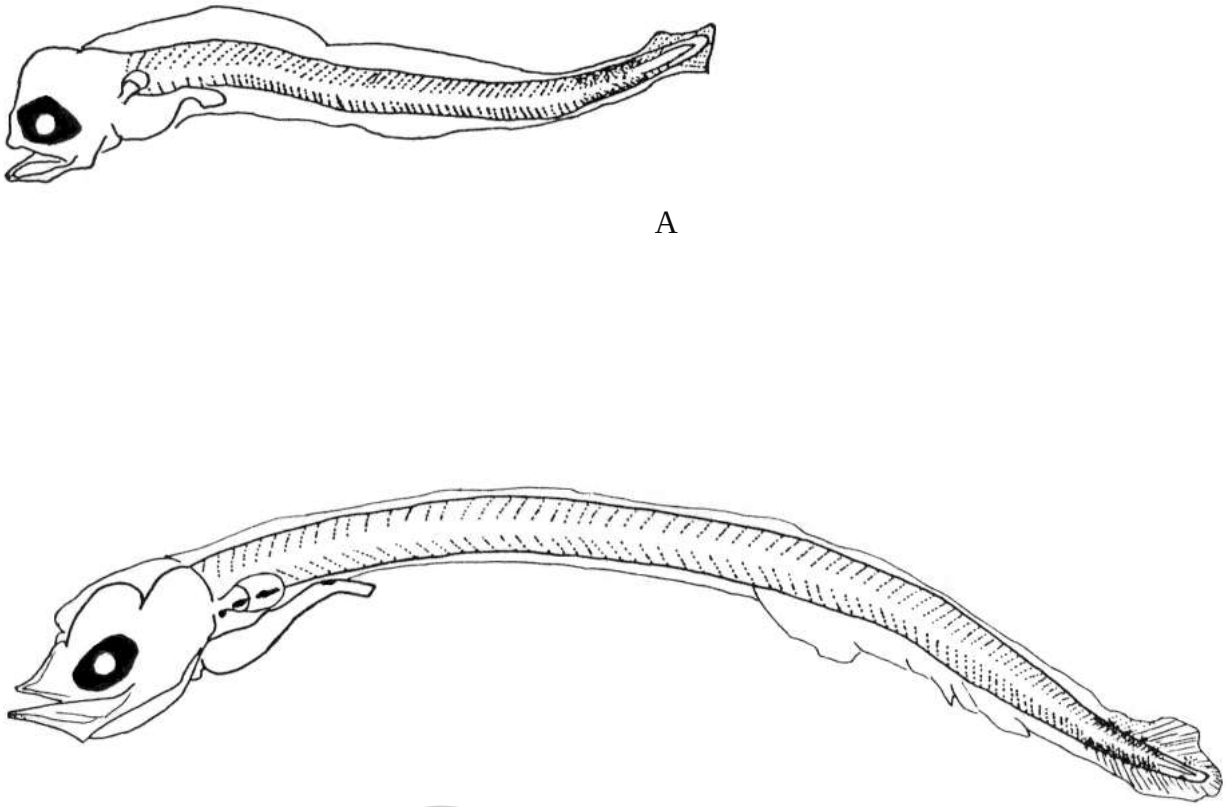
Vertebrae 9 - 10 + 74 = 83 - 84

Pigmentation

Small pigment dots at tip of the snout. Dash pigmentation at base of the pectoral fin and on dorsal side of gut. A short row of stellate chromatophores on mid dorsal and mid ventral ridge of the extreme posterior part of the tail region. Myotomes and developing rays of this region also darkly pigmented.

Colour of the Body

Light brown and yellowish.



A

B

Figure 38. Larvae of *Lestidiops jayakari*. A) 2.75 mm; B) 6.775 mm.

FAMILY PLATYCEPHALIDAE

(Spiny flat-head)

Occurrences: Station No. 26 and 28
Size range 3.375 mm – 7.825 mm
Genus *Platycephalus*
Species undetermined

Description of larvae

3.375 mm: Body elongate, sub-cylindrical, evenly tapering towards the tail. Stomach large, round sac-like with a short protruding intestine, emerging out from its dorsal side, deflecting obliquely from the ventral side of the body. Snout- anus distance 59.25 - 59.74 percent of the body length. Head large, compressed with a depression on dorsal profile infront of eye. Snout slightly bent upward. Operculum with a bunch of delicate spines on its ventral side. In dorsal view, head slightly depressed (7.825 mm larva). Surface of the head smooth. Eyes large, round and symmetrical in both sizes. Mouth large, not reaching to the anterior margin of the eye. Mouth opening oblique. Two dorsal fins. In spiny dorsal fin, 1st spine smallest, 2nd largest, and remaining show gradual decrease in length. A common sheath in between second dorsal fin and anal fin with equal numbers of soft rays. Caudal fin round to truncate with countable rays. Pectoral fin very large and spotted. Pectoral fin-base at the low side of the body. Notochord straight in smaller larvae (3.375 mm) and flexed upward in 7.825 mm larva.

Vertebrae 12 + 15 -17(?) - 27 -29 (?) in size 7.83 mm.

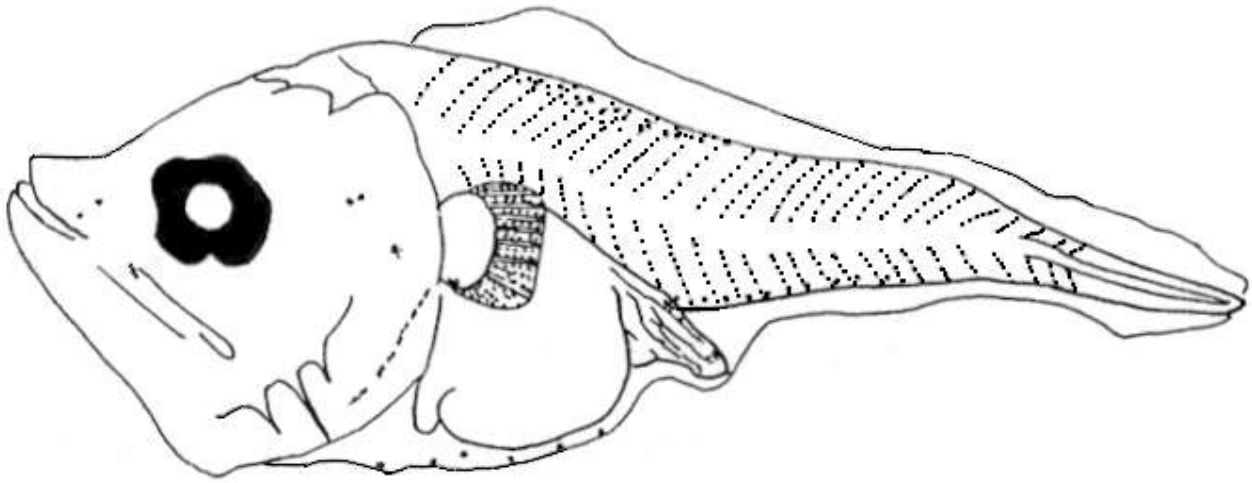
Pigmentation

In 3.375 mm larva, two chromatophores on upper side of snout. Few pigmented dashes on the posterior side of operculum in row. Concentrated pigment spots on the mid dorsal side of the body not reaching beyond vertical line from anus to dorsal edge of body. A row of chromatophores on the posterior-dorsal side of intestine and a few in row on ventral side of the stomach. A short row of pigment spots on the mid ventral side of the tail. Pectoral fin with horizontal lines of pigment spots.

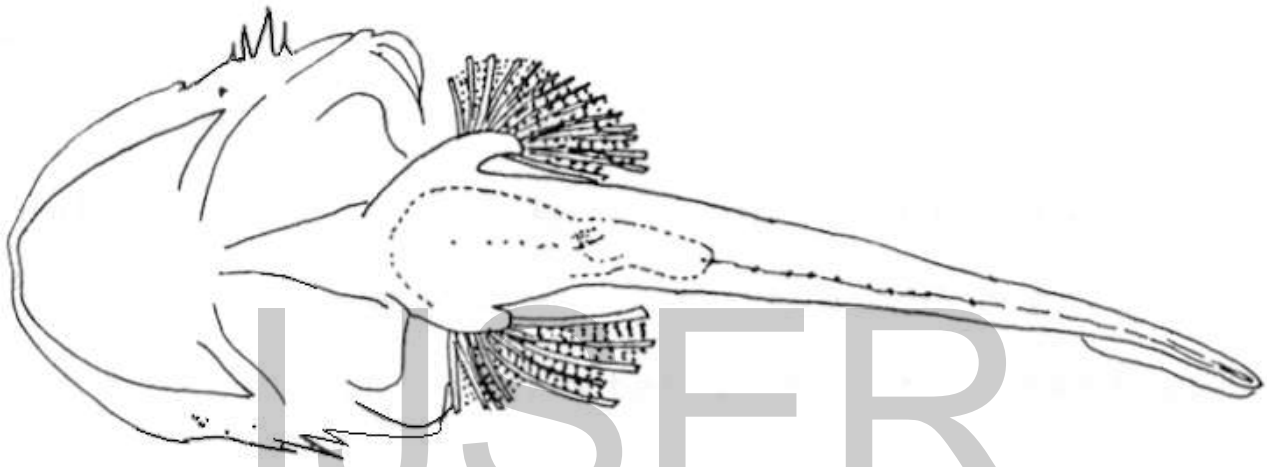
In 7.825 mm larva a row of prominent pigment spots on ventral side of the body on anal fin base. A patch of concentrated pigment spots on dorsal side of the body. Few chromatophores on the dorsal side of the head and few near the spiny region of operculum. Posterio-dorsal and ventral side of rectal portion also pigmented.

Colour of the Body

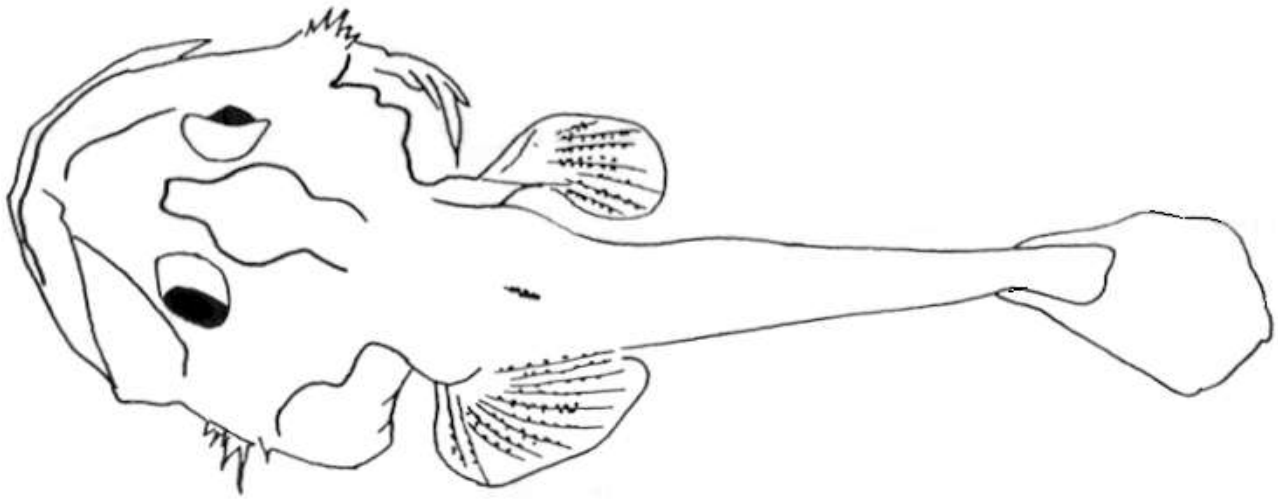
Brown.



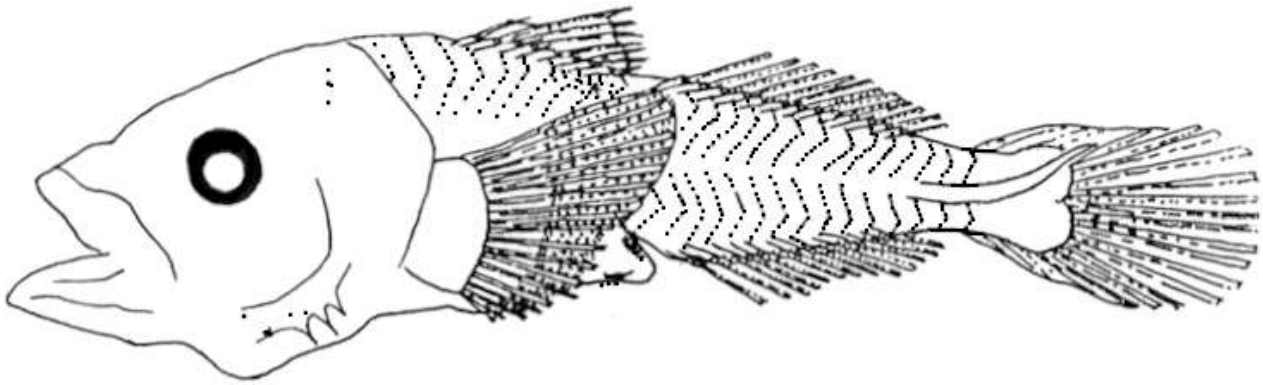
A



B



C



D

Figure 39. Larvae of *Platycephalus* sp. A) 3.375 mm; B) Ventral view; C) Dorsal view; D) 7.825 mm.

FAMILY POMACENTRIDAE

(Damsel fishes)

Occurrences: Station No. 28
Size range Single, 5.9 mm
Genus undetermined (I)
Species undetermined

Description of larva

Body oblong, moderately elongate and fusiform. Stomach large bag-shaped with short protruding intestine horizontally situated along ventral side of the body. Anus opening in the second half of body. Head large, more or less round. Eyes moderate in size, round and symmetrical. Mouth opening large, reaching to the posterior margin of the eye, oblique and terminal in position. Tip of the snout blunt. Two dorsal fins with developing rays, continuous dorsal fin-fold up to caudal fin. Caudal fin with countable rays. Anal fin with short based developing rays, more or less opposite to second fin in position. Anal fin also continuous with anal fin-fold on its anterior and posterior sides. Pectoral fin large, round with countable rays on low side of the body. Notochord flexed upward in 5.9 mm larva.

Vertebrae 13 + 12 = 25

Pigmentation

Ventral side of the stomach with a number of stellate chromatophores and a few on its dorsal edge. A number of chromatophores in bunch in between the dorsal side of stomach and the mid lateral line of the body. A single stellate chromatophore on the dorsal side of head, two on the lower and upper jaw respectively. A single stellate chromatophore on the posterior side of head and one on posterior side of operculum. Four stellate chromatophores on dorsal mid line, out of which 2 before dorsal fin origin, one at anterior side and other on the posterior side of the second dorsal fin base. Similarly two stellate pigments on mid ventral side of the body i.e. one each on anterior and posterior end of anal fin base. One chromatophore on the caudal rays of hypural side.

Colour of the Body

Yellowish brown.

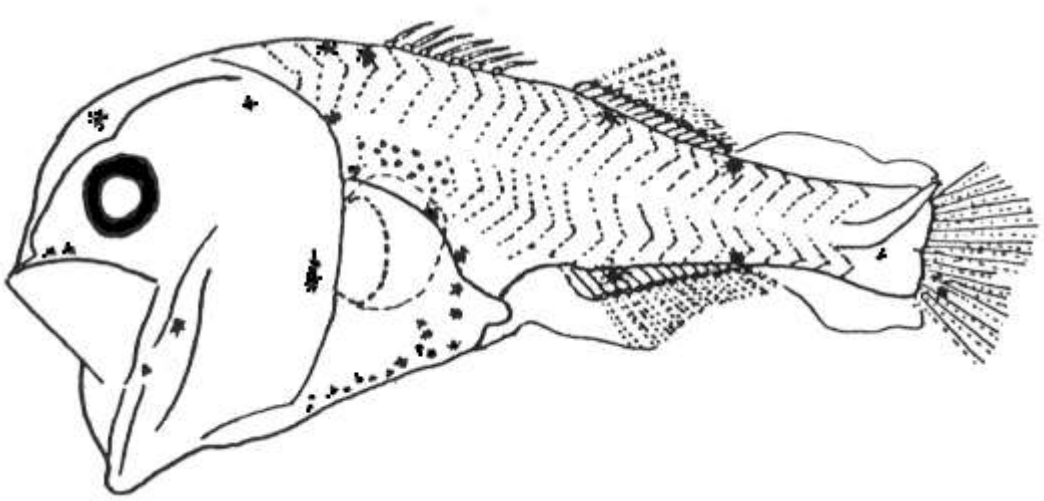


Figure 40. Larva of Pomacentridae type 1: 5.9 mm.

FAMILY POMACENTRIDAE

(Damsel fishes)

Occurrences: Station No. 24
Size range 1.9 mm – 2.7 mm
Genus undetermined (II)
Species undetermined

Description of larva

Morphological characters more or less the same as given for figure 40 except the following: Body moderately compressed. Dorsal profile of head with 2-3 notches. Tip of the snout pointed. Fin-fold transparent, continuous, from nape, around the tail to the posterior end of the intestine with sign of developing embryonic caudal rays. Notochord straight in 2.65 mm.

Vertebrae $11 + 14 = 25$

Pigmentation

A number of chromatophores on the dorsal and posterior dorsal side of head. Snout with chromatophores on its lower and upper portion. Chromatophores on the posterio-dorsal and ventral side of the rectal portion. A single chromatophore on the mid-ventral side of the tail region.

Colour of the Body

Light brown.

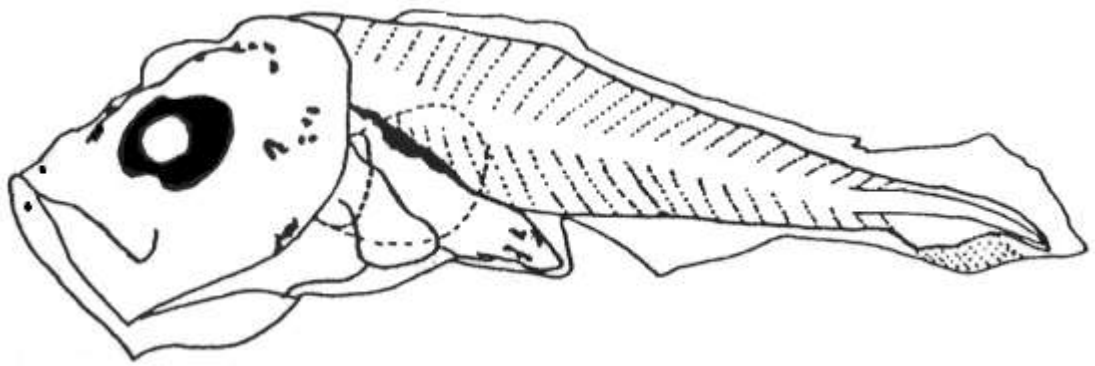


Figure 41. Larva of Pomacentridae type II: 2.65 mm.

FAMILY POMACENTRIDAE

(Damsel fishes)

Occurrences: Station No. 32
Size range 3.7 mm
Genus Undetermined (III)
Species undetermined

Description of larva

Morphological characters more or less the same as given for figure.40 except the following:

Body moderately compressed. Dorsal profile of head with notch in front of the eye. Mouth small with thick lips, opening oblique and terminal in position. Tip of the snout blunt. Body covered with fin-fold, with sign of developing anal fin base and a few countable caudal fin rays. Pectoral fin large, round with developing rays. Notochord moving upward from posterior end.

Vertebrae $7 - 9\ (?) + 17 = 24 - 26\ (?)$

Pigmentation

Seven small chromatophores on the dorsal side of the head, a single small chromatophore on the posterior side of operculum and on the ventral side of operculum. Three dark black coloured blotches embedded in the muscles of dorsal side of the body behind head, one on the body below the pectoral fin base and one at junction of rectal portion to the body respectively. Few chromatophores on the dorso-lateral and mid-lateral side of the body. Two chromatophores on the mid ventral side of the tail region. One chromatophore on the ventral side of the tail at the of anal fin base and one beyond it. A single chromatophore on caudal fin fold. Similarly 3 small chromatophores on the body region below pectoral fin base.

Colour of the Body

Brown.

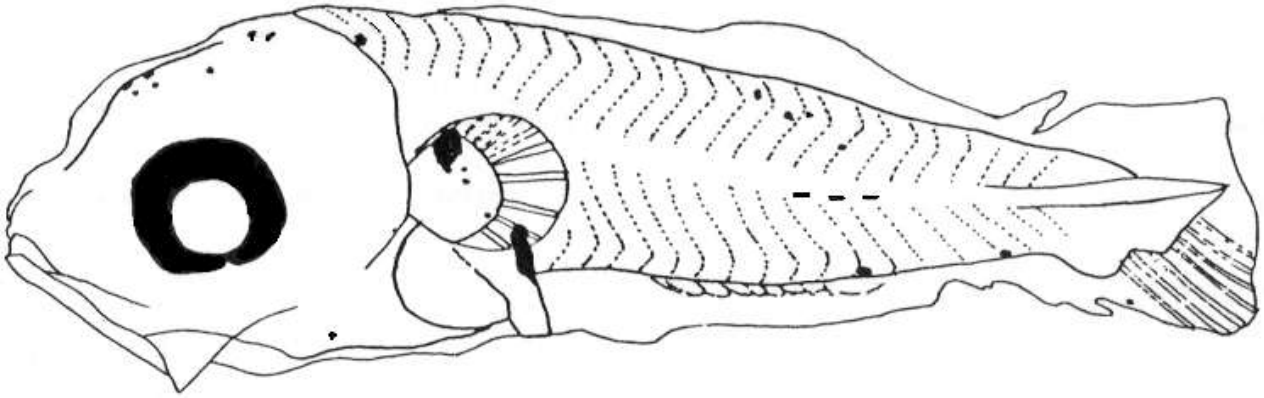


Figure 42. Larva of Pomacentridae type III: 3.7 mm.

FAMILY POMADASYIDAE

(Grunt, sweetlips, rubber lips, hot lips)

Occurrences: Station No. 32 and 61
Size range 2.25 mm – 5.875 mm
Genus *Pomadasys*
Species undetermined

Description of larvae

Body elongate, slightly compressed, evenly tapering towards the tail in smaller size larvae and broadening as the size increases. Gut in the first half of the body. Stomach bag-shaped with short intestine reflecting obliquely against the body. Head broad, dorsal profile of the head sloping anteriorely. Operculum with small and strong spines in 2 rows. Mouth opening small, oblique and terminal in position. Lower jaw slightly projecting in smaller size larvae. Tip of the snout blunt. Eyes large, round and symmetrical. Smallest larvae enclosed in transparent sheath while relatively larger larvae show the sign of dorsal and anal fins development. Origin of dorsal fin is more or less opposite to the anal fin, away from the anus. Pectoral fin short, fan-like on low side of the body with indistinct rays. Caudal fin round, rays countable. Notochord moving upward from its posterior end in 5.875 mm larva.

Vertebrae $9 + 17 = 26$

Pigmentation

Four prominent chromatophores on the ventral side of the gut region: one on the anterio-ventral, one on the posterio-ventral side of the gut region, remaining 2 on the mid ventral side of the gut. A large spreaded chromatophore on the dorso-posterior side of the rectal end. Dark pigmentation in between the lateral line and the gut portion. In smaller size, a row of small stellate chromatophores on the mid lateral ridge of the tail. At a later stage, they restricted on the anal fin base with few pigment spots beyond it. One stellate chromatophore at hypural portion of caudal fin.

Colour of the Body

Lateral side more paler than the dorsal and ventral side of the body.

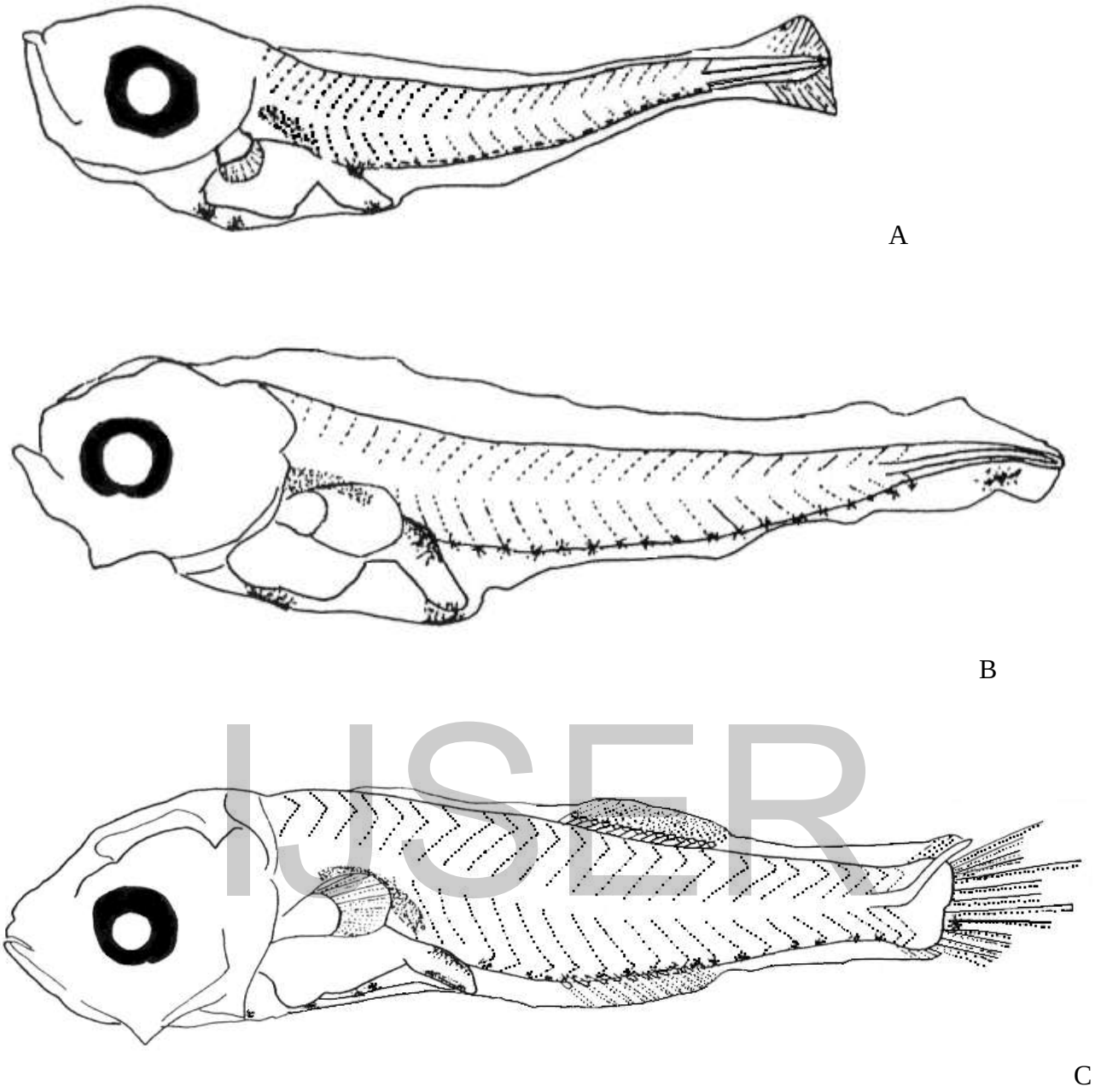


Figure 43. Larvae of *Pomadasys* sp. A) 2.25 mm; B) 3.075 mm; C) 5.875 mm.

FAMILY PRIACANTHIDAE

(Big eyes, glass eyes, bulls eyes)

Occurrences: Station No. 12, 14, 28, 32, and 40
Size range 1.85 mm – 4.625 mm
Genus *Priacanthus*
Species undetermined

Description of larvae

Body relatively deep and compressed, evenly tapering towards the tail end in smaller size larva of 2.525 mm, whereas in larger size larva (4.625 mm) the dorsal and ventral sides of the body convex, with well developed caudal peduncle. Digestive portion in the first half of the body. Intestine coiled singly with a short portion deflecting obliquely in the early stage. Later, intestine coiled twice and found more closer to the head region. Head broad, compressed with 3-4 long delicate spines on the posterior-ventral side of the operculum, reaching beyond intestine in smaller larvae and are comparatively smaller in larger size larvae. A single prominent, median cranial crest armed throughout its length with seven strong dorso-median serrations and a sharply upturned back ward projection present in 2.525 mm individuals. Serration lacks in larva of 4.625 mm whereas projection angle decreases against the head and body. Mouth opening small, strongly oblique with thick lips. Tip of the snout blunt. Eyes large, round and squarish in smaller larvae and more or less round with choroid tissue on its dorsal side in larger larvae. Transparent fin fold extends from the posterior side of the cranial crest, around the tail and forward to the intestinal end in smaller larvae. In larva of 4.625 mm, dorsal fin continuous, first portion with shorter fin bases and slender feeble spines. Anal fin with three spines, first smaller than the remaining two. Bases of the anal fin are as large as that of soft portion of dorsal fin. Terminal portion of dorsal and anal fins rounded. Caudal fin round with two lobs at its origin. Pectoral fin large, fan-shaped. Pelvic fin not yet developed. Notochord straight in smaller larvae and flexed in 4.625 mm larva.

Vertebrae 8 + 16 = 24 (2.525 mm)
7 + 17 = 24 (4.535 mm)

Pigmentation

In larvae smaller than 2.5 mm, a row of stellate chromatophores on the ventral side of the tail, a few in between the dorsal side of intestinal coil and the body and a few on the ventral side of coiled intestine. A few stellate chromatophores also appear on the dorsal side of the head. In 4.625 mm, the number and size of stellate chromatophores increased on the dorsal side of the head. A dark blotch develop on the posterior side of the operculum, two spine like (appearance) pigment spots on the ventral side of the operculum and a spot on the ventral side of the coiled intestine. The

area between the dorsal side of coiled intestine and the posterior lateral side of intestine pigmented. Three dark stellate chromatophores on the ventral side of the tail beyond anal fin base.

Colour of the Body

Light brown.

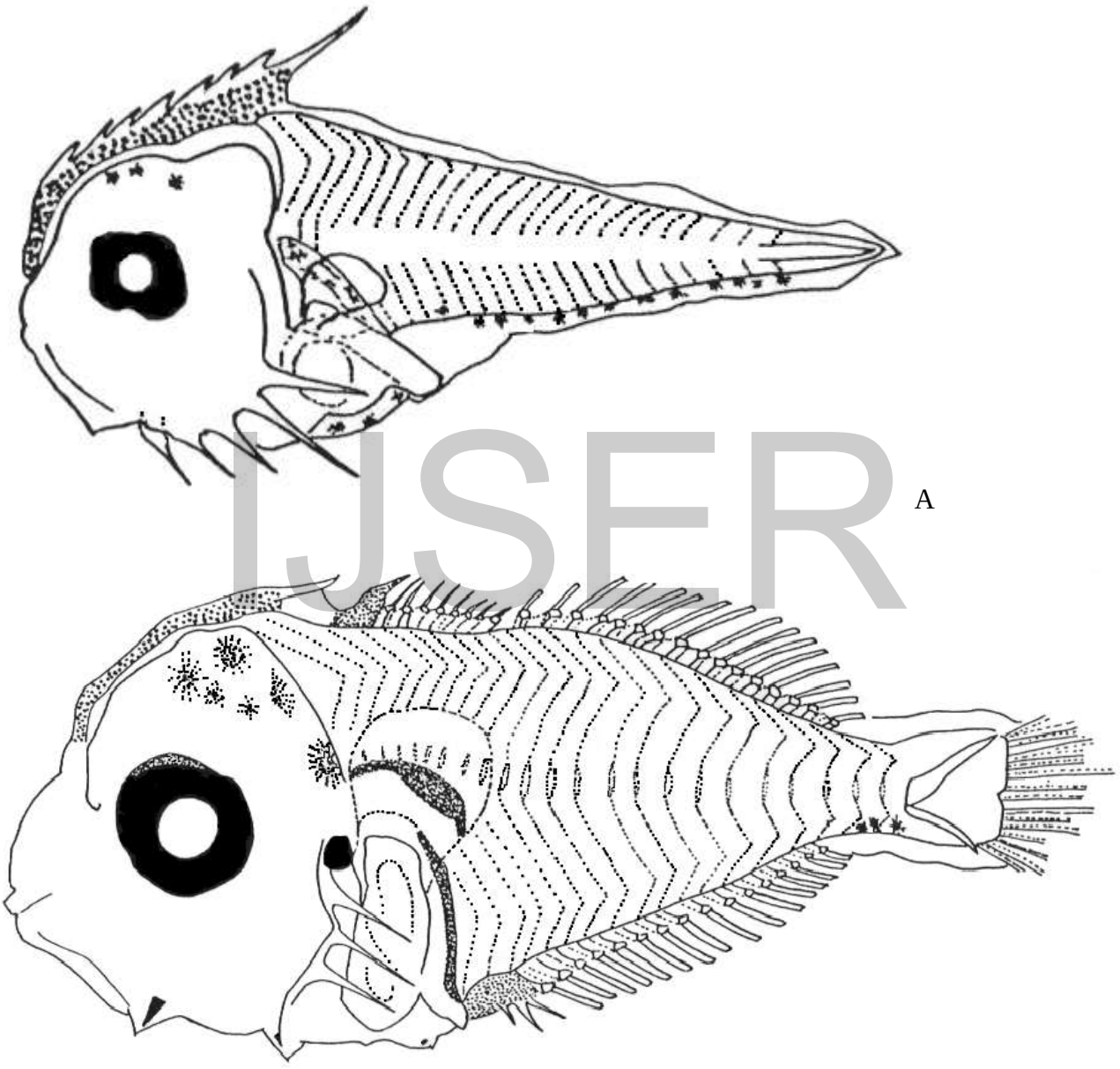


Figure 44. Larvae of *Priacanthus* sp. A) 2.525 mm; B) 4.625 mm.

FAMILY SCIAENIDAE

(Croakers, drums, meagres, weak fishes)

Occurrences: Station No. 28, 32, 40, 58, and 61
Size range 1.65 mm – 2.825 mm
Genus undetermined
Species undetermined

Description of larvae

Body gradually tapers posteriorly. Gut in the first half of the body length, closer towards the head region. Intestine making a single circular coil, rectal portion directed obliquely downward from the ventral side of the body. Head broad, dorsal profile humped above eye level. Mouth small with oblique opening. Tip of the snout blunt. Eyes large, more or less round. No sign of rays development. Larvae enclosed in transparent fin fold. Only small pectoral fin on lower side of the body with indistinct rays. Notochord straight.

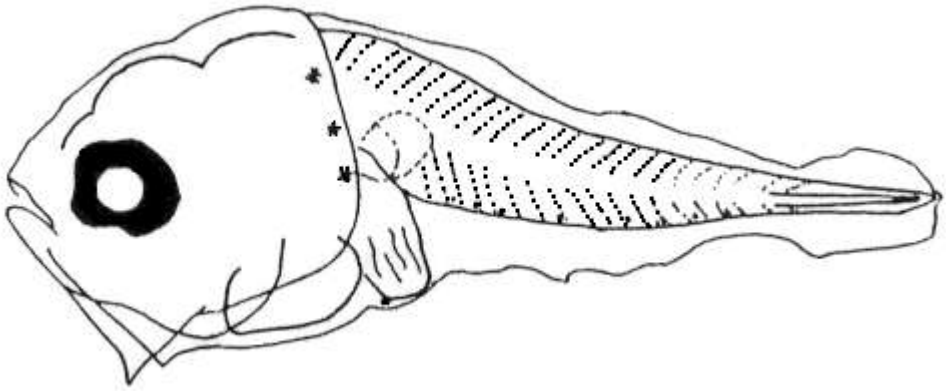
Vertebrae 7 + 19 = 26
10 + 16 = 26

Pigmentation

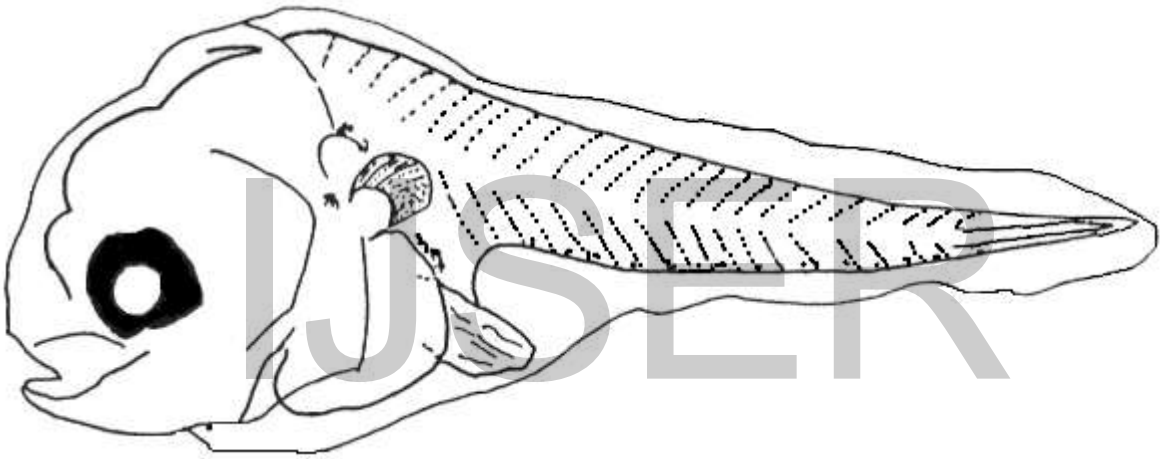
A row of chromatophores on the mid ventral side of tail. A small dark pigmented area between the gut and the body. Few stellate chromatophores on the posterior side of the operculum.

Colour of the Body

Brown.



A



B

Figure 45. Larvae of Sciaenidae . A) 2.3 mm; B) 2.825 mm.

FAMILY SCOMBRIDAE

(Mackerels)

Occurrences: Station No. 32 and 72
Size range 1.875 mm – 2.375 mm
Genus undetermined
Species undetermined

Description of larva

Body elongate, moderately compressed and gradually narrowing towards the tail end. Alimentary canal with a single circular coil, small intestinal portion deflected obliquely from the ventral side of the body. Digestive portion in the first half of the body. Head moderately broad. Mouth opening oblique. Jaws reaching to the anterior margin of the eyes. Upper jaw shorter than lower jaw. Tip of the snout blunt. Eyes large and round. Fin fold starts from the nape, continuous around the tail to the ventral side up to the posterior end of the intestine. The sign of embryonic caudal rays appear after 2.2 mm length. Pectoral fin round and slightly high on body, rays developing. Notochord straight.

Vertebrae 9 + 22 - 23 (?) = 31 - 32

Pigmentation

A row of chromatophores on the ventral mid line of tail and dark pigmentation at junction of gut region to the body. Two spot pigments on dorsal side of head.

Colour of the Body

Light brown to brown.

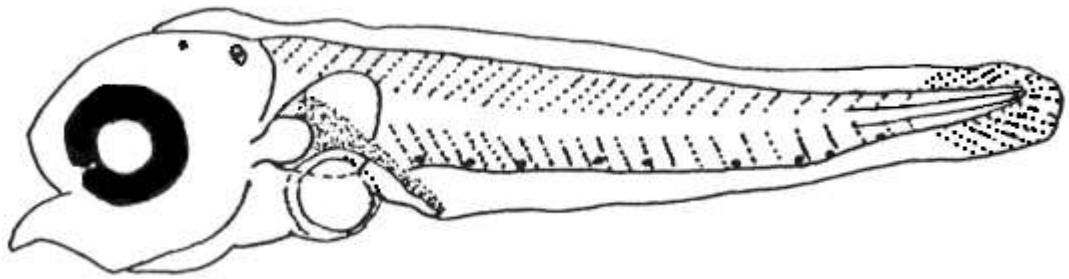


Figure 46. Larva of Scombridae. 2.375 mm.

FAMILY SILLAGINIDAE

(Sillagos)

Occurrence: Station No. 28
Size range 2.775 mm
Genus undetermined
Species undetermined

Description of larva

Body elongate, slightly compressed, tapering towards the posterior end. Alimentary canal short, parallel to the body. Head moderately elongate, dorsal profile notched in front and beyond the eye. Mouth small, oblique and terminal in position. Tip of the snout blunt. Eyes large more or less round. Fin fold present on the dorsal and anal side of the body. Thin thread like embryonic caudal rays developing. Pectoral fin round and small. Posterior end of the notochord slightly bent upward.

Vertebrae 11 + 23 – 26 (?) = 34 – 37 (?)

Pigmentation

Dark pigmentation on the body above the anterio-dorsal side of the digestive tract. Four stellate chromatophores on the ventral side of the gut, one on the posterior-dorsal side of the gut region. Two large and five small chromatophores in a row on the mid ventral side of the tail.

Colour of the Body

Light brown.

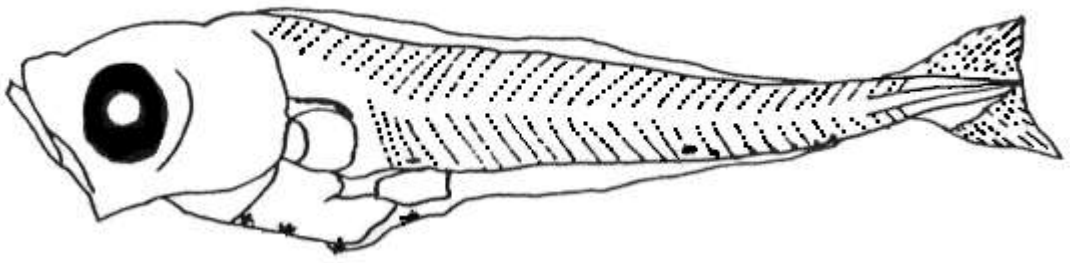


Figure 47. Larva of Sillaginidae, 2.775 mm.

FAMILY SOLEIDAE

(Sole)

Occurrence: Station No. 24
Size range Single, 1.825 mm
Genus undetermined
Species undetermined

Vertebrae 8 (?) + 36 = 44 (?)

Colour of the Body

Brown.

Remarks

This larva was found in disintegrated condition. However, when compared with the drawings of the larva of *Solea heinii* by BALAKRISHNAN and DEVI (manuscript) and *Brachirus orientalis* by HODA 1978, the vertebral count were found in agreement.

Note: No Drawing.

FAMILY SPHYRAENIDAE

(Barracudas)

Occurrences: Station No. 32
Size range 7.3 mm – 8.505 mm
Genus *Sphyraena*
Species undetermined

Description of larvae

Body elongate, slightly compressed. Dorsal profile of body convex. Alimentary canal long and cylindrical reaching to about 2/3rd of the body length. Anus opening large. Thick muscular folds on the intestine. Head large, with a long pointed snout. Mouth large, horizontal, lower jaw slightly projecting beyond upper jaw. Teeth small, strong, pointed unequal in size. Mouth opening large, extended up to the anterior margin of the eyes. Eyes large, round and symmetrical a very delicate fin fold near the dorsal profile of head that continues with the dorsal fin. Dorsal fin base just above the anal fin base. Pectoral fin very small. Rays in pectoral fin undeveloped. Caudal fin rays long and well developed. Notochord moving upward from its posterior end.

Vertebrae 14 + 10 – 11 (?) = 24 – 25 (?)

Pigmentation

Few stellate chromatophores on tip of the lower and upper jaw. Two large expanded chromatophores on the upper posterior side of the head. A row of round chromatophores beyond head on the mid dorsal ridge continuing with the row of stellate chromatophores from the dorsal fin origin to caudal peduncle. Similarly a row of stellate chromatophores on the ventral side of the tail above anal fin base, continues with a row of dash pigments. Similarly a row of stellate chromatophores on the mid lateral line of the body and a few stellate chromatophores scattered in between mid lateral and ventral line of the body. Seven large round chromatophores at the origin of caudal fin.

Colour of the Body

Dark brown. Head pale and intestine darker.

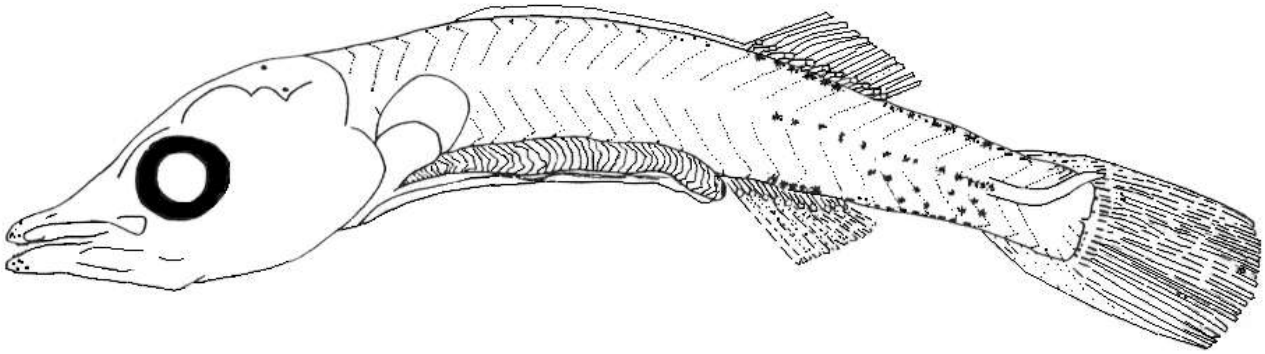


Figure 48. Larva of *Sphyraena* sp. 8.505 mm.

FAMILY SYNODONTIDAE

(Lizard fishes)

Occurrences: Station No. 24, 26, 32 and 61
Size range 2.6 mm – 14.9 mm
Genus *Trachinocephalus*
Species *myops* (FORSTER, 1801)

Description of larvae

Body elongate, cylindrical with long intestine. Slightly thicker and wavy in smaller sizes, but becoming smoother with uniform diameter in larger larvae. With larval growth the posterior short portion of intestine deflected obliquely from the ventral side of the body. Anus situated at $3/4^{th}$ part of the body length. Snout –anus distance remains constant between 70-77 percent of the body length before and during notochord flexion. Head oblong, mouth large with oblique opening. Eyes large nearly round, developed at top of the head near anterior end of upper jaw. Tip of the snout blunt. Snout length shorter than the eye diameter. The anal fin rays first appear in larvae above 7 mm. Anal fin originates with long anal fin base at the posterior end of the intestine. Dorsal fin not yet appeared in larva of 14.9 mm. The anal, pectoral, pelvic and caudal fin rays well developed. Notochord starts moving upward from its posterior end in larvae above 7.2 mm, but was found flexed in 14.9 mm larva.

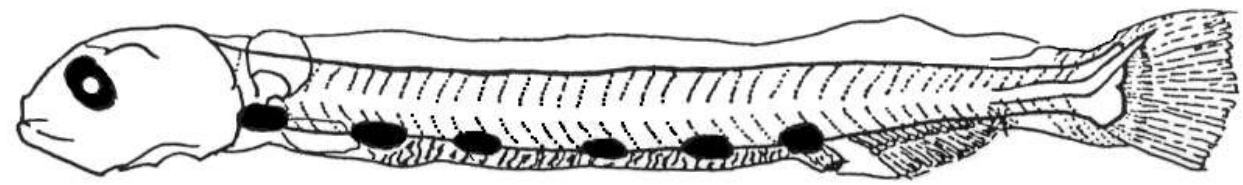
Vertebrae 30 + 18 – (?) = 48 – (?)

Pigmentation

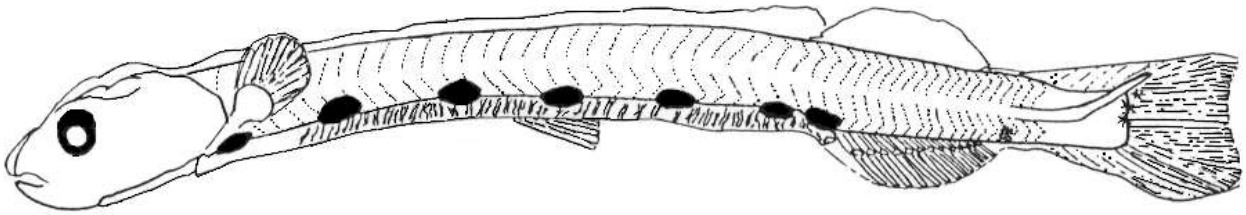
One spot pigment persistently found at the mid ventral side of the tail. With larval development six to seven peritoneal pigment spots lying in pairs along the ventro-lateral sides of the gut. Two to three small stellate chromatophores at caudal fin origin.

Colour of the Body

Brown to dark brown.



A



B

Figure 49. Larvae of *Trachinocephalus myops* A) 9.3 mm; B) 14.9 mm.

FAMILY TRICHIURIDAE

(Hair tail fishes)

Occurrences: Station No. 26, and 32
Size range 6.73 mm – 9.07 mm
Genus *Lepidopus*
Species *caudatus* (EUPHRASEN, 1788)

Description of larvae

Body extremely elongate, compressed and ribbon like. Evenly tapering posteriorly. Dorsal profile of the body convex. Digestive tract very short, tail region very long and slender. Intestine of uniform diameter having two distinct regions: first making a coil, second makes a ventral deflection. Anus opening directed vertically down. Head broad, long pointed snout, lower jaw projecting beyond upper jaw. Mouth opening large, horizontal, reaching slightly beyond the anterior margin of the eyes. Eyes large, round and symmetrical.

A single long based dorsal fin with partially developed fin rays continuous around the tail and ventrally up to the posterior end of the gut. Origin of the dorsal fin fold at the level of posterior margin of operculum. Pectoral fin short, on lower side of the body with developing rays. Notochord straight.

Vertebrae 20 + 124 – (?) = 144 – (?) in 6.72 mm

Pigmentation

Few expended stellate chromatophores above eye level on head and one beyond eye on operculum. Few on the snout. A row of chromatophores on the mid dorsal side of body.

Colour of the Body

Dark brown body colour.

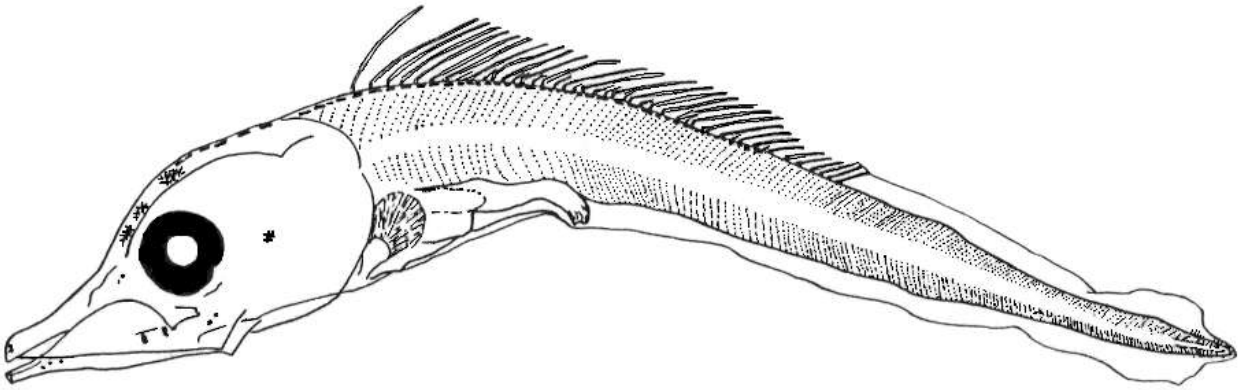


Figure 50. Larva of *Lepidopus caudatus*, 9.0675 mm.

FAMILY TRIGLIDAE

(Gurnards and searobins)

Occurrences: Station No. 47
Size range 2.725 mm
Genus undetermined
Species undetermined

Description of larva

Body elongate, tapering towards the posterior end of tail, with moderately elongate intestine. Two-third part of intestine cylindrical in shape. Intestine attached horizontally to the ventral side of the body. Anus opening in the second half of the body length. Head moderately elongate, dorsal profile convex with a notch in front of the eyes. Mouth large, opening oblique and terminal in position. Lower jaw slightly larger than the upper jaw. Snout bent upward. Eyes moderately large, round, symmetrical, high on head. Dorsal fin fold continuous from nape up to the tail and turns on ventral side forwarded to reach the posterior end of the intestine. No sign of dorsal and anal fin rays. Only embryonic caudal fin rays present. Pectoral fin round with developing rays. Notochord straight.

Vertebrae 12 + 19 = 31

Pigmentation

Chromatophores on the top of upper jaw and on the dorsal side of the head region, on the anterio-ventral side of the intestine. A row of dark chromatophores along the junction of poterio-dorsal side of the intestine. Small pigmented area on the mid ventral side of the operculum. Concentrated small pigment spots on the mid ventral part of the tail region. Similarly few pigment spots along the mid dorsal side of the body.

Colour of the Body

Light brown.

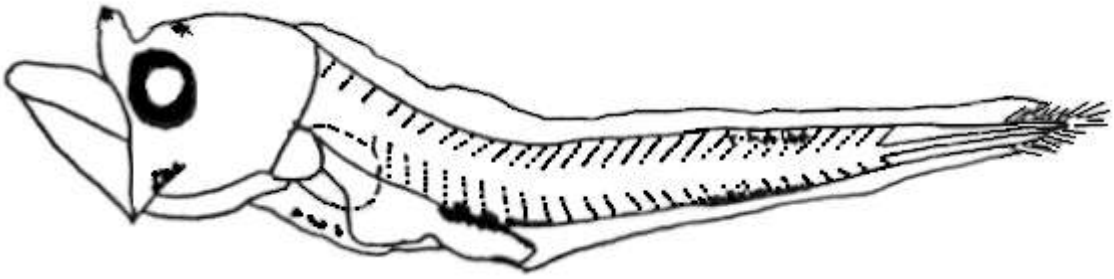


Figure 51. Larva of Triglidae 2.725 mm.

9. DISCUSSION

The previous workers (KABANOVA, 1964; RYTHER et al., 1966) have observed higher rates of primary and organic production in the northern most part of the Arabian Sea, including areas of the Pakistan coast. MICHEL et al., (1986) stated that "the water column of the Western Arabian Gulf is thoroughly mixed throughout most or all of the year, so that nutrients appear to be available at all times, even during the annual minimum of plankton production in March". The high rates of adult fish occurred mostly in the shelf area off Cutch (near Bombay, India), off the coast Pakistan, and the Gulf of Oman (HIDA and PEREYRA 1966).

In present analyses of zooplankton samples showed extreme variation in number of ichthyoplankton collected during a short period from January – February 1977. A number of 1557 fish larvae were sorted out, which average to 70.8 larvae / positive haul. The highest abundance was noted in the waters south of Karachi as reported by ALI-KHAN (1976), and lower in the west of Karachi.

ALI-KHAN (1976) identified 27 larval fish families, 20 genera, and 7 species from the same region. While ALI-KHAN and WAQR (1985 a) reported 24 larval fish families from the Manora Channel, alone. Most of the fish taxa were common in both the cited published papers. During the present study, the larvae of 28 fish families, 23 Genera and 12 species identified based on 1513 larvae are being reported. Their distribution and abundance has been studied in detail.

The four families: Myctophidae, Bregmacerotidae, Nomeidae, and Pomadasyidae dominated the other families of ichthyoplankton in our region (Table-3, Section 5.1). These families combined contributed 78.0 % to the total number of larvae.

The myctophid larvae were found abundant because of higher number of *Benthosema pterotum* larvae (44.24 %). The higher concentration of *B. pterotum* was found in south of Karachi. The other myctophid larvae such as *Diaphus splendidus* (2 %), *Diaphus* sp., *Hygophum* sp. (0.45 % each), and the three undetermined genera were found scattered in our waters also in lesser numbers.

Our present results with regard to the dominating abundance of *B. pterotum* are in agreement with the previous studies (NELLEN, 1973; ALI-KHAN 1976; 1985 b).These studies indicates the presence of these larvae in various regions of the Arabian Sea during 1964 to 1968. It is now being reported that the same species was found abundant in the Pakistan waters during January – February, 1977. HUSSAIN and ALI-KHAN (1987) during their study on the fecundity of this species observed the presence of mature stocks of *B. pterotum* in the waters off Oman and Pakistan throughout the year except in the months of August and September. The present information when added to the previous information, it appears that the species spawn in various months of the year in the Arabian Sea as portion spawners.

The codlet larvae (Bregmacerotidae) were the second dominant larvae represented by a single genus *Bregmaceros*. Among the three identified species of this genus, *B. macclellandi, B. rarisquamosus* and *B. nectabanus*, a higher concentration of *B. nectabanus* larvae was found off the Sindh coast (Fig. 3). The presence of higher number of newly hatched larvae and a few above 4 mm in our material allow to assume that this species probably breeds in our waters in colder months (winter), and most probably prefers the waters off south of Karachi than west of Karachi.

The previous investigators (NELLEN, 1973; ALI-KHAN, 1976, 1985 b; ALI-KHAN and WAQAR, 1985 a) reported a single species of codlet larvae from the Arabian Sea. Recently, HOUDE et al., (1986) described in detail of these three species of *Bregmaceros* from Kuwait waters (Western Arabian Gulf) and found them as abundant. The larvae of *B. macclellandi* and *B. rarisquamosus* are now reported for the first time from our waters.

The larvae of Nomeidae were represented by a single genus *Psenes* sp. High concentration of these larvae was found along the Makran coast. The smaller larval size group was obtained from the west of Karachi and larger size group from the south of Karachi. It is guessed that *Psenes* sp. might have spawned latter in the waters west of Karachi. These larvae were found distributed along the west coast of India and Oman (NELLEN, 1973), and also in the waters south and west of Karachi from December – April (ALI-KHAN, 1976).

The larvae of Pomadasyidae (an important commercial fish) were represented by *Pomadasys* sp. and were taken on only two stations. These larvae have been reported earlier from India and Gulf of Oman (NELLEN, 1973), from the Manora Channel (ALI-KHAN and WAQAR, 1985 a) and also from the Somalian coast (ALI-KHAN, 1985 b). HOUDE et al., 1986 reported these larvae in the coastal and off shore waters of Kuwait as well as in the Kuwait Bay. It appears that these larvae are widely distributed in the Arabian Sea.

The commercially important Clupeidae larvae represented by *Sardinella sindensis* and another undetermined genus were found off the Makran coast only during 4-6 February. Previously, peak season of *Sardinella sindensis* was noted as late in winter in Pakistan's coastal waters (ALI-KHAN, 1976). They were also found in summer in the Manora Channel (ALI-KHAN and WAQAR, 1985 a). HOUDE et al., (1986) observed that clupeid eggs and larvae (mostly *Sardinella* spp.) decline to low levels of abundance in the winter and noted most abundant in spring, summer and early fall in the West Arabian Gulf. NELLEN (1973) also found these larvae in considerable quantities in the Northern Persian Gulf in spring.

The larvae of *Gobius* spp. were found from the shelf as well as from the slope area. ALI-KHAN (1976) reported these larvae less frequently in winter months, whereas (ALI-KHAN and WAQAR, 1985 a; HOUDE et al., 1986) noted maximum abundance of these larvae during the summer period than in winter.

The gonostomid larvae, *Vinciguerria lucetia* occurred frequently in our waters. The larvae of this family were previously reported from the Pakistan waters in the North East Monsoon by ALI-KHAN, 1976; ALI-KHAN and WAQAR, 1985 a.

NELLEN (1973) reported *Champsodon* larvae as abundant in the waters off the Sindh and Makran coast. A few larvae were also noted from the south and west of Karachi in November and March (ALI-KHAN, 1976). In the present study these larvae occurred frequently and were also found relatively abundant in our region of investigation. Their high concentration was found in February off the Makran coast.

Family Apogonidae was represented by genus *Apogon* sp. found distributed off Sindh and Makran coast during this study The Highest calculated abundance (57 larvae / m^2) obtained from Sindh coastal waters. Previously, the larvae of Apogonidae reported from Gulf of Aden in ranged from 2.4 to 4.6 larvae / m^2 in the NE monsoon period (ALI-KHAN 1985 b). Apogonidae larvae reported from Manora Channel during 1968-1970 (ALI-KHAN and WAQAR 1985 a)

Previously, the larvae of Engraulidae were reported as abundant and were taken frequently along the west coast of India, Pakistan, coast of Aden, Somalia, Arabia and the western Arabian Gulf (NALLEN, 1973; ALI-KHAN, 1976; 1985 b; ALI-KHAN & WAQAR, 1985 a; HOUDE et al., 1986) during the present study, the larvae of *Stolephorus zollingeri* were found restricted to the waters south of Karachi.

This study showed that the larvae of *Decapterus macarellus* (1.35 %) found only in the south of Karachi and were confined to the coastal waters. ALI-KHAN (1985 b) reported *D. russellii* (RUPP.) from the Gulf of Aden in late NE monsoon time.

The larvae of the 17 identified fish families and an order Angulliformes were found "Rare" and were caught in much lesser numbers (Section 6.3). Among these larvae Priacanthidae, Sciaenidae, Synodontidae, Pomacentridae, Sphyraenidae, Bothidae, Cynoglossidae, Scombridae, Platycephalidae, Trichiuridae, Lutjanidae, Sillaginidae, and Soleidae are of commercial importance. These larvae were found rarely and lesser in numbers. It is assumed that with some hesitation that the adult of these fish families might have spawned either elsewhere in the neighbouring waters, or it is due to avoidance.

A thorough and regular studies are required in future to learn more about these fish larvae in the region of present study.

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