Chapter 3

Results

Species Composition

There were total 14,710 eggs and 16,016 larvae collected from every haul. The larvae of 38 Families of 15,613 individuals were diagnosed, but the other 403 individuals were the unknowns. Larvae of the Family Gobiidae.were the most dominant and widely distributed in all season and in the studied area. The 47.90 % of the total larvae belonged to the gobies, that was three times the density of the second dominant group, the Family Engraulidae (16.29 %). The third most abundant group was the Family Bregmacerotidae (7.86 %). Those of the next abundance were the Leiognathidae, Nemipteridae, Clupeidae, Callionymidae, etc., respectively (Table 3). The 40.96 % of the total larval fishes abounded in the NE-monsoon period and the 62.32 % in the inner zone of the Chang Islands (Table 4).

Identification

The larval fishes of 73 samples representing the 38 Families were selected for description, respectively.

Table 3 Total number of fish larvae around the Chang Islands during January - December 1987.

Family	Total		Average/1000 m^3			%
	No	No/1000 m^3	per Month	per Station	per Haul	
1. Clupeidae	436.00	11837.11	1076.10	739.82	79.98	2.72
2. Engraulidae	2609.00	70832.62	6439.33	4427.04	478.60	16.29
3. Eel Leptocephalus	1.00	27.15	2.47	1.70	0.18	0.01
4. Syncdontidae	18.00	488.69	44.43	30.54	3.30	0.11
5. Belonidae	1.00	27.15	2.47	1.70	0.18	0.01
6. Exocoetidae	3.00	81.45	7.40	5.09	0.55	0.02
7. Bregmacerotidae	1259.00	34181.01	3107.36	2136.31	230.95	7.86
8. Bothidae	259.00	7031.68	639.24	439.48	47.51	1.62
9. Soleidae	27.00	733.03	66.64	45.81	4.95	0.17
10. Cynoglossidae	36.00	977.38	88.85	61.09	6.60	0.22
11. Syngnathidae	3.00	81.45	7.40	5.09	0.55	0.02
12. Pegasidae	30.00	814.48	74.04	50.91	5.50	0.19
13. Fistulariidae	4.00	108.60	9.87	6.79	0.73	0.02
14. Sphyraenidae	31.00	841.63	76.51	52.60	5.69	0.19
15. Scombridae	128.00	3475.11	315.92	217.19	23.48	0.80
16. Trichiuridae	1.00	27.15	2.47	1.70	0.18	0.01
17. Carangidae	280.00	7601.81	691.07	475.11	51.36	1.75
18. Menidae	1.00	27.15	2.47	1.70	0.18	0.01
19. Leiognathidae	898.00	24380.10	2216.37	1523.76	164.73	5.61
20. Apogonidae	134.00	3638.01	330.73	227.38	24.58	0.84
21. Epinephelidae	3.00	81.45	7.40	5.09	0.55	0.02
22. Priacanthidae	39.00	1058.82	96.26	66.18	7.15	0.24
23. Lutjanidae	31.00	841.63	76.51	52.60	5.69	0.19
24. Theraponidae	35.00	950.23	86.38	59.39	6.42	0.22
25. Nemipteridae	552.00	14986.43	1362.40	936.65	101.26	3.45
26. Mullidae	33.00	895.93	81.45	56.00	6.05	0.21
27. Sciaenidae	394.00	10696.84	972.44	668.55	72.28	2.46
28. Sillaginidae	56.00	1520.36	138.21	95.02	10.27	0.35
29. Siganidae	3.00	81.45	7.40	5.09	0.55	0.02
30. Scorpaenidae	90.00	2443.44	222.13	152.72	16.51	0.56
31. Platycephalidae	30.00	814.48	74.04	50.91	5.50	0.19
32. Labridae	12.00	325.79	29.62	20.36	2.20	0.07
33. Gobiidae	7672.00	208289.70	18935.43	13018.11	1407.36	47.90
34. Callionymidae	419.00	11375.57	1034.14	710.97	76.86	2.62
35. Champsodontidae	5.00	135.75	12.34	8.48	0.92	0.03
36. Blenniidae	35.00	950.23	86.38	59.39	6.42	0.22
37. Monacanthidae	42.00	1140.27	103.66	71.27	7.70	0.26
38. Tetraodontidae	3.00	81.45	7.40	5.09	0.55	0.02
39. Unknown	403.00	10941.18	994.65	683.82	73.93	2.52
Total	6016.00	434823.75	39529.43	27176.48	2938.00	100.00

Table 4 Seasonal and spatial occurrence of fish larvae in percentage around the Chang Islands in 1987

Family	NE-Monsoon	NE-SW	SW-Moonsoon	SW-NE	Outer Zone	Inner Zone
1. Clupeidae	53.08	25.31	13.71	7.91	72.71	27.29
2. Engraulidae	35.00	23.19	30.38	11.43	43.77	56.23
3. Eel Leptocephalus	-	-	-	100.00	100.00	-
4. Synodontidae	80.72	13.25	-	6.03	94.44	5.56
5. Belonidae	-	-	-	100.00	100.00	-
6. Exocoetidae	64.15	-	-	35.92	33.33	66.67
7. Bregmacerotidae	54.61	34.54	9.66	1.19	53.93	46.07
8. Bothidae	52.06	27.47	16.53	3.95	40.15	59.85
9. Soleidae	70.65	17.82	8.42	3.09	18.52	81.48
10. Cynoglossidae	76.55	16.60	6.85	-	30.56	69.44
11. Syngnathidae	100.00	-	-	-	33.33	66.67
12. Pegasidae	61.62	25.88	9.15	3.35	13.33	86.67
13. Fistulariidae	75.00	25.00	-	-	50.00	50.00
14. Sphyraenidae	16.66	60.55	22.79	-	100.00	-
15. Scombridae	55.61	33.74	3.98	6.67	93.75	6.25
16. Trichiuridae	100.00	-	-	-	100.00	-
17. Carangidae	35.39	40.21	22.28	2.12	33.22	66.78
18. Menidae	100.00	-	-	-	100.00	-
19. Leiognathidae	42.77	26.55	28.28	2.40	12.36	87.64
20. Apogonidae	28.75	19.37	29.31	22.57	38.06	61.94
21. Epinephelidae	61.90	38.10	-	-	75.00	25.00
22. Priacanthidae	48.46	49.12	-	2.42	79.49	20.51
23. Lutjanidae	30.82	65.13	4.05	-	93.94	6.06
24. Theraponidae	5.81	1.89	90.17	2.12	86.11	13.89
25. Nemipteridae	44.55	31.62	17.75	6.07	57.43	42.57
26. Mullidae	31.59	2.43	65.98	-	37.84	62.16
27. Sciaenidae	34.67	26.82	35.32	3.19	2.79	97.21
28. Sillaginidae	4.99	43.96	19.54	31.52	37.50	62.50
29. Siganidae	100.00	-	-	-	100.00	-
30. Scorpaenidae	38.76	25.32	21.48	14.44	8.89	91.11
31. Platycephalidae	12.52	34.79	52.70	-	26.67	73.33
32. Labridae	55.18	33.35	11.47	-	91.67	8.33
33. Gobiidae	39.04	29.36	18.63	12.96	33.16	66.84
34. Callionymidae	40.51	31.52	21.60	6.37	24.11	75.89
35. Champsodontidae	100.00	-	-	-	100.00	-
36. Blenniidae	42.59	25.05	26.97	5.39	45.71	54.29
37. Monacanthidae	80.46	14.05	3.16	2.32	45.24	54.76
38. Tetraodontidae	28.89	71.11	-	-	100.00	-
39. Unknown	53.80	23.36	13.39	9.44	41.69	58.31
Total	40.96	28.42	20.83	9.80	37.68	62.32

Family Clupeidae

Common Name : Herrings, Sardines, Pilchards

Diagnostic Features

The clupeid larvae are distinguished by their long and slender body with 44-45 myomeres. The gut is longer than the dorsal fin portion. Maxilla is shorter than the center of eye. The anus is very close to tail-tip and the preanal myomeres are about 30-40 while the engraulids are 27-29.

Description

One of the clupeid larvae of 12.55 mm TL (Figure 5) obtained from station 4 in March is a postflexive with elongated, slender and laterally compressed body. Head is elongated and so deep as the body. Mouth is oblique not reaching the mid eye. The gut lying on the ventral body is straight and long with verticle striations on the posterior half. Anus locates at about 90 % SL. Dorsal fin is situated just about 75 % SL posteriorly but prior to the anal position. Myomeres are 42 (38+4); D.12. Anal fin is not developed yet.

Family Engraulidae

Commom Name : Anchovies

Diagnostic Features

The engraulid larvae are separated from other long and slender by 38-45 myomeres, the overlapping position of dorsal and anal fins, oblique mouth and large

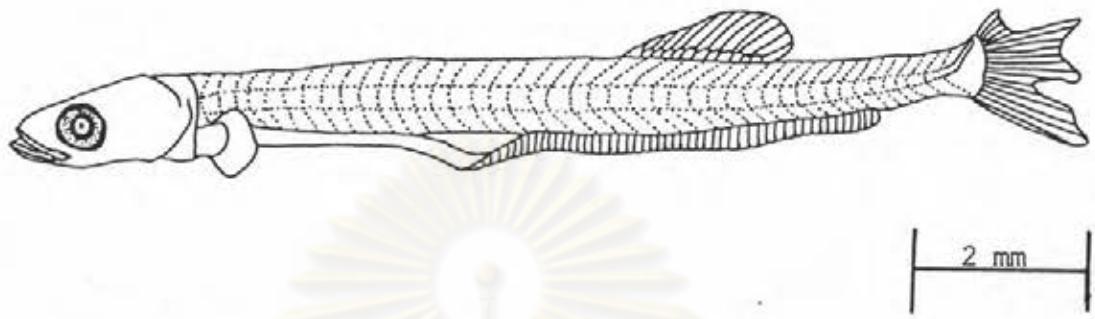


Figure 5 Clupeid larva, 12.55 mm TL

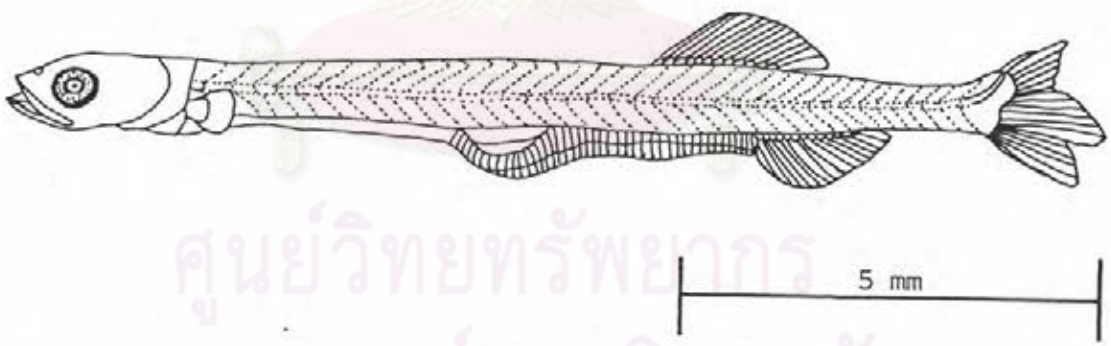


Figure 6 Engraulid larva, 13.08 mm TL

maxilla extending to beyond the mid eye. Pigment pattern is necessary for species diagnosis.

Description

An engraulid larva of 13.08 mm TL (Figure 6) obtained from station 8 in January is a post-flexive one. Its body is long, slender and laterally compressed. Mouth is large and oblique with the maxilla extending to about mid eye. Head is elongated and deep as the body similar to the Clpeidae. However, the gut of the engraulid is relatively shorter than that of the Clupeidae. Moreover, the overlapping position of dorsal and anal fins is very distinctive. The myomeres are 37 (27+10); D. 12; A. 13.

Eel Leptocephalus

Common Name : Eels

Diagnostic Features

The leptocephalus is very elongate, extremely compresed and transparent body. Dorsal and anal fins vary from short to long, but are always confluent with caudal fin. Pectoral fins are reduced or absent. Number of the myomere is also very important for identification the species.

Description

The anguillid leptocephalus of 20.20 mm TL (Figure 7) is the single specimen obtained from the station 8 in September. It is very elongated, extremely compressed and transparent body. Head is small with a

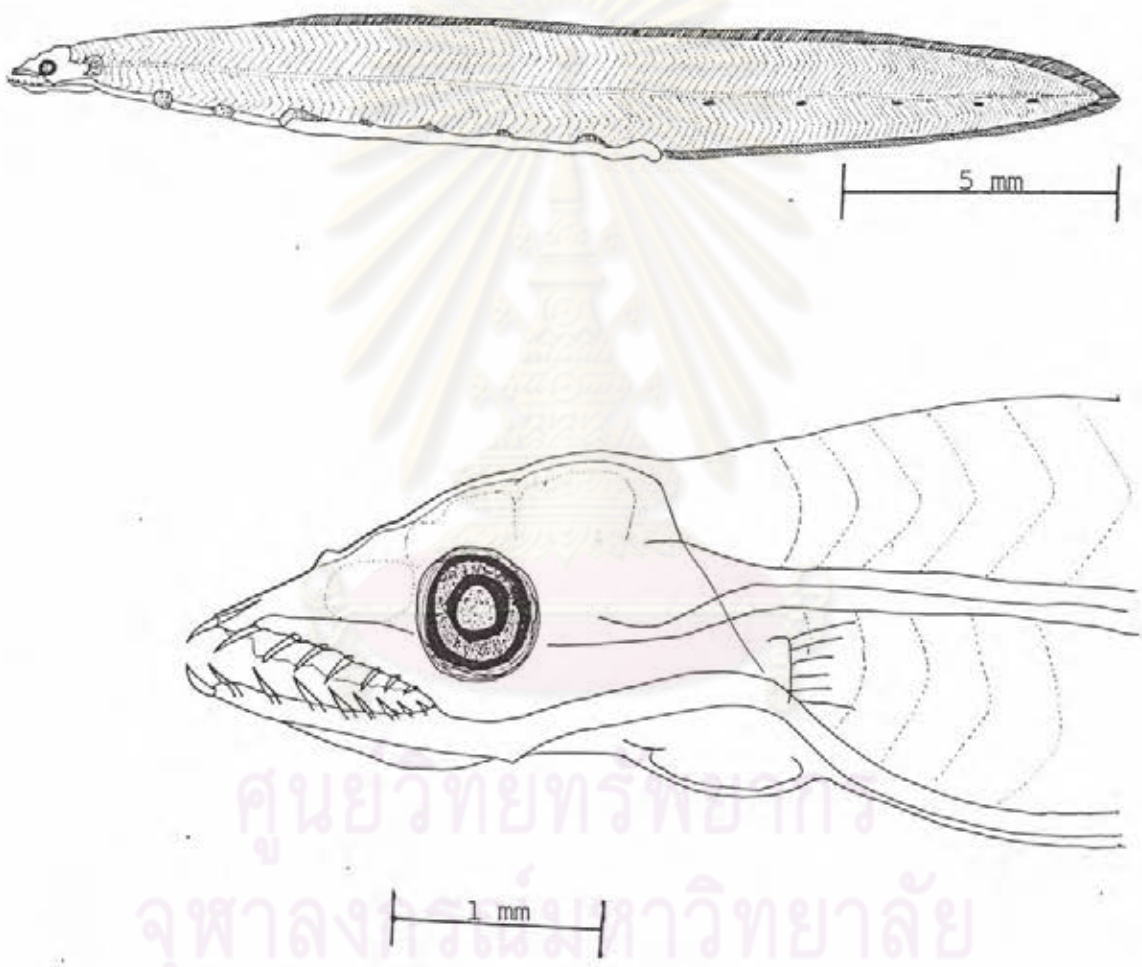


Figure 7 Eel leptocephalus, 20.20 mm TL

large mouth and conspicuous teeth on both jaws; 8 pairs on the upper and 9 on the lower. Gut is straight and long, on which locate the 7 nephric units. Anus opens at about 60 % TL. Dorsal fin is very long about 80 % SL, twice longer than the anal fin. They are confluent with the caudal fin. There are 5 pigmented spots along the ventral mid-line postanally. Myomeres are more than 130, the first 65 belong to the preanal.

Family Synodontidae

Common Name : Lizardfishes, Grinners

Diagnostic Features

The synodontid larvae are very elongate with 46-65 myomeres. The pigment patches on the gut are very distinctive. Myomere number is very important for identification the species.

Description

Saurida undosquamis (Richardson)

The preflexive larva of 6.15 mm TL (Figure 8 A) obtained from the station 5 in January is greatly elongate and slender. Head is large and rather rounded, with short and rounded snout and big eyes. Mouth is small not reaching the anterior edge of eye. Gut is straight and elongates to about 70 % BL. There are 4 pairs of melanophore patches present on the ventral body; three are on the gut and one on caudal peduncle closely to the caudal fin base. Rays on caudal finfold are initially developing, whereas

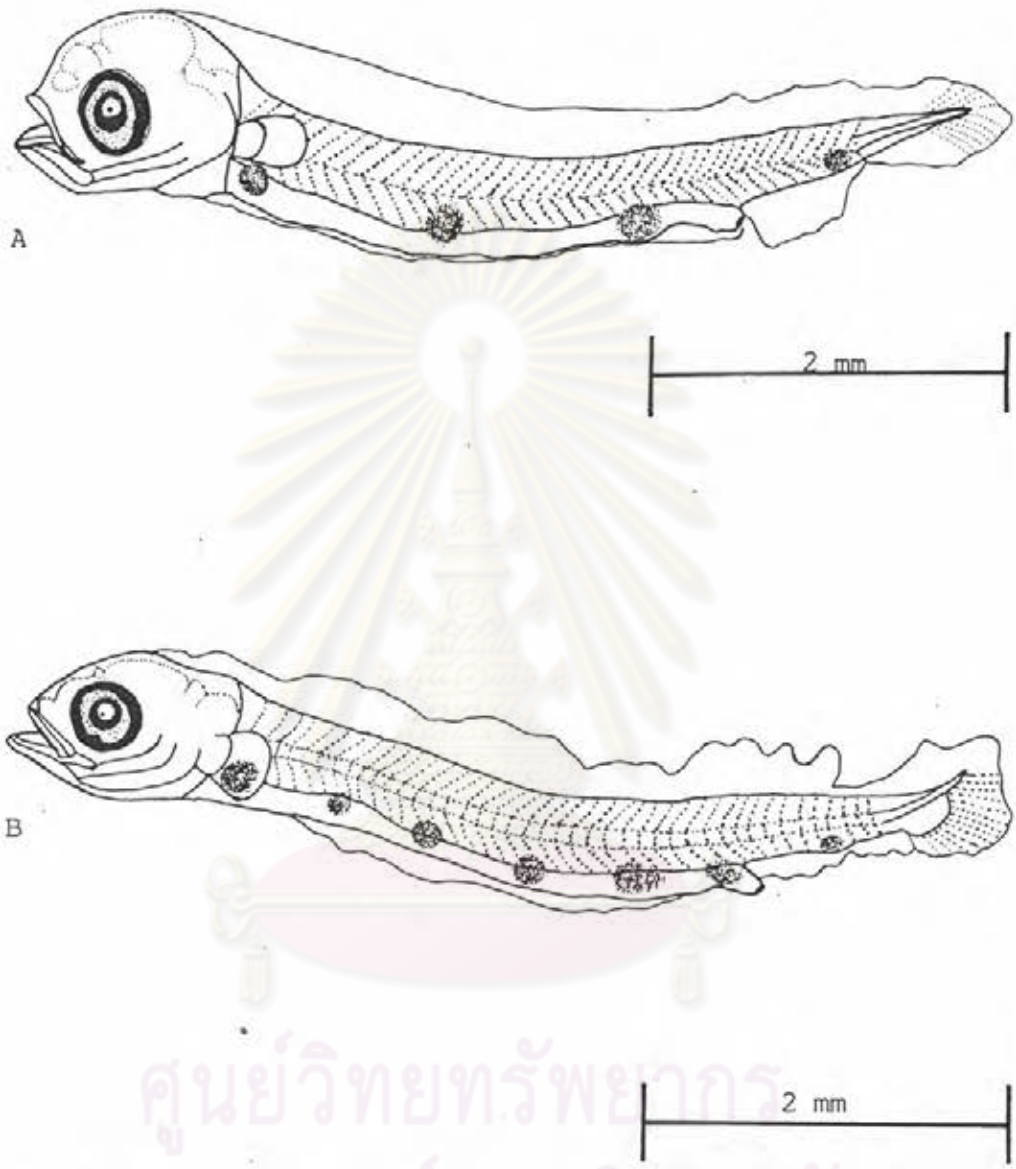


Figure 8 A Saurida undosquamis, 6.15 mm TL

B Trachinocephalus myops, 5.28 mm TL

the others invisible. Myomeres are 40 (32+8).

Trachinocephalus myops (Bloch & Schneider)

The early flexive larva of 5.28 mm TL (Figure 8 B) obtained from the station 10 in February is very elongate and slender like the S. undosquamis. Head is slightly elongate , with short snout and small mouth. Gut is straight and elongates to about 80 % TL. Unlike the S undosquamis, it has 7 pairs of pigment patches on the ventral body; 6 on the gut and 1 on caudal peduncle and attains the flexion stage even smaller size. There are 42 myomeres (34+8). Dorsal and anal fin elements are not developed yet.

Family Belonidae

Common Name : Needlefishes, Long Toms, Alligator Gars

Diagnostic Features

The belonid larvae are elongate, slender and tapered bodies with 52-97 myomeres. The anus locates at about 66 % TL. The lower jaw is about 50 % longer than the upper jaw, that characterizes the half-beaked stage.

Description

The belonid larvae of 25.51 mm TL (Figure 9) in early juvenile phase was diagnosed from the station 8 in September. It is elongated and slightly tapered body which rather rounded in cross-section. Head is small and elongate with relatively small eyes. Both upper and lower

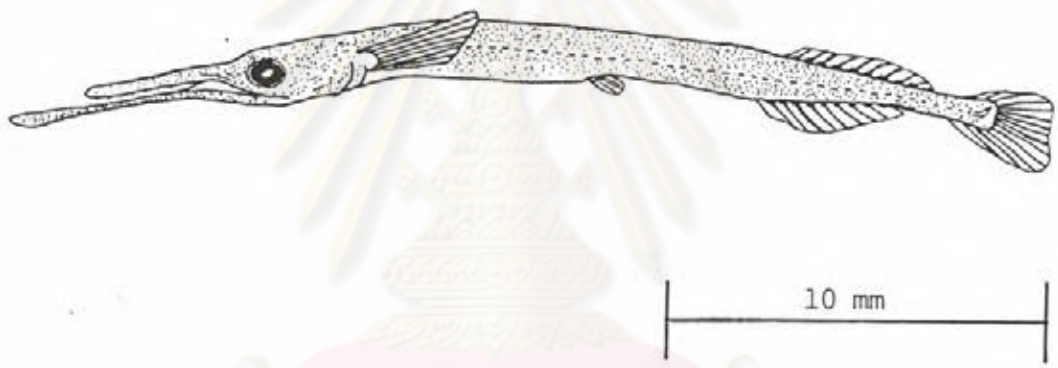


Figure 9 Belonid larva, 25.51 mm TL

jaws are elongated, but the upper is just about 65 % of the lower length. Small teeth are present on the upper jaw. All fins are fairly developed. Pelvic fins are located about 50 % TL. Pigment spots scatter throughout the body, but less abundant on ventrum of belly. Myomeres are invisible. Dorsal and anal fins situate at about 25 % BL posteriorly; D. 9; A. 9.

Family Exocoetidae

Common Name : Flyingfishes

Diagnostic Features

The exocoetid larvae are anteriorly deep, tapering bodies and narrow peduncle with 35-52 myomeres. All fins are well-developed. The pelvic fins develop far back, slightly anterior to the anus The entire bodies are heavily pigmented.

Description

Exocoetid Larva I

The exocoetid larva type I of 3.91 mm TL (Figure 10 A) obtained from the station 12 in February is a post-flexive one. It has an elongated body which rounded in cross-section. Head is quite rounded and short with the large eyes occupying 50 % HL. Snout is short. Mouth is oblique. Gut mass is large and elongates to about 60 % BL. All fins are developed. Pectoral fins locate rather high on body, whereas the pelvic fins developed far back about 50 % SL. Dorsal fin is longer than the anal located

on the posterior half of the body. Pigmentation is heavily present on the dorsal margin, on the dorsal gut, on lateral mid-line and ventral edge of the tail. Melanophores also scatter on the head, mouth and operculum. Myomeres are about 50 (34+16); D. 14; A. 16.

Exocoetid Larva II

The exocoetid larva type II of 25.16 mm TL (Figure 10 B) obtained from the station 1 in April is a juvenile one. Its body is elongated and rather rounded in cross-section. Head is rounded with large eyes and supraoccular ridges. Pectoral fins are large and elongated as well as the pelvic fins. Dorsal and anal fins are rather large and located on the posterior body. The caudal fin is forked asymmetrically; the lower part is longer than the upper one. Pigment spots scatter throughout the entire body with more concentration on the pectoral fins and the distal part of the dorsal fin. Vertical pigmented bands also appear on the posterior end of the operculum and on the caudal peduncle. Myomeres are invisible; D. 9; A. 10. The two larvae are very different in both size and stage of development; however, they are differentiated from each other by the dorsal and anal fin complements.

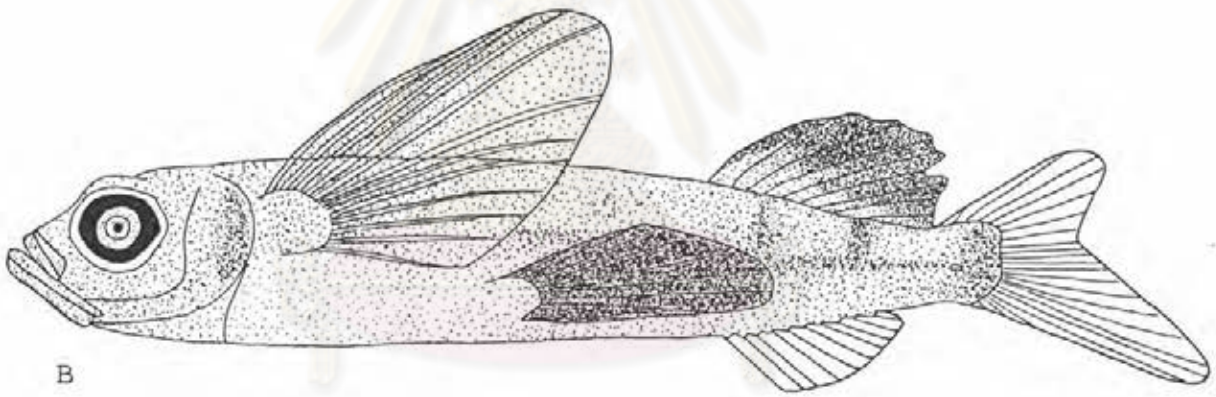


Figure 10 A Exocoetid larva I, 3.91 mm TL

B Exocoetid larva II, 25.16 mm TL

Family Bregmacerotidae

Common Name : Unicorn-Cods, Codlets

Diagnostic Features

The bregmacerotid larvae are long and tapered with 43-59 myomeres. There is one long filament on the head. Pectoral fins are paddle-like and develop high on the body. Dorsal and anal fins are long and ray number can differentiate the species.

Description

Bregmaceros sp. I

The larva of 8.00 mm TL (Figure 11 A) obtained from the station 9 in January is a postflexive one. It is elongate, laterally compressed and tapered. Head is large with a large oblique mouth stretching to about mid eye. Gut is coiled. Anus is located about 35 % TL. Occipital and pelvic rays are distinctively elongated. The second dorsal and anal fins are clearly notched in the middle. Myomeres are 50 (17+33); D. I, 47; A. 43.

Bregmaceros sp. II

The larva of 7.83 mm TL (Figure 11 B) obtained from station 16 in January is also a postflexive one. It is elongate, laterally compressed and tapered. Head is large and quite ovoid with a large mouth extending to posterior of eye. The mouth is not so oblique as the Bregmaceros sp. I. Occipital and pelvic rays are distinctively elongate. Gut is coiled. Anus is located at about 30 % TL. Unlike Bregmaceros I, the larva

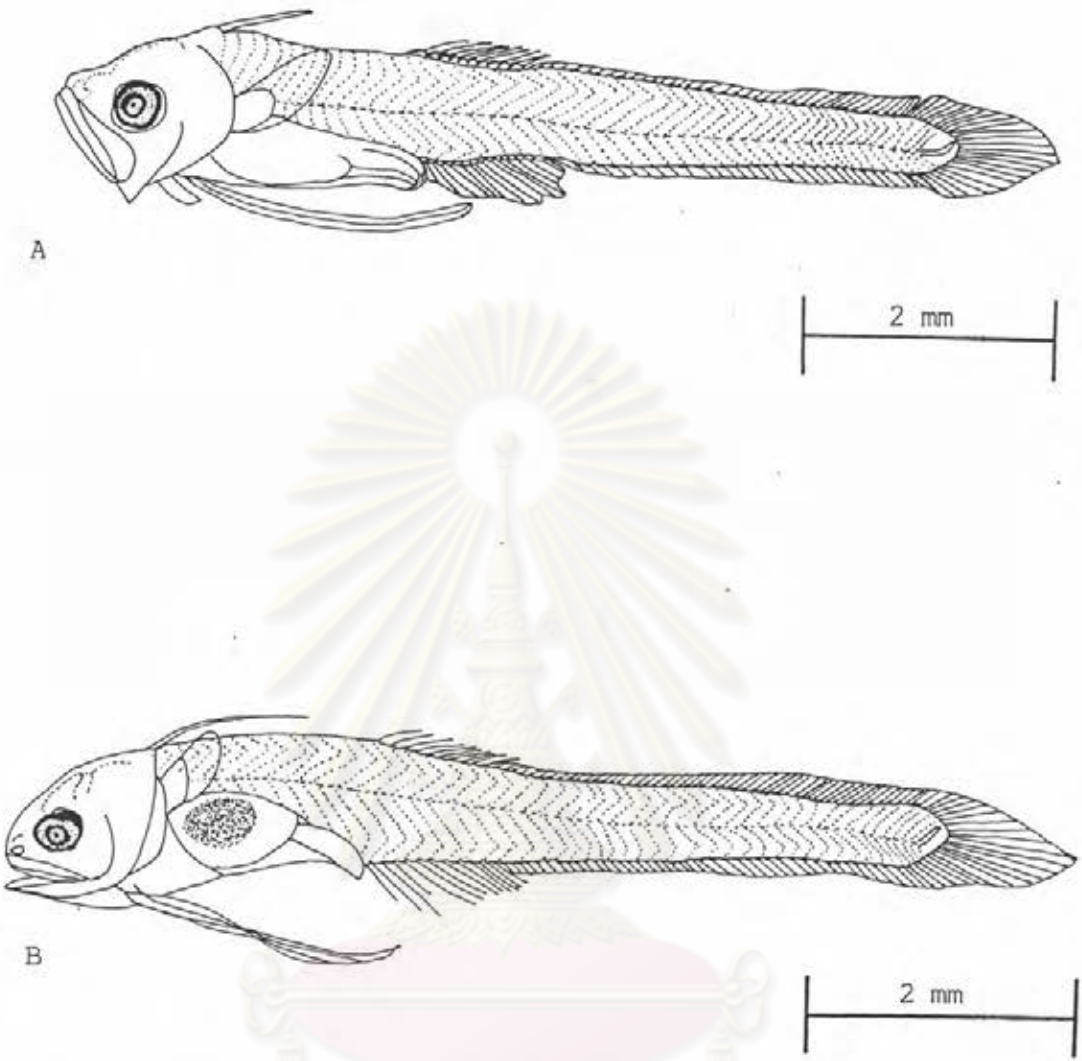


Figure 11 A Bregmaceros sp I, 8.00 mm TL
B Bregmaceros sp II, 7.83 mm TL

develops internal pigmented patch on the gut. The second dorsal and anal fin notches are also noticeable. Myomeres are 50 (13+37); D. 1,16; A. 54.

The Bregmaceros sp. I and II are quite different in myomere pattern, head shape, dorsal and anal elements, and the pigmentation.

Family Bothidae

Common Name : Left-Handed Flounders

Diagnostic Features

The bothid larvae are extremely thin and from moderately elongate to nearly rounded bodies with 34-48 myomeres. The head is large with a small mouth reaching about the anterior eye. Dorsal and anal fin bases are long with numerous slender fin rays. The elongate ray or rays are developed on the top of the head and the second one is extremely long.

Description

Pseudorhombus sp.

The larva of a Pseudorhombus sp. of 5.02 mm TL (Figure 12 A) obtained from the station 11 in January is a preflexive one. It is elongated, slightly tapered and strongly compressed body. Head is deep and large with the mouth extending to about the anterior eye and a short snout. Gut is coiled and rather compact with the anal opening about 40 % TL. There are 6 elongated rays developed on the top of the head. The second ray is the

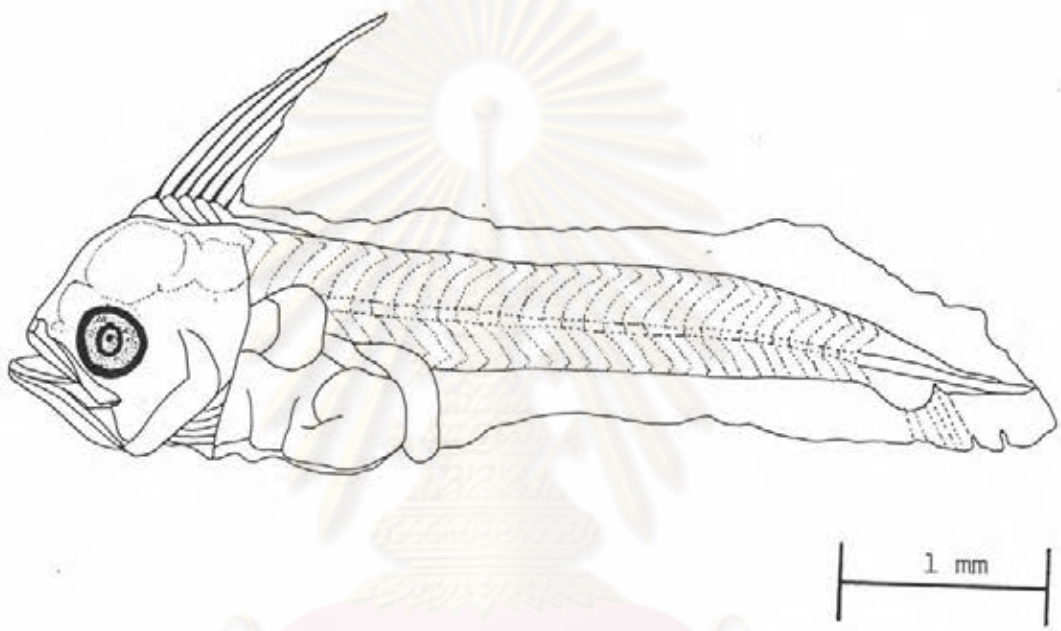


Figure 12 A Pseudorhombus sp, 5.02 mm TL

longest. Dorsal and anal fins are not developed yet, while the caudal is growing. Myomeres are 32 (10+22).

Psettina sp.

The Psettina larva of 4.06 mm TL (Figure 12 B) obtained from the station 8 in November is a preflexive one. It has a large and deep head and a strongly compressed body which tapering posteriorly to the sharp pointed tail-tip. The head is steeply sloped with a short snout and a small mouth not reaching the anterior of eye. A long dorsal rays developed on the top of the head is located about anterior of eye as the same as the chin barbel. Gut is large and coiled with the anal opening about 50 % TL. Pigment spots are lying along the ventral head and body from the cleithral portion, the ventral gut to the caudal peduncle. Melanophores are also present on the head and the barbel. No fins are developed except the pectoral buds. Myomeres are 34 (12+22).

The other preflexive larva of the Psettina sp. of 5.79 mm TL (Figure 12 C) obtained from the station 13 in October has a deep head and deep body tapering to the pointed tail similar to the last one. The dorsal ray slightly moved ahead. Tiny teeth are present on both jaws. Gut is more compact. Consequently, the anal position slightly moved forwards. The chin barbel is still visible. Dorsal and anal fins with distinctively long fin bases as well as the caudal fin are fairly

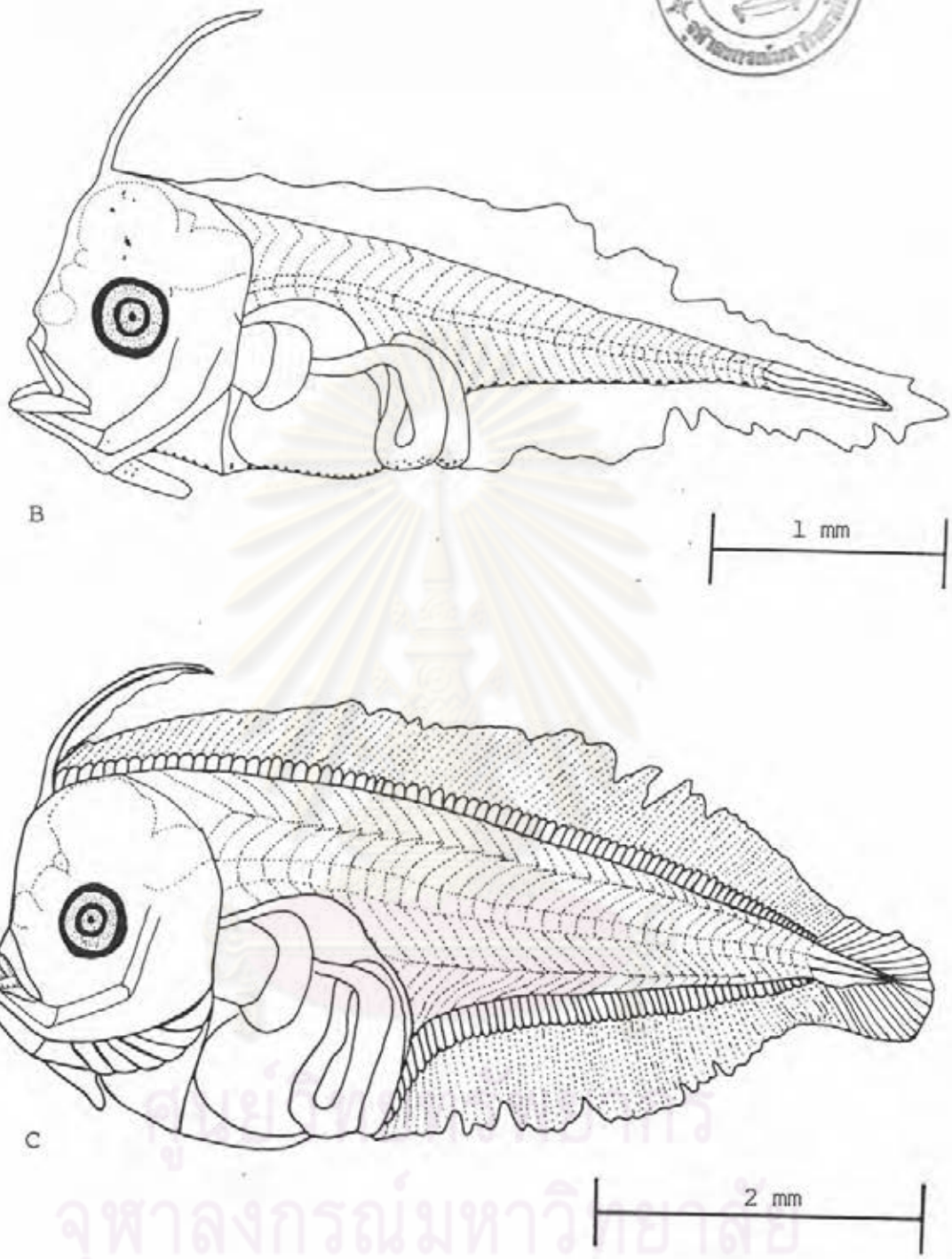


Figure 12 B Psettina sp, 4.06 mm TL

C Psettina sp, 5.79 mm TL

developed. Pigments, on the other hand, become invisible. Myomeres are 36 (10+26). Dorsal and anal fin elements are about 80 and 55, respectively.

Larvae of the Psettina sp. are distinctly different from the Pseudorhombus larva in the deeper head and body, single dorsal ray, more steeply sloped head, and myomere number, as well.

Family Soleidae

Common Name : Soles

Diagnostic Features

The soleid larvae are elongated, tapering, deep and strongly compressed bodied with 25-52 myomeres. The head is large with a large oblique mouth and the prominent dorsal hump on the head.

Description

Soleid Larva I

The preflexive soleid larva of 2.78 mm TL (Figure 13 A) obtained from the station 15 in December has a deep head with elongated and tapering body. The head has neither ray nor barbel, but sloped with slightly elongated snout and a small mouth not reaching the anterior eye. Gut is large and compact with the anal opening about mid-body. Pigment spots distribute on the head, trunk and gut, even on the finfold. Melanophores appear more concentrated on the dorsal and ventral margins of the caudal portion as wellas the ventral gut. Myomeres

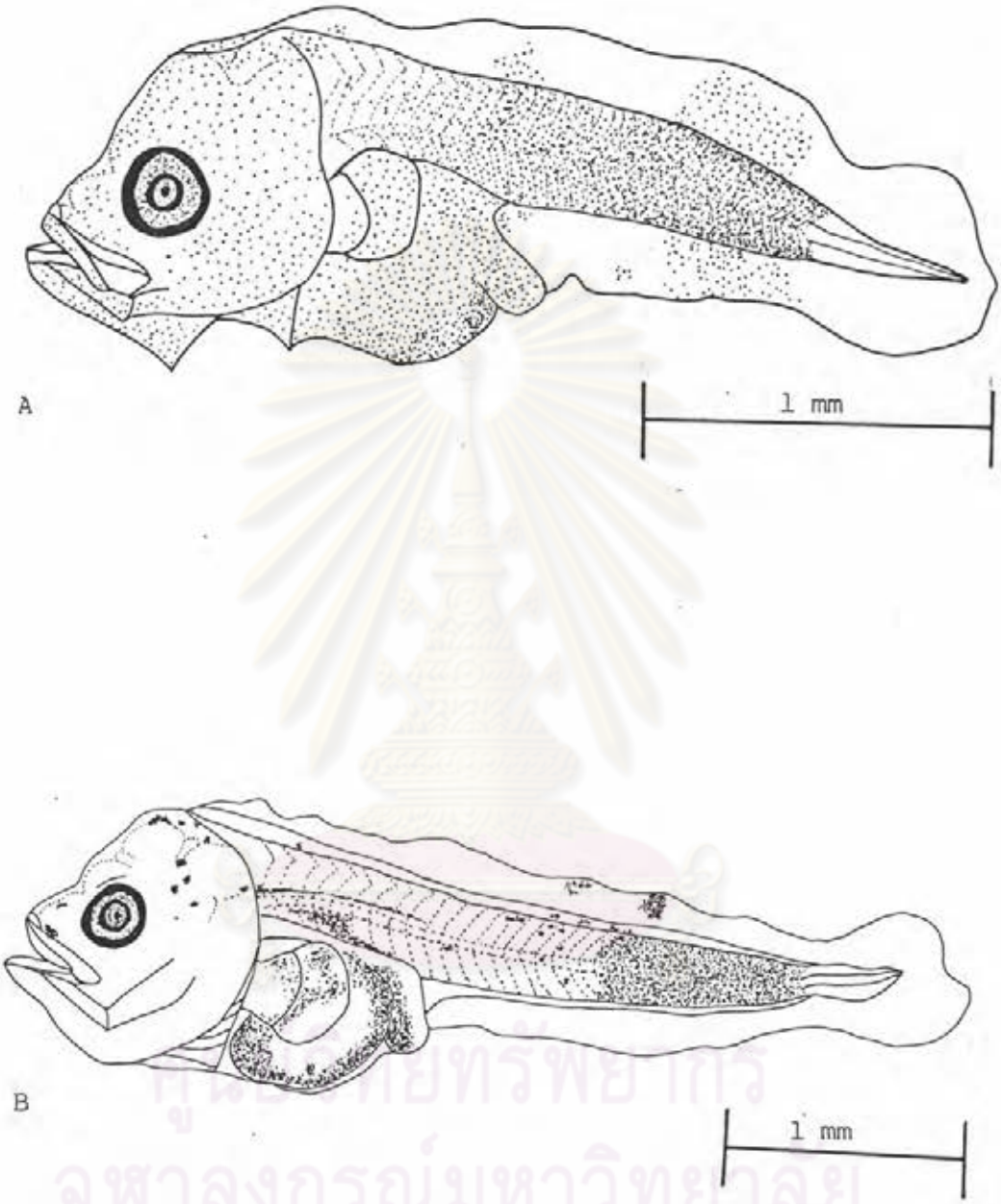


Figure 13 A Soleid larva I, 2.78 mm TL

B Soleid larva II, 3.97 mm TL

are 40 (14+26). Dorsal and anal fins are invisible.

Soleid Larva II

The other preflexive larva of the Soleidae of 3.97 mm TL (Figure 13 B) obtained from the station 3 in October has a large head and elongated body. The head without any spines is sloped with slightly elongated snout and a large mouth extending to about mid eye. Gut is large and compact with the anal opening at about 40 % TL. Pigmentation is dense on the 1/3 BL posteriorly and on the ventral gut. A pigmented row is present on lateral mid-line preanally. The pigment spots are also present on the head, mid body and even on the dorsal finfold. Myomeres are 36 (10+26). Dorsal and anal fin anlagen are noticeable.

The soleid larva II was differentiated from the larva I by the myomere number and pigmentation, even the general features of them look alike each other but no enough evidence to confide the same type.

Family Cynoglossidae

Common Name : Tonguefishes, Tongue-Soles

Diagnostic Features

The larvae are extremely compressed and elongate bodies with a broad anterior and a tapering posterior end. The jaws are relatively smaller than the soleid larvae and the body is more attenuate.

Description

Cynoglossus sp.I

The preflexive larva of 3.44 mm TL (Figure 14 A) obtained from the station 5 in September is elongated, tapering and strongly compressed body. Head is relatively large and rounded with an elongated dorsal ray, large eyes and a large mouth extending to about mid eye. Gut is loosely coiled and protrusive. Pigments row on dorsal and ventral edges of the tail and the ventrum of gut. Some pigment spots are present above the gut. Myomeres are 35 (5+30). Dorsal and anal fins are not developed.

Cynoglossus sp.II

The preflexive larva of the Cynoglossus sp. II of 6.29 mm TL (Figure 14 B) obtained from the station 15 in May is elongated, tapering and strongly compressed body. Head is large and steeply sloped with a large mouth extending to about mid eye. A pair of dorsal rays are distinctively long on the top of the head at about the eye position. The protruding gut is large and coiled. Caudal and anal fins are fairly developed, while the dorsal still developing the fin bases. Pigment spots are present on the head, on the body and the ventral gut. Myomeres are 51 (11+40); D. 97; A. 66.

The post-flexive larva of Cynoglossus sp. II of 8.39 mm TL (Figure 14 C) obtained from the station 16 in January has a large head and elongated, tapering and strongly compressed body as the preflexive but more

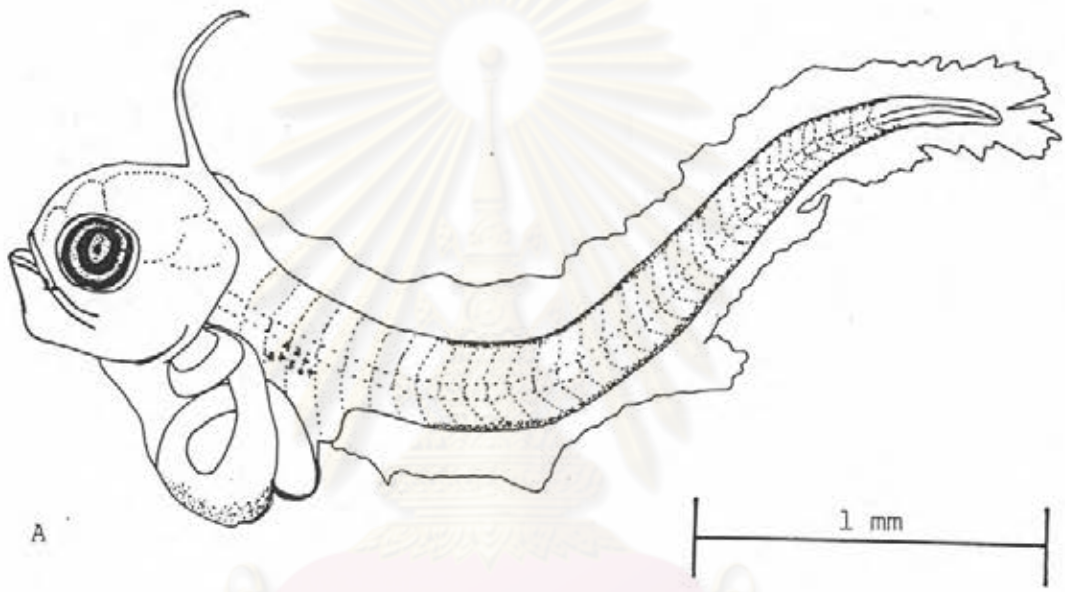


Figure 14 A Cynoglossus sp I, 3.44 mm TL

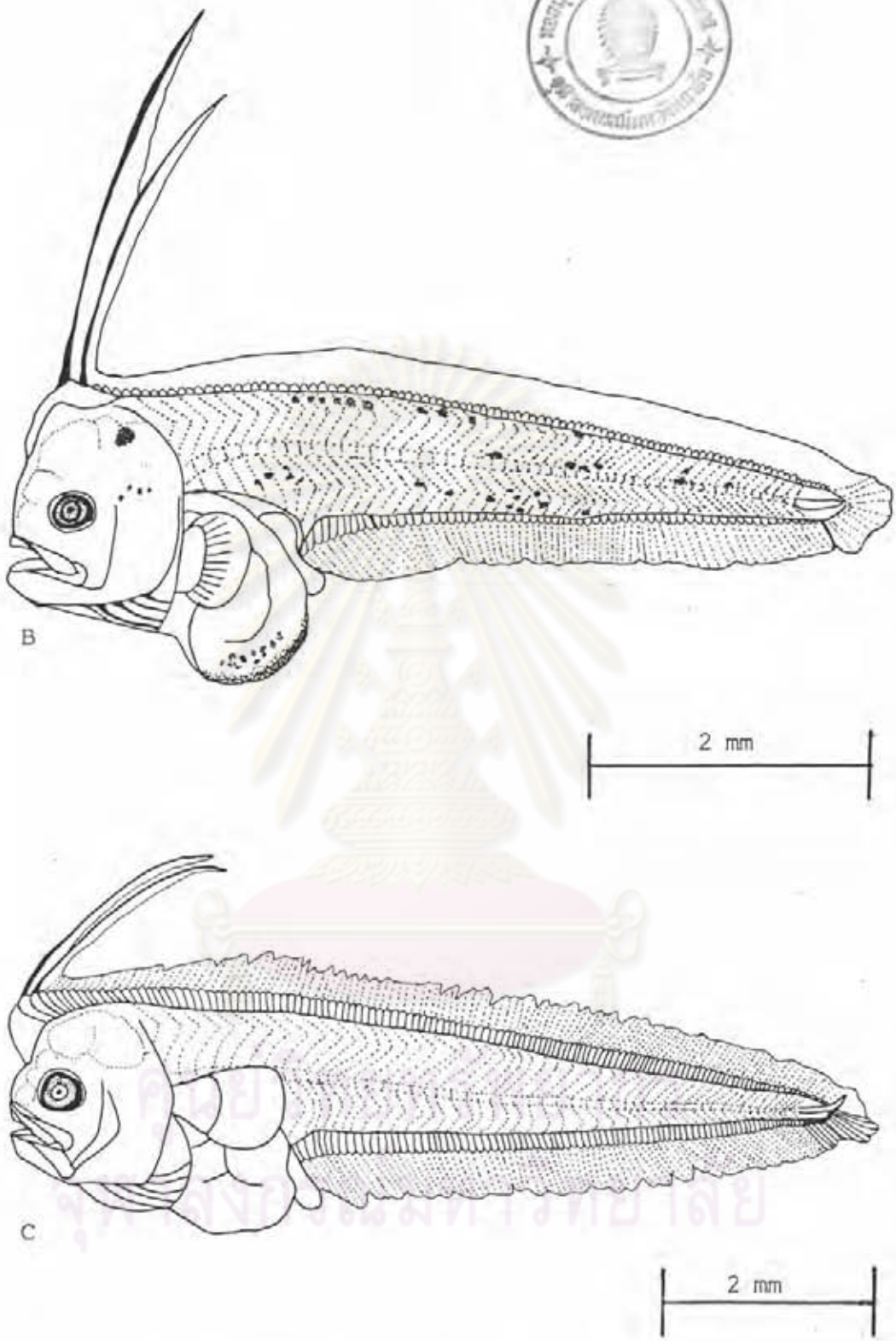


Figure 14 B Cynoglossus sp II, 6.29 mm TL

C Cynoglossus sp II, 8.39 mm TL

growing. Dorsal rays slightly moved forwards. Dorsal fin is well-developed whereas the pigmentation is scarcely seen. Myomeres are 53 (12+41); D. 130; A. 84.

The two larvae of Cynoglossus sp. II were determined the same species because of the similarity of the ray formation and myomere count, even the pigmentation could not be traced, that probably due to the preservation. The Cynoglossus sp. I might be the younger form of the Cynoglossus II, if the present evidence of the developing process of this fish could be more clearified.

Family Syngnathidae

Common Name : Pipefishes, Seahorses

Diagnostic Features:

The syngnathid larvae are elongate, slender and rather squared body encased with bony structure. The mouth is tubular. The dorsal fin is more larger than the anal fin. The number of bony rings can identify the species.

Description

Hippocampus sp.

The postlarva of a Hippocampus sp. of 14.81 mm TL (Figure 15) was obtained from the station 7 in February. It is elongate, slender and laterally compress-bodied with a rather squardrangular tail. Supraocular ridges are developed, as well as the body ridges. Bony

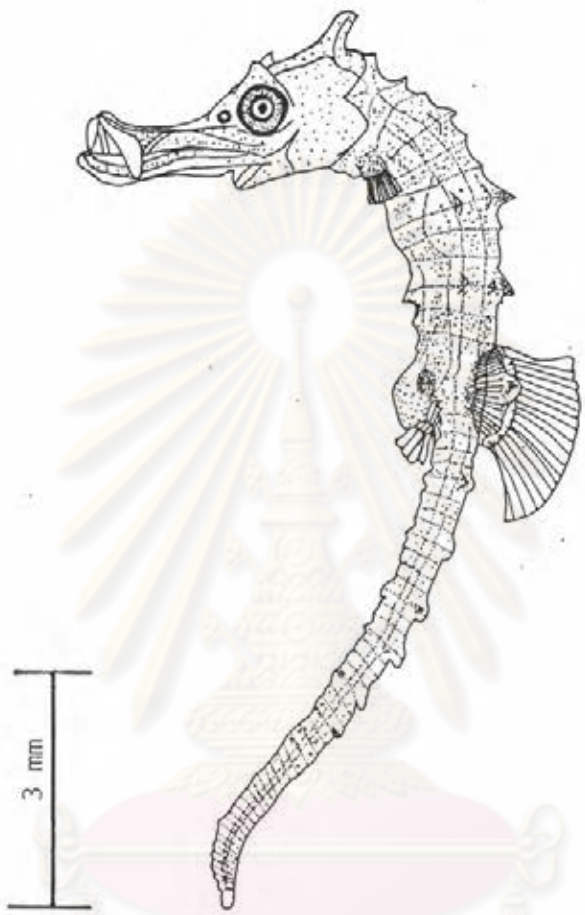


Figure 15 Hippocampus sp, 14.81 mm TL

rings are developed; 12 on the trunk and 46 on the tail. Gut is located about 1/2 BL. There is no gap between anus and anal fin. Pectoral and anal fins are small but the dorsal is distinctively larger. Pigment spots scatter throughout the whole body, especially densed on bony rings that become light and dark bands alternating on the body. Myomeres are invisible; D. 17; A. 4.

Family Pegasidae

Common Name : Sea-Moths, Winged-Dragonfishes

Diagnostic Features

The pegasid larvae have the dermal sac, body rings and ridges with depressed head and trunk, early-forming protractile mouth, and moderate to heavy pigmentation.

Description

Pegasid Larvae

The larva of 2.03 mm TL (Figure 16 A) obtained from the station 11 in February is moderate and tapered. Head is large and dorsoventrally flattened, whereas the trunk is laterally compressed. Snout is short and enclosed in dermal sac. Gut is deep with anal opening about midbody. Supraocular and posttemporal ridges are develop on the head. Pectoral fins are large and slightly elongate. Pigmentation is present along the ventral body of the postanal region, on dorsum of the gut, pectoral

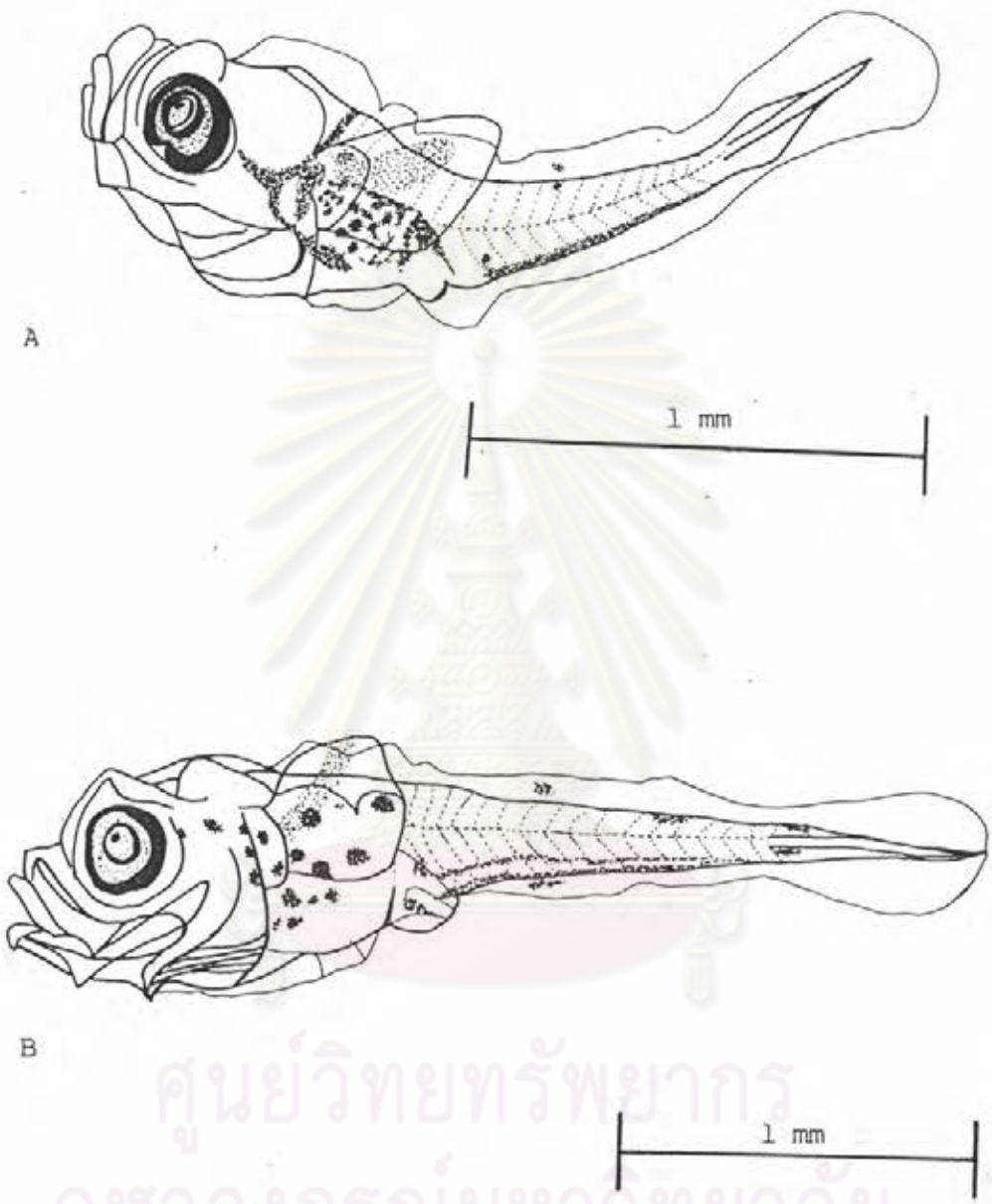


Figure 16 A Pegasid larva, 2.03 mm TL

B Pegasid larva, 2.82 mm TL

fins, operculum and pigment spots on the dorsal surface and dorsal finfold. Myomeres are 18 visible (7+11). Except the pectoral, the other fins are still undeveloped.

The larva of 2.82 mm TL (Figure 16 B) obtained from the station 12 in February is similar to the preceding one. However, dermal sac is more extending on the body, and more ridges are formed respectively. Pigment is moreover developed on the gut, pectoral fins, dorsal and ventral edges of the tail, and finfolds. Visible myomeres are 16.

Both larvae are very similar in size and stage of development in addition to the similarity of the other features, that could assure the same series.

Family Fistulariidae

Common Name : Cornetfishes, Flutemouths

Diagnostic Features

The fistulariid larvae are elongated bodies with the elongated snout, terminal mouth, spination from head to tail, and long filaments on the caudal fin.

Descriptions

Fistulariid Larvae

The preflexive larva of 12.53 mm TL (Figure 17 A) obtained from the station 5 in January is extremely elongate and slender. The body is slightly curved up. Head is small but elongate with a long flute-mouth. Gut is long and straight with anal opening at about 75 % BL.

Many small spines develop on the anterior half of the body. Dorsal and anal fin anlagen are visible on 25 % BL posteriorly. The gap between anus and anal fin origin is present. Pigment is developed along ventral surface of the body from the cleithral area to tail-tip. Myomeres are 66 (44+22); D. 11; A. 11.

The postflexive larva of 29.35 mm TL (Figure 17 B) obtained from the station 9 in January is more developed than the previous one. Spines are developed on head, supraocular, and posttemporal portions. Serrations on proximal tubular snout are developed. Gut extends to anal fin origin; the gap becomes invisible. Two elongated filaments protrudes out of the caudal elements. Dorsal and anal fins are well-developed. Myomeres are numerous with about 48 preanal myomeres; D. 12; V. 13.

The two larvae are very different in size; however, they are still determined the same series because the dorsal and anal compositions are more likely not distinctly different as well as the myomeres, even those meristics in the larger larva appear more amount, that should be affected by the growth mechanism.

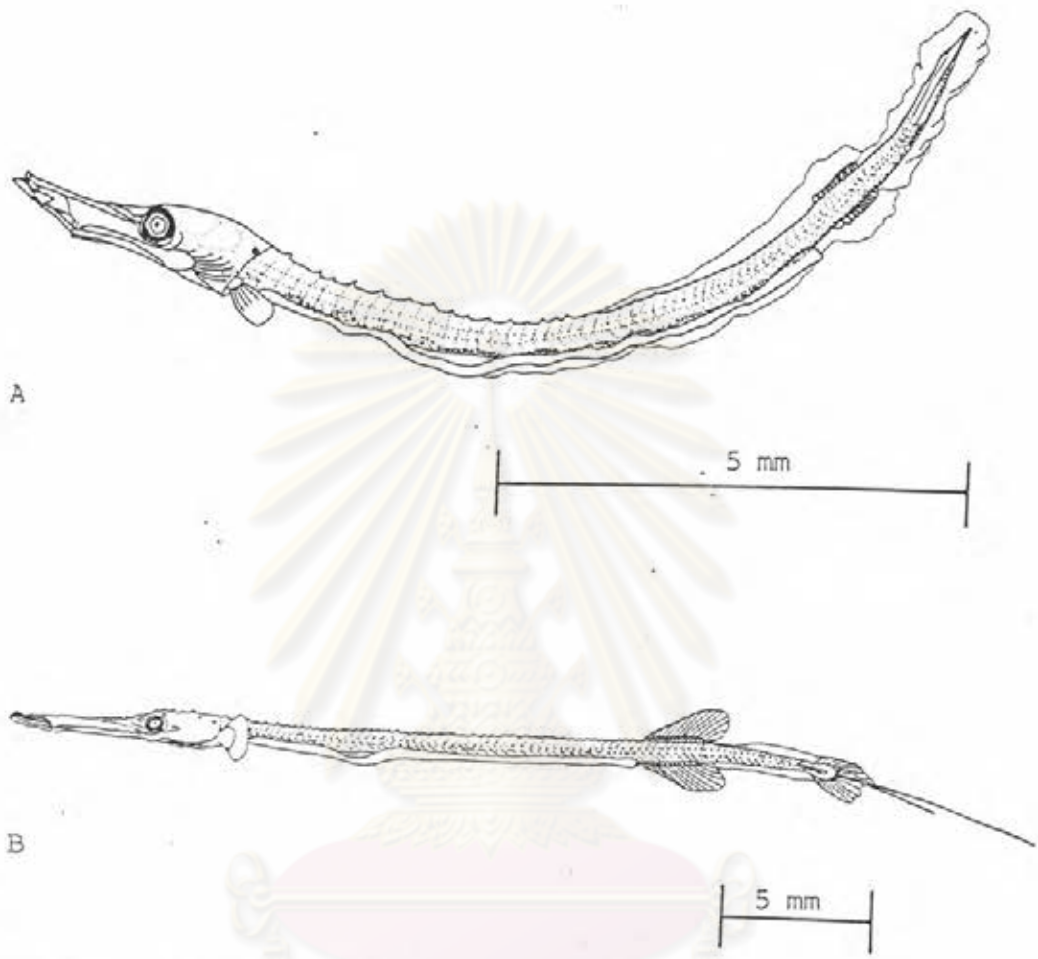


Figure 17 A Fistulariid larva, 12.53 mm TL

B Fistulariid larva, 29.35 mm TL

Family Sphyraenidae

Common Name : Barracudas, Sea Pikes

Diagnostic Feature

The sphyraenid larvae are distinguished by elongate bodies with the pointed snout, tiny teeth, minute preopercular spines and the characteristics of pigmentation. The gut is long and straight to about 70 % BL.

Description

Sphyraena sp.

The flexive larva of 5.74 mm TL (Figure 18 A) obtained from the station 3 in May has an elongated and laterally compressed body, large head, large rounded eyes and pointed snout. Mouth is large extending to about mid eye, with small teeth on the upper jaw. Gut is long and straight. Anus locates about 60 % BL. reaching the anal fin origin. Notochord tip slightly protrudes out of caudal finfold. Caudal elements are visible, but the dorsal and anal elements are not clearly seen. Pigmentation is hardly remarkable. Myomeres are 24 (14+10); D. 8; A. 8.

The larva of 12.86 mm TL (Figure 18 B) obtained from the station 5 in January is the late postflexive one with relatively small and elongate head, pointed snout and elongate body. Pelvic fins and the first dorsal fin are present. Pigment is developed on the head, hind gut, along the dorsal and anal surfaces of the tail, and rows

on the lateral mid line from cleithral portion to about midbody. Melanophores are also present on caudal mid line and the dorsal surface between the first and second dorsal fins. Myomeres are 24 (14+10); D. 10; A. 10.

The two larvae should be the same type because they have the same myomere count and pattern and fin formations, besides the other similar features.

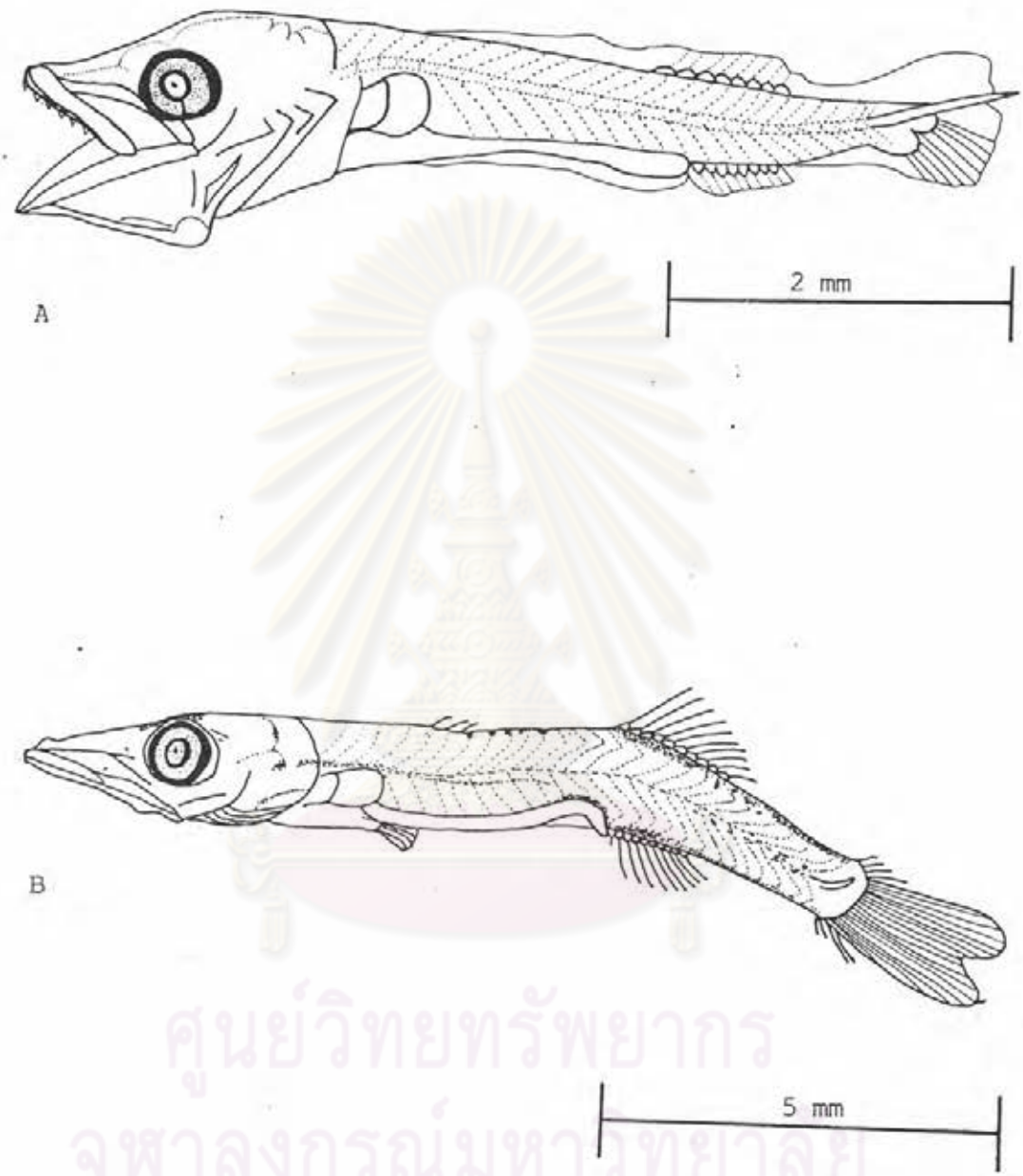


Figure 18 A Sphyraena sp, 5.74 mm TL

B Sphyraena sp, 12.86 mm TL

Family Scombridae

Common Name : Indo-pacific mackerels

Diagnostic Features

The Rastrelliger larvae are fusiform bodied with 31 myomeres. Head spines are absent. The gut is short with the anal opening about the 6^{th}-7^{th} myomere. Melanophores are present along the mid-ventral body and the preanal position.

Description

Rastrelliger sp.

The flexive Rastrelliger larva of 2.43 mm TL (Figure 19) obtained from the station 8 in January is fusiform bodied. Head is large and rather rounded with the large rounded eyes and a large mouth extending to about mid eye. Many small teeth are present on the upper and lower jaws. No head spines are developed. Gut is coiled and short with the anal opening at about the 6^{th}-7^{th} myomere. Dorsal and anal fins begin to develop within the finfold. Melanophores are invisible. Myomeres are 28 (7+21); D. 12; A. 11. The larva is clearly distinguished from the nemipterids by the myomere count.

Family Trichiuridae

Common Name : Hairtails, Cutlassfishes, Sabrefishes

Diagnostic Features

The trichiurid larvae are elongate and strongly compressed with more than 100 myomeres, the pointed snout

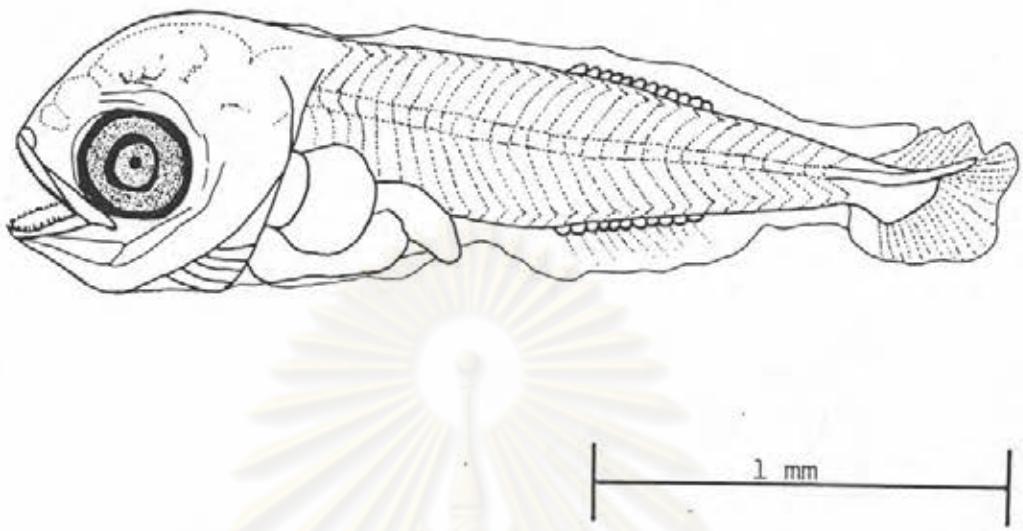


Figure 19 Rastrelliger sp, 2.43 mm TL

Figure 20 Trichiurid larva, 7.17 mm TL

and elongated fin spines.

Description

The trichiurid larva of 7.17 mm TL (Figure 20) obtained from the station 9 in February is and early flexion one. It is elongate, tapered, and strongly compressed. Head is small with a pointed snout. Mouth is wide but not reaches the anterior of eye, which located about 50 % HL and HD. The 5 preopercular spines are conspicuous. Developing dorsal spines are elongate, the first one is longer than others respectively. Gut is short with anal location about 40 % TL. Dorsal and anal finfolds are visible but not the anal anlage. Caudal rays are initially developing. Myomeres are numerous, the first 13-14 ones are preanal. Dorsal spines are 9 prominant and other 8 dorsal bases growing.

Family Carangidae

Common Name: Trevallys, Jacks, Pompanos

Diagnostic Features:

The carangid larvae are distinguished by the character of the 3 anal spines and dorsal fin spines. The large head, head spination including the preopercular spines, median occular crest, supraocular ridge and post-temporal spines are also distinctive, as well.

Description

Caranx mate (Cuvier)

The early juvenile of Caranx mate of 13.30 mm TL (Figure 21 A) obtained from the station 13 in August has a fusiform bodied with the large head and large rounded eyes. Mouth is large and oblique extending to about anterior eye. Anal position is about 50 % BL. Head spination is absent. All fins are well-developed. Myomeres remain invisible, while pigment spots still recognizable. The pigments are mainly concentrated on the dorsal head and body. They also scatter on the fin membranes. D. VII, I-24; A. III-19.

Caranx leptolepis (Cuvier & Valenciennes)

The preflexive larva of the Caranx leptolepis of 4.30 mm TL (Figure 21 B) obtained from the station 5 in February has a large and deep head with a large oblique mouth reaching about mid eye. The crest is developed on the nape as well as the preopercular spines. Gut is coiled with the anal opening at about mid body. Pigment spots row on the ventral edge of the tail. The pigmentation is also prominant on the gut but scarcely seen on the head and trunk. Dorsal fin is undeveloped while the anal fin bases are noticeable. Myomeres are 24 (11+13); A. 13.

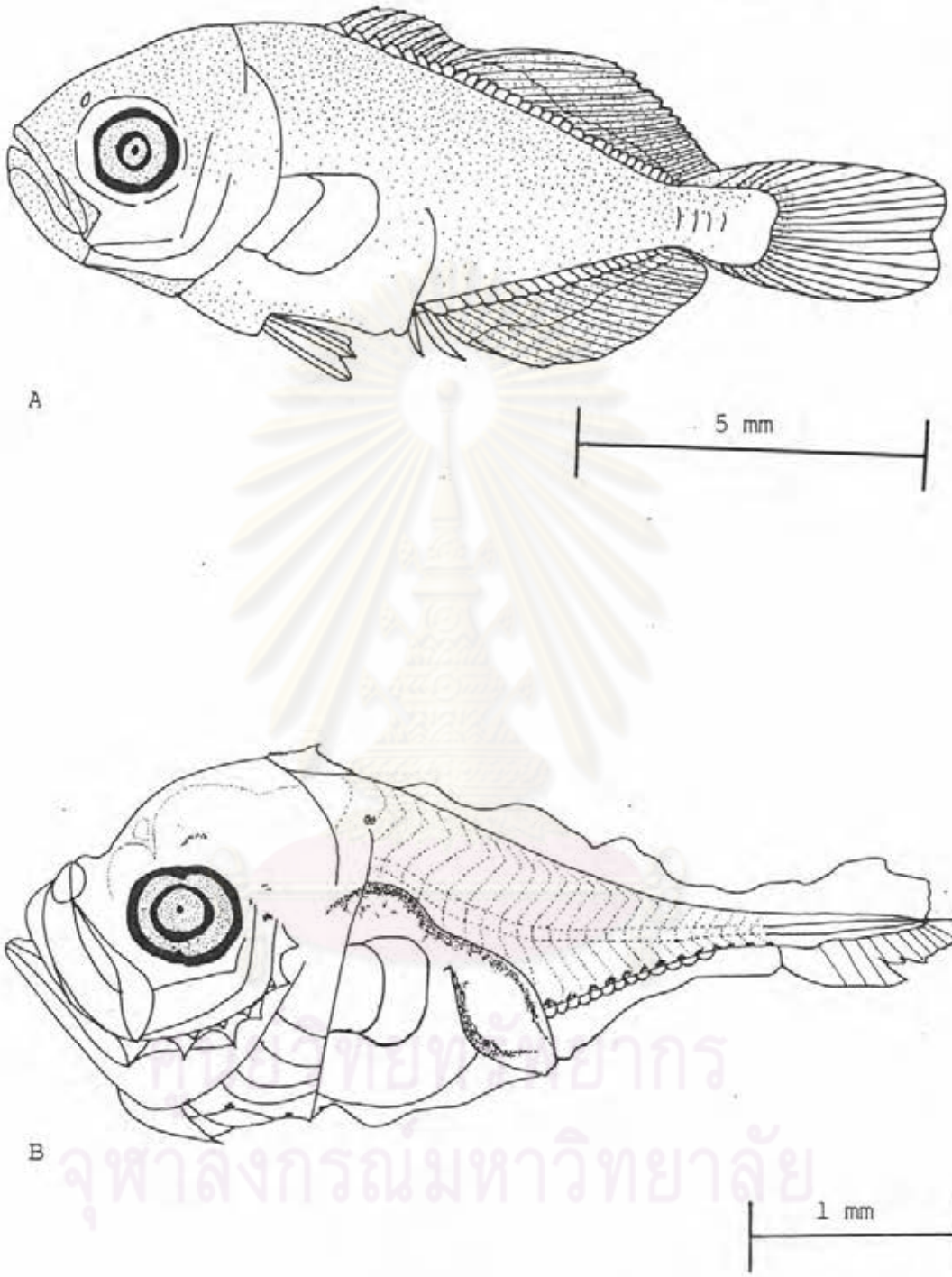


Figure 21 A Caranx mate, 13.3 mm TL

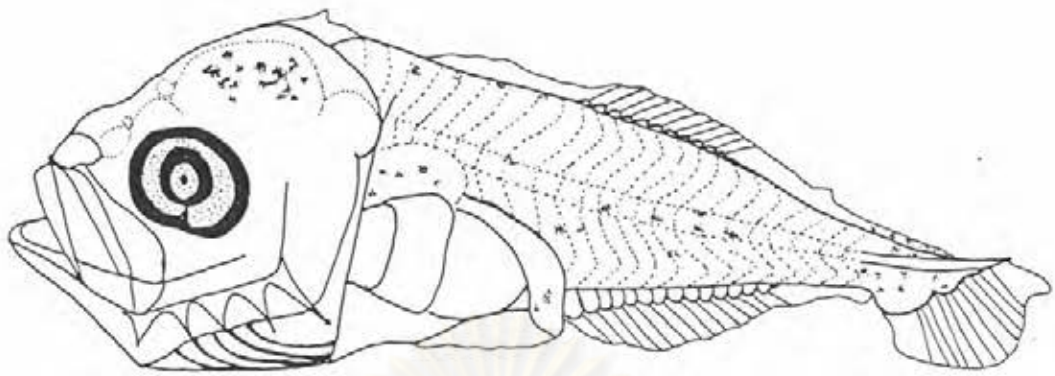
B Caranx leptolepis, 4.30 mm TL

Selar sp.

The larva of Selar sp. of 4.52 mm TL (Figure 21 C) obtained from the station 1 in May has a relatively elongate body, the cranial crest and preopercular spines. Mouth is large and oblique extending to about mid body. Pigmentation is on the head, dorsal margin of the body, on the gut, on lateral region and on the caudal peduncle. The larva is different from the Caranx spp. in its moderate body and pigment pattern on the caudal peduncle. Myomeres are 24 (11+13); D. 11; A. 14.

Decapterus sp.

The postflexive larva of Decapterus sp. of 9.56 mm TL (Figure 21 D) obtained from station 8 in January has a relatively elongate body. Head is large with the large mouth, large rounded eyes, serrated cranial crest and preopercular spines. The anus locates at about mid body. Dorsal and anal spines are prominantly developed. Pigmentation is poorly traced. The larva is different from the Caranx spp. in its shallow body and longer tail, as well as the absence of melanophores on the nape. The myomeres are 24 (11+13); D. VII, 21; A. III, 23.



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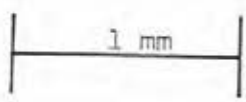

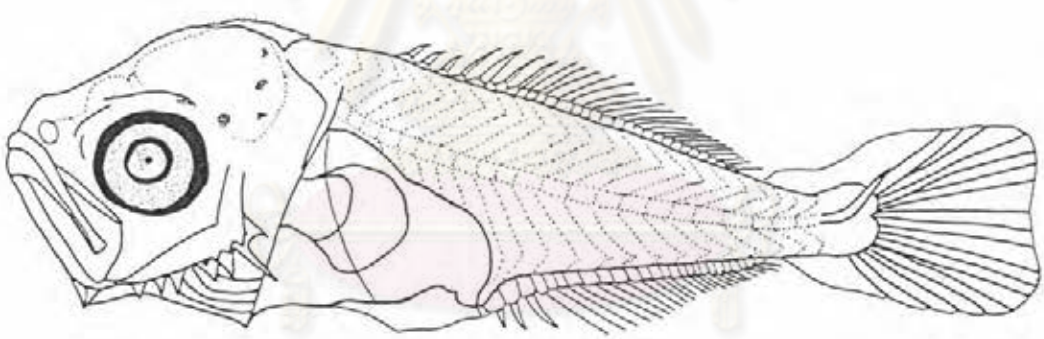

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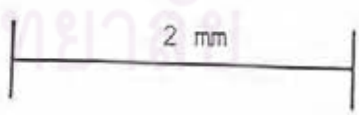


Figure 21 C Selar sp., 4.52 mm TL

D Decapterus sp., 9.56 mm TL

Family Menidae

Common Name : Moonfishes, Razor Trevally

Diagnostic Features:

The moonfish larvae are very deep bodied with triangular shape of the ventral body. Pelvic fins are thin and long like thread and close to the anus and anal fin. The Family contain only one species Mene maculata.

Description

Mene maculata (Bloch & Schneider)

The larva of Mene maculata (Bloch & Schneider) of 4.94 mm TL (Figure 22) obtained from the station 9 in January is very deep and laterally compressed bodied. Head is large and deep with large eyes. Preopercular spines are present. The ventral body extends downwards and look like a triangle, so that the filamented pelvic fins reach closely to the anus, as well as the anal fin. The gap between anus and anal fin becomes narrow. Dorsal fin rays are VI, 30 and anal rays are 24. Myomere count is 24 (11+13). Pigmentation is poorly seen; it may be decomposed by the preservation.

Family Leiognathidae

Common Name: Ponyfishes, Slipmouths, Slimys

Diagnostic Features

The leiognathid larvae have a steeply large head with preopercular spines, cranial crest, and laterally flattened bodies with the 6 - 7 preanal myomeres and

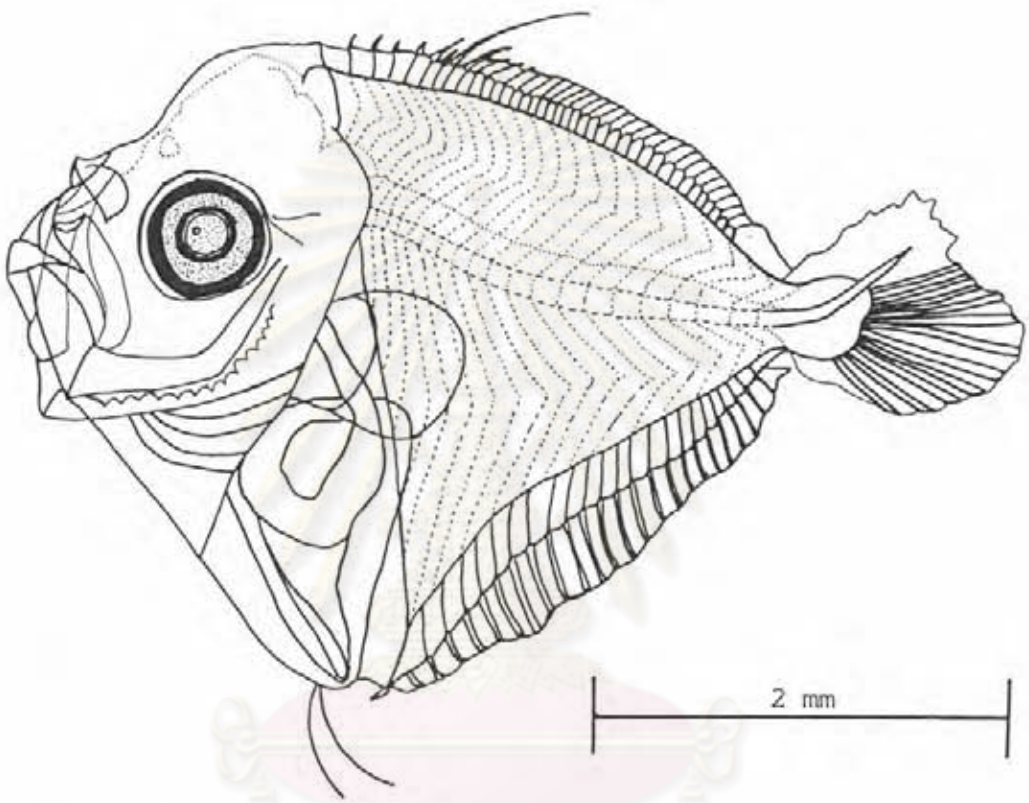


Figure 22 Mene maculata, 4.94 mm TL

pigmented spots on the ventral gut and mid-ventral body.

Description

Leiognathid Larva I

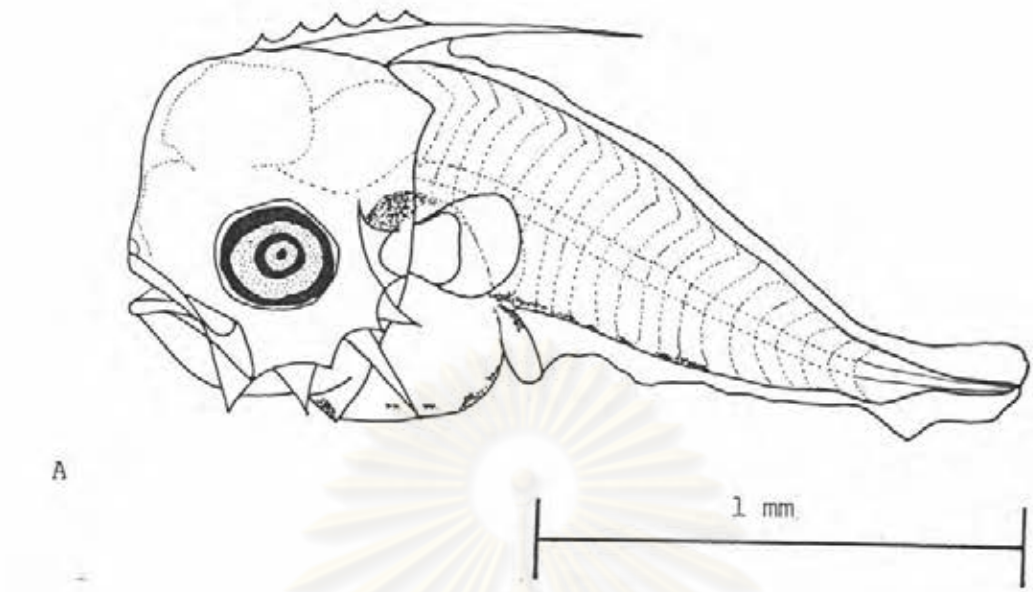
The preflexive larva of 1.87 mm TL (Figure 23 A) obtained from the station 6 in February has a large and deep head and laterally compressed body. The head is steeply sloped with a long serrated spine on the nape and the spines on the preoperculum. Mouth is large and oblique stretching to about the anterior eye. Gut is large and compact with the anal opening at about 50 % TL between the 7^{th}-8^{th} myomere. Pigments are on the dorsal and ventral gut, at the cleithral portion and on the ventrum of the tail. Myomeres are 21 (7-8 + 13-14). Dorsal and anal fins are not growing.

Leiognathid Larva II

The postflexive larva of 5.36 mm TL (Figure 23 B) obtained from the station 15 in March is elongated and laterally compressed body. Head is large with serrated crest and preopercular spines. Mouth is rather small not reaching the anterior eye. Anus locates about 40 % BL. There are 2 anal spines remarkable. Pigment is evident only on the head. Myomeres are 23 (7+16); D. 12; A. II-12.

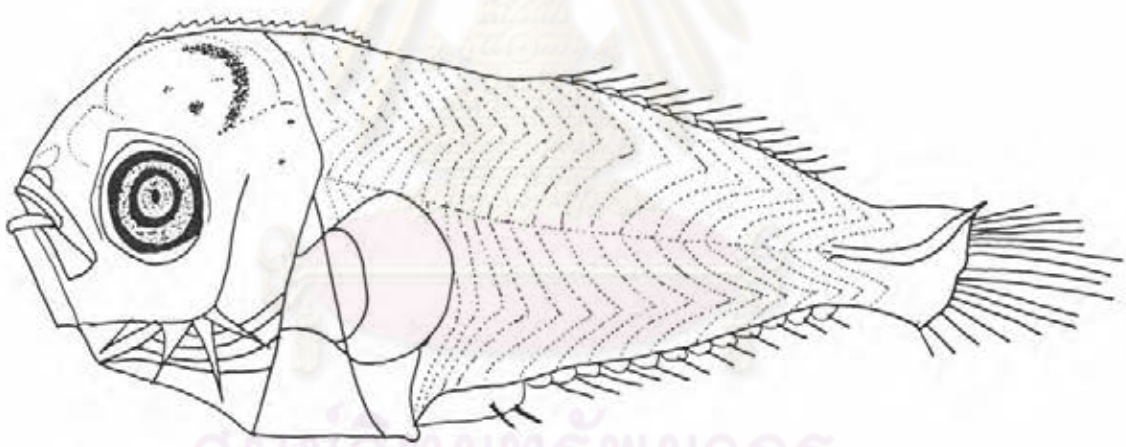
Leiognathid Larva III

The postflexive larva of 7.05 mm TL (Figure 23 C) also obtained from the station 15 in March has an



A

1 mm



B

2 mm

Figure 23 A Leiognathid larva I, 1.87 mm TL

B Leiognathid larva II, 5.36 mm TL

elongated body. The head also develops the serrated crest and preopercular spines. Two supracleithral spines are also visible. Mouth is small not reaching the anterior eye. Dorsal fin is separated. Three spines on the first dorsal fin are prominant as well as the 2 anal spines. Pigmentation is invisible. Myomeres are 24 (7+17); D. III, 16; A. II-14.

Leiognathid Larva IV

The early juvenile of 10.08 mm TL (Figure 23 D) obtained from the station 13 in May is fusiform bodied. The serrated crest is still visible on the nape. Mouth is protrusive. Anus locates about mid body. All fins are well-developed. The pelvic fins reduced to a pair of small spines. The first dorsal spines are more developed. Pigmentation is on the head, on the trunk and gut and rows along the ventral margin of the tail. Myomeres are 24 (7+17); D. IV, 16; A. II-16.

The four specimens would be the Leiognathus spp. (Chantarasakul, 1988; Termvidhchakorn, 1987; Vatanachai, 1975, 1978), but no sufficient confidence to consider the same species. Although the larvae have many similar characters such as the myomere and fin patterns, but rather highly different in size and pigmentation that causes the lost linkage between them.

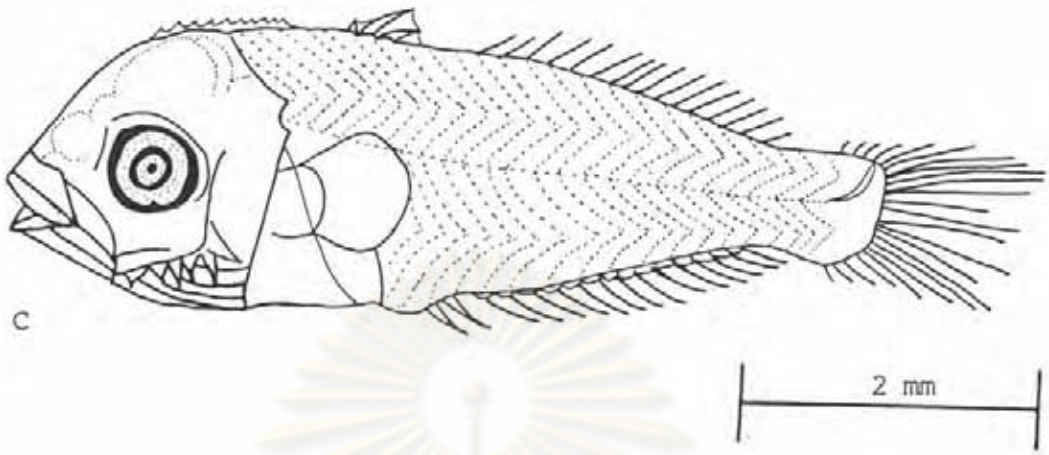


Figure 23 C Leiognathid larva III, 7.05 mm TL

D Leiognathid larva IV, 10.08 mm TL

Family Apogonidae

Common Name : Cardinalfishes, Soldierfishes, Siphonfishes

Diagnostic Features

The apogonid larvae have a large head, rounded snout, the prominent, anteriorly located gas bladder, 24 myomeres, and 2 dorsal fins.

Description

Apogonid larva I

The larva of 4.00 mm TL (Figure 24 A) obtained from the station 15 in December is a flexive one. It is moderate, laterally compressed and deep-bodied. Head is large with a rounded snout, large eyes and large oblique mouth extending to about mid eye. No preopercular spines are present. Gut is coiled with the anus present about midbody. The larva is heavily pigmented on the trunk, similar to the apogonid larva evident in Rayong Bay (Chantarasakul, 1988). Myomeres are inconspicuous. The pigment is also present on the dorsal and ventral surfaces of the gut and of the body. D. 11; A. 7.

Apogonid larva II

The larva of 6.77 mm TL (Figure 24 B) obtained from the station 9 in January is a postflexive one. It is similar body shape to the last one, but attains slightly more development. Preopercular spines and small supraoccipital crest with a single spine are present. All fins are developed. Pigment is not remarkable. Myomeres are 24 (12+12); D. 7, 10; A.10. The larva might be the

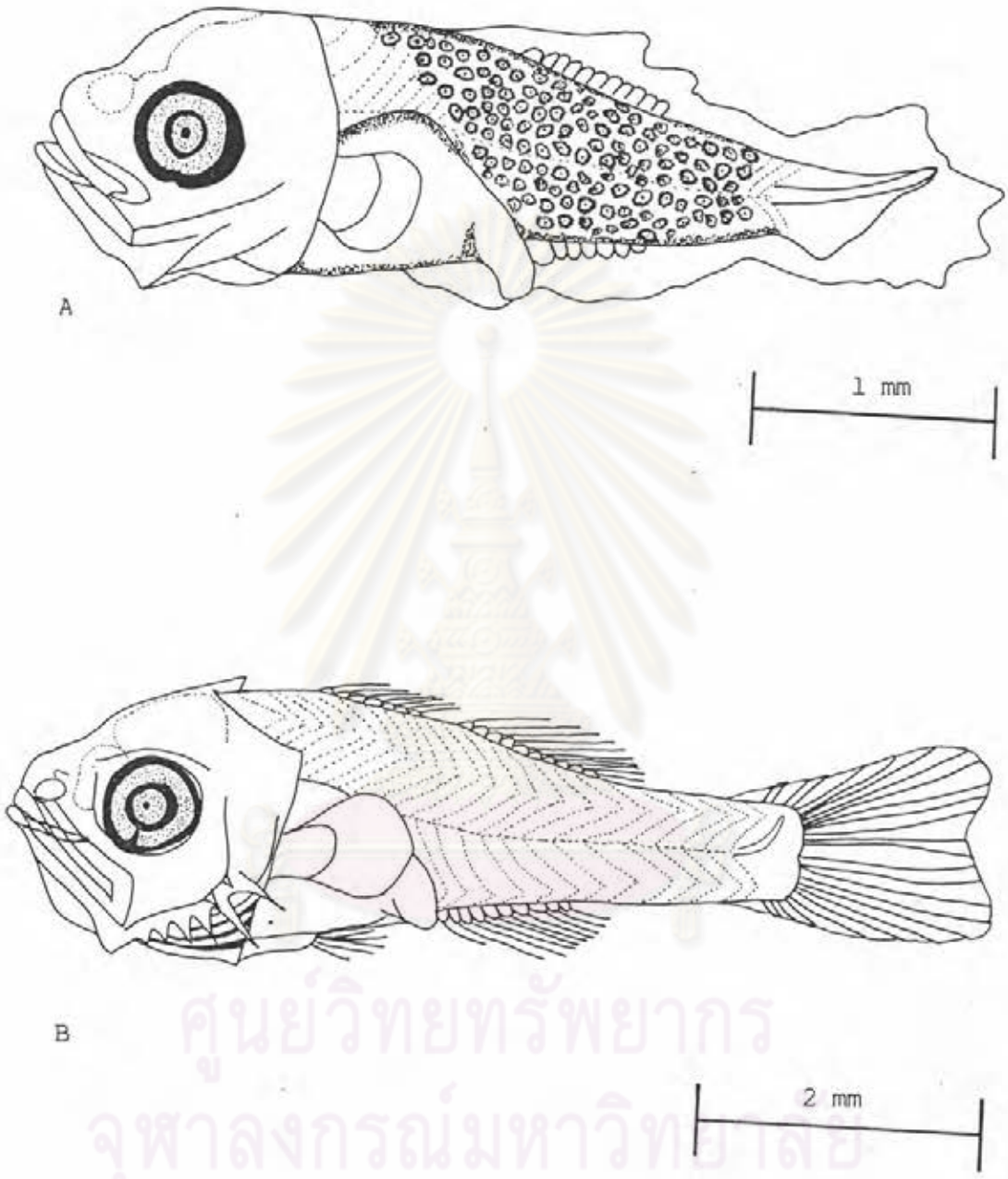


Figure 24 A Apogonid larva I, 4.00 mm TL

B Apogonid larva II, 6.77 mm TL

same species as described by Vatanachai (1975, 1978)

Family Epinephelidae

Common Name: Groupers, Rock-Cods, Coral-Trouts

Diagnostic Features

The epinephelid larvae have elongate, serrated dorsal and pelvic spines. The second dorsal spine is much longer than the body length. The head spines are also well-developed.

Description

Epinephelid larva I

The epinephelid larva of 6.04 mm TL in postflexion stage (Figure 25 A) obtained from the station 5 in November is moderately deep-bodied and laterally compressed, with the second prominant elongated and serrated dorsal spine and pelvic spines. Head is large with a short rounded snout. Supraocular ridge is remarkable. Spines on the head include 7-8 preopercular, 1 supraopercular and 3 posttemporal. There are 5 serrated dorsal and 2 smooth spines on the first dorsal fin and 1 smooth on the second one. Two anal spines are smooth and prominant. Melanophores on dorsal portion of the gut and a pigment spot at the last anal fin base are distinctive. The larva has a short and compact gut extending to about midbody. Anus is very closed to the first anal spine; thus, the gap is rarely visible. Myomeres are 23 (12+11); D. VII, I+16; A. II, 10.

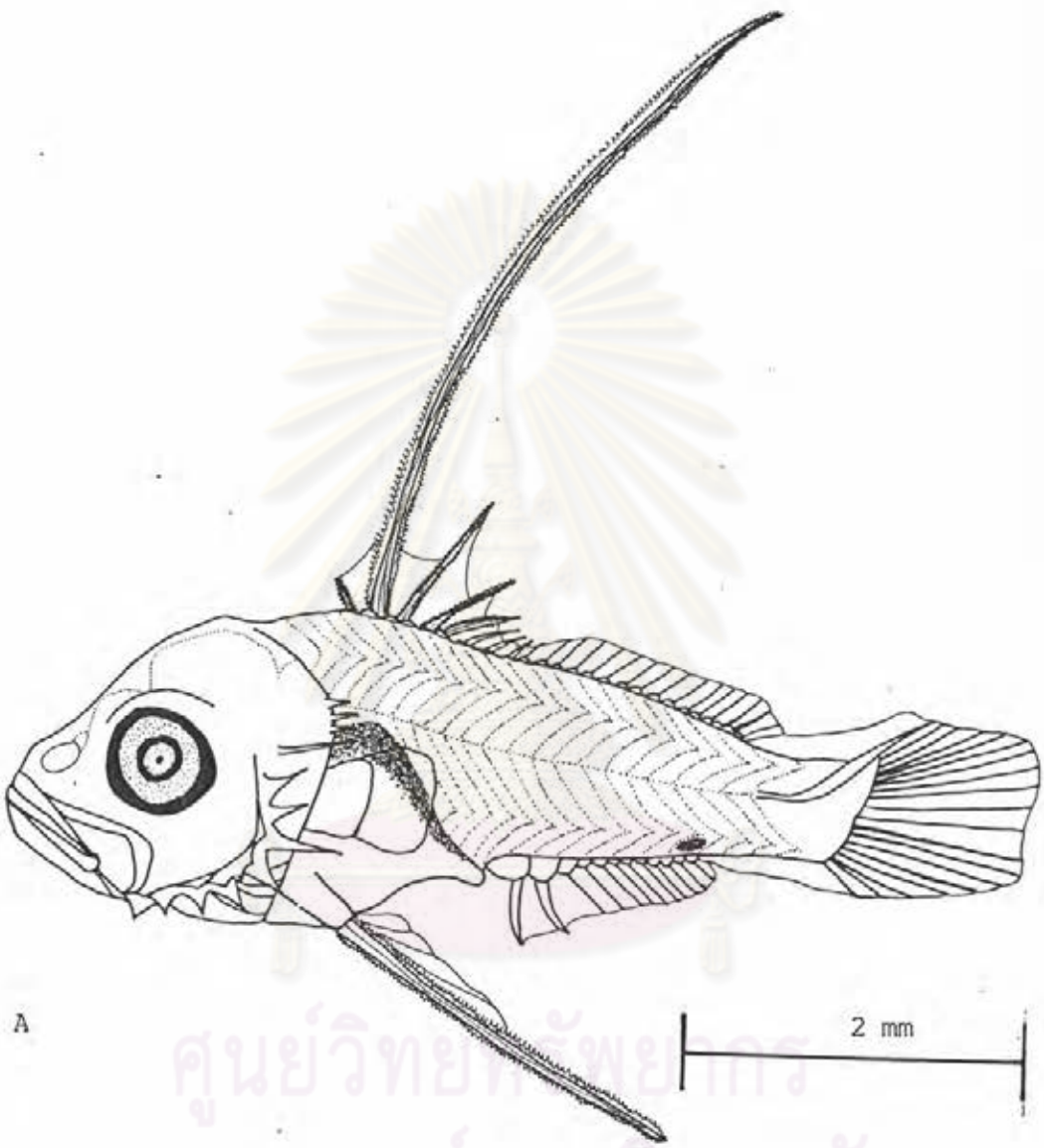


Figure 25 A Epinephelid larva I, 6.04 mm TL

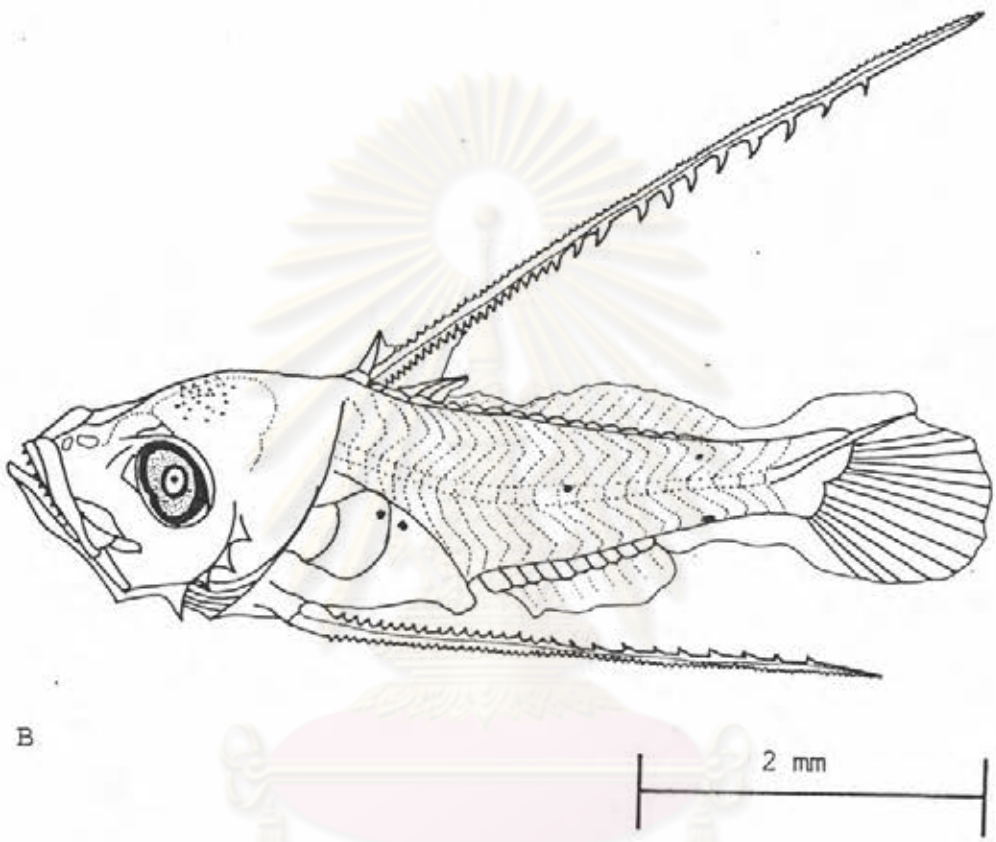


Figure 25 B Epinephelid larva II, 5.64 mm TL

Epinephelid larva II

The postflexive larva of 5.64 mm TL (Figure 25 B) from the station 7 in January is moderately elongate, with a short snout, and large deep head. The second dorsal and pelvic spines are elongated and serrated. Unlike the epinephelid I, serrations on posterior surface of the dorsal spine are coarse and hook-like. Small spines are present on mid-brain region. Supraocular ridge and 4 preopercular spines are also conspicuous. Mouth is large and oblique not reaching the anterior of eye, with small teeth on the upper jaw. The larva scarcely develops pigment. Pigmented spots are on the dorsum of gut, ventral surface of caudal peduncle and on lateral mid line. Small gap between anus and anal fin origin is noticeable. Myomeres are 22 (8+14); D. III+3, 11; A. 10.

Family Priacanthidae

Common Name : Bulleyes, Bigeyes

Diagnostic Features

The priacanthid larvae are deep bodied with the coiled gut. The broad and round head develops the serrate supraoccipital crest and a retrorse spine on the crest.

Description

Priacanthus sp.

The preflexive Priacanthus larva of 4.26 mm TL (Figure 26) from the station 10 in February is deep-bodied and laterally compressed. Head is large and broad with a

Figure 26 Priacanthus sp, 4.26 mm TL

short sloped snout. Mouth is moderate extending to about mid eye. Gut is coiled and compact. Anus is located about 37 % BL. The serrated spine on the top of the head is retrorse. Preopercular spines are present, one of them is serrated and specially elongated. Spines are also visible beneath the lower jaw. Pigment spots are on the mid-brain and ventral margin of the postanal body. Dorsal surface of the gut is also pigmented. Dorsal and anal fin anlagen are not developed yet, but caudal rays are slightly visible. Myomeres are 21 (7+14).

Family Lutjanidae

Common Name : Snapper, Sea-Perch, Hussars, Bass

Diagnostic Features

The lutjanid larvae develop elongate serrated dorsal and pelvic spines as the epinephelids. But the dorsal spine is shorter than the body length and the pelvic ray is larger than the spine.

Description

Lutjanid larva I

The larva of 3.46 mm TL (Figure 27 A) obtained from the station 10 in February is an early flexive one. It is deep-bodied and laterally compressed. Head is large with 6 preopercular and 2 supracleithral spines. Snout is short. Mouth is moderate, extending to about anterior edge of eye. Gut is coiled and rather compact. Anus is

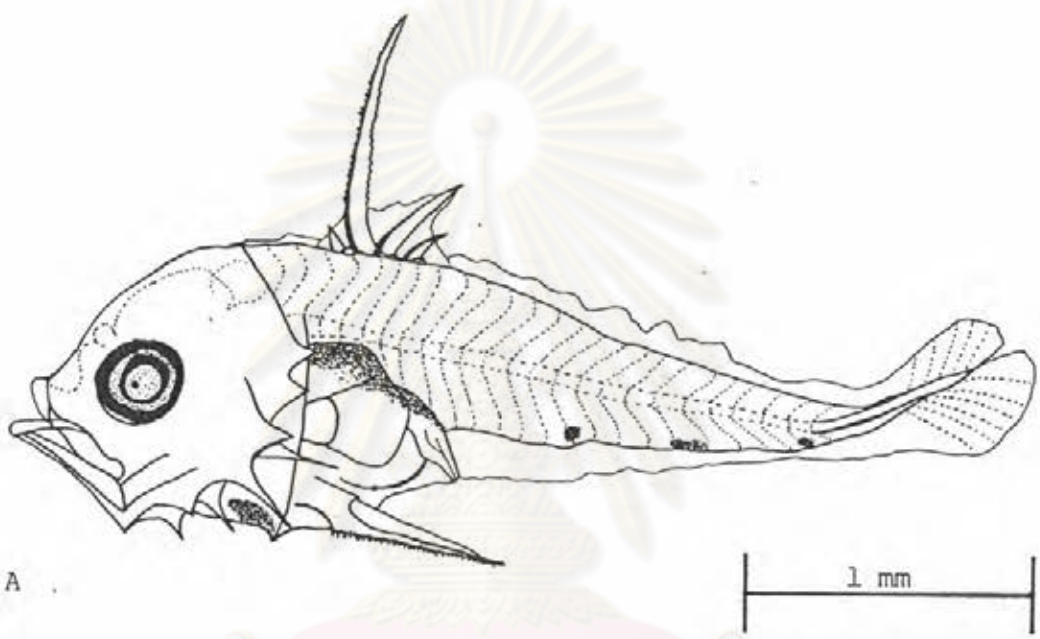


Figure 27 A Lutjianid larva I, 3.46 mm TL

located near to midbody. The second dorsal spine is elongated with the presence of serrations, while the other 3 spines remain smooth and shorter. The larva also develops a pair of elongate serrated pelvic spines. Pigment is on the dorsum of gut, on the ventral head prior to the cleithrum and on the ventral part of the tail. Dorsal and anal fin anlagen are not developed yet, whereas the caudal rays are developing. Myomeres are 24 (10+14); D. III.

Lutjanid larvae II.

The two lutjanid larvae were collected from the station 9 in January; one preflexive, and one flexive.

The preflexive larva of 4.82 mm TL (Figure 27 B) is elongate, slightly tapered, laterally compressed, and deep-bodied. Head is large with a moderate mouth reaching about the anterior edge of eye. Supraocular ridge is noticeable but not serrated yet. There are 5 preopercular spines, and 3 cleithral spines, 2 of which are prominant but the third one remains inconspicuous. Eight dorsal spines are developed; 5 of them are serrated. The second dorsal spine and pelvic spines are distinctively elongate. Besides the serrated spine, a smooth spine is also present on each pelvic fin. The second dorsal and anal fin bases are growing within the finfolds, while the caudal rays are forming. Pigment scatters only on the head. Myomeres are 24 (10+14); D. VIII, 12; A. 10.

The flexive larva of 5.06 mm TL (Figure 27 C) is

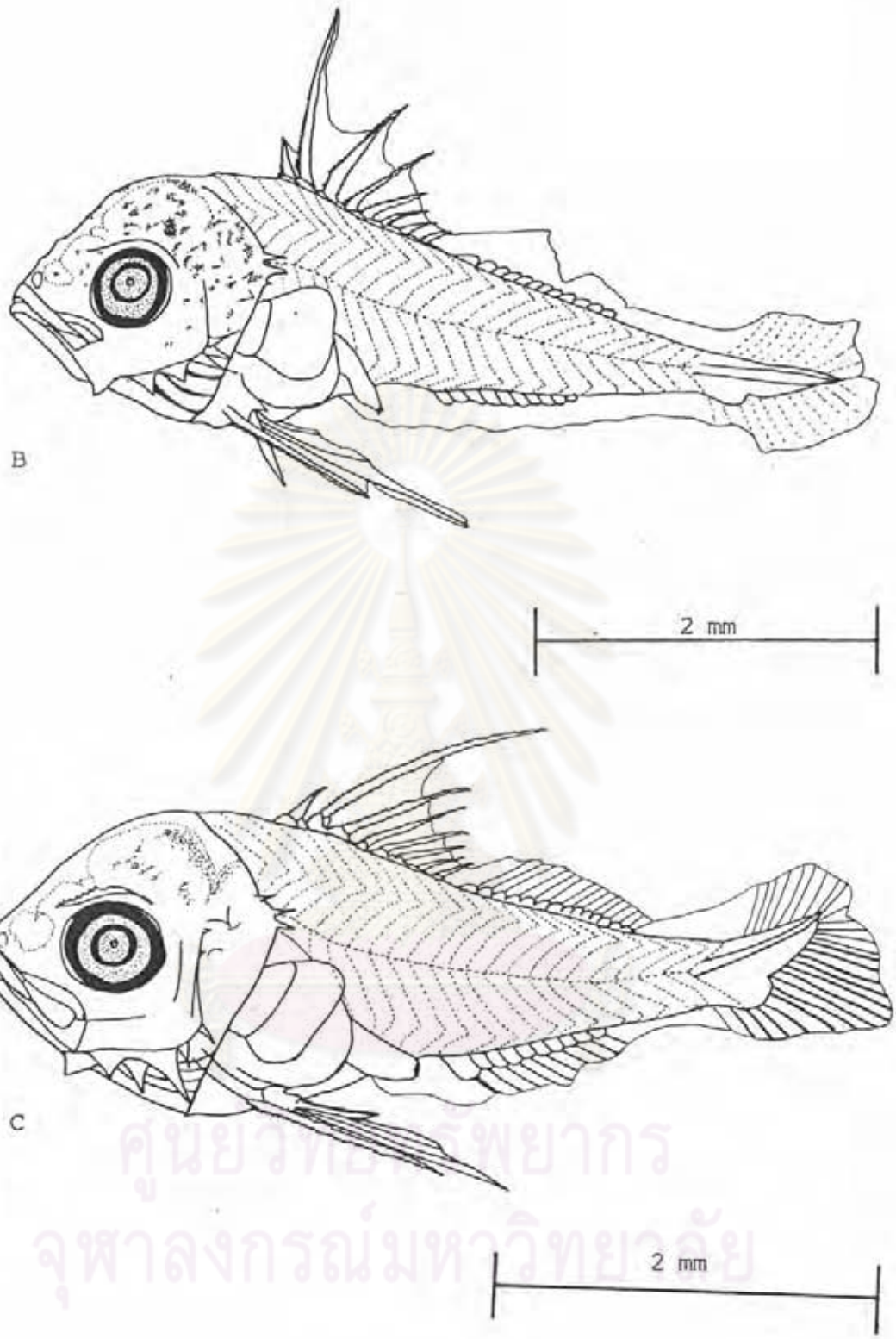


Figure 27 B Lutjanid larva II, 4.82 mm TL

C Lutjanid larva II, 5.06 mm TL

generally similar to the last one ; however, the larva is quite deeper-bodied. The first dorsal spines are more elongate. Dorsal and anal fin elements are more developing. The third cleithral spine is distinctively recognized. Supraocular ridge becomes serrate. Small spines are present on the operculum. Head pigment, on the other hand, mostly vanished. Myomeres are 24 (10+14); D. VIII,14; A. 10.

The lutjanid larvae I and II might be of the same species if the present knowlege could help confirm it. However, the lutjanid I could attain flexion stage at smaller size than even the preflexive lutjanid II. The presence of pigment on cleithral region and the ventral body in lutjanid I remains invisible in lutjanid II. That is also the reason of separation them from each other.

Family Theraponidae

Common Name : Therapon-Perches, Crescent-Perches, Grunters

Diagnostic Features

The theraponid larvae are moderately short and slender bodies with 24 myomeres. The anus locates about 40-43 % BL. The two series of the preopercular spines and the rigid spine on the operculum are distinctive as well as the pigment pattern.

Figure 28 Therapon theraps, 9.42 mm TL

Description

Therapon theraps (Cuvier & Variennes)

The early juvenile of Therapon theraps of 9.42 mm TL (Figure 28) obtained from the station 4 in March is fusiform bodied with heavily pigmentation on the head, gut, lateral line, dorsal and ventral margins of the tail, dorsal and vental of the lateral line and on the first dorsal fin membranes. Head is ovoid with the prominant opercular spine and preopercular spines. All fins are well-developed. Anus locates at about 50 % BL. Myomeres are 24 (11+13); D. VII, 12; A. III-10.

Family Nemipteridae

Common Name : Threadfin-Breams, Butterfly-Breams, Sea-Breams

Diagnostic Features

The nemipterid larvae have elongate bodies with 24 myomeres, large head without spines, large eyes and compact gut. The pigments on the ventral midline of the tail are more spotted than the mullids. In addition, the gap between the anus and anal fin is also narrower than the mullid larvae.

Description

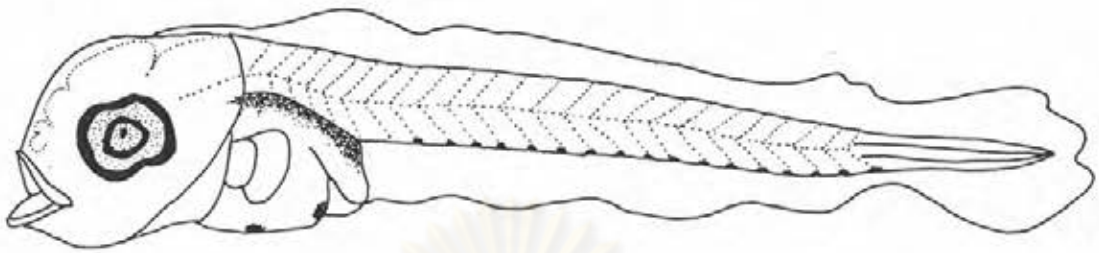
Nemipterus sp.

The preflexive larva of Nemipterus sp. of 2.76 mm TL (Figure 29 A) obtained from the station 9 in December is elongated body. The head is large with the

large eyes occupying about 50 % HL. No head spination is evident. Gut is coiled and compact with the anal position at the 6th myomere (about 35 % TL). Pigment spots row on the ventral margin of the tail and on the dorsum and ventrum of the gut. Myomeres are 23 (6+17). Dorsal and anal fins are not developed yet.

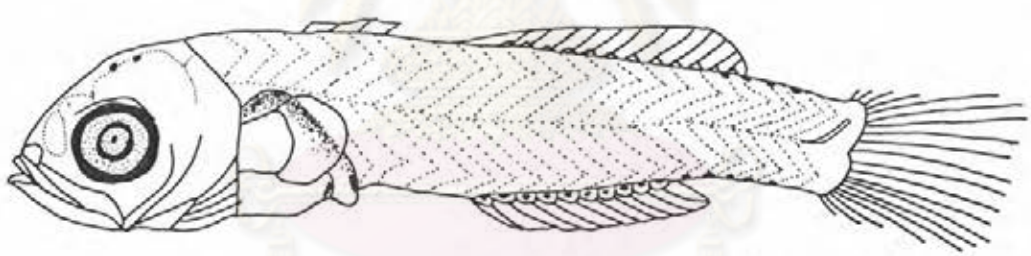
The post flexive Nemipterus larva of 7.43 mm TL (Figure 29 B) obtained from the station 12 in November is elongated body. Head is ovoid with the large rounded eyes and free from spination. Gut is coiled and compact with the anal opening about 1/3 BL. Pigment spots are still present on the ventral margin of the tail as well as the dorsal margin of the caudal peduncle. The gut is also pigmented. Some pigment spots also develop on the head. There is a gap between anus and anal fin origin. Myomeres are 24 (6+18); D. 4, 12; A. 10.

The two nemipterid larvae are similar in myomere and pigment patterns , that could assure the same type.



A

1 mm



B

2 mm

Figure 29 A Nemipterus larva I, 2.76 mm TL

B Nemipterus larva II, 7.43 mm TL

Family Mullidae

Common Name : Goatfishes, Surmullets, Red-Mullets

Diagnostic Features

The mullid larvae are moderately elongate and more compressed bodies than the nemipterids. The gas bladder is inconspicuous or absent. The 3 melanophores on the brain and the melanophores on the lateral surface of the tail are also distinctive.

Description

Upeneus sp.

The postlarva of the Upeneus sp. of 16.67 mm TL (Figure 30) obtained from the station 12 in November has an elongated body. The ovoid head is free from spination. All fins are fairly developed. The pelvic fins sepsrate from each other that could help differentiate it from the gobies. Pigment is dense on the lateral line and rows on the ventral margin of the tail and the second dorsal fin base. Moreover, the pigment also scatters on the head, lips and gut. Myomeres are 24 (14+10); D. 6,9; A. 8.

Family Sciaenidae

Common Name : Jewfishes, Croakers, Drums, River-Kingfishes

Diagnostic Features

The sciaenid larvae have a deep and broad head with tapering bodies. The small preopercular spines and posttemporal spines are present in all species. The myomeres are 23-27.

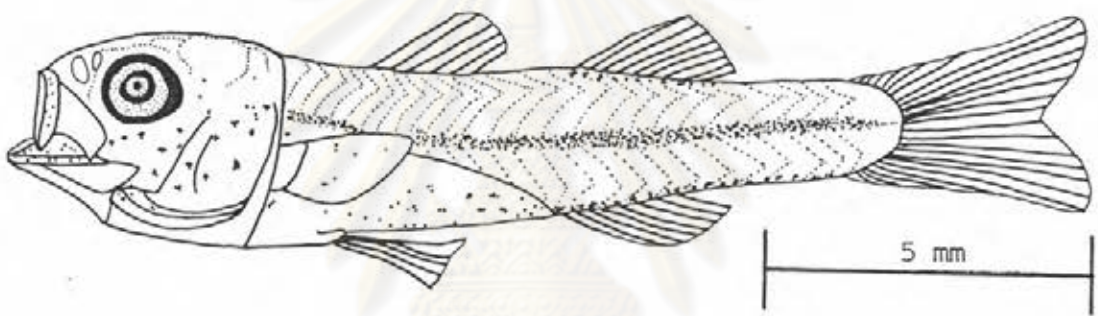


Figure 30 Upeneus sp, 16.67 mm TL

Description

Sciaenid Larva

The postflexive sciaenid larva of 4.66 mm TL (Figure 31) obtained from the station 4 in March has a deep and broad head and tapered body. The head develop preopercular and opercular spines as well as the posttemporal spines which are distinctive in the Sciaenidae. Body depth is more than 32 % SL, that determines the deep-bodied fish. Gut is compactly short with the anal position about 45 % TL. Pigment spots distribute on the ventral margin of the tail, on the dorsal body and on the head. Myomeres are 27 (10+17); D. 25; A. 6.

Family Sillaginidae

Common Name : Sand Whitings

Diagnostic Feature

The sillaginid larvae are elongated and slender bodies, with small head and large eyes. The head spination is absent. Gut is straight with the anul position at about midbody. Pigment spots lining on ventral body from cleitral region along the gut to caudal peduncle are very common for the Sillaginidae.

Description

Sillago sp

The larva of 4.49 mm TL (Figure 32 A) obtained from the station 5 in January is elongate, slender and

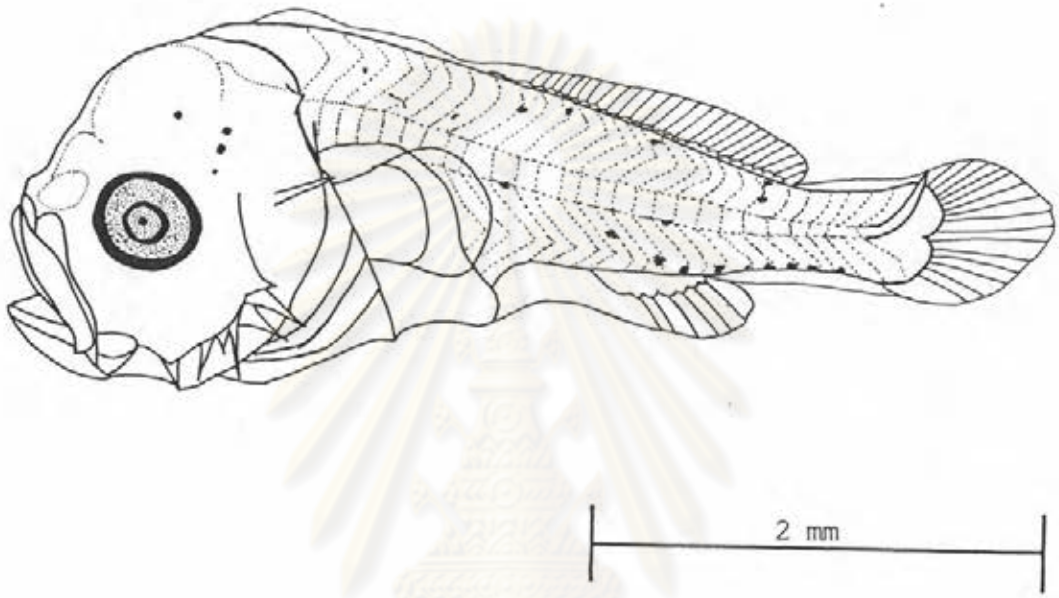


Figure 31 Sciaenid larva, 4.66 mm TL

laterally compressed. Head is rounded with large eyes and a small mouth reaching about anterior edge of eye. No head spination is evident. Gut is straight and elongates to about midbody. Pigment is present along ventral surface of the body from the cleithral region to the tail tip. Melanophores are also developed on anal fin bases and on dorsal surface of gut. Myomeres are 32 (10+22); D. 10; A. 13.

The larva of 9.24 mm TL. (Figure 32 B) obtained from the station 1 in May is similar in shape to the last one, but dorsal and anal elements are more developed. Dorsal and anal fins occupy about 70-80 % of the trunk. Eyes become comparatively small. Small melanophores are visible on the middle of operculum. Myomeres are 33 (10+23); D. 54; A. 45.

The two sillagid larvae are considered the same series because of the similarity of myomere pattern.

Family Siganidae

Common Name : Rabbitfishes, Spine-feet

Diagnostic Features

The siganid larvae are deep body with 22-24 myomeres. The dorsal and pelvic spines are elongate and spinous. The small spines on the head, snout and preoperculum distinguish the larvae from the epinephelids and the lutjanids.

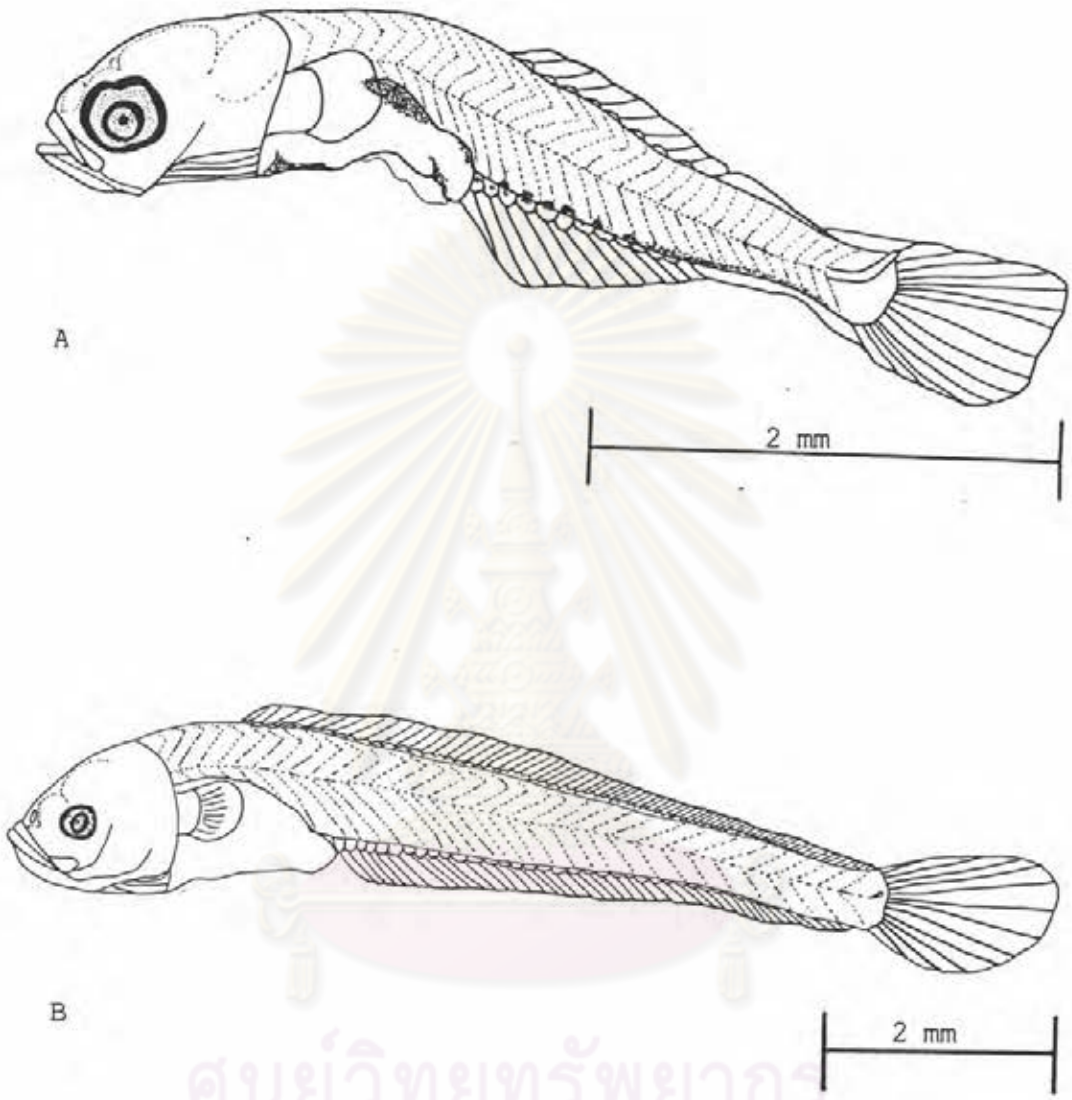


Figure 32 A Sillago sp, 4.49 mm TL

B Sillago sp, 9.24 mm TL

Description

Siganus sp.

The postflexive siganid larva of 6.14 mm TL (Figure 33) collected from the station 9 in January is deep-bodied and laterally compressed. Head is large with rows of small spines on the snout and preoperculum. Spinous ridge is also present on the top of the head. Gut is coiled and compact. Anal opening is located about 45 % BL. Dorsal fin spines are developed, the first one is longer than others respectively. Serrations form not only on the first and second dorsal spines but also the pelvic spines which are distinctively elongated. A pair of preanal spines are visible but not serrated, as well as the first spine on anal fin. Pigmentation is not recognizable. Myomeres are 23 (11+12); D. VII, 13; V. I, 11.

Family Scorpaenidae

Common Name : Stingfishes, Sorpionfishes, Waspfishes, Firefishes, Gurnet-Perches.

Diagnostic Features

The scorpaenid larvae are recognized by the large pectoral fins, head spination, pigmented bodies, myomere and fin counts. The head is not flattened as the platycephalids.

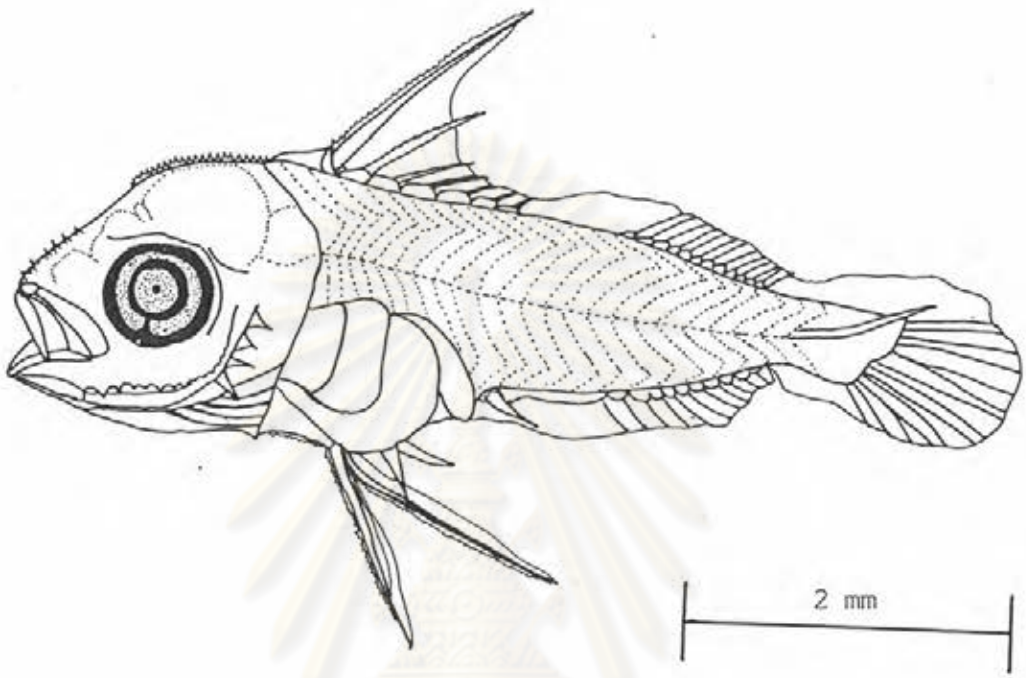


Figure 33 Siganus sp, 6.14 mm TL

Description

Scorpaenid Larva I

The preflexive larva of the Scorpaenidae of 3.16 mm TL (Figure 34 A) obtained from the station 11 in January has developed a pair of the large fan-shaped pectoral fins on the elongated, slender and laterally compressed body. Head is rounded with a large mouth extending to about mid eye. Gut is coiled with the anal opening about 40 % BL. Finfold still cover the entire body. Myomeres are 22 (8+14).

Scorpaenid Larva II

The preflexive larva of 4.06 mm TL (Figure 34 B) obtained from the station 12 in January has the similar body as the last one, but larger size. The head develops supraocular, pterotic and parietal spines. Pectoral rays are distinctly formed. Gut is coiled with the anal opening at about mid body. Caudal rays are developing while the left remained invisible. Myomeres are 23 (10+13). The larva II might be the growing form of the last one because of the similarity of myomere formation.

Scorpaenid Larva III

The other preflexive larva of 4.21 mm TL (Figure 34 C) obtained from the station 10 in February has a curved down and laterally compressed body. The head is large with a pair of serrated horns on the parietal portions. Supraocular and preopercular spines are

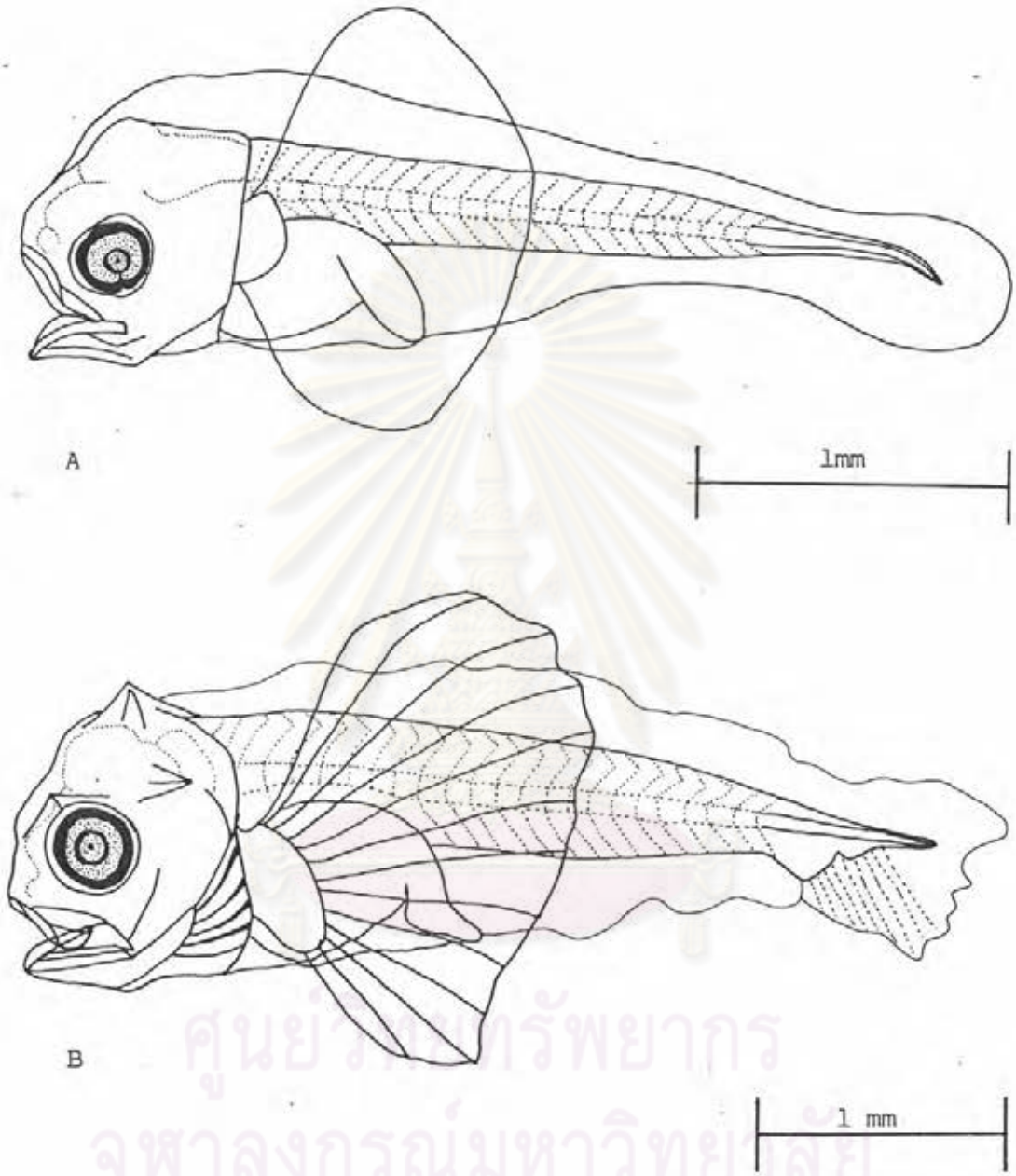
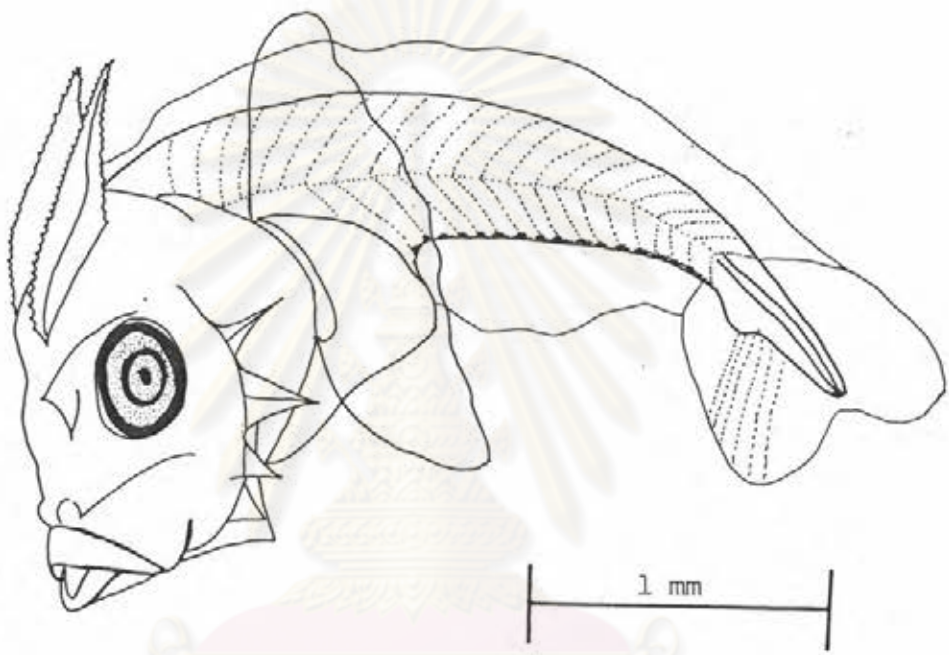


Figure 34 A Scorpaenid larva I, 3.16 mm TL

B Scorpaenid larva II, 4.06 mm TL



C

Figure 34 C Scorpaenid larva III, 4.21 mm TL

prominant. Mouth is large reaching to about mid eye. Anus opens about mid body. Pigment spots row along the ventral margin of the tail. Myomeres are 22 (7+15). The larva III is quite different from the other two in the myomere number, pigmentation as well as the head spination.

Family Platycephalidae

Common Name : Flatheads

Diagnostic Features

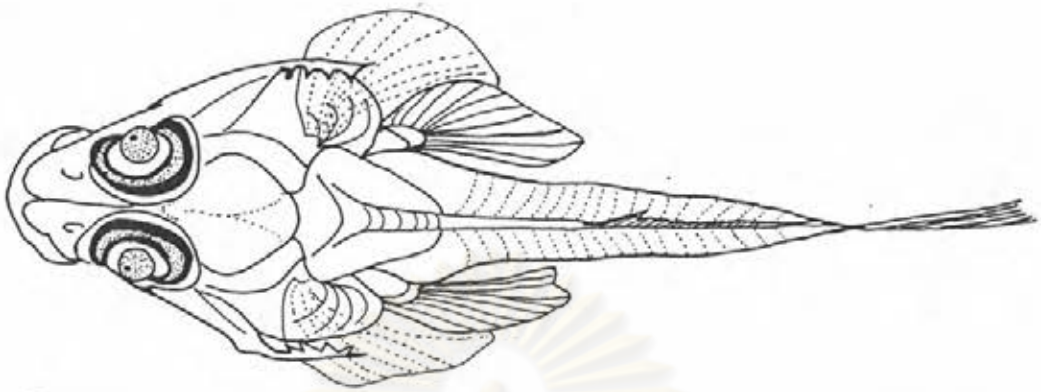
The platycephalid larvae are distinguished from other scorpaeniformes by their large mouth, head spination and elongate, flattened snout. Unlike the other scopaeniformes, the platycephalid head spines are persist and become more pronounced in juveniles.

Description

Platycephalid Larva I

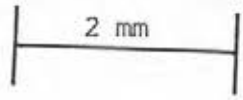
The preflexive platycephalid larva of 3.74 mm TL (Figure 35 A) obtained from the station 12 in December has a large deeped head with the pointed snout and a large oblique mouth stretching to about mid eye. The upper jaw develops many tiny teeth. Pectoral fins are broadened to be fan-shaped. The tapered body is curved up with slender tail. Gut is coiled with anal location about mid body. Pigment spots row along the ventral margin of the tail, dorsal edge of the anterior trunk, on the dorsal and ventral gut, and along the pectoral rays, as well.

Figure 35 A Platycephalid larva I, 3.74 mm TL



B

(1)



(2)

Figure 35 B Platycephalid larva II, 9.45 mm TL

(1) dorsal view

(2) ventral view

Myomeres are 28 (11+17).

Platycephalid Larva II

The early juvenile of the Platycephalidae of 9.45 mm TL (Figure 35 B) obtained from the station 16 in January has a broaded and dorsoventrally flattened head and has the large eyes dorsally moved, consequently. There are 2 serrated opercular spines developed on the head. Gut is compacted with the anal opening about 1/3 TL. Pelvic and pectoral fins are well-developed as well as the other fins. There is a gap between the anus and anal fin origin. The larva is highly more developed than the last one, that hardly considered the same species.

Family Labridae

Common Name : Wrasses, Tuskfishes

Diagnostic Features

Most labrid larvae are a laterally compressed body with a deep caudal peduncle and 23-28 myomeres. The head spines are absent. The mouth is small and the snout is pointed, that characterizes the triangular head. The larger larvae are distinguish by the long-base dorsal fin and anal fin counts.

Description

Labrid Larvae

The preflexive larva of 4.71 mm TL (Figure 36 A) obtained from the station 9 in January is moderate, laterally compressed and rather deep-bodied. Head is

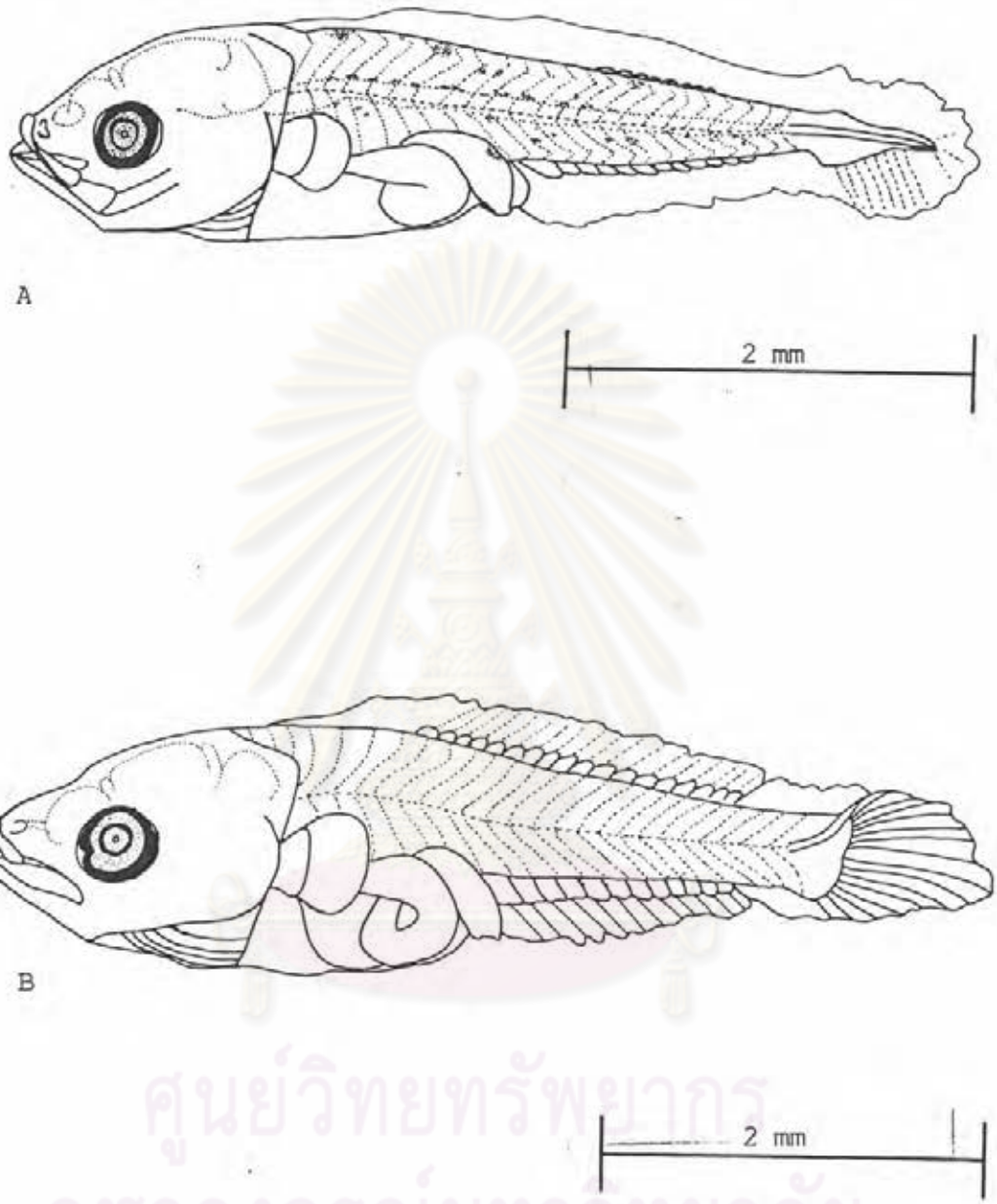


Figure 36 A Labrid larva, 4.71 mm TL

B Labrid larva, 5.32 mm TL

large and triangular with a pointed snout. Mouth is small not reaching the anterior edge of eye. No spines develop on the head. Gut is coiled with anal opening located just about midbody. Pigment spots scatter on the trunk. Myomeres are 22 (11+11); D. 8; A. 12.

The flexive larva of 5.32 mm TL (Figure 36 B) also obtained from the station 9 in January develops more myomeres and more fin elements, but finfolds are still present. The pointed snout is slightly elongate. The mouth is, therefore, moved anteriorly. Pigment is hardly visible. Myomeres are 25 (13+12); D. 18; A. 12.

Morphologically, the two larvae are very similar to each other in both body shape and myomere pattern, that could be confided the same series.

Family Gobiidae

Common Name : Gobies

Diagnostic Features

The gobiid larvae are elongate to deep bodies with 24-27 myomeres. The gut is uncoiled. The gas bladder is prominent. Head spines are absent. Pigmentation is present on the gas bladder, hind gut and the ventral midline of the tail.

Description

Gobiid Larva I

The postflexive larva of 10.31 mm TL (Figure 37 A) obtained from the station 7 in January is elongated and

laterally compressed. The head without spines is rather elongate and as deep as the body. Mouth is large and oblique. Anus opens at about mid body. The prominant gas bladder locates on midway of the gut. Myomeres are 24 (10+14); D. 5,7; A. 9.

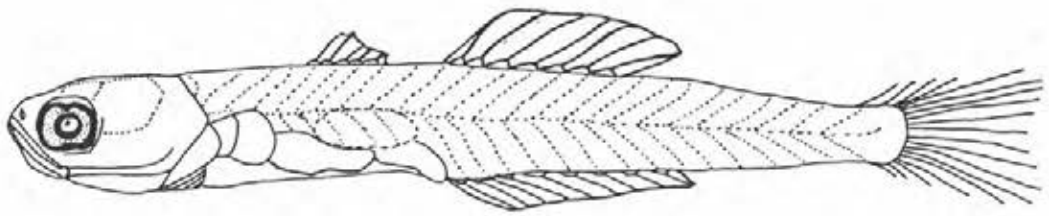
The postflexive larva of 13.50 mm TL (Figure 37 B) obtained from the station 4 in March has the similar characters as the last one except the larger size and the development of pelvic fins. Gas bladder slightly moves anteriorly. Myomeres are 24 (10+14); D. 5,9; A. 9.

Gobiid Larva II

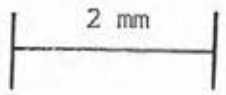
The postflexive larva of 11.25 mm TL (Figure 37 C) obtained from the station 13 in September has an elongated and laterally compressed body. Head is elongated without spines. Gut is tubular with the anal opening about mid body. Gas bladder is prominant on the posterior half of gut. Myomeres are 24 (10+14); D. 12; A. 14. The larva II, unlike the larva I, has no separation of the dorsal fin, and has tubular gut.

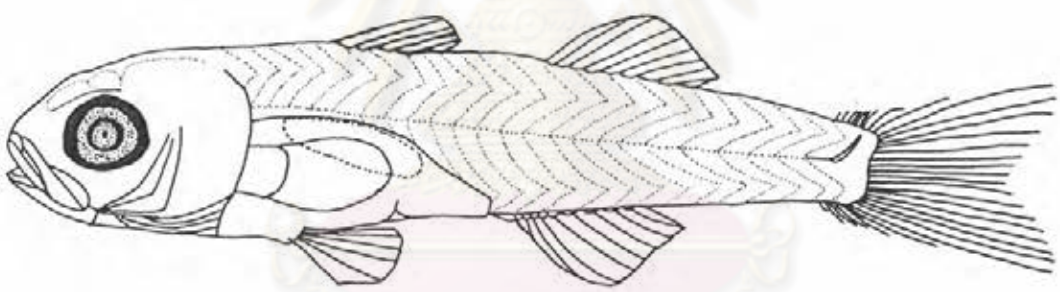
Gobiid Larva III

The postflexive larva of 5.52 mm TL (Figure 37 D) obtained from the station 12 in September has a large rounded and slightly flattened head. Its body is elongated. Anus opens about the mid body. The gas bladder locates on the anterior part of the gut. All fins are well-developed. The pelvic fins are joined together



A





B

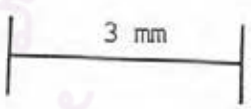


Figure 37 A Gobiid larva I. 10,31 mm TL

B Gobiid larva I, 13.50 mm TL

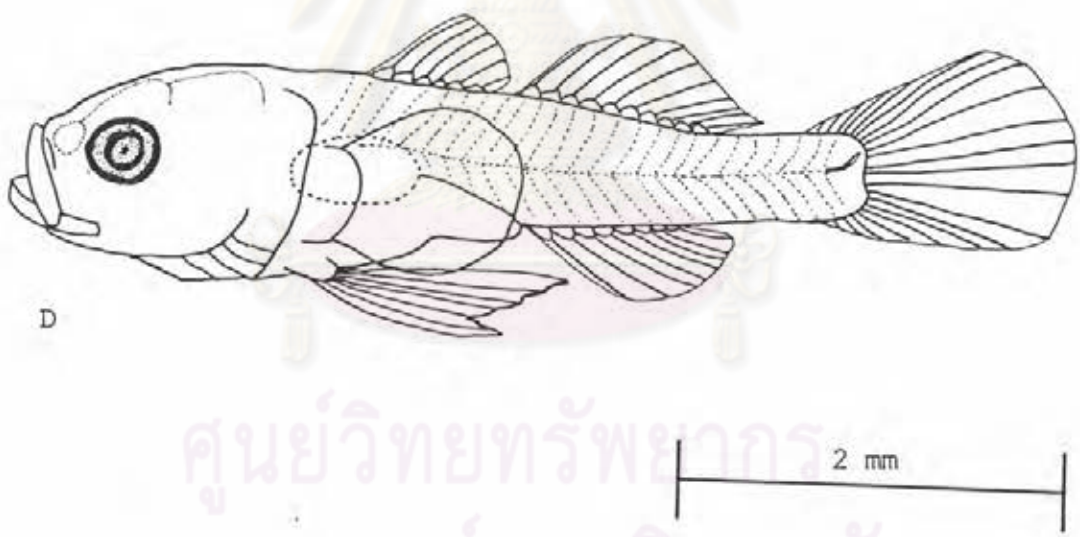


Figure 37 C Gobiid larva II, 11.25 mm TL

D Gobiid larva III, 5.52 mm TL

to form a disc. Myomeres are 24 (9+15); D. 6,10; A. 8. The larva III is distinctly different from the larva I and II in the character of head and fin formation which earlier developed, even in the smaller one.

Family Callionymidae

Common Name : Dragonets

Diagnostic Features

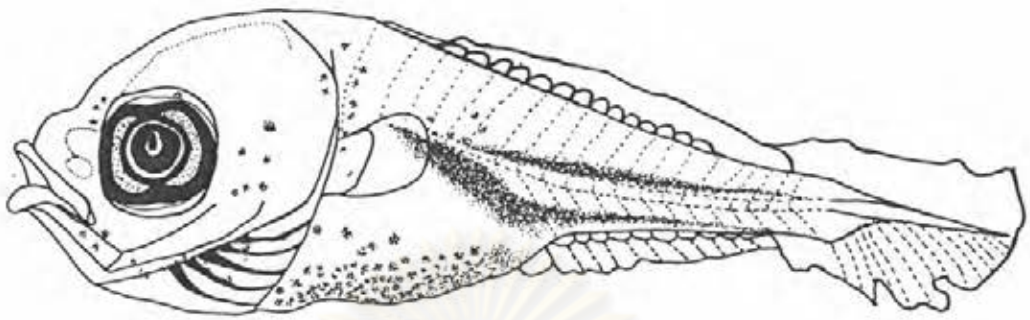
The callionymid larvae are separated by the short, deep body, long notochord tip, heavy pigmentation and small size at which development occurres.

Description

Callionymid Larvae

The preflexive larva of the Callionymidae of 2.65 mm TL (Figure 38 A) obtained from the station 6 in May has a large and rounded head. The body is deep and rounded in cross-section. The eyes are also large and rounded. Anus opens about mid body. Notochord tip is long. The larva is heavily pigmented especially along the lateral line, on the dorsal gut and along the ventral margin of the tail. Pigment spots are also scattered on the head, on the ventrum of gut and on the dorsal part of the trunk. Myomeres are 19 (6+13); D. 14; A. 10.

The postflexive larva of 4.98 mm TL (Figure 38 B) also obtained from the station 6 in May has the same characteristics as the last one, but slightly flattened head and more developed fins. Myomeres are 20 (6+14); D.



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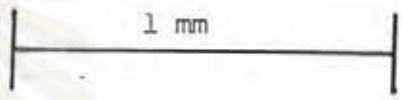

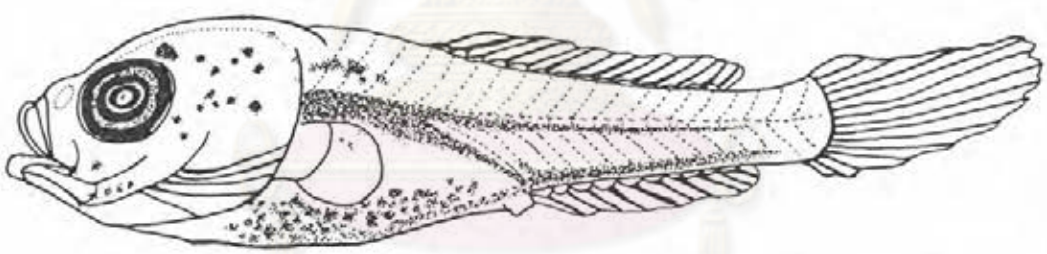

B

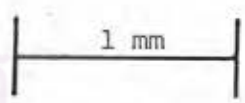

Figure 38 A Callionymid larva, 2.65 mm TL

B Callionymid larva, 4.98 mm TL

14; A. 10. The similarity of myomere and pigment patterns indicate the same type of the larvae.

Family Champsodontidae

Common Name : Sabre-Gills

Diagnostic Features

The champsodontid larvae are easily identified because of the presence of the long appendages on the operculum. They are distinctively prominant even in the newly hatched larvae. The large jaws with many teeth, bony crest above the head and myomeres are also distinctive.

Description

Champsodon sp.

The preflexive larva of 3.07 mm TL (Figure 39 A) obtained from the station 9 in February is elongate and slender. Head is large with distinctively long filaments protruding from the operculum. Mouth is large extending about posterior of eye. Gut is loosely coiled. Anus is located about midbody. Pectoral fins are small. Caudal elements begin to develop. Myomeres are 20 (8+12).

The other preflexive larva of 3.49 mm TL (Figure 39 B) collected from the station 5 in January develops more myomeres and melanophores. Pigment is present on the membrane of head filaments, dorsal surface of the gut and on the ventral body of the postanal part. Myomeres are 25

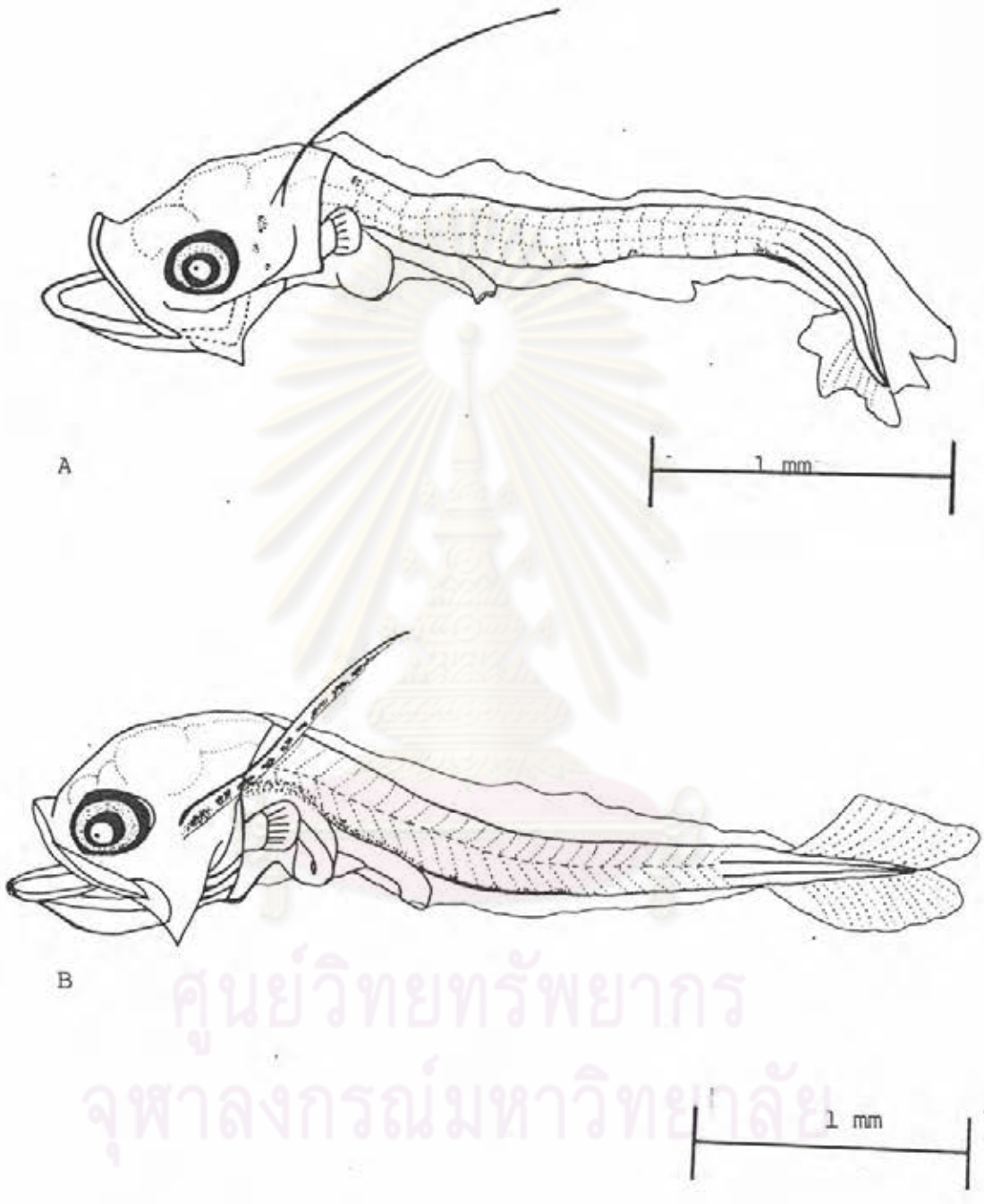

Figure 39 A Champsodon sp, 3.07 mm TL

B Champsodon sp, 3.49 mm TL

(10+15).

The larvae are very similar in morphology and stage of development. It is no doubt, they are the same species.

Family Blenniidae

Common Name : Combtooth Blennies

Diagnostic Features

The blenniid larvae have an elongate body, short to moderate gut length, myomere number between 30 - 40, and the elaborate preopercular spination, large teeth or long pectoral fin rays. The pigmentation also occurs on the gut and along the ventral margin of the body.

Description

Blenniid Larva I

The preflexive larva of 3.74 mm TL (Figure 40 A) obtained from the station 8 in August has a large and rounded head and elongate compressed body. Mouth is oblique reaching about the anterior of the large rounded eye. Gut is compactly short with the anal opening at about 1/3 BL. Pigmentation is dense on the gut and spots along the posterior ventral half of the tail. The pigment is also present on the head. Myomeres are 28 (5+23).

Blenniid Larva II

The juvenile of 16.46 mm TL (Figure 40 B) obtained from the station 6 in August has the similar body

shape as the last one, but more heavily pigmented throughout the body even on the fin membranes. Pigmented bands are vertically arranged along the body from the nape unto the caudal peduncle. Caudal and anal fins are long. The pelvic fins reduced to a pair of spines. Myomeres are invisible; D. 40; A. 19. The larva II may be the same genus as the larva I but rather difficult to consider the same species because of widely different in size and stage of development.

Blenniid Larva III

The preflexive larva of 3.34 mm TL (Figure 40 C) obtained from the station 15 in November has a large head with the large eyes. Its body is laterally compressed and tapered. Snout is anteriorly protrusive as the large preoperculer spines. Supraocular ridges are also developed. Pigment spots row along the ventral margin of the tail. Pectoral fins are fairly developed and heavily pigmented. Myomeres are 41 (12+29). The larva is propably the same type as Chantarasakul (1988) described.

The blenniid larva III is distinctly different from the larva I and II in the head spination and protruding snout.

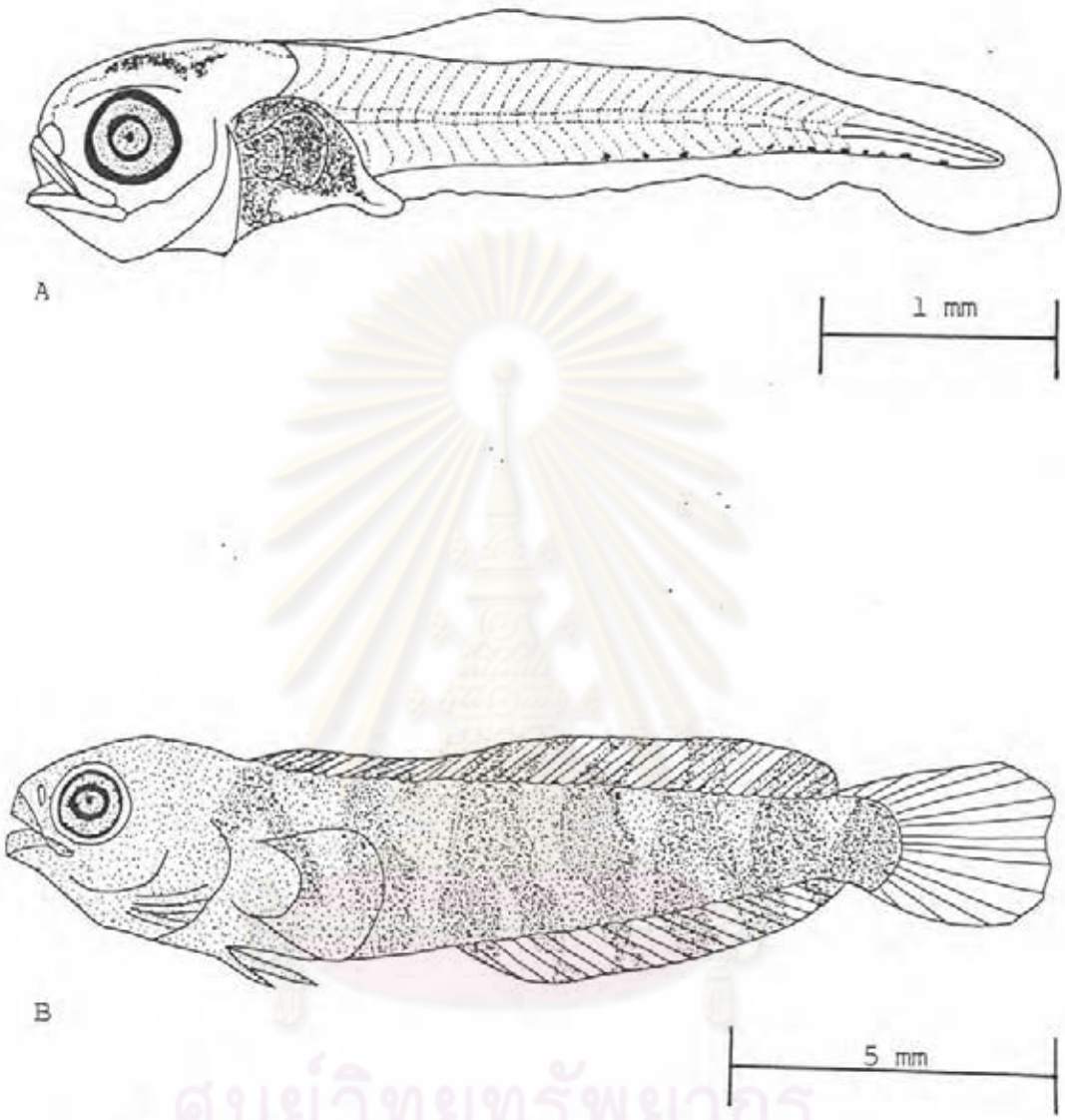

Figure 40 A Blenniid larva I, 3.74 mm TL

B Blenniid larva II, 16.46 mm TL

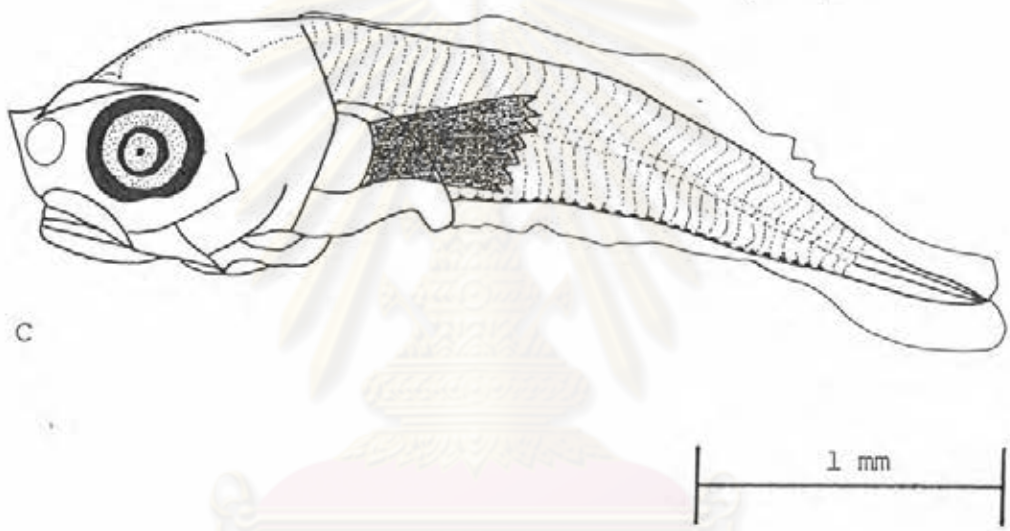

Figure 40 C Blenniid larva III, 3.34 mm TL

Family Monacanthidae

Common Name : Leatherjackets, Fliefishes

Diagnostic Features

The monocanthid larvae are distinguished by compressed body, the strongly coiled gut, pigment pattern, the lack of pelvic fin, dorsal fin spine, spiny tuft on preoperculum, dermal spinules, myomere count, and pelvic flap with protruding spine.

Description

Monacanthid Larvae

The larva of 1.92 mm TL (Figure 41 A) obtained from the station 11 in February is deep-bodied, laterally compressed and tapered. Head is large with the large rounded eyes occupying just about 1/2 HL. Snout is shorty and steeply sloped. Mouth is small not reaching the anterior edge of eye. A lot of small spines are present on the head and beneath the lower jaw, as well. An elongated spine on the nape is distinctive. The pelvic spine starts to form. Gut is coiled with anus at about 40 % BL. A row of pigment spots is present on ventral surface postanally. Internal pigment also appears on the brain and dorsal surface of the gut. Myomeres are 21 (6+15). Dorsal and anal fin components are not developed yet.

The larva of 2.10 mm TL (Figure 41 B) also obtained from the station 11 in February is similar to the last one, unless the larger size and elongation of head

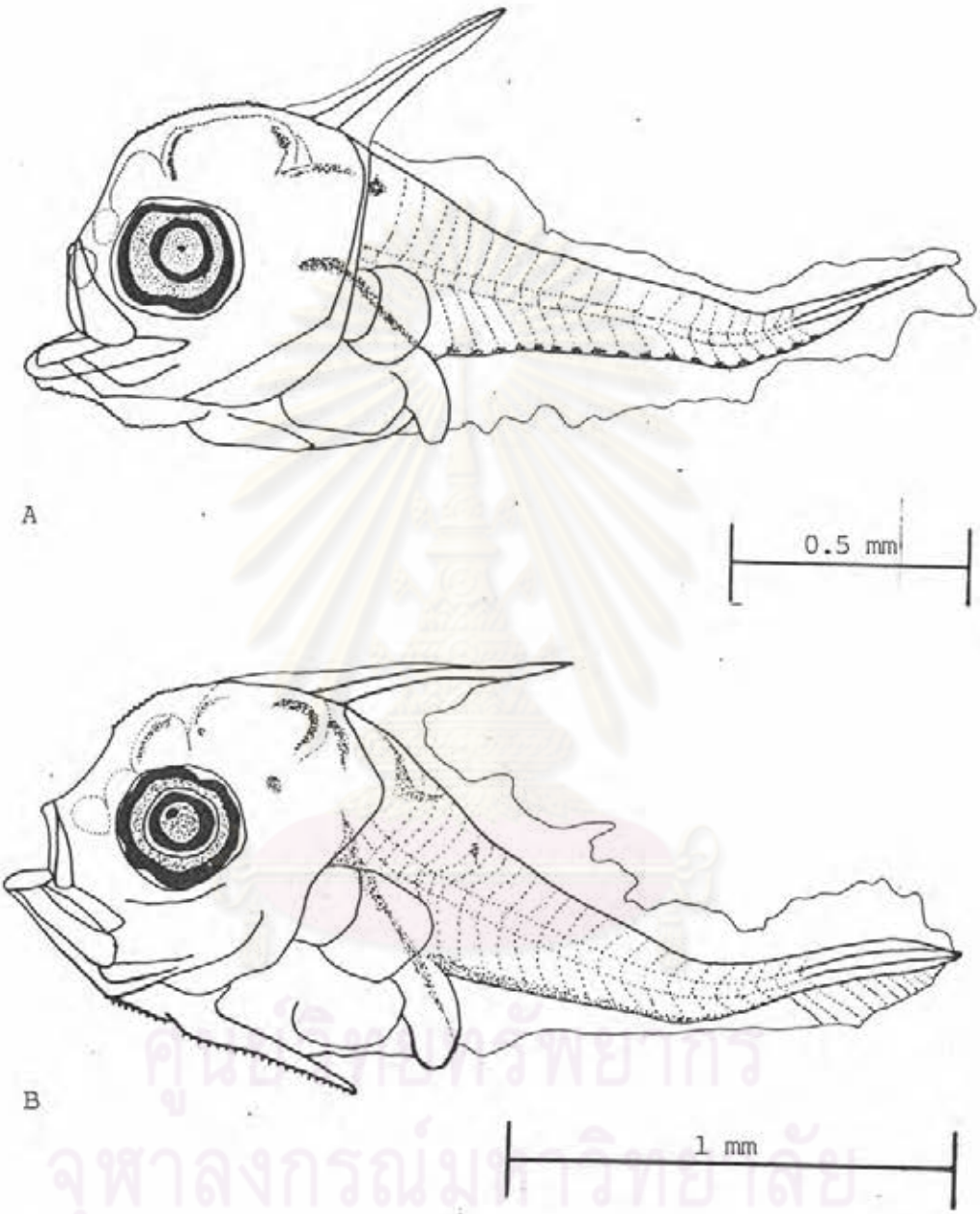

Figure 41 A Monacanthid larva, 1.92 mm TL

B Monacanthid larva, 2.10 mm TL

and pelvic spines, on which serrations are present. Caudal rays are appearing. The larva is more pigmented on the ventral surface of the body and dorsum of the gut. Myomeres are 23 (9+16). Dorsal and anal fin elements still remain invisible.

Family Tetraodontidae

Common Name : Puffers, Blowfishes, Toadfishes, Globefishes

Diagnostic Features

The tetraodontid larvae have the ovoid to rotund head and trunk, coiled gut, small gill opening, dermal sac, beak-like teeth, small mouth, body spines, and the absence of pelvic fins.

Description

Tetraodontid Larva

The single preflexive larva of the Tetraodontidae of 3.85 mm TL (Figure 42) collected from the station 8 in January. It has ovoid head and body with a slender tapered tail, short snout and small mouth. The large and rounded eye occupies nearly 1/2 HL. Gut is large and coiled. Anal opening is at about 2/3 BL. Inflation of dermal sac is still evident in the preserved larva. No gap is exist between the anus and anal fin origin. Fin elements are nearly completely developed. Pigmentation occurs on dorsal and lateral of gut and ventrum of dermal sac. There are 27 myomeres (10+7); D. 11; A. 5.

Figure 42 Tetraodontid larva, 3.85 mm TL

Abundance

The occurrence of the fish larvae was statistically different among the seasons, months, and stations. During the monitoring period, fish larvae of the Family Gobiidae were found to be the most abundant species, followed by larvae of the Families Engraulidae, Bregmacerotidae, Leiognathidae, Nemipteridae, Clupeidae and Callionymidae, respectively (Table 3). Most of the larvae were abundant in the inner zone of the Chang Islands during the NE-monsoon period. The high peaks occurred in April, February and July, respectively. The larvae were more abundant at stations 1, 15 and 16 comparing to the other inner stations. Whereas in the outer zone, the larvae were more abundant at stations 9 and 10 (Figures 43 and 44).

1. Total Fish Larvae

The number of total fish larvae were governed by the fractions of eggs and larvae within the samples. The total fish larvae increased to the peak in February and decreased to the lowest density in August (Figure 44). In general, the fish larvae were more abundant during the NE-monsoon to April or May and less abundant in the SW-monsoon period. At stations 3 and 7 of the outer zone and station 11 of the inner zone, the total number of eggs and larval fishes succeeded the highest peaks but the station 5 which located far off the Islands attained the lowest

level (Figure 43). The egg component was found to be the major component of all peaked stations and months, except at stations 1 and 15 of the inner zone and in April which larval fishes were the dominance.

2. Fish Eggs

Fish eggs were evident around the Chang Islands in every month with 3 distinctive peaks in February, July and September (Table 5). These three peaks coincided with the total larval peaks (Figure 44) at stations 3, 4 and 7 of the outer zone and staiton 11 of the inner zone (Figure 43). However, the abundance of fish eggs were not different between the seasons and between the outer and inner zones.

3. Larval Fishes

Abundance of the larval fishes of all Families achieved the highest peaks during the NE-monsoon in April and February respectively. The density, on the other hand, decreased to the lowest level during the SW-monsoon in August, coincidently to the eggs and the total larvae (Figure 44). The abundance of larval fishes were not greatly varied among stations throughout the year comparing to the eggs and the total larvae (Table 6 and Figure 43). However, the peaks at stations 1 and 15 of the inner zone as well as in April were remarkably distinctive. In addition, the analysis of variance still confirmed the difference of the means of larval fish

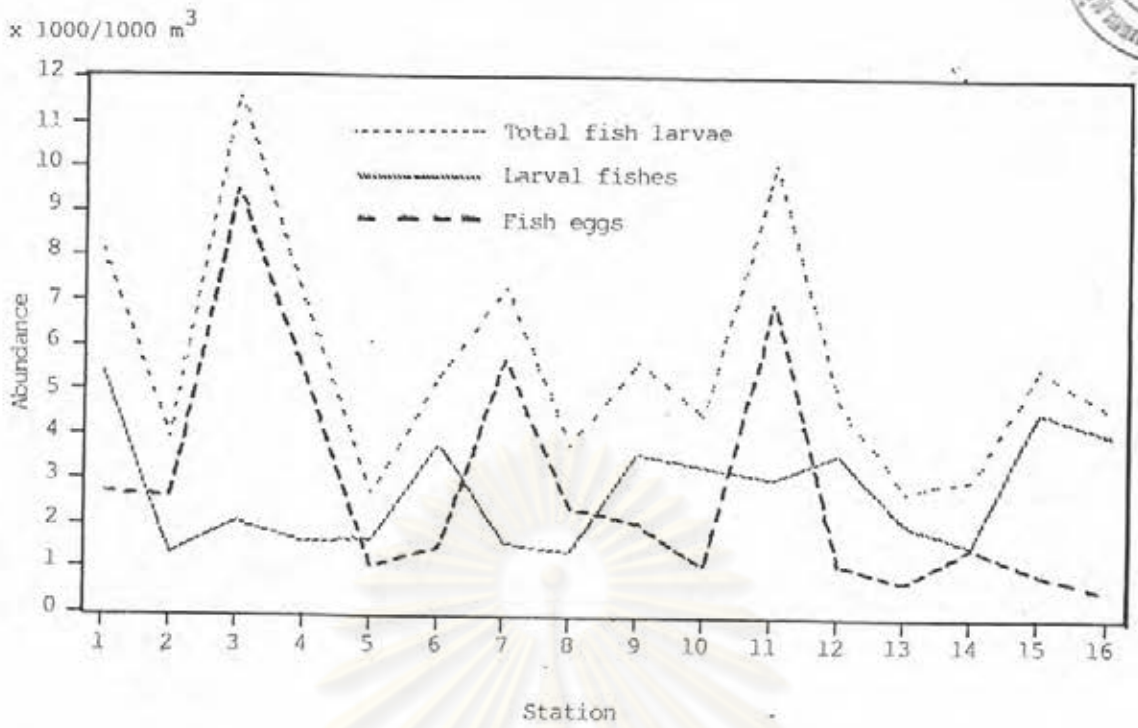

Figure 43 Fluctuation of the mean abundance in each station of the fish larvae around the Chang Islands in 1987.

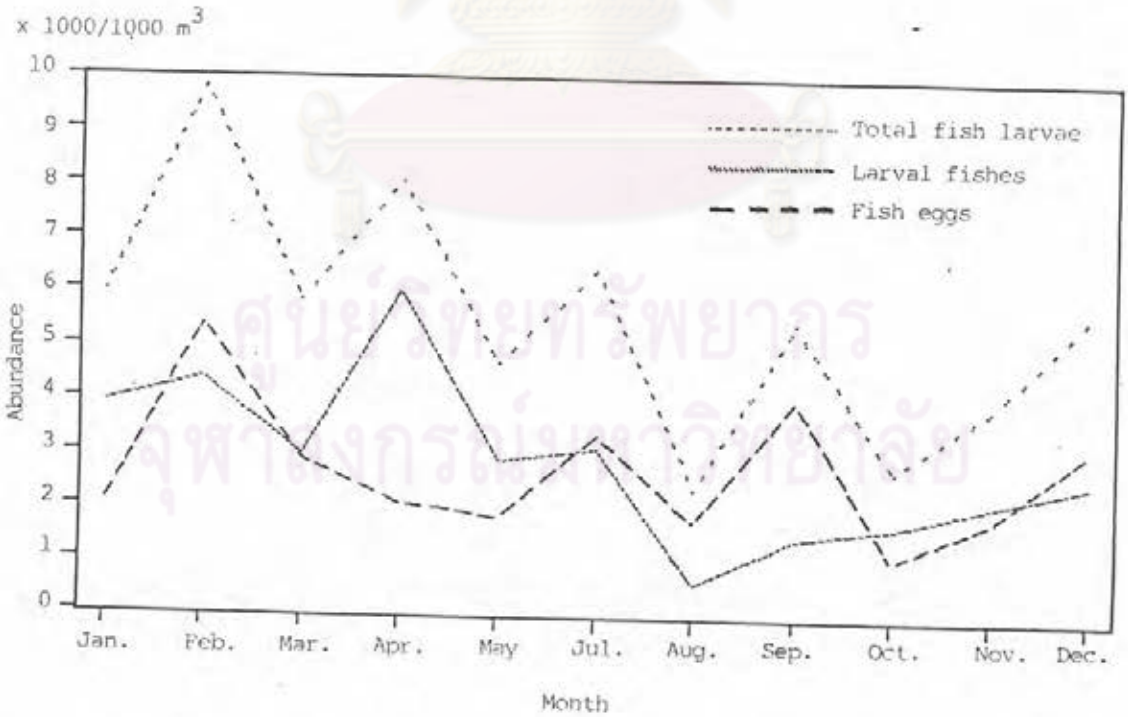

Figure 44 Fluctuation of the mean abundance in each month of the fish larvae around the Chang Islands in 1987.

Table 5 Abundance of fish eggs around the Chang Islands during January - December 1987.

(no/1000 m^3)

Station \ Month	Jan.	Feb.	Mar.	Apr.	May	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	average
1	7221.72	1330.31	4561.08	1873.30	2036.20	–	9583.71	27.15	81.45	1276.01	1846.15	29837.10	2712.46
2	1221.72	1710.40	542.99	3393.66	950.23	*	*	380.09	5864.25	7411.76	1900.45	23375.50	2597.28
3	542.99	7628.96	21828.00	3638.01	325.79	13221.70	*	32932.10	2687.78	2986.42	*	85791.80	9532.43
4	6461.54	5266.97	1384.61	*	3285.06	9040.72	*	5131.22	4778.28	10181.00	2144.79	47674.20	5297.13
5	1601.81	27.15	1737.55	3610.86	*	*	*	27.15	271.49	27.1 5	*	7303.17	1043.31
6	2063.34	1574.66	54.30	1520.36	2361.99	2334.84	–	–	108.60	108.60	6570.13	16696.80	1517.89
7	3963.80	18651.50	5321.26	*	*	*	*	1900.45	108.60	1194.57	9230.77	40371.00	5767.29
8	542.99	190.05	461.54	2036.20	54.30	27.15	2769.23	15638.00	950.23	1411.76	*	24081.40	2408.14
9	2796.38	3719.45	2280.54	3963.80	3203.62	597.29	2090.49	54.30	–	814.48	3176.47	22696.80	2063.34
10	380.09	2443.44	244.34	4316.74	1276.01	*	*	162.89	27.15	27.15	*	8877.83	1109.72
11	1547.51	34235.30	1927.60	162.90	1384.61	*	3040.72	*	*	*	*	42298.60	7049.77
12	1167.42	1737.55	1819.00	–	5837.10	27.15	*	–	27.15	–	1791.85	12467.20	1127.93
13	244.34	108.60	542.99	1954.75	–	4533.93	*	–	–	298.64	542.99	8226.24	747.84
14	2199.09	787.33	1601.81	162.90	*	7194.57	27.15	–	841.62	977.38	*	13791.80	1532.42
15	787.33	6570.13	1303.16	244.34	923.08	27.15	*	135.75	–	135.75	705.88	10832.50	984.78
16	244.34	352.94	380.09	*	*	–	*	27.15	434.39	217.19	3447.96	5104.07	567.12
Total	32986.44	86334.89	45990.97	26877.84	21638.02	37004.54	17511.32	56416.32	16181.00	27067.89	31357.48	399366.71	
average	2061.65	5395.93	2874.43	2067.52	1803.16	3364.04	1751.13	4029.73	1078.73	1804.52	3135.74		

* no sampling because of the monsoon

Table 6 Abundance of fish larvae around the Chang Islands during January - December 1987.

(no/1000 m^3)

Station \ Month	Jan.	Feb.	Mar.	Apr.	May	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Average
1	9529.41	9800.90	9502.26	16099.50	10642.50	325.79	570.14	760.18	244.34	1656.10	217.19	59348.40	5395.31
2	352.94	1004.52	624.43	3665.16	27.15	*	*	4371.04	461.54	1167.42	352.94	12027.10	1336.35
3	244.34	1466.06	2633.48	3475.11	4479.64	542.99	*	434.39	1954.75	3583.71	*	18814.40	2090.49
4	2904.97	1004.52	3257.92	*	162.90	1221.72	*	*	923.08	2497.73	2904.97	14877.80	1653.09
5	733.03	2497.73	1628.96	271.49	*	*	*	868.78	570.14	5076.92	*	11647.00	1663.86
6	7710.41	6108.60	3665.16	1819.00	6244.34	7140.27	787.33	2687.78	977.38	733.03	4208.14	42081.40	3825.58
7	434.39	3502.26	597.28	*	*	*	*	841.63	1411.76	2063.34	2334.84	11185.50	1597.93
8	923.08	135.75	162.90	1981.90	542.99	298.64	1004.52	407.24	2090.49	6434.39	*	13981.90	1398.19
9	7819.00	6162.89	1085.97	13900.40	3638.01	1981.90	1574.66	298.64	54.30	2090.49	1330.31	39936.60	3630.60
10	135.75	3040.72	651.58	22479.60	81.45	*	*	27.15	81.45	597.28	*	27095.00	3386.87
11	2334.84	6271.49	4018.10	3393.66	1194.57	*	1411.76	*	*	*	*	18624.40	3104.07
12	3040.72	13493.20	3095.02	4859.73	1764.70	5294.12	81.45	1493.21	1493.21	1737.55	3800.90	40153.80	3650.35
13	4615.38	4099.54	3149.32	2606.33	2063.34	2742.68	81.45	950.23	570.14	678.73	1547.51	23104.00	2100.37
14	4832.58	407.24	2361.99	461.54	*	1493.21	27.15	705.88	2904.97	1004.52	*	14189.10	1577.67
15	8090.50	4968.32	6787.33	3040.72	3773.75	3800.90	27.15	3067.87	10452.40	1004.52	5619.91	50633.50	4603.04
16	9122.17	6542.98	4235.29	*	*	9149.32	434.39	3040.72	814.48	1031.67	2742.08	37113.10	4123.68
Total	62823.50	70506.80	47457.00	78054.30	34615.40	33990.90	6000.00	19954.70	25004.50	31357.40	25058.80	434823.00	
Average	3926.47	4406.67	2966.06	6004.17	2884.61	3090.08	600.00	1425.34	1666.96	2090.49	2505.88		

* no sampling because of the monsoon

abundance among the larval populations themselves, among months and stations, as well as the seasons and zones (Tables 7 and 8).

3.1 Family Gobiidae

The gobiid larvae were dominant in all stations and all cruises. The density was statistically different among both seasons and areas. They peaked very highly during the first half-year in April at stations 1, 11, 13 and 16 of the inner zone and stations 6 and 10 of the outer zone (Figures 45 and 46).

3.2 Family Engraulidae

The engraulid larvae were abundant throughout the year. Unlike the Gobiidae, the Engraulidae could not express their different means in all seasons and studied areas significantly. The larvae, nevertheless, slightly fluctuated throughout the year with a relatively low density in August, as well as the others. In July, February, April and November respectively, the larvae obtained their peaks at stations 1 and 16 of the inner zone and stations 8 and 10 of the outer zone (Figures 45 and 46).

3.3 Family Bregmacerotidae

Larvae of the Bregmacerotidae were highly abundant in January to April, during the NE-monsoon, at the station 1 and 11 of the inner zone and station 10 of the outer. The means were statistically different between

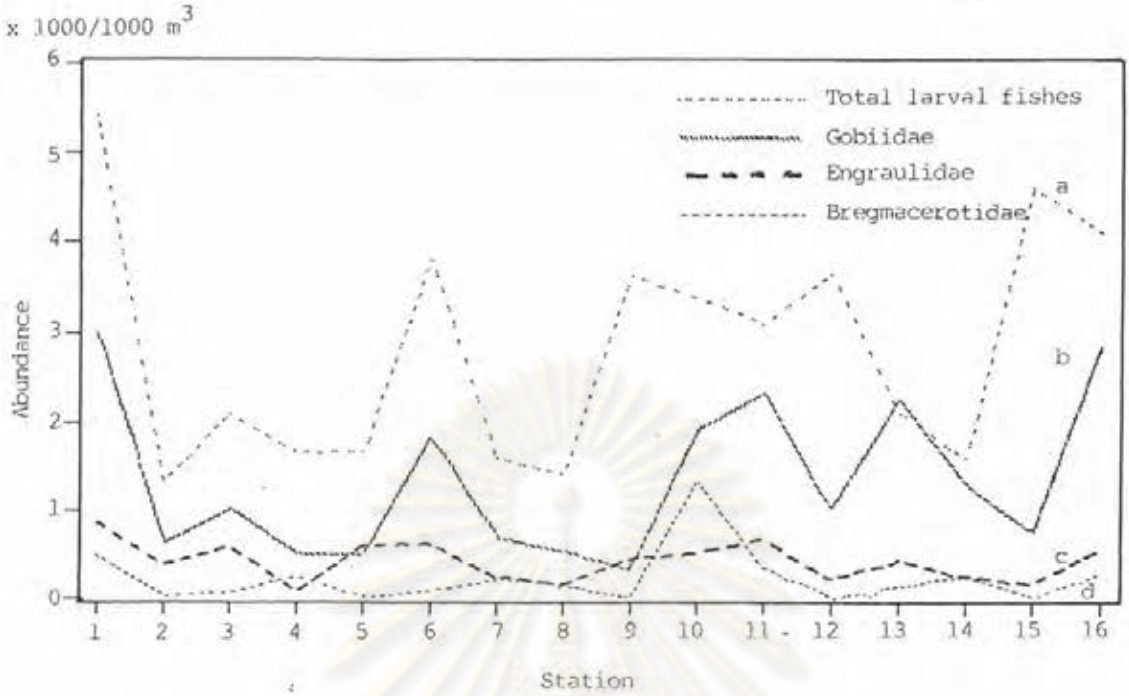

Figure 45 Fluctuation of the mean abundance in each station of the fish larvae around the Chang Islands in 1987.

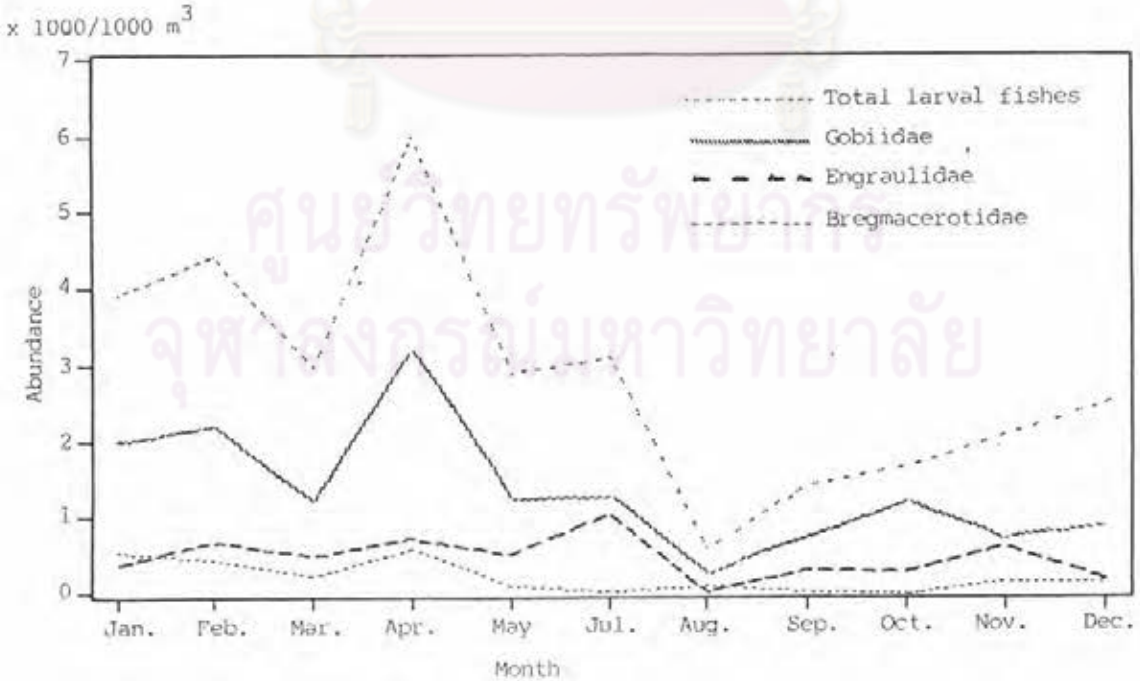

Figure 46 Fluctuation of the mean abundance in each month of the fish larvae around the Chang Islands in 1987.

the stations, seasons and months, but not between the inner and outer areas (Figures 45 and 46).

3.4 Family Leiognathidae

Leiognathid larvae were remarkably concentrated in NE-monsoon from December until May. The most distinctively abundant spot was at the station 16 of the inner zone, which contained 43.2 % of the leiognathid larvae. However, the statistics could not show the significant difference in means among months and seasons (Figures 47 and 48).

3.5 Family Nemipteridae

Nemipterid larvae, as well as the larvae of Leiognathidae, were distinctively abundant during the NE-monsoon to the early SW-monsoon period. The stations 10 of the outer and 11 of the inner zones were more concentrated than others but non-significance among the stations and areas (Figures 47 and 48).

3.6 Family Clupeidae

The Clupeidae was more concentrated during the NE-monsoon at stations 4 and 10 of the outer zone, but not significantly different (Figures 47 and 48).

3.7 Family Callionymidae

Larvae of the Callionymidae were similarly abundant to the Leiognathidae and the Nemipteridae during

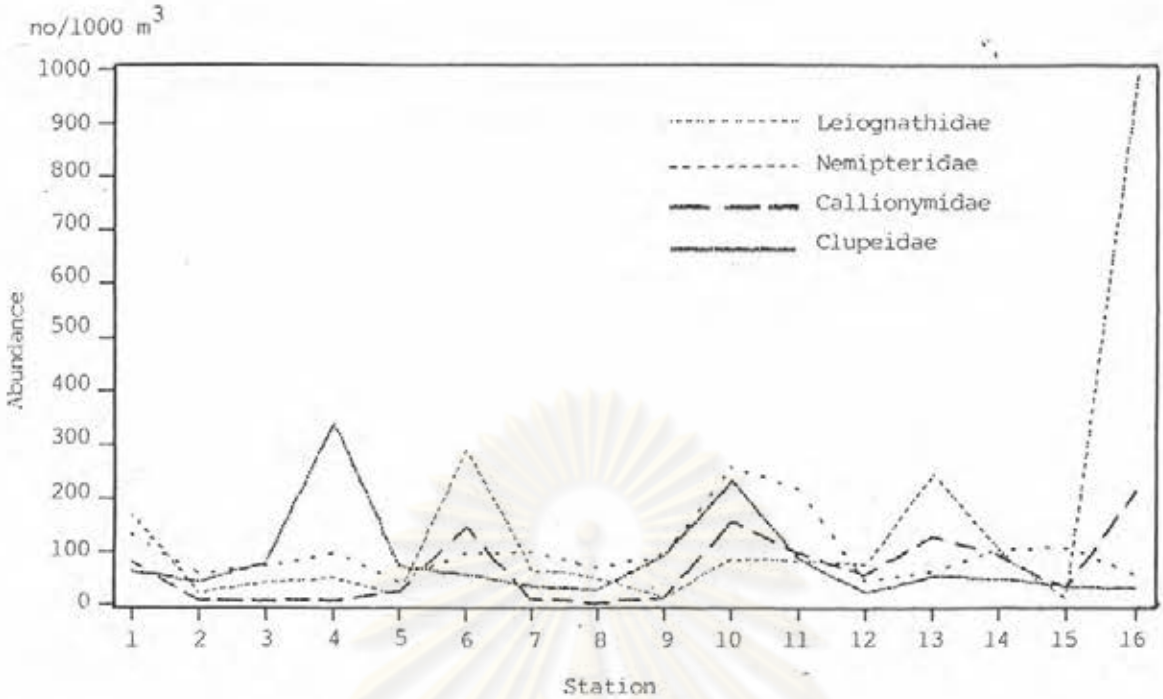

Figure 47 Fluctuation of the mean abundance in each station of the fish larvae around the Chang Islands 1987.

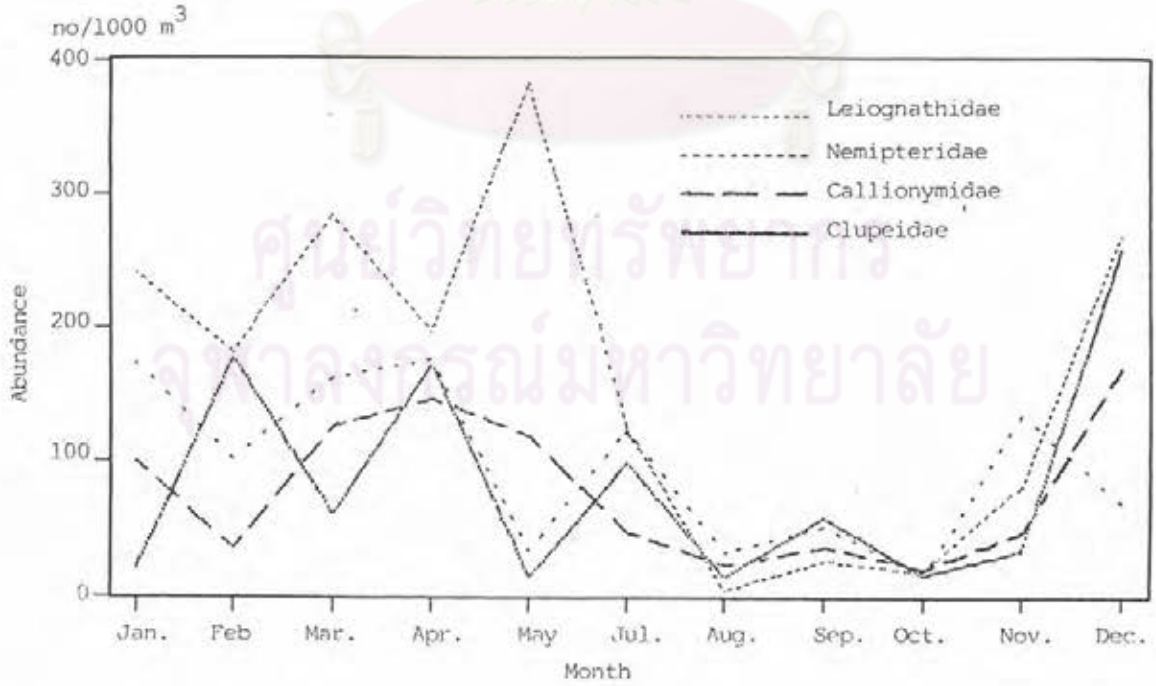

Figure 48 Fluctuation of the mean abundance in each month of the fish larvae around the Chang Islands in 1987.

Table 7 Average total number of fish larvae around the Chang Islands in each station. (no/1000 m^3)

Station Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total Average
1. Clupeidae	61.70	39.22	78.43	337.86	69.81	54.30	34.91	24.43	93.79	234.16	85.97	22.21	51.83	48.27	32.09	30.17	739.82
2. Engraulidae	868.78	395.17	591.25	90.50	608.92	614.56	236.59	165.61	471.41	529.41	683.26	227.07	441.79	244.34	170.30	582.20	4427.04
3. Eel Leptocephalus									2.47								1.70
4. Symodontidae			3.02	6.03	7.76				2.47	16.97	18.10			3.02	4.94		30.54
5. Belonidae									2.47								1.70
6. Exocoetidae	2.47									3.39			2.47				5.09
7. Bregmacerotidae	476.35	48.27	72.40	253.39	11.64	78.98	213.32	149.32	32.09	1337.10	348.42	24.68	138.21	265.46	32.09	289.59	2136.31
8. Bothidae	71.58	39.22	6.03	36.20	31.03	91.32	27.15	19.00	17.28	81.45	104.07	34.55	59.23	33.18	19.74	66.37	439.48
9. Soleidae			6.03	3.02		4.94				3.39		14.81			2.47	27.15	45.81
10. Cynoglossidae	12.34			15.08	3.88	2.47	7.76	5.43	2.47	3.39				21.12	2.47	30.17	61.09
11. Syngnathidae						2.47	3.88	2.71						3.02			5.09
12. Pegasidae	17.28	6.03								6.79		2.47	4.94	33.18		9.05	50.91
13. Fistulariidae					3.88					3.39		2.47				3.02	6.79
14. Sphyraenidae			18.10	18.10	3.88		15.51	10.86	9.87	6.79	22.62				7.40		52.60
15. Scombridae	2.47		45.25	9.05	224.95	2.47	3.88	2.71	12.34	3.39	162.90	2.47	2.47	12.07	2.47		217.19
16. Trichiuridae										3.39							1.70
17. Carangidae	140.68	9.05	9.05	33.18	77.57	56.77	34.91	24.43	29.62	50.91	45.25	9.87	69.11	21.12	27.15	90.50	480.20
18. Kuhlidae										3.39							1.70
19. Leiognathidae	165.36	21.12	39.22	48.27	19.39	288.77	65.93	46.15	12.34	84.84	81.45	74.04	244.34	99.55	12.34	989.44	1523.76
20. Apogonidae	7.40	6.03	6.03	30.17		17.28	19.39	13.57	2.47	27.15	81.45	7.40	9.87	72.40	12.34	51.28	227.38
21. Epinephelidae	2.47				3.88		3.88	2.71		3.39							6.79
22. Priacanthidae	4.94		6.03	3.02	11.64	2.47			9.87	6.79	81.45		4.94	6.03	2.47	3.02	66.18
23. Lutjanidae	4.94		9.05	3.02	7.76					20.36	85.97						56.00
24. Theraponidae				3.02					69.11		9.05		2.47			6.03	61.09
25. Nemipteridae	128.34	60.33	72.40	96.53	42.66	96.26	100.84	70.59	93.79	257.92	212.67	44.43	64.17	102.56	106.13	54.30	936.65
26. Mullidae	4.94			33.18	3.88	2.47				3.39	4.52		9.87	9.05			62.78
27. Sciaenidae	167.83	3.02	6.03	6.03	3.88	424.52				16.97		54.30	29.62	57.32		129.71	668.55
28. Sillaginidae	2.47	36.20	6.03		7.76				2.47	13.57		2.47		3.02		54.30	95.02
29. Siganidae										10.18							5.09
30. Scorpaenidae	17.28					17.28	7.76	5.43			4.52	19.74	64.17	24.13	12.34	51.28	152.72
31. Platycephalidae	22.21		6.03							10.18	9.05			18.10	2.47	15.08	50.91
32. Labridae				9.05						27.15				3.02			20.36
33. Gobiidae	2988.89	624.43	1019.61	506.79	500.32	1811.60	713.64	499.55	338.13	1914.03	2321.27	1014.40	2248.46	1315.23	750.31	2838.61	3018.11
34. Calliocymidae	76.51	9.05	9.05	9.05	23.27	143.15	7.76	5.43	12.34	156.11	95.02	54.30	125.87	90.50	29.62	214.18	710.97
35. Champsodontidae					3.88				2.47	10.18							8.48
36. Blenniidae	4.94		6.03	6.03		12.34	11.64	8.14	7.40	13.57	4.52	19.74			2.47	9.05	59.39
37. Monacanthidae	12.34				7.76	4.94	15.51	10.86	4.94	13.57	4.52	9.87		30.17	14.81	3.02	71.27
38. Tetraodontidae									2.47		9.05						5.09
39. Unknown	130.81	39.22	75.41	96.53	7.76	96.25	73.69	51.58	37.02	115.38	45.25	51.83	86.38	51.28	44.43	78.43	683.82
Total	5395.31	1336.35	2090.50	1653.09	1687.14	3825.59	1597.93	1118.55	1271.08	4992.08	4520.36	1693.13	3660.22	2567.12	1290.83	5625.95	7195.15

Table 8 Average total number of fish larvae around the Chang Islands during January - December 1987.

(no/1000 m^3)

Month Family	Jan.	Feb.	Mar.	Apr.	May	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total average
1. Clupeidae	20.36	176.47	61.09	171.25	13.57	98.72	13.57	58.10	14.48	32.58	257.92	83.47
2. Engraulidae	356.34	668.55	478.51	724.68	509.05	1029.21	38.01	319.82	273.30	611.77	179.19	471.67
3. Eel Leptocephalus	-	-	-	-	-	-	-	1.90	-	-	-	0.17
4. Synodontidae	13.57	11.88	-	4.18	-	-	-	1.90	-	-	-	2.87
5. Belonidae	-	-	-	-	-	-	-	1.90	-	-	-	0.17
6. Exocoetidae	-	3.39	-	-	-	-	-	1.90	-	-	-	0.48
7. Bregmacerotidae	549.77	437.78	239.25	586.84	104.07	34.55	92.31	21.18	7.24	155.66	162.90	217.41
8. Bothidae	59.39	42.42	57.69	87.71	47.51	34.55	5.43	15.48	5.43	59.73	114.03	48.12
9. Soleidae	3.39	13.57	-	10.44	-	4.94	-	-	1.81	-	24.43	5.33
10. Cynoglossidae	30.54	11.88	6.79	4.18	4.52	-	-	-	-	-	8.14	6.00
11. Syngnathidae	-	1.70	-	-	-	-	-	-	-	-	5.43	0.65
12. Pegasidae	6.79	23.76	11.88	2.09	-	4.94	-	-	1.81	-	2.71	4.91
13. Pistulariidae	5.09	-	1.70	-	-	-	-	-	-	-	-	0.62
14. Sphyraenidae	3.39	1.70	15.27	22.97	4.52	9.87	-	-	-	-	5.43	5.74
15. Scombridae	5.09	8.48	5.09	77.27	4.52	2.47	2.71	-	16.29	119.46	2.71	22.19
16. Trichiuridae	-	1.70	-	-	-	-	-	-	-	-	-	0.15
17. Carangidae	95.02	42.42	69.57	150.37	52.04	61.70	8.14	9.77	1.81	45.25	10.86	49.72
18. Menidae	1.70	-	-	-	-	-	-	-	-	-	-	0.15
19. Leiognathidae	240.95	181.56	283.37	196.31	382.35	125.87	2.71	25.25	18.10	81.45	268.78	164.25
20. Apogonidae	20.36	27.15	6.79	45.95	45.25	34.55	-	25.25	36.20	9.05	21.72	24.75
21. Epinephelidae	3.39	-	-	2.09	-	-	-	-	-	-	-	0.50
22. Priacanthidae	15.27	10.18	3.39	33.41	-	-	-	-	1.81	5.43	5.43	6.81
23. Lutjanidae	10.18	6.79	-	39.68	-	2.47	-	-	-	1.81	-	5.54
24. Theraponidae	-	3.39	1.70	-	2.26	2.47	76.02	1.9	-	1.81	-	8.14
25. Nemipteridae	173.08	101.81	162.90	175.43	33.94	123.41	32.58	50.50	14.48	133.94	67.87	97.27
26. Mullidae	3.39	18.67	1.70	-	9.05	37.02	-	-	-	-	-	6.35
27. Sciaenidae	10.18	225.68	59.39	152.45	194.57	78.98	5.43	23.35	1.81	-	38.01	71.80
28. Sillaginidae	3.39	-	45.81	-	20.36	-	-	32.85	-	1.81	-	9.48
29. Siganidae	5.09	-	-	-	-	-	-	-	-	-	-	0.46
30. Scorpaenidae	32.24	13.57	44.12	-	22.62	14.81	-	23.35	1.81	-	21.72	15.84
31. Platycephalidae	1.70	-	11.88	10.44	13.57	14.81	5.43	-	-	3.62	2.71	5.83
32. Labridae	11.88	-	5.09	2.09	-	2.47	-	-	-	-	-	1.96
33. Gobiidae	2010.75	2202.49	1203.05	3195.27	1246.61	1273.55	271.49	731.13	1210.86	729.41	906.79	1361.94
34. Callionymidae	100.11	35.63	125.57	146.19	117.65	46.89	21.72	35.02	19.91	45.25	168.33	78.39
35. Champsodontidae	5.09	3.39	-	-	-	-	-	-	-	-	-	0.77
36. Blenniidae	-	22.06	6.79	10.44	2.26	-	16.29	1.9	1.81	7.24	-	6.25
37. Monacanthidae	33.94	15.27	6.79	4.18	-	2.47	-	-	1.81	-	13.57	7.09
38. Tetraodontidae	1.70	-	-	4.18	-	-	-	-	-	-	-	0.53
39. Unknown	93.33	93.33	50.91	144.10	54.30	49.36	8.14	42.62	36.20	45.25	217.19	75.88
Total	3926.47	4406.60	2966.06	6004.18	2884.62	3090.14	600.00	1425.34	1666.97	2090.50	2505.88	2869.71

Table 9 Abundance of fish larvae around the Chang Islands in January 1987. (no/1000 m^3)

Station Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1. Clupeidae						190.05	54.30	54.30		27.15							325.79
2. Engraulidae	407.24		27.15	54.30	108.60	2714.93	27.15	108.60	244.34		271.49	542.99	81.45	407.24	298.64	407.24	5701.36
3. Eel Leptocephalus																	
4. Synodontidae				54.30	54.30			27.15	54.30					27.15			217.19
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae	2199.10	54.30	27.15	407.24		461.54		54.30	2579.19		27.15	27.15	570.14	190.05	1140.27	1058.82	8796.38
8. Bothidae	54.30					27.15			162.90	27.15	81.45	54.30	54.30	54.30	81.45	352.94	950.23
9. Soleidae																54.30	54.30
10. Cynoglossidae				81.45				27.15	27.15				108.60		190.05	54.30	488.69
11. Syngnathidae																	
12. Pegasidae	27.15														27.15	54.30	108.60
13. Fistulariidae					27.15				27.15						27.15		81.45
14. Sphyraenidae					27.15			27.15									54.30
15. Scombridae			27.15					54.30									81.45
16. Trichiuridae																	
17. Carangidae	54.30			27.15	27.15	298.64		54.30				81.45		54.30	190.05	733.03	1520.36
18. Menidae									27.15								27.15
19. Leiognathidae	488.69					135.75			135.75		27.15		244.34	54.30	1058.82	1710.41	3855.21
20. Apogonidae	27.15								162.90						135.75		325.79
21. Epinephelidae							27.15		27.15								54.30
22. Priacanthidae				27.15		27.15		81.45	54.30			27.15		27.15			244.34
23. Lutjanidae	54.30								108.60								162.90
24. Theraponidae																	
25. Nemipteridae	515.84			190.05	54.30	108.60	27.15	54.30	488.69	54.30	135.75	108.60	298.64	217.19	190.05	325.79	2769.23
26. Mullidae	27.15				27.15												54.30
27. Sciaenidae	54.30											54.30			54.30		162.90
28. Sillaginidae									27.15							27.15	54.30
29. Siganidae									81.45								81.45
30. Scorpaenidae	54.30					54.30					135.75	54.30	27.15		27.15	162.90	515.84
31. Platycephalidae																27.15	27.15
32. Labridae									190.05								190.05
33. Gobiidae	5185.52	271.49	162.90	1710.41	298.64	3556.56	162.90	271.49	2796.38	27.15	1384.62	1927.60	2850.68	3502.26	4479.64	3583.71	32171.96
34. Callionymidae	135.75			81.45					380.09		190.05	27.15	135.75	81.45	54.30	515.84	1601.81
35. Champsodontidae					27.15			27.15	27.15								81.45
36. Blenniidae																	
37. Monacanthidae	27.15				27.15		81.45	54.30	81.45				54.30	162.90	27.15	27.15	542.99
38. Tetraodontidae								27.15									27.15
39. Unknown	217.19	27.15		271.49	54.30	135.75	54.30		135.75		81.45	135.75	190.05	54.30	108.60	27.15	1493.21
Total	9529.42	352.94	244.34	2904.98	733.03	7710.41	434.39	923.08	7819.01	135.75	2334.84	3040.73	4615.39	4832.58	8090.50	9122.18	62823.56

Table 10 Abundance of fish larvae around the Chang Islands in February 1987. (no/1000 m^3)

Station Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1. Clupeidae	190.05	54.30			352.94	190.05	81.45	54.30	1357.47	162.90	244.34	54.30		27.15	54.30		2823.53
2. Engraulidae	3610.86	325.79	787.33		1113.12	597.29	352.94		678.73	461.54	1466.06	488.69	162.90		217.19	434.39	10696.84
3. Eel Leptocephalus																	
4. Synodontidae									81.45	108.60							190.05
5. Belonidae																	
6. Exocoetidae	27.15											27.15					54.05
7. Bregmacerotidae	814.48	135.75	135.75			162.90	407.24		950.23	162.00	81.45	1031.67	814.48		1058.82	1248.87	7004.53
8. Bothidae	54.30	27.15				81.45	54.30		217.19	54.30		108.60			27.15	54.30	678.73
9. Soleidae			27.15	27.15					27.15		81.45					54.30	217.19
10. Cynoglossidae	108.60				27.15		27.15						27.15				190.05
11. Syngnathidae							27.15										27.15
12. Pegasidae	27.15										27.15	54.30	271.49				380.09
13. Fistulariidae																	
14. Sphyraenidae										27.15							27.15
15. Scombridae			108.60		27.15												135.75
16. Trichiuridae									27.15								27.15
17. Carangidae	54.30				54.30	54.30	27.15	27.15			54.30	81.45			190.05	135.75	678.73
18. Kenidae																	
19. Leiognathidae	27.15				81.45	54.30	271.49			27.15	244.34	977.38	135.75	27.15	787.33	271.49	2904.98
20. Apogonidae						54.30	135.75			81.45	81.45	27.15	27.15			27.15	434.39
21. Spinephelidae																	
22. Priacanthidae	54.30		27.15							54.30					27.15		162.90
23. Lutjanidae			27.15						27.15	54.30							108.60
24. Theraponidae															54.30		54.30
25. Nemipteridae	217.19	81.45			108.60	380.09	81.45		488.69	27.15	108.60		27.15	54.30		54.30	1628.96
26. Mullidae				217.19					27.15	27.15						27.15	298.64
27. Sciaenidae	27.15		27.15	27.15		2633.49					190.05		54.30		135.75	515.84	3610.86
28. Sillaginidae																	
29. Siganidae																	
30. Scorpaenidae										27.15		162.90			27.15		217.19
31. Platycephalidae																	
32. Labridae																	
33. Gobiidae	4398.19	352.94	271.49	570.14	705.88	1764.71	1737.56	54.30	2036.20	1656.11	3176.47	10181.00	2226.25	271.49	2226.25	3610.86	35239.84
34. Callionymidae	54.30					108.60			27.15		81.45	54.30	162.90		81.45		570.14
35. Champsodontidae									54.30								54.30
36. Blenniidae							54.30		108.60	27.15	108.60				27.15	27.15	352.94
37. Monacanthidae					27.15	27.15			27.15	27.15	108.60		27.15				244.34
38. Tetraodontidae																	
39. Unknown	135.75	27.15	54.30	162.90			244.34		27.15	54.30	217.19	244.34	162.90	27.15	54.30	81.45	1493.21
Total	9800.91	1004.53	1466.06	1004.53	2497.74	6108.60	3502.26	135.75	6162.90	3040.73	6271.50	13493.22	4099.55	407.24	4968.33	6542.99	70506.82

Table 11 Abundance of fish larvae around the Chang Islands in March 1987. (no/1000 m^3)

Station Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1. Clupeidae	54.30		298.64	434.39					54.30				108.60	27.15			977.38
2. Engraulidae	1357.47		1140.27	190.05	1113.12	787.33		54.30	108.60	108.60	271.49	488.69	325.79		1058.82	651.58	7656.11
3. Eel Leptocephalus																	
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae	950.23		380.09	950.23					244.34	27.15	135.75	217.19	624.43	81.45	54.30	162.90	3828.06
8. Bothidae	190.05	135.75		81.45		27.15					190.05	81.45	27.15	108.60	81.45		923.08
9. Soleidae																	
10. Cynoglossidae	27.15			54.30									27.15				108.60
11. Syngnathidae																	
12. Pegasidae	108.60								54.30				27.15				190.05
13. Fistulariidae											27.15						27.15
14. Sphyraenidae			27.15	108.60			108.60										244.34
15. Scombridae				27.15		27.15							27.15				81.45
16. Trichiuridae																	
17. Carangidae	380.09	27.15		54.30	135.75		54.30					81.45		108.60	108.60	162.90	1113.12
18. Kyphosidae																	
19. Leiognathidae	678.73	27.15		217.19		108.60	108.60			27.15	135.75		27.15		2470.59	733.03	4533.94
20. Apogonidae			27.15	27.15												54.30	108.60
21. Epinephelidae																	
22. Priacanthidae					27.15					27.15							54.30
23. Lutjanidae																	
24. Therapontidae				27.15													27.15
25. Nemipteridae	380.09	135.75	217.19	217.19		352.94	162.90	54.30	81.45		162.90	298.64	244.34	81.45	54.30	162.90	2606.34
26. Mullidae				27.15													27.15
27. Sciaenidae	325.79			27.15									244.34		217.19	135.75	950.23
28. Sillaginidae											27.15		27.15		325.79	352.94	733.03
29. Siganidae																	
30. Scorpaenidae	81.45					54.30	54.30				54.30	54.30	135.75	108.60	108.60	54.30	705.88
31. Platycephalidae	135.75												27.15	27.15			190.05
32. Labridae				81.45													81.45
33. Gobiidae	4398.19	217.19	542.99	542.99	352.94	1927.60	81.45		542.99	407.24	2877.83	1791.86	1140.27	1710.41	1737.56	977.38	19248.88
34. Callionymidae	135.75					352.94				54.30	54.30	54.30	81.45	108.60	515.84	651.58	2009.05
35. Champsodontidae																	
36. Blenniidae				27.15													
37. Monacanthidae	81.45										81.45						108.60
38. Tetraodontidae													27.15				108.60
39. Unknown	217.19	81.45		162.90		27.15	27.15	54.30				27.15	27.15		54.30	135.75	814.48
Total	9502.27	624.43	2633.49	3257.92	1628.96	3665.16	597.29	162.90	1085.97	651.58	4018.10	3095.02	3149.32	2361.99	6787.33	4235.30	47457.04

Table 12 Abundance of fish larvae around the Chang Islands in April 1987. (no/1000 m^3)

Station / Family	1	2	3	4 *	5	6	7 *	8	9	10	11	12	13	14	15	16 *	Total
1. Clupeidae	162.90	298.64	271.49					760.18	162.90	325.79			27.15	108.60	108.60		2226.25
2. Engraulidae	3040.73	461.54	434.39		135.75	135.75		651.58	1058.82	3230.77	81.45		81.45	81.45	27.15		9420.82
3. Eel Leptocephalus																	
4. Synodontidae													27.15	27.15			54.30
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae	1085.97	27.15	81.45						4398.19	1846.15	27.15	81.45	81.45				7628.96
8. Bothidae	217.19					27.15			27.15	515.84	54.30	135.75	135.75		27.15		1140.27
9. Soleidae											81.45			27.15	27.15		135.75
10. Cynoglossidae													27.15	27.15			54.30
11. Syngnathidae																	
12. Pegasidae		27.15															27.15
13. Fistulariidae																	
14. Sphyraenidae			108.60					45.30	27.15	108.60							298.64
15. Scombridae									27.15	977.38							1004.53
16. Trichiuridae																	
17. Carangidae	841.63		54.30			54.30		108.60	244.34	271.49	54.30	217.19	54.30		54.30		1954.75
18. Kyphosidae																	
19. Leiognathidae	162.90	54.30				54.30			217.19	380.09	135.75	27.15	108.60	27.15	1384.62		2552.04
20. Apogonidae	54.30	27.15				27.15			54.30	407.24					27.15		597.29
21. Epinephelidae	27.15																27.15
22. Priacanthidae			27.15							407.24							434.39
23. Lutjanidae			27.15						27.15	461.54							515.84
24. Theraponidae																	
25. Kemipteridae	108.60	108.60	54.30					81.45	570.14	1167.42		108.60	81.45				2280.54
26. Mullidae																	
27. Sciaenidae	1221.72	27.15	27.15			108.60			27.15		244.34				325.79		1981.90
28. Sillaginidae																	
29. Siganidae																	
30. Scorpaenidae																	
31. Platycephalidae	108.60								27.15								135.75
32. Labridae									27.15								27.15
33. Gobiidae	8633.49	2579.19	2009.05		135.75	1248.87		54.30	6081.45	11701.36	2253.39	4153.86	1737.56	108.60	841.63		41538.48
34. Callionymidae	162.90	27.15				54.30		27.15	542.99	515.84	190.05	81.45	190.05		108.60		1900.45
35. Champsodontidae																	
36. Blenniidae						81.45		27.15						27.15			135.75
37. Monacanthidae	27.15												27.15				54.30
38. Tetraodontidae										54.30							54.30
39. Unknown	244.34	27.15	380.09			27.15		217.19	380.09	108.60	271.49	54.30	27.15	27.15	108.60		1873.30
Total	16099.56	3665.16	3476.11		271.49	1819.01		1918.90	13900.46	22479.65	3393.67	4859.73	2606.34	461.54	3040.73		78054.34

* no sampling because of the monsoon

Table 13 Abundance of fish larvae around the Chang Islands in May 1987. (no/1000 m^3)

Station Family	1	2	3	4	5*	6	7*	8	9	10	11	12	13	14*	15	16*	Total
1. Clupeidae						27.15		27.15					81.45		27.15		162.90
2. Engraulidae	1031.67		1710.41	27.15		325.79		81.45	814.48		352.94	542.99	271.49		950.23		6108.60
3. Bel Leptocephalus																	
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae	135.75		27.15	81.45		27.15		27.15	923.08						27.15		1248.87
8. Bothidae	190.05		54.30					27.15	81.45		54.30				162.90		570.14
9. Soleidae																	
10. Cynoglossidae						27.15									27.15		54.30
11. Syngnathidae																	
12. Pegasidae																	
13. Fistulariidae																	
14. Sphyraenidae			27.15						27.15								54.30
15. Scombridae													54.30				54.30
16. Trichiuridae																	
17. Carangidae	162.90		27.15			27.15		54.30	108.60			81.45			162.90		624.43
18. Kenidae																	
19. Leiognathidae	298.64	27.15	217.19	27.15		2361.99			81.45		271.49	108.60	135.75		1 058.82		4588.24
20. Apogonidae												27.15	461.54		54.30		542.99
21. Epinephelidae																	
22. Priacanthidae																	
23. Lutjanidae																	
24. Theraponidae										27.15							27.15
25. Nemipteridae			135.75					162.90		27.15		27.15	54.30				407.24
26. Mullidae	27.15												81.45				108.60
27. Sciaenidae	54.30					1764.71					162.90		190.05		162.90		2334.84
28. Sillaginidae	27.15								54.30						162.90		244.34
29. Siganidae																	
30. Scorpaenidae	54.30					54.30					27.15	108.60			27.15		271.49
31. Platycephalidae													135.75		27.15		162.90
32. Labridae																	
33. Gobiidae	8144.80		2226.25			950.23		108.60	1194.57		325.79	787.33	461.54		760.18		14959.28
34. Callionymidae	352.94		27.15			570.14			271.49				135.75		54.30		1411.77
35. Champsodontidae																	
36. Blenniidae			27.15														27.15
37. Monacanthidae																	
38. Tetraodontidae																	
39. Unknown	162.90			27.15		108.60		54.30	81.45	27.15		81.45			108.60		651.58
Total	10642.54	27.15	4479.64	162.90		6244.35		542.99	3638.01	81.45	1194.57	1764.71	2063.35		3773.76		34615.40

* no sampling because of the monsoon

Table 14 Abundance of fish larvae around the Chang Islands in July 1987. (no/1000 m^3)

Station Family	1	2*	3	4	5*	6	7*	8	9	10*	11*	12	13	14	15	16	Total
1. Clupeidae			81.45	515.84				54.30	54.30			27.15	54.30			298.64	1085.97
2. Engraulidae						950.23			325.79			1384.62	434.39		1574.66	6651.59	11321.27
3. Eel Leptocephalus																	
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae									244.34			54.30	27.15		54.30		380.09
8. Bothidae						81.45			54.30			190.05			27.15	27.15	380.09
9. Soleidae															27.15	27.15	54.30
10. Cynoglossidae																	
11. Syngnathidae																	
12. Pegasidae															54.30		54.30
13. Fistulariidae																	
14. Sphyraenidae								27.15						81.45			108.60
15. Scombridae	27.15																27.15
16. Trichiuridae																	
17. Carangidae	54.30			54.30		162.90			54.30			162.90		135.75	54.30		678.73
18. Menidae																	
19. Leiognathidae						108.60		54.30	190.05			54.30	190.05		705.88	81.45	1384.62
20. Apogonidae				244.34				27.15				27.15	81.45				380.09
21. Epinephelidae																	
22. Priacanthidae																	
23. Lutjanidae				27.15													27.15
24. Therapomidae												27.15					27.15
25. Nemipteridae	108.60		135.75	27.15								81.45	54.30	542.99	81.45	325.79	1357.47
26. Mullidae				54.30		27.15										325.79	407.24
27. Sciaenidae	27.15					81.45			108.60			162.90				488.69	868.78
28. Sillaginidae																	
29. Siganidae																	
30. Scorpaenidae																	
31. Platycephalidae			54.30									54.30	54.30		54.30		162.90
32. Labridae															81.45	27.15	162.90
33. Gobiidae	108.60		244.34	217.19		5538.46		108.60	895.93			2877.83	27.15 1791.86	542.99	814.48	868.78	27.15 14009.06
34. Callionymidae						108.60						162.90	27.15		217.19		515.84
35. Champsodontidae																	
36. Blenniidae																	
37. Monacanthidae						27.15											27.15
38. Tetraodontidae																	
39. Unknown			27.15	81.45		54.30		27.15	54.30			27.15		190.05	54.30	27.15	542.99
Total	325.79		542.99	1221.72		7140.28		298.64	1981.90			5294.12	2742.08	1493.21	3800.91	9149.33	33990.97

* no sampling because of the monsoon

Table 15 Abundance of fish larvae around the Chang Islands in August 1987. (no/1000 m^3)

Station / Family	1	2*	3*	4*	5*	6	7*	8	9	10*	11	12	13	14	15	16	Total
1. Clupeidae	54.30					27.15		-	54.30		-	-					135.75
2. Engraulidae								81.45	27.15		54.30	54.30				162.90	380.09
3. Eel Leptocephalus																	
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae	54.30					27.15			814.48								
8. Bothidae	54.30															27.15	923.08
9. Soleidae																	54.30
10. Cynoglossidae									-								
11. Syngnathidae																	
12. Pegasidae																	
13. Fistulariidae																	
14. Sphyraenidae																	
15. Scombridae																	
16. Trichiuridae											27.15						27.15
17. Carangidae																	
18. Kenidae						27.15							54.30				81.45
19. Leiognathidae						27.15											
20. Apogonidae																	27.15
21. Epinephelidae																	
22. Priacanthidae																	
23. Lutjanidae																	
24. Theraponidae																	
25. Nemipteridae								760.18									760.18
26. Mullidae						27.15			81.45		81.45					135.75	325.79
27. Sciaenidae						54.30											
28. Sillaginidae																	54.30
29. Siganidae																	
30. Scorpaenidae																	
31. Platycephalidae																	
32. Labridae									54.30								
33. Gobiidae	380.09					380.09		108.60	515.84		1140.27	27.15	27.15	27.15	27.15	81.45	54.30
34. Callionymidae						108.60			27.15		81.45						2714.93
35. Champsodontidae																	217.19
36. Blenniidae	27.15					54.30		54.30			27.15						
37. Monacanthidae																	162.60
38. Tetraodontidae																	
39. Unknown						54.30										27.15	81.45
Total	570.14					787.33		1004.53	1574.66		1411.77	81.45	81.45	27.15	27.15	434.39	6000.00

* no sampling because of the monsoon

Table 16 Abundance of fish larvae around the Chang Islands in September 1987. (no/1000 m^3)

Station Family	1	2	3	4*	5	6	7	8	9	10	11*	12	13	14	15	16	Total
1. Clupeidae	162.90				54.30							325.79	135.75		27.15	108.60	814.48
2. Engraulidae		2334.84	27.15		407.24	244.79	325.79	190.05	27.15			162.90	162.90	108.60	244.34	244.34	4479.64
3. Bel Leptocephalus								27.15									27.15
4. Synodontidae			27.15														27.15
5. Belonidae								27.15									27.15
6. Exocoetidae									27.15								27.15
7. Bregmacerotidae						27.15	81.45		27.15				27.15	27.15	81.45	27.15	298.64
8. Bothidae	27.15	27.15			81.45	27.15		27.15					27.15				217.19
9. Soleidae																	
10. Cynoglossidae																	
11. Syngnathidae																	
12. Pegasidae																	
13. Fistulariidae																	
14. Sphyraenidae																	
15. Scombridae																	
16. Trichiuridae																	
17. Carangidae		27.15													27.15	54.30	135.75
18. Keniidae																	
19. Leiognathidae					27.15	217.19							27.15		27.15	54.30	352.94
20. Apogonidae						54.30									54.30	244.34	352.94
21. Epinephelidae																	
22. Priacanthidae																	
23. Lutjanidae																	
24. Therapontidae																	
25. Nemipteridae		135.75	108.60		81.45	108.60	54.30					81.45	54.30	27.15		27.15	27.15
26. Mullidae																54.30	705.88
27. Sciaenidae	135.75				27.15	27.15											
28. Sillaginidae		325.79	54.30		54.30				27.15							135.75	325.79
29. Siganidae																	461.54
30. Scorpaenidae						27.15						54.30			217.19	27.15	325.79
31. Platycephalidae																	
32. Labridae																	
33. Gobiidae	271.49	1438.91	81.45		108.60	1819.01	325.79	108.60	162.90			760.18	488.69	434.39	2226.25	2009.05	10235.30
34. Callionymidae		54.30			27.15	81.45	27.15	27.15				54.30	27.15	27.15	108.60	54.30	488.69
35. Champsodontidae																	
36. Blenniidae							27.15										27.15
37. Monacanthidae																	
38. Tetraodontidae																	
39. Unknown	162.90	27.15	135.75			54.30			27.15	27.15		27.15		81.45	54.30		597.29
Total	760.18	4371.04	434.39		868.78	2687.78	841.63	407.24	298.64	27.15		1483.21	950.23	705.88	3067.87	3040.73	19954.76

* no sampling because of the monsoon

Table 17 Abundance of fish larvae around the Chang Islands in October 1987. (no/1000 m^3)

Station / Family	1	2	3	4	5	6	7	8	9	10	11 *	12	13	14	15	16	Total
1. Clupeidae			27.15		81.45			54.30									
2. Engraulidae	54.30	162.90	488.69	217.19	244.34	190.05	81.45	923.08		27.15		271.49	162.90	1221.72	27.15	27.15	217.19
3. Eel Leptocephalus																54.30	4099.55
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae				54.30													
8. Bothidae				27.15			27.15							54.30			108.60
9. Soleidae			27.15										27.15				81.45
10. Cynoglossidae																	27.15
11. Syngnathidae																	
12. Pegasidae		27.15															
13. Fistulariidae																	27.15
14. Sphyraenidae																	
15. Scombridae			27.15	54.30	81.45			27.15				27.15		27.15			244.34
16. Trichiuridae																	
17. Carangidae				27.15													27.15
18. Menidae																	
19. Leiognathidae				27.15		54.30						81.45	27.15	27.15	27.15	27.15	271.49
20. Apogonidae												27.15	81.45	135.75	81.45	217.19	542.99
21. Epinephelidae																	
22. Priacanthidae												27.15					27.15
23. Lutjanidae																	
24. Theraponidae																	
25. Nemipteridae	54.30				54.30									27.15	54.30	27.15	217.19
26. Mullidae																	
27. Sciaenidae													27.15				27.15
28. Sillaginidae																	
29. Siganidae																	
30. Scorpaenidae														27.15			27.15
31. Platycephalidae																	
32. Labridae																	
33. Gobiidae	108.60	244.34	1357.47	434.39	81.45	733.03	1248.87	1031.67	54.30			977.38	217.19	1221.72	10099.55	352.94	18162.91
34. Callionymidae					27.15		27.15					81.45		108.60	54.30		298.64
35. Champsodontidae																	
36. Blenniidae				27.15													
37. Monacanthidae													27.15				27.15
38. Tetraodontidae																	27.15
39. Unknown	27.15	27.15	27.15	54.30			27.15	54.30		54.30				54.30	108.60	108.60	542.99
Total	244.34	461.54	1954.75	923.08	570.14	977.38	1411.77	2090.50	54.30	81.45		1493.21	570.14	2904.98	10452.49	814.48	25004.54

* no sampling because of the monsoon

Table 18 Abundance of fish larvae around the Chang Islands in November 1987. (no/1000 m^3)

Station Family	1	2	3	4	5	6	7	8	9	10	11 *	12	13	14	15	16	Total
1. Clupeidae	54.30		27.15					27.15				162.90		190.05	27.15		488.69
2. Engraulidae	54.30	271.49	705.88	325.79	1140.27	81.45	570.14	3095.02	950.23	271.49		868.78	298.64	54.30	380.09	108.60	9176.48
3. Bel Leptocephalus																	
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae		190.05		787.33	81.45		488.69	271.49	352.94	54.30		54.30				54.30	2334.84
8. Bothidae		54.30		217.19	135.75	27.15	54.30	135.75	81.45	27.15		54.30	27.15	54.30	27.15		895.93
9. Soleidae																	
10. Cynoglossidae																	
11. Syngnathidae																	
12. Pegasidae																	
13. Fistulariidae																	
14. Sphyraenidae																	
15. Scombridae			244.34		1466.06			54.30					27.15				1791.86
16. Trichiuridae																	
17. Carangidae		27.15		135.75	325.79		135.75	81.45					54.30				760.18
18. Mexidae																	
19. Leiognathidae	162.90	81.45	135.75	108.60	27.15	54.30	27.15	81.45	54.30	54.30		162.90			135.75	135.75	1221.72
20. Apogonidae		27.15	27.15			54.30									27.15		135.75
21. Epinephelidae					27.15												27.15
22. Priacanthidae					54.30			27.15									81.45
23. Lutjanidae			27.15		54.30												81.45
24. Theraponidae										27.15						27.15	54.30
25. Nemipteridae	27.15	81.45		352.94		81.45	244.34	678.73						217.19	108.60	217.19	2009.05
26. Mullidae												108.60					108.60
27. Sciaenidae																	
28. Sillaginidae								27.15									27.15
29. Siganidae																	
30. Scorpaenidae																	
31. Platycephalidae										54.30							54.30
32. Labridae																	
33. Gobiidae	1248.87	407.24	2280.54	461.54	1819.01	298.64	461.54	1873.30	515.84	135.75		434.39	244.34	434.39	135.75	190.05	10941.18
34. Callionymidae			54.30		108.60	108.60		81.45							108.60	217.19	678.73
35. Champsodontidae																	
36. Blenniidae	27.15		27.15												54.30		108.60
37. Monacanthidae																	
38. Tetraodontidae																	
39. Unknown	81.45	27.15	54.30	108.60		27.15	81.45		135.75				27.15	54.30		81.45	678.73
Total	1656.11	1167.42	3583.71	24 97.74	5239.82	733.03	2063.35	6434.39	2090.50	624.43		1846.15	678.73	1004.53	1004.53	1031.67	31656.12

* no sampling because of the monsoon

Table 19 Abundance of fish larvae around the Chang Islands in December 1987. (no/1000 m^3)

Station Family	1	2	3 *	4	5 *	6	7	8 *	9	10 *	11 *	12	13	14 *	15	16	Total
1. Clupeidae				2090.50		162.90	108.60		190.05				27.15				2579.19
2. Engraulidae						733.03	298.64					54.30	217.19		488.69		1791.86
3. Eel Leptocephalus																	
4. Synodontidae																	
5. Belonidae																	
6. Exocoetidae																	
7. Bregmacerotidae		27.15				162.90	515.84		162.90			54.30	244.34		190.05	271.49	1628.96
8. Bothidae		108.60				705.88	54.30		27.15			27.15			162.90	54.30	1140.27
9. Soleidae						54.30									190.05		244.34
10. Cynoglossidae							27.15								54.30		81.45
11. Syngnathidae						27.15							27.15				54.30
12. Pegasidae	27.15																27.15
13. Fistulariidae																	
14. Sphyraenidae				54.30													54.30
15. Scombridae							27.15										27.15
16. Trichiuridae																	
17. Carangidae							27.15					27.15	27.15		27.15		108.60
18. Kyphosidae																	
19. Leiognathidae				54.30			54.30					1276.02			1248.87	54.30	2687.78
20. Apogonidae															81.45	135.75	217.19
21. Epinephelidae																	
22. Priacanthidae													54.30				54.30
23. Lutjanidae																	
24. Theraponidae																	
25. Nemipteridae				81.45			135.75		352.94				108.60				678.73
26. Mullidae																	
27. Sciaenidae												108.60			271.49		380.09
28. Sillaginidae																	
29. Siganidae																	
30. Scorpaenidae												217.19					217.19
31. Platycephalidae															27.15		27.15
32. Labridae																	
33. Gobiidae		108.60		624.43		1710.41	977.38		515.84			814.48	651.58		2199.10	1466.06	9067.88
34. Callionymidae						81.45						868.78	54.30		624.43	54.30	1683.26
35. Champsodontidae																	
36. Blenniidae																	
37. Monacanthidae							27.15						108.60				135.75
38. Tetraodontidae																	
39. Unknown	190.05	108.60				570.14	81.45		81.45			352.94	27.15		54.30	705.88	2171.95
Total	217.19	352.94		2904.98		4208.15	2334.84		1330.32			3800.91	1547.51		5619.91	2742.08	25058.84

* no sampling because of the monsoon

the NE-monsoon but no significance among the months. Whereas the stations 6, 13 and 16 of the inner and 10 of the outer zones contained distinctively more abundant (Figures 47 and 48).

3.8 Other Families

Occurrence of fish larvae of the each other Families were less than 2.0 % of the total larval fishes. Their abundance was only shown in the tables 7-19.

Distribution

1. Total Fish larvae

The total fish larvae were widely distributed in both inner and outer regions throughout the year, except the less distribution in the inner zone in August (Figure 49).

2. Fish Eggs

The fish eggs were highly distributed during the NE-monsoon in both inner and outer zones. However, the less distribution was found in the inner zone during the SW-monsoon from July to October (Figure 50).

3. Larval Fishes

The larvae of all Families were widely distributed in both inner and outer zones throughout the year, but the less distribution in the inner zone in August was remarkable (Figure 51).

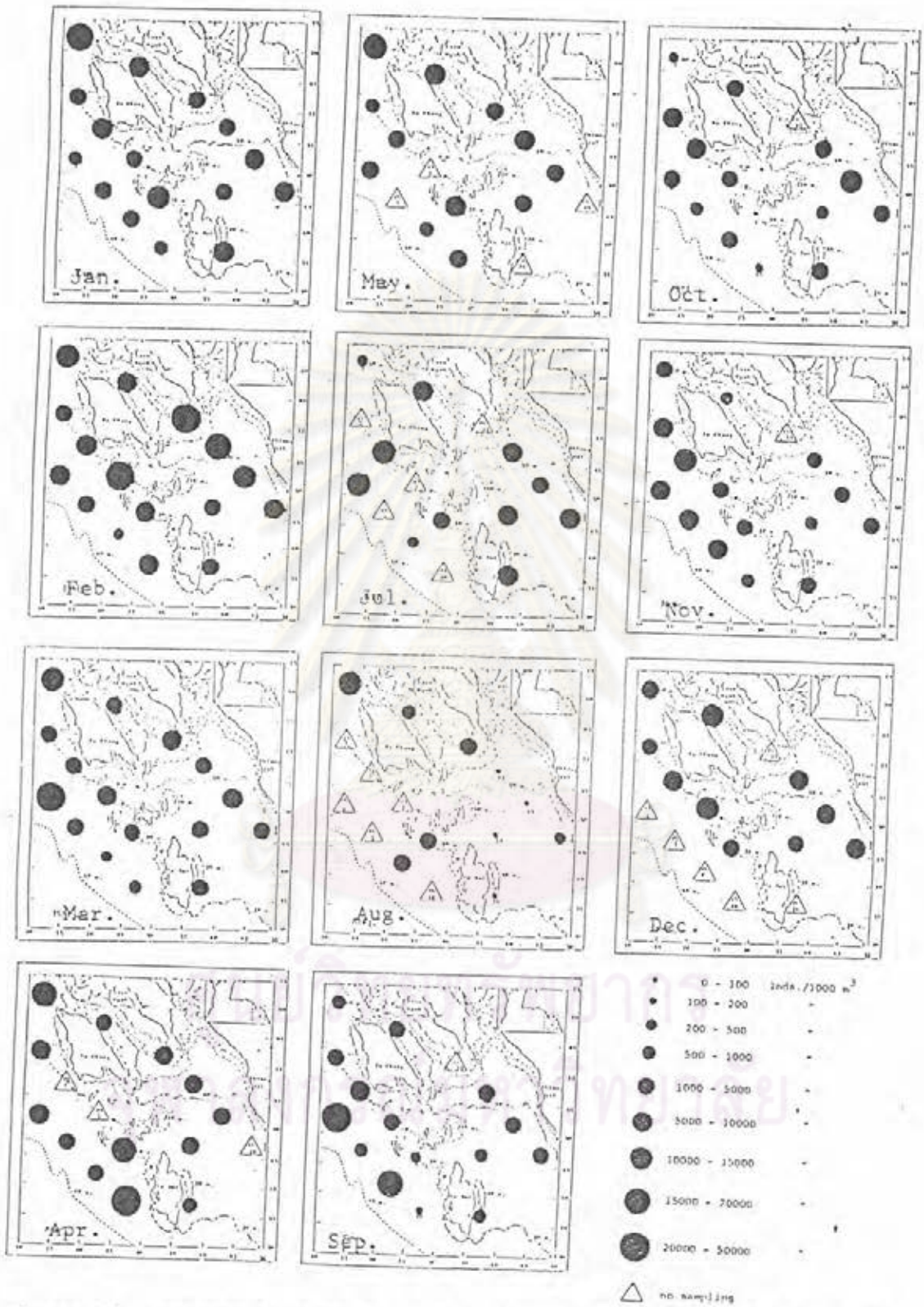

Figure 49 Distribution of the total larval fishes around the Chang Islands in 1987

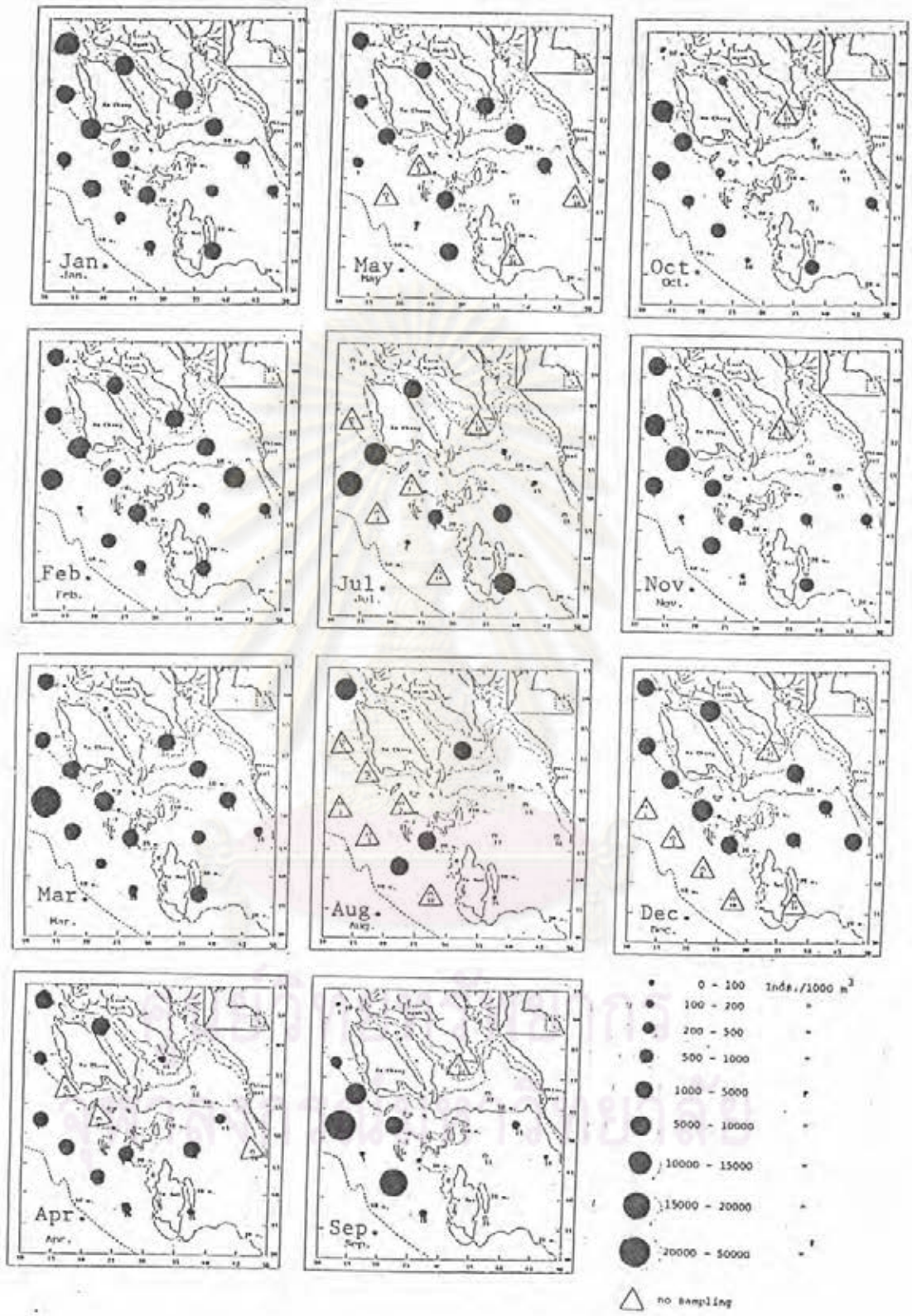

Figure 50 Distribution of fish eggs around the Chang Island in 1987.

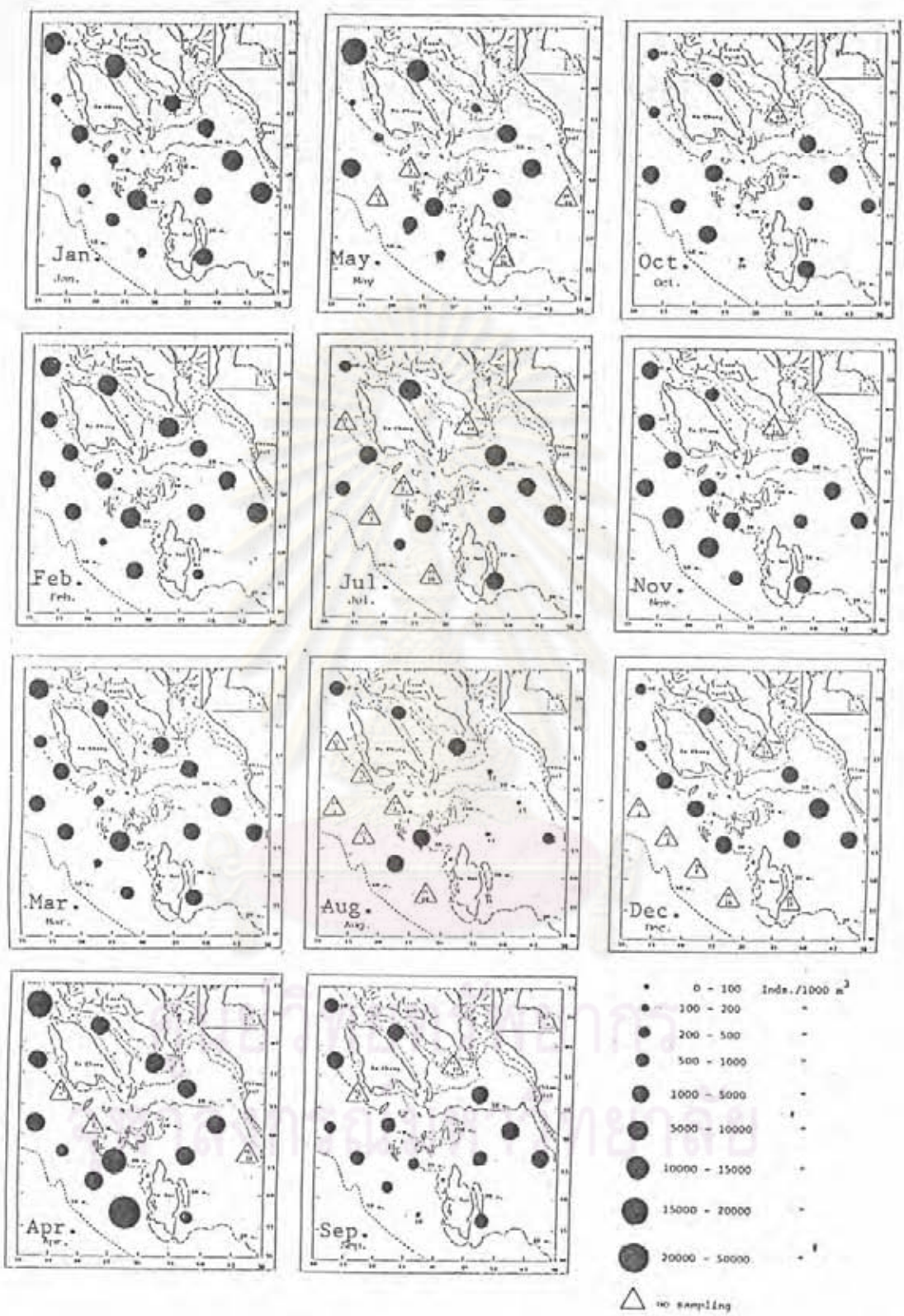

Figure 51 Distribution of fish larvae around the Chang Islands in 1987.

3.1 Family Gobiidae

The gobiid larvae were widely distributed almost all year round the inner and outer regions except in the inner zone in August (Figure 52).

3.2 Family Engraulidae

The engraulid larvae were widely distributed during the NE-monsoon period. The less distribution occurred in both inner and outer stations in August (Figure 53).

3.3 Family Bregmacerotidae

The bregmacerotid larvae of the outer and inner zones were distinctively wide distributed in the NE-monsoon period and less distributed during the SW-monsoon to the second intermonsoon period (Figure 54).

3.4 Family Leiognathidae

The leiognathid larvae were widely distributed in the NE-monsoon to May in the inner zone rather than the outer. The less distribution was present in August, September and October (Figure 55).

3.5 Family Nemipteridae

Larvae of the Nemipteridae were also widely distributed in both regions all the year, but less distribution was found in the inner zone during November to December (Figure 56).

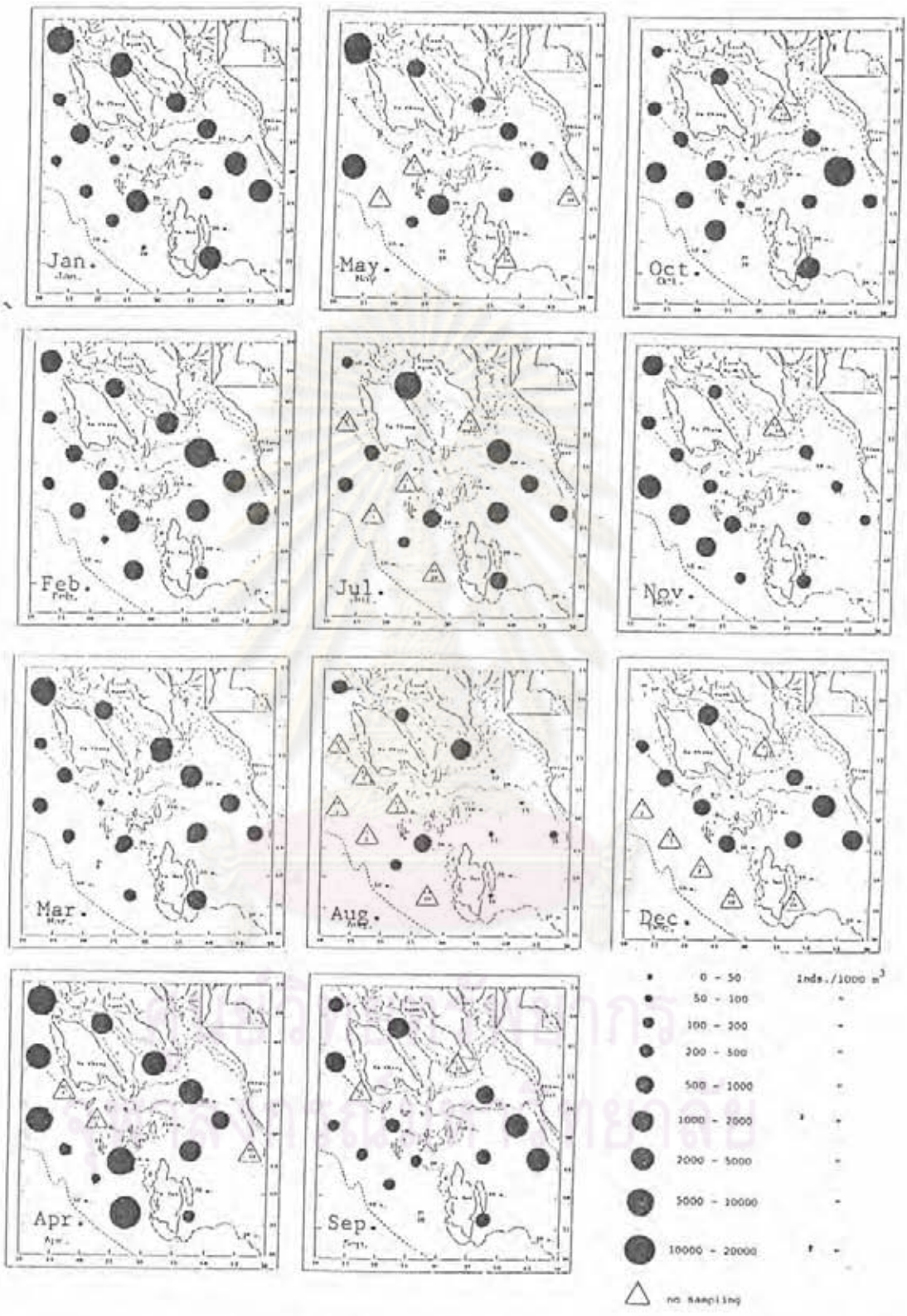

Figure 52 Distribution of the Gobiidae around the Chang Islands in 1987.

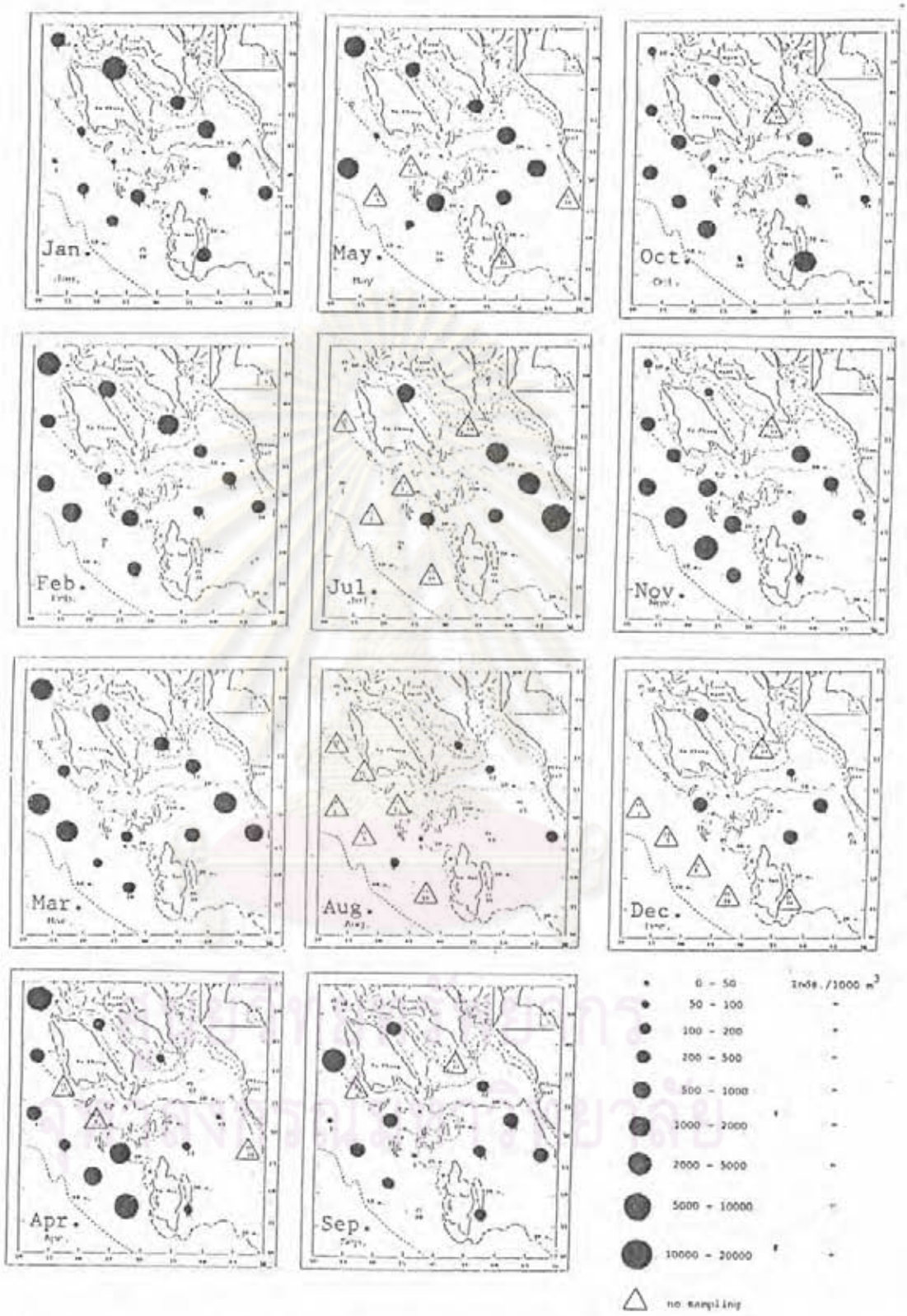

Figure 53 Distribution of the Engraulidae around the Chang Islands in 1987.

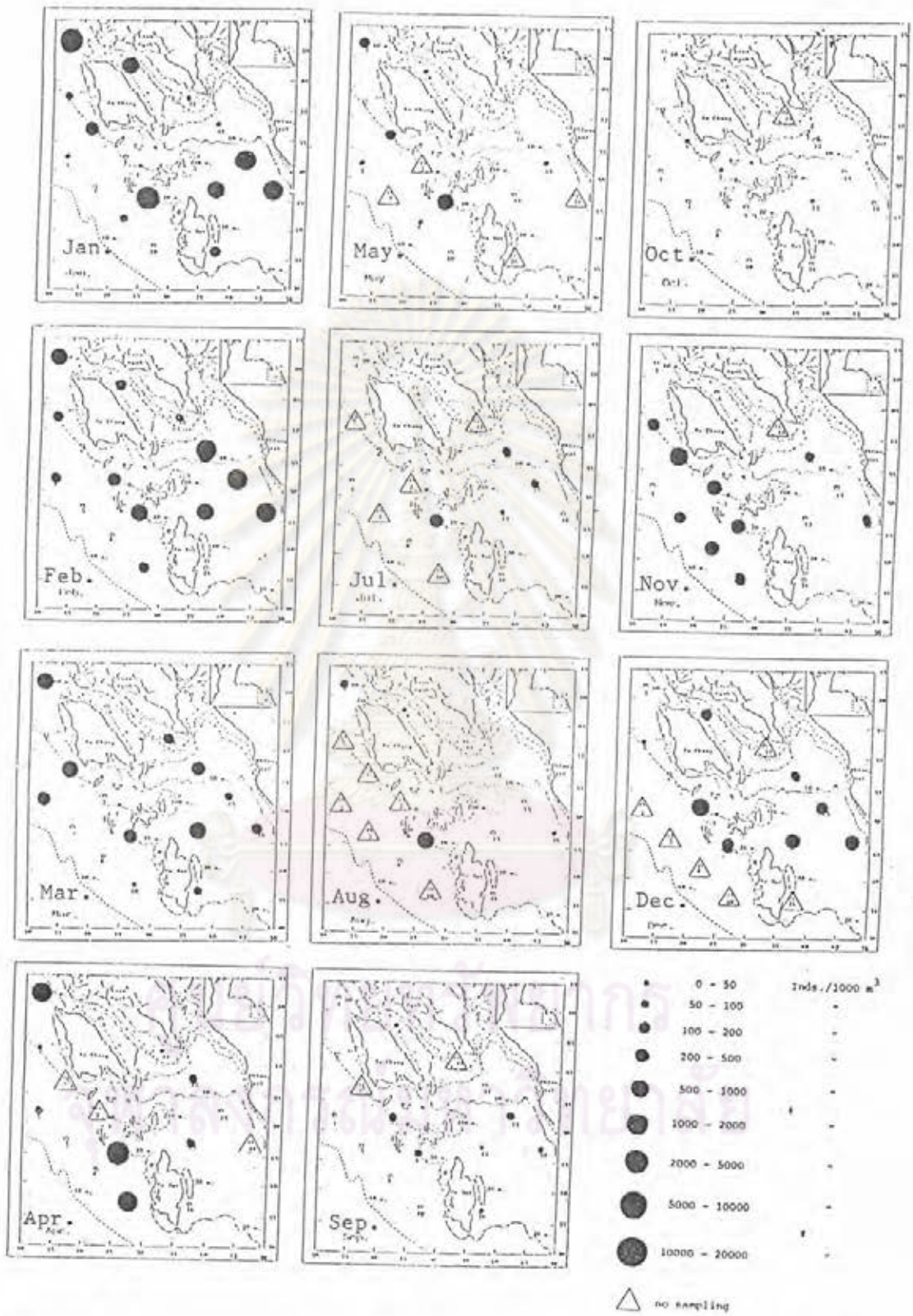

Figure 54 Distribution of the Bregmacerotidae around the Chang Islands in 1987.

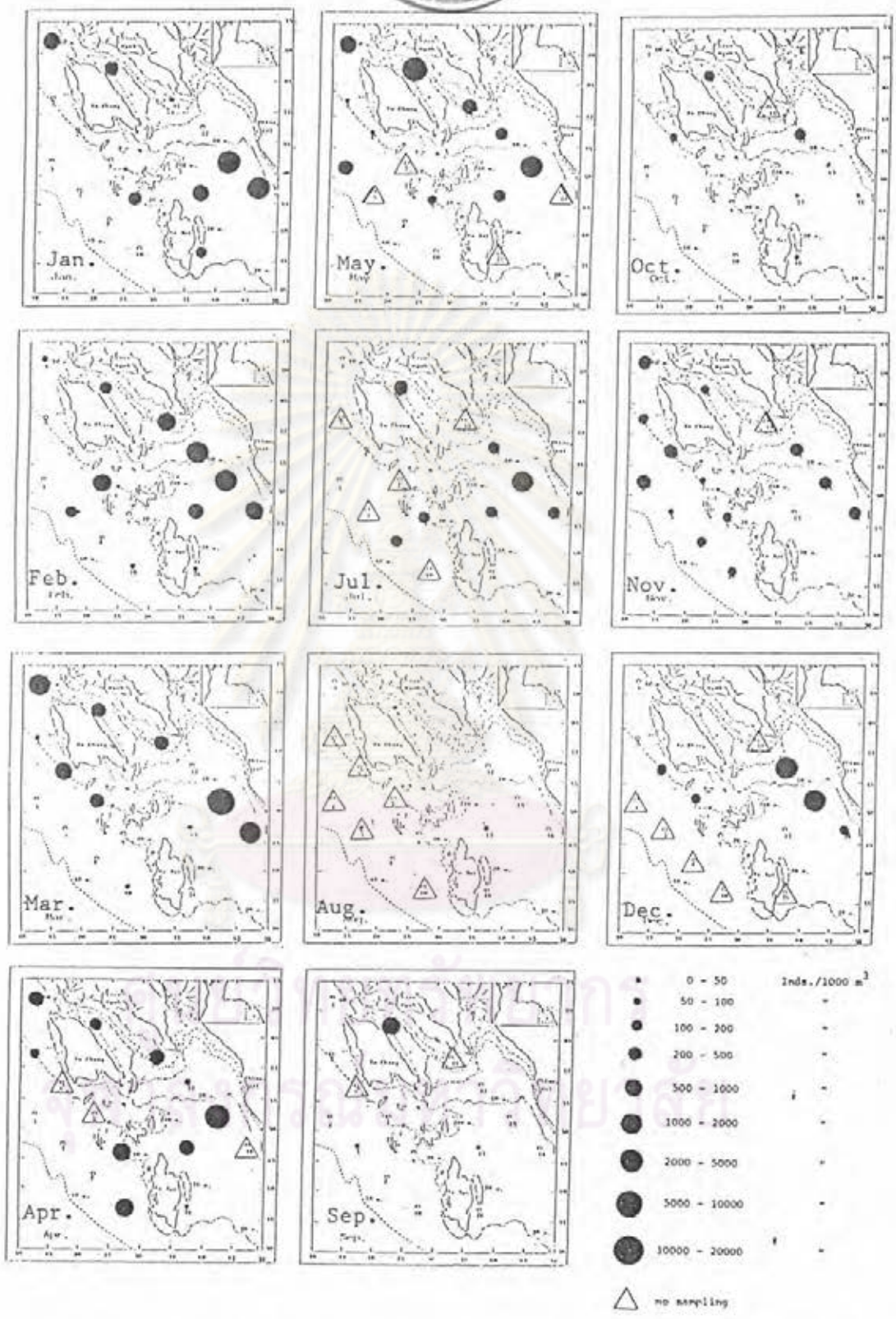

Figure 55 Distribution of the Leiognathidae around the Chang Islands in 1987.

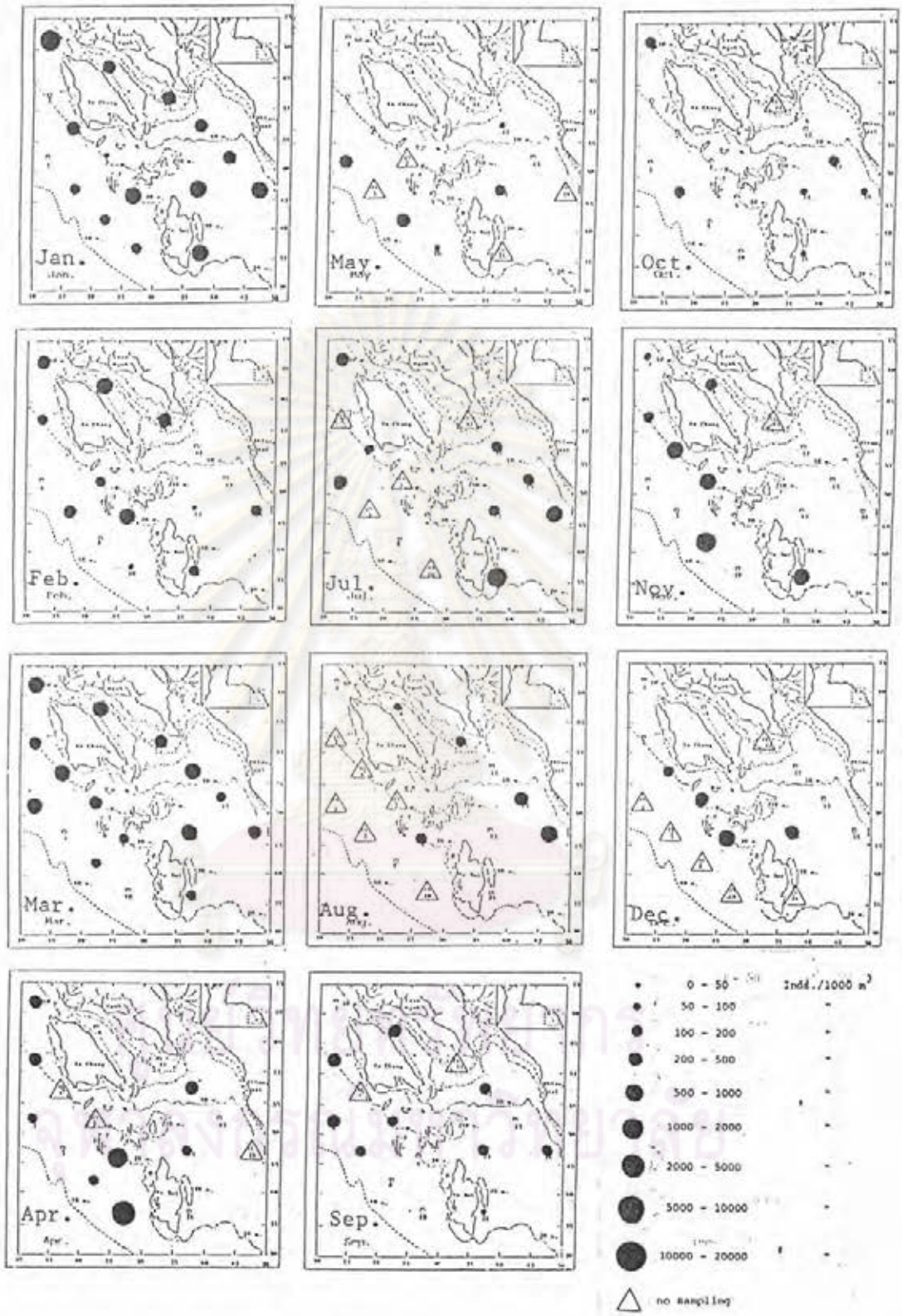

Figure 56 Distribution of the Nemipteridae around the Chang Islands in 1987.

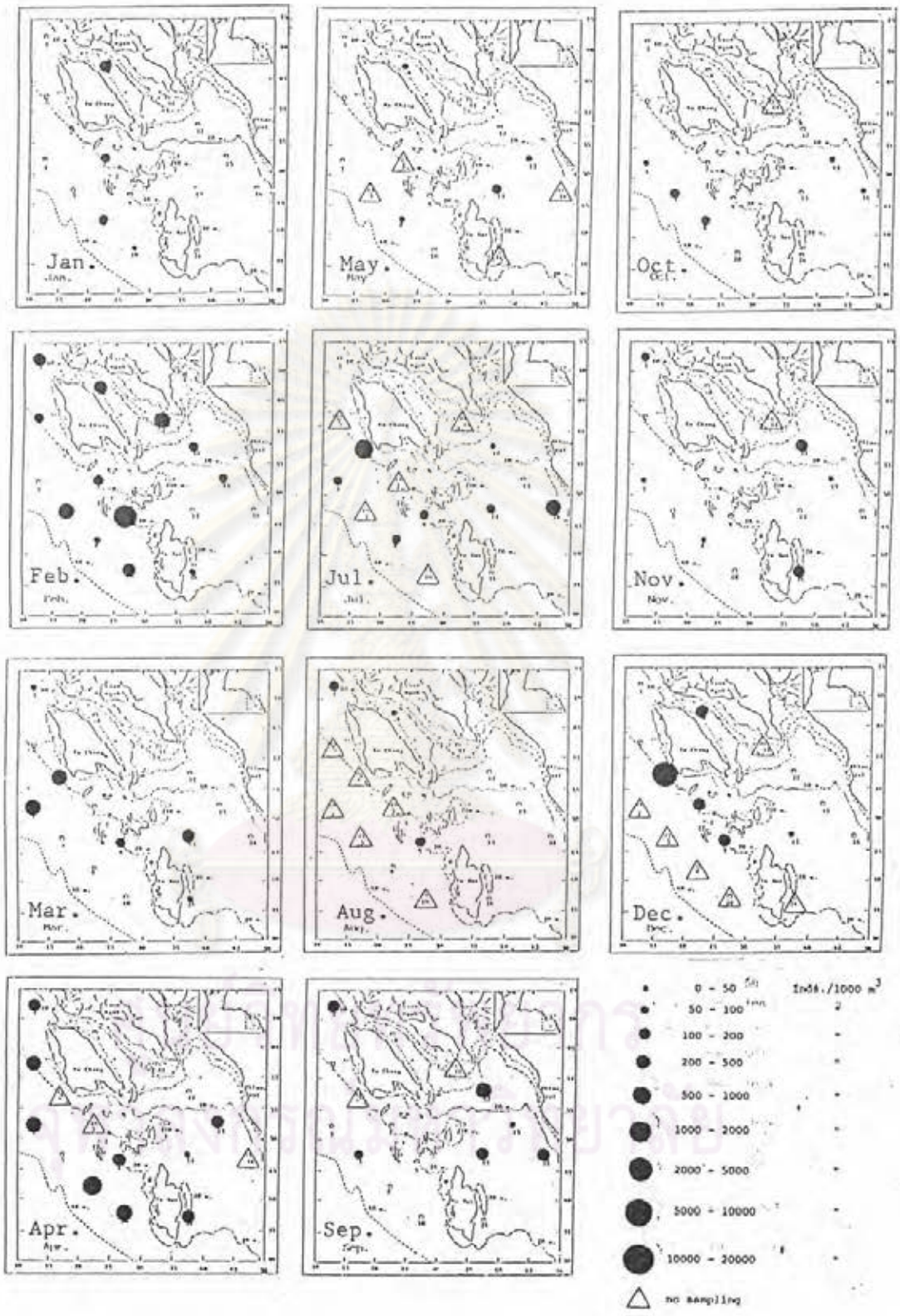

Figure 57 Distribution of the Clupeidae around the Chang Islands in 1987.

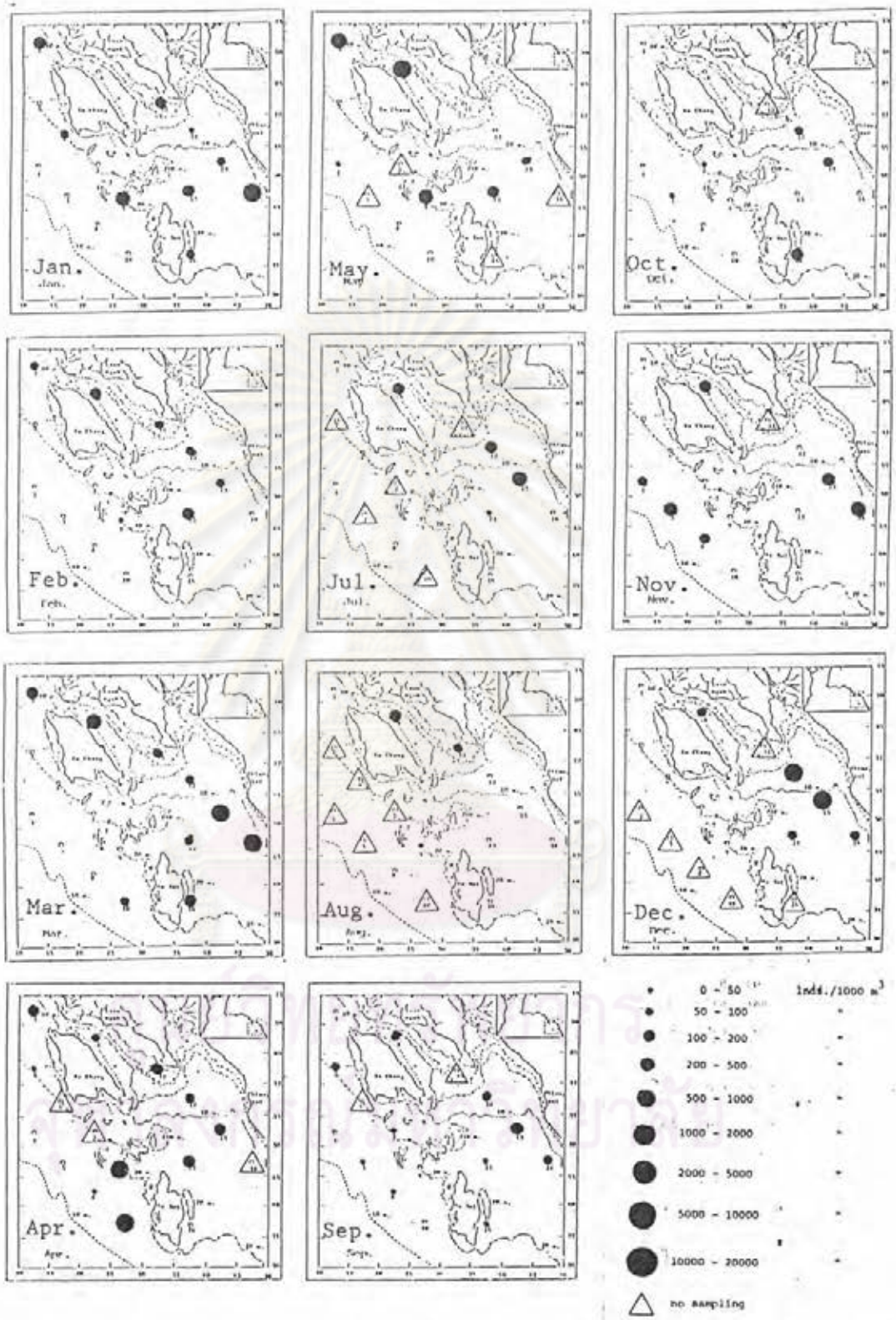

Figure 58 Distribution of the Callionymidae around the Chang Islands in 1987.

3.6 Family Clupeidae

The clupeid larvae were highly distributed in the outer zone than the inner. The distribution was higher in both areas in February and April than other months (Figure 57).

3.7 Family Callionymidae

The Callionymid larvae were more widely distributed in the inner zone throughout the year, but the less distribution was also found in August (Figure 58).

Environmental Factors

Temperature

The surface temperature ranged from 28.5-32.3°C. with the total mean of 30.12°C. It increased in April (31.33 °C), May (30.12° C.) and September (31.64° C.), but dropped in December (28.64 °C). The means surface temperature of inner and outer zones were 30.11 °C. and 30.19°C., respectively (Table 20, Figures 59 and 60).

Salinity

The surface salinity ranged from 25.5-32.2 ppt with the total mean of 30.84 ppt. It increased during the NE-monsoon period unto July (30.72-32.28 ppt) , but decreased during August - October (28.59-29.01 ppt). The means surface salinity of inner and outer zones were 30.79 and 30.98 ppt, respectively (Table 21, Figures 59 and 60).

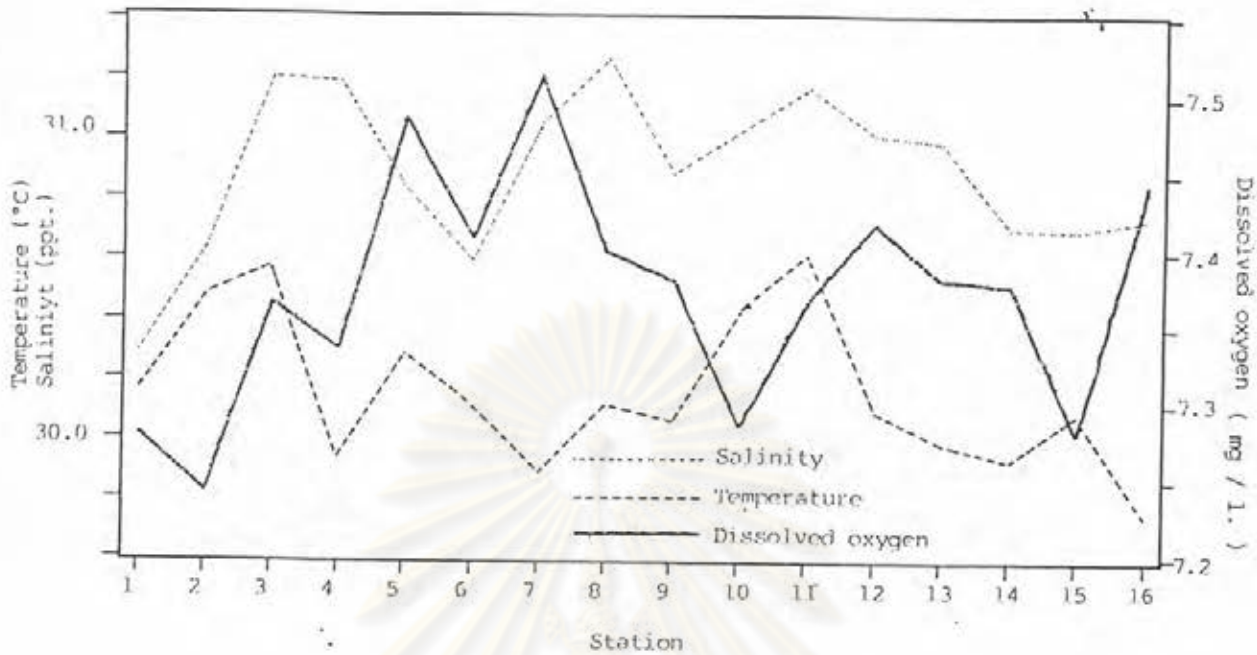

Figure 59 Fluctuation of the mean temperature, salinity and dissolved oxygen in each station around the Chang Islands in 1987.

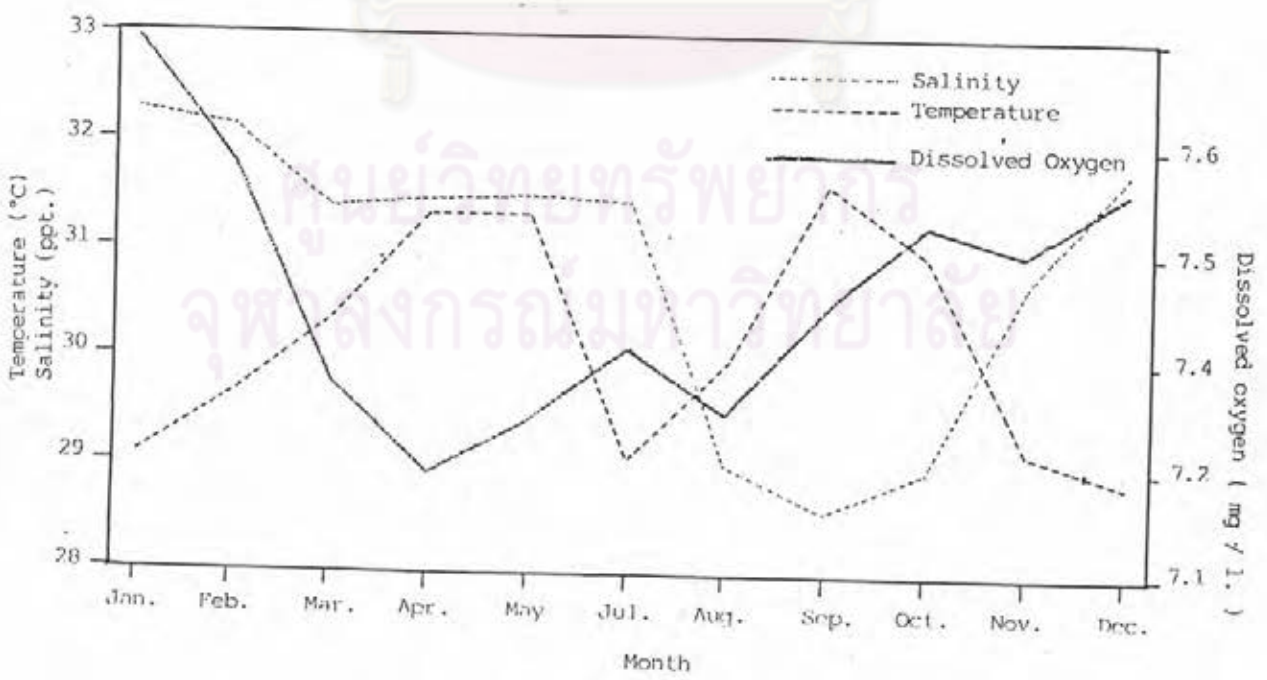

Figure 60 Fluctuation of the mean temperature, salinity and dissolved oxygen in each month around the Chang Islands in 1987.

Table 20 Recordof the temperature (°C) from the Chang Islands in 1987.

Station / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	mean
January	28.8	29.0	29.3	29.2	29.0	28.7	29.0	29.3	29.2	29.7	29.5	28.9	29.0	29.1	28.8	29.0	29.09
Febuary	29.2	30.1	30.5	29.4	30.5	30.0	28.8	29.0	29.1	29.7	29.9	29.2	30.0	30.0	29.3	29.6	29.64
March	30.6	31.0	30.8	30.6	29.8	30.2	30.0	29.8	30.7	30.5	30.5	30.0	30.3	30.4	30.2	30.0	30.33
April	31.1	31.5	30.5	- *	30.6	31.4	- *	31.0	30.9	30.7	32.0	31.5	32.3	31.8	32.0	- *	31.33
May	31.7	31.5	31.5	31.2	- *	31.8	- *	30.9	31.0	31.7	31.3	31.2	30.8	- *	31.5	- *	31.34
July	29.3	- *	29.1	29.2	- *	28.8	- *	29.0	29.0	- *	- *	29.2	28.2	28.7	29.8	29.5	29.07
August	29.5	- *	- *	- *	- *	29.9	- *	30.0	30.2	- *	30.5	29.7	29.7	30.0	30.0	30.0	29.95
September	31.4	31.7	32.0	- *	32.3	31.6	31.7	32.0	31.9	31.7	- *	31.5	31.5	30.8	31.4	31.5	31.64
October	31.5	31.2	32.0	32.0	30.8	31.5	31.7	30.5	30.6	30.0	- *	31.3	30.7	30.0	30.2	30.5	30.96
November	29.7	29.8	29.5	28.7	29.0	28.8	28.8	29.7	29.5	29.4	- *	29.6	28.7	28.6	28.5	29.0	29.15
December	29.0	28.5	- *	29.2	- *	28.5	29.2	- *	28.6	- *	- *	29.0	28.7	- *	29.2	28.7	28.86

* no sampling because of the monsoon

Table 21 Record of the salinity (ppt.) from the Chang Island in 1987.

Station / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	mean
January	33.0	33.2	32.0	32.1	32.0	33.0	32.2	32.0	32.0	32.3	32.0	32.2	32.0	32.0	32.4	32.0	32.27
February	32.0	32.2	33.0	32.5	32.0	31.8	32.7	32.5	32.3	32.4	31.2	31.4	32.2	31.8	32.0	32.0	32.12
March	30.5	30.8	31.0	31.2	30.5	32.0	32.0	31.7	31.6	31.8	32.2	32.0	31.8	30.9	31.0	31.2	31.38
April	31.5	31.6	31.5	- *	30.7	31.4	- *	31.2	31.5	31.6	31.5	31.5	31.5	32.0	31.5	- *	31.46
May	31.3	31.2	31.5	31.5	- *	32.0	- *	32.0	32.2	30.8	31.4	31.7	31.2	- *	31.2	- *	31.50
July	31.7	- *	31.3	31.5	- *	31.0	- *	31.8	30.8	- *	- *	31.7	31.5	31.5	31.5	31.8	31.46
August	28.7	- *	- *	- *	- *	28.8	- *	30.0	28.5	- *	28.7	29.2	29.2	28.7	28.3	30.0	29.01
September	24.5	25.3	30.0	- *	29.7	25.5	29.3	30.0	29.0	31.0	- *	29.0	30.0	30.0	28.3	28.7	28.59
October	27.5	29.2	30.0	29.7	30.0	28.8	29.2	30.2	28.7	27.5	- *	29.7	28.5	28.5	28.8	28.5	28.98
November	30.7	30.0	30.5	30.2	31.0	30.6	30.7	31.2	31.2	30.8	- *	30.8	31.0	31.0	30.5	30.7	30.72
December	31.8	32.2	- *	30.8	- *	31.7	31.2	- *	32.0	- *	- *	32.0	32.0	- *	32.2	31.8	31.77

* no sampling because of the monsoon

Table 22 Record of the dissolved oxygen (mg/l.) from the Chang Islands in 1987.

Station / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	mean
January	7.6	7.4	7.7	7.7	7.5	7.5	7.6	7.7	7.7	7.2	7.5	7.7	7.9	7.7	7.5	7.6	7.59
February	7.4	7.2	7.5	7.4	7.5	7.4	7.6	7.7	7.5	7.6	7.5	7.5	7.5	7.3	7.6	7.5	7.48
March	7.0	7.3	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.2	7.2	7.7	7.2	7.0	7.2	7.2	7.27
April	7.2	7.2	7.3	- *	7.3	7.2	-*	7.2	7.3	7.2	7.2	7.2	7.2	7.0	7.0	-*	7.19
May	7.3	7.2	7.2	7.3	- *	7.3	-*	7.2	7.2	7.2	7.3	7.2	7.5	- *	7.0	-*	7.24
July	7.3	- *	7.2	7.4	- *	7.2	-*	7.3	7.3	- *	- *	7.2	7.4	7.5	7.3	7.3	7.30
August	7.2	- *	- *	- *	- *	7.2	-*	7.2	7.2	- *	7.5	7.2	7.3	7.2	7.3	7.2	7.25
September	7.4	7.2	7.3	- *	7.5	7.5	7.3	7.5	7.4	7.2	- *	7.3	7.2	7.5	7.3	7.3	7.35
October	7.2	7.2	7.5	7.3	7.5	7.7	7.7	7.6	7.2	7.2	- *	7.4	7.5	7.5	7.2	7.7	7.42
November	7.2	7.2	7.2	7.2	7.7	7.7	7.5	7.3	7.4	7.5	- *	7.5	7.2	7.7	7.2	7.5	7.40
December	7.3	7.3	- *	7.0	- *	7.5	7.6	- *	7.7	- *	- *	7.7	7.3	- *	7.5	7.7	7.46

*

no sampling because of the monsoon

Dissolved Oxygen

The surface dissolved oxygen ranged from 7.0-7.9 mg/l with the total mean of 7.36 mg/l. It increased during the NE-monsoon period from October to February (7.40-7.59 mg/l) and slightly decreased during March to September (7.19-7.35 mg/l). The means dissolved oxygen of inner and outer zones were 7.37 mg/l equally (Table 22, Figures 59,60).

Correlation of the Larvae and the Environment

The test at 0.05 significant level of the linear correlation coefficients indicated that the salinity was the main factor affecting the abundance of fish larvae in the inner zone of the Chang Islands; e.g. the total larvae (r=0.328), total larval fishes (r=0.402), the larvae of the Family Engraulidae (r=0.268), Bregmacerotidae (r=0.385), Leiognathidae (r=0.276), Nemipteridae (r=0.326) and Callionymidae (r=0.281). Larvae of the Family Bregmacerotidae of the inner zone also expressed the relationship to the temperature (r=0.278) and dissolved oxygen (r=0.255). On the other hand, the fish larvae of the outer zone as well as the fish eggs, gobiid larvae and clupeid larvae of the inner zone showed no significant relationship to the temperature, salinity and dissolved oxygen (Appendix III).