



Chapter 2

Materials and Methods

Study Area

The survey on fish larvae was carried out around the Chang Islands, in Trat Province, $11^{\circ} 35' - 12^{\circ} 15'$ N. latitude and $102^{\circ} 10' - 102^{\circ} 50'$ E. longitude. The area covering 650 km^2 was divided into 16 stations and 2 zones, the inner and the outer (Figure 2).

1. The inner zone was composed of 7 stations; the stations number 1, 6, 11, 12, 13, 15 and 16, which located nearshore between the Islands and the coastal line, adjacent to Trat Bay and the mangrove areas. It had the mean water depth less than 20 m.

2. The outer zone was composed of 9 stations; the stations number 2, 3, 4, 5, 7, 8, 9, 10 and 14, which located far off the Islands. It was exposed directly to the open sea. The mean water depth was more than 20 m.

Sampling Schedule

Samplings of the fish larvae were monthly taken in the night time (06.00-12.00 p.m.) during January - December 1987 including 11 cruises and 148 hauls (Table 2), which covered all of the monsoon seasons :-

November - February	: Northeast monsoon (NE-monsoon)
March - April	: First intermonsoon (NE-SW)
May - August	: Southwest monsoon (SW-monsoon)
September -October	: Second intermonsoon (SW-NE)

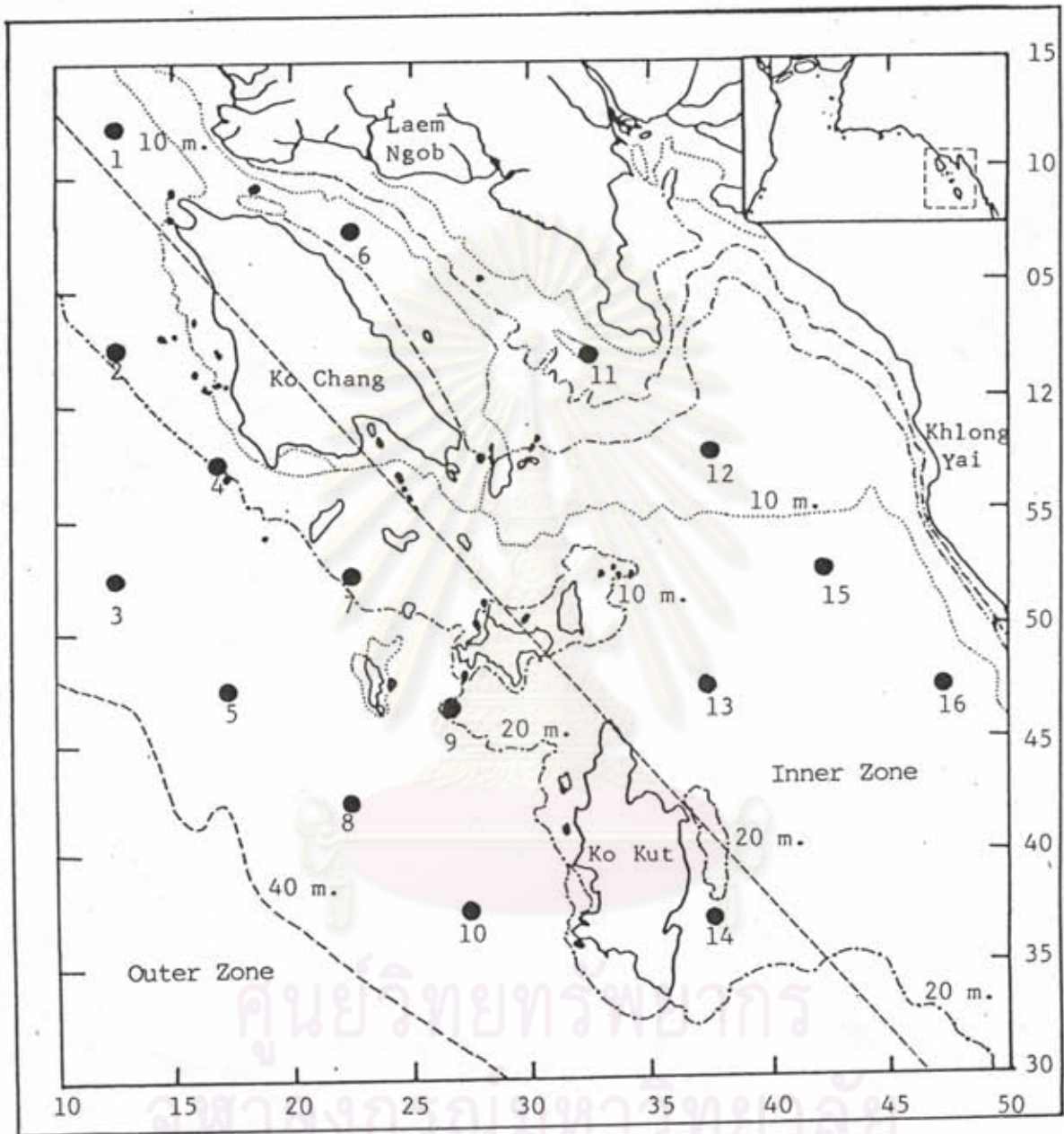


Figure 2 The sampling stations of fish larva survey around the Chang Islands in 1987.

Table 2 Sampling date of fish eggs and larvae around the Chang Islands by the R.V. Pramong Talay 15 in 1987.

Station	Position		Depth (m)	Cruise											Total sampling
	Lat.	Long.		1	2	3	4	5	6	7	8	9	10	11	
1	12-12.5 N	102-12.5 E	18	12-1-87	13-1-87	9-3-87	14-4-87	18-5-87	20-7-87	10-8-87	21-9-87	15-11-87	25-11-87	21-12-87	11
2	12- 2.5 N	102-12.5 E	20	13-1-87	13-1-87	10-3-87	14-4-87	19-5-87	- *	- *	21-9-87	15-10-87	25-11-87	22-12-87	9
3	11-52.5 N	102-12.5 E	34	13-1-87	12-1-87	10-3-87	14-4-87	19.5-87	20-7-87	- *	21-9-87	16-10-87	25-11-87	- *	9
4	11-57.5 N	102-12.5 E	20	13-1-87	13-1-87	10-3-87	- *	19-5-87	20-7-87	- *	- *	15-10-87	25-11-87	24-12-87	8
5	11-47.5 N	102-12.5 E	34	13-1-87	12-1-87	11-3-87	15-4-87	- *	- *	- *	22-9-87	16-10-87	26-11-87	- *	7
6	12- 2.5 N	102-11.5 E	8	16-1-87	9-1-87	13-3-87	17-4-87	18.5-87	24-7-87	10-8-87	25-9-87	19-10-87	29-11-87	22-12-87	11
7	11-52.5 N	102-22.5 E	16	14-1-87	12-1-87	11-3-87	- *	- *	- *	- *	22.9-87	16-10-87	26-11-87	24-12-87	7
8	11-42.5 N	102-22.5 E	35	13-1-87	12-1-87	11-3-87	15-4-87	20-5-87	22-7-87	11-8-87	22-9-87	16-10-87	26-11-87	- *	10
9	11-47.5 N	102-27.5 E	20	14-1-87	11-1-87	11-3-87	15-4-87	20-5-87	22-7-87	11-8-87	23-9-87	17-10-87	27-11-87	23-12-87	11
10	11-37.5 N	102-27.5 E	30	14-1-87	11-1-87	11-3-87	15-4-87	20-5-87	- *	- *	23-9-87	17-10-87	26-11-87	- *	8
11	12- 2.5 N	102-32.5 E	10	16-1-87	9-1-87	13-3-87	17-4-87	22-5-87	- *	10-8-87	- *	- *	- *	- *	6
12	11-56.5 N	102-37.5 E	8	17-1-87	10-1-87	13-3-87	17-4-87	22-5-87	24-7-87	13-8-87	24-9-87	18-10-87	28-11-87	13-12-87	11
13	11-47.5 N	102-37.5 E	18	15-1-87	11-1-87	12-3-87	16-4-87	21-5-87	22-7-87	11-8-87	23-9-87	17-10-87	27-11-87	23-12-87	11
14	11-37.5 N	102-37.5 E	17	15-1-87	11-1-87	12-3-87	16-4-87	- *	23-7-87	12-8-87	23-9-87	17-10-87	28-11-87	- *	9
15	11-52.5 N	102-42.5 E	12	15.1-87	10-1-87	12-3-87	16-4-87	21-5-87	23-7-87	12-8-87	24-9-87	18-10-87	28-11-87	22-12-87	11
16	11-47.5 N	102-47.5 E	13	16-1-87	10-1-87	12-3-87	- *	- *	23-7-87	12-8-87	24-9-87	18-10-87	28-11-87	22-12-87	9
Total sampling				16	16	16	13	12	11	10	14	15	15	10	148

* no sampling because of the monsoon

Sampling Methods

Fish larvae

The samples were obtained by R/V Pramong Talay 15 which was belonging to the Eastern Marine Fisheries Development Center, Department of Fisheries, Thailand. The zooplankton net used in sampling was a ring net with the mesh size of 330 microns and 45 cm. in mouth part diameter, where the weight of 4 kg. sinker was attached to the joint of the trawling line. There was a flow-meter attached at the center of the mouth part. The horizontal trawls at surface level were operated at speed of 1.5 knots. Each haul took approximately 5 minutes. All samples were kept in 4 - 10 % sea-water formalin. After sorting out, however, the fish larvae were preserved in 4 % neutralized formalin solution.

Environmental Factors

Environmental parameters were measured at the same time of larval samplings. The 5-litre Van Dorn bottle was used for water sampling at 1 m. under surface. Temperature and dissolved oxygen were measured by a HORIBA Water Checker Model U-7 and salinity by a hand refractometer of ATAGO Model ATC-1.

Fish Larval Density

Fish eggs and larvae were sorted out of the plankton samples. The total number of eggs and larvae

were observed under the zoom stereomicroscope, then the amount of both eggs and larvae were estimated to numbers in 1000 m³ sea water by the following equation.

$$T = 1000 \times t/V$$

When $T =$ number in 1000 m³

$t =$ number of the samples

$V =$ volume of water passed through the plankton net

$$V = n \times M \times a \quad \text{or} \quad V = a \times n/N$$

$n =$ revolution number recorded by the current meter

$a =$ surface area of the net opening (m²)

$N =$ constant of the revolution number per 1 meter distance

$M =$ constant of displacement (m) per 1 revolution

notes : N and M were calibrated in each cruise

Identification

Documents of Delsman (1921-1938), Uchida (1958), Mito (1960-1967), Leis and Rennis (1983), Fahay (1983), Vatanachai (1972, 1975), Miller et al. (1979), Nozawa (1986), Okiyama (1988) were mainly used for identifying the larval fishes. The fish eggs were only counted, not identified. The yolk-sac larvae, the fractured larvae and the unidentified larvae were incorporated to the unknown group.

Identification of all larval fishes was mostly at Family level. However, some of them were identified to genus or species level. The characteristics including body shape, myomeres, stricted characters, and positions

of pigmentation in each Family were described and illustrated by the camera lucida. The order of fish larva descriptions was reliable on the evolutionary trend proposed by Jordan (1968) and Munro (1969).

Analysis

Occurrence of the fish larvae in term of relative abundance and geographic distribution was analysed by mapping techniques.

One way classification of the analysis of variance was used for the test of the different means of abundance in both spatial and seasonal associations. The F-values which obtained by calculation were compared to the F-values in the table at the 0.05 significant level (Appendix I, II).

The linear correlation coefficients between abundance of fish larvae and the environmental factors were also calculated to check the relationship of fishes and the environmental factors. The calculated coefficients (r) were compared to the correlations coefficients at the 0.05 level of significance from the table (Appendix III).

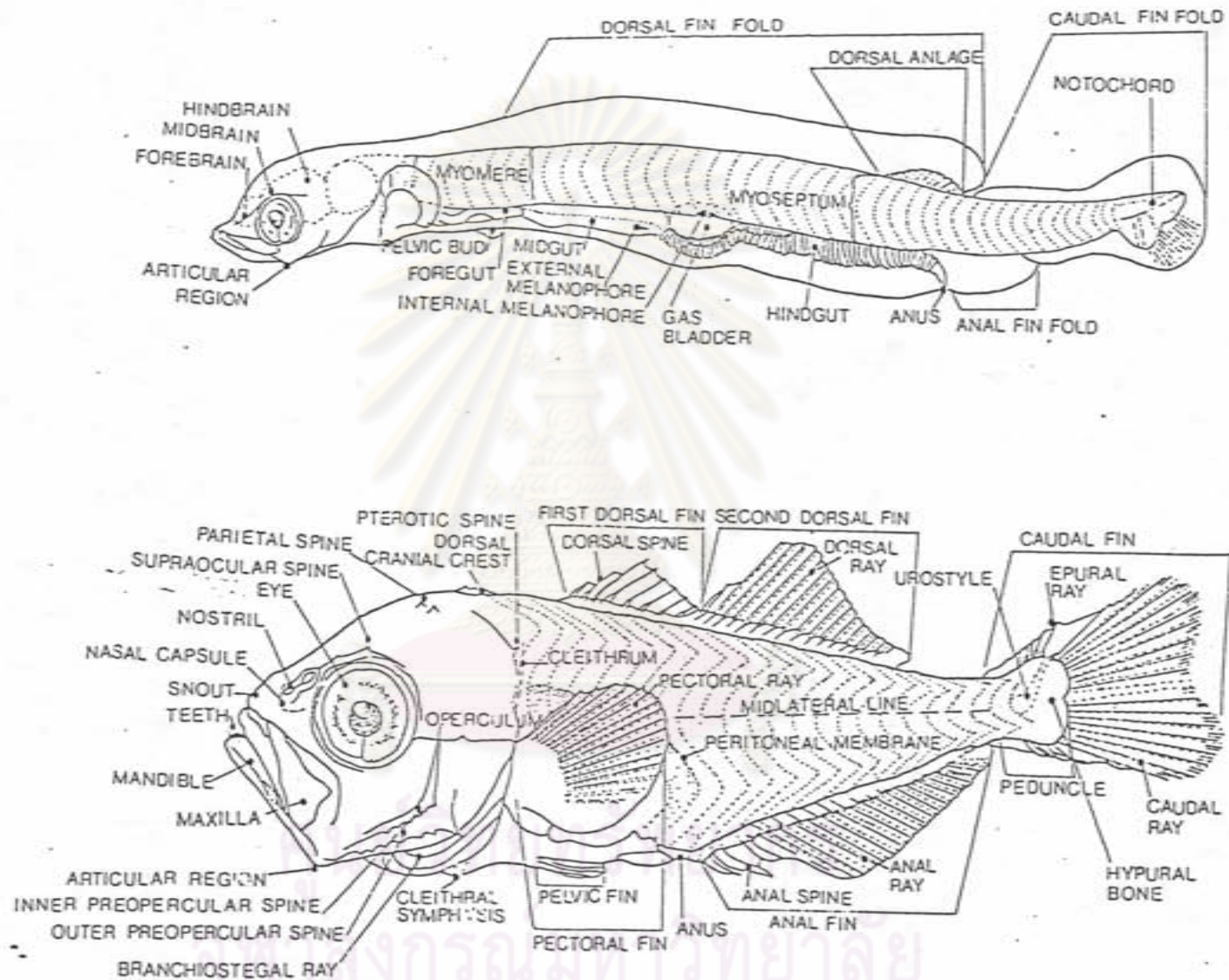


Figure 3 The major morphological characters found in larval fishes. (Source : Miller, et al., 1978)

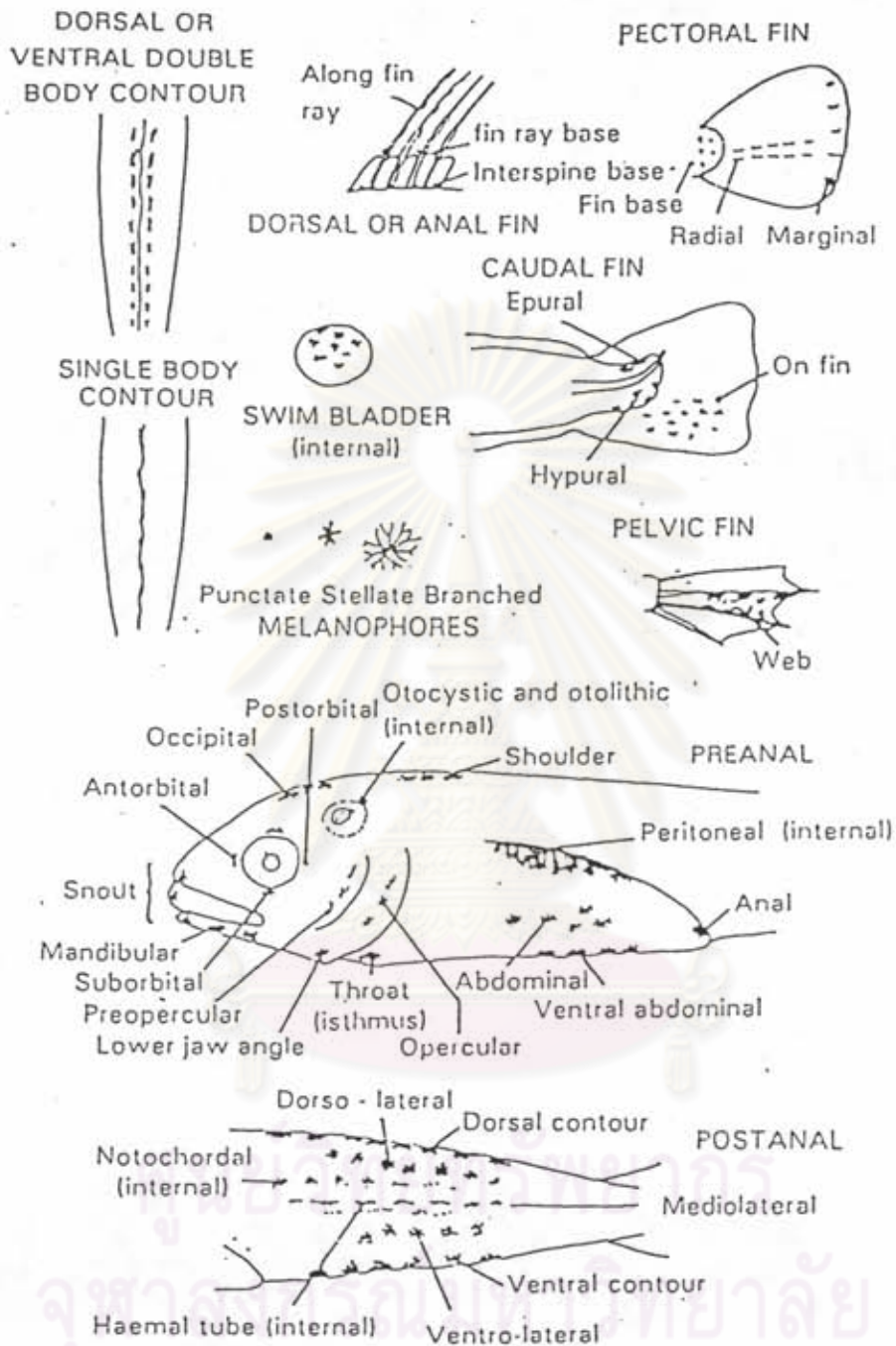


Figure 4 Characters of pigmentation on the larval fish body. (Source : Russel, 1976)

Terminology

(Figure 3)

Total length (TL) : The distance between the tip of snout and a vertical at the tip of the longest lobe of the caudal fin, as same as the term body length (BL) appeared in this paper.

Standard length (SL) : The distance between the tip of snout and the posterior end of the hypural bone.

Notochord length (NL) : The distance between the tip of snout and the posterior end of notochord tip.

Head length (HL) : The distance between the tip of snout and the posterior-most part of the opercular membrane, excluding spines.

Head depth (HD) : The transverse distance between margin at the widest area of the head, measured at the posterior end of the eye cup.

Body depth (BD) : The vertical distance between body margins at the pectoral fin base.

Snout length : The distance between the tip of snout and the anterior margin of the eye cup.

Snout to anal length : The distance between the tip of snout along the mid lateral line and a vertical line through the posterior edge of anus.

Dorsal fin : The median, longitudinal, vertical fins located on the dorsal of the body.

Anal fin : The median fin, immediately behind anus.

- Caudal fin** : The median horizontal fin located at the tail (Tail fin).
- Pectoral fins** : Paired fins behind head, articulating with pectoral girdle.
- Pectoral fin bud** : Swelling at site of future pectoral fin; anlage of pectoral fin.
- Pelvic fins** : Paired fins articulating with pelvic girdle (Ventral fins).
- Pelvic fin bud** : Swelling at site of future pelvic fins; anlage of pelvic fin.
- Fin fold** : Median fold of integument which extends along body of developing fishes and from which median fin arise.
- Fin base** : The base of the fin supporter (spines and rays), the appearance is clear before the fin element has formed.
- Fin let** : Paired fin ray which separated from the posterior end of the dorsal and anal fin ray.
- Spines** : Unpaired, unsegmented and unbranched fin supports.
- Rays** : Bilaterally paired, usually segmented fin supports.
- Branchiostegal rays** : A part of supports bone inserting on the hyoid arch and supporting, in a fanwise fasion.
- Caudal peduncle** : Area lying between posterior end of dorsal and anal fin rays.
- Hypural bones** : Expanded, fused, haemal spines of last few vertebrae which support caudal fin.

- Dorsal cranial crest : The bony crest on the dorsal of the cranium over the supraoccipital.
- Supraocular spines : Strong bone spine on the dorsal of the eye cup.
- Pterotic spines : Strong spines on the dorso-posterior end of the cranium.
- Inner preopercular spines : The inner row of the spines along the margin of the preopercle.
- Outer preopercular spines : The outer row of the spines along the margin of the preopercle.
- Peritoneal membrane : The membrane lining on the abdominal cavity.
- Nasal opening : The opening in front of the eye which develop to the nostril.
- Snout : The anterior most part of the head.
- Maxilla : The dorsal most of the two bones in the upper jaw.
- Mandible : Lower jaw, comprised of three bones.
- Urostyle : Terminal vertebrate element in higher teleosts.
- Mid lateral line : Series of sensory pore and/or tubes extending backward from head along the middle of the lateral side.