Southeast Asian Fisheries Development Center

Composition, Abundance and Distribution of Fish Eggs and Larvae in the South China Sea, Area IV: Vietnamese Waters

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ABSTRACT

This report is based on the data of fish eggs and larvae samples which were collected at the 58 stations of the Vietnamese waters, it covered from latitude 7^0 - 21^0 N and longitude 103^0 - 112^0 E. The cruise was carried out from April 30 to May 29, 1999 by M/V SEAFDEC. The Standard larvae net and Bongo net were used for the surface and oblique sampling respectively and 14,507 fish eggs and 18,919 fish larvae were caught. The specimens have been identified, which comprise of 78 families, 94 genera, 94 species of fish eggs and larvae observed from this cruise. The most abundant fish eggs and larvae during the survey were *Engraulidae*, accounted for 8.5% total of eggs and 23.8% total of larvae. The species composition was observed to be very abundant. In each station, at least 6 families and the highest 30 families were collected during the survey. The abundance of ichthyoplankton is rather relatively high, the distribution occurred mainly in the areas of along the coastal, near estuaries and around the islands. The abundance of fish eggs concentrated higher than fish larvae. The density of distribution of fish eggs and larvae in the North sea waters concentrated the most abundant of all and of the Central sea waters was the least abundant of all. Some of families of which fish eggs and larvae have dominated which were presented.

Key words: Ichthyoplankton, Southern China Sea, Tonkin Gulf

Introduction

Studying on fish eggs and larvae (FE - FL) is to identify spawning period and ground of fishes, especially the economical fish species, to serve for fisheries. Simultaneously, study on the growth grounds of concentration and the periods of occurrence of FL that is scientific basis for resources conservation and development of fry source for brackish water aquaculture in the coastal areas. On the other hand, the study materials on FE - FL have importantly contributed to the stock assessment of target fishes. Therefor, study on FE - FL has been carried out in many countries of the world such as Soviet Union, China, Japan, Indonesia, Philippines, India, etc.

In Vietnam, up to now the problem of study on FE - FL has been always mentioned in the program of generally marine research. Many documents have been published not only inside also outside and still the documents haven't been published yet.

The most significantly is the collaborative survey program in the Tonkin Gulf between Vietnam and China (1959 - 1965); and Vietnam - Soviet Union (1960 - 1961). The scientific documents have been published as: On spawning of *Scombridae* [Gorbunova, (1965)]; The FE - FL of *Beloniformes* [Kovalevskaja, (1965)]; Morphology and classification of Flatfishes larvae (*Pleuronectiformes)* [Pertzeva-Ostroumova, (1965)]; The FE - FL of *Synodontidae* and *Theraponidae* [Zviagina, (1965)]; Morphology of *Schindleria praematuna* species [Nguyen Huu Phung, (1971)]. The Institute of Marine Products under the Ministry of Fisheries:

- During 1962 - 1965, carried out the survey of FE - FL in the West coast of the Tonkin Gulf and the report of the survey the entitled: "The season and distribution of FE - FL", which was made by Nguyen Huu Phung, (1973).

- During 1974 - 1975, carried out the survey of FE - FL in the estuary area of Hai Phong rivers (4 surveys for 4 seasons) and the report was made by Do Van Nguyen, (1976).

- During 1975 - 1976, carried out the survey of FE - FL in the coastal waters from Mong Cai (Quang Ninh province) to Cua Sot (Ha Tinh province) (12 surveys for 12 months) and the report was made by Do Van Nguyen, (1977).

- During 1978 - 1980, carried out the program of general survey of study on FE- FL in the sea waters from Nghia Binh province to Minh Hai province (12 surveys cruises) and the report was made by Do Van Nguyen, (1981).

Nha Trang Institute of Oceanography, at present is under the National Center for Sciences and Technology:

- During 1971 - 1972, carried out the survey of FE - FL in the coastal areas of Quang Ninh - Hai Phong provinces (11 cruise surveys) and reports were made by Nguyen Manh Long, Nguyen Huu Phung, Dao Tat Kim, Nguyen Van Be (1977). The reports of taxonomic study on FE - FL of *Clupeiformes*, of *Salangidae*, of *Elopiformes*, of *Mene maculata*; of *Stolephorus*; and of *Synodontidae* were published by Nguyen Huu Phung (1973, 1974, 1976, 1978, 1980). The reports of morphology of *Bregmaceros atripinnis* Tickel, were published, by Dao Tat Kim (1974).

- During 1978 - 1980, carried out the surveys of FE - FL in the sea waters of Thuan Hai - Minh Hai provinces on R/V NCB No.03. The reports of these surveys were made by Nguyen Huu Phung, Hoang Phi, Bui The Phiet (1981) and the report of FE - FL in the estuary areas of the Mekong river was published in 1982. Hoang Phi with the report of the embryo development of *Synodontidae* in Nha Trang sea waters (1980). The reports of FE - FL of sea milk fish (*Chanos chanos* Forskal) living in Van Phong - Ben Goi bay, Nha Trang were published by Nguyen Duy Phuong, Dao Xuan Loc, Pham Thi My, Nguyen Thi Le (1980).

Generally, comparing the results of FE - FL survey in Vietnamese waters, the results of surveys conducted in the Tonkin Gulf more detail and comprehensive than in other sea waters.

With agreement of Vietnamese Government, the Collaborative Research Program among the SEAFDEC member countries has carried out the cruise surveys to collect necessary data and information and to manage the resources of marine fishes and protect the environment of the Vietnamese waters. The surveys were covered from latitude $7^0$00' - $21^0$00' N, longitude $103^0$00' - $112^0$00' E. Study on FE - FL is one of subject that has mentioned in this cruise survey.

Materials and Methods

Materials

The materials used for making this report, mainly based on the data and specimens were collected during the cruise of joint survey in the Vietnamese waters on board of M/V SEAFDEC from April 30th to May 29th 1999. Total number of FE - FL was 14,507 and 18,919, respectively [Table 1].

Methods

Chart of research stations and study sub- areas.

- Research stations were illustrated by quadrangles, the minimum interval between each station is 30 knots and maximum 60 knots.

- There is a line, which passes through $109^0$30' E, divided the survey area into 3 sub- areas:
Area I: The North
Area II: The Center
Area III: The South.

The research stations were situated in the area I and III with the main depth below 100 m (except 5 stations with the depth from 104 to 155 m). The stations in the area II had very great depth (about 95% of the stations with over 500 m); The stations no.25 and 32 had the depth over 4000 m [Fig.1].

Sampling and preservation.

At each research station, 2 types of net were used to collect samples as follows:

- Standard larvae net: 1,300 mm in diameter with a mesh size is 500 micron, using to collect samples at the water layer from 1 to 0 m (surface water layer : SWL).

- Bongo net: 600 mm in diameter with mesh size 500 micron at the net mouth part and 330 micron at the cod end was employed for the oblique haul and for sampling at the water layer from the depth 6 - 7 m near bottom to surface (in the stations with the depth below 106 m) or from 100 m to surface (in the stations with the depth over 107 m). (Oblique haul water layer : OHWL).

For both Standard larvae and Bongo net, a flow meter was attached to the mouth part of the each net to determine the volume of water which passed. The sampling time was about 20 - 30 minutes with the towing speed at 1.5 - 2.0 knots. Collected specimens were kept in plastic bottles with capacity from 500 to 1000 ml, and preserved in 4 - 7% formaline solution immediately after each haul and these specimens were analyzed and readjusted by Vietnamese researchers in the laboratories of the Research Institute of Marine Products.

Data identification and readjustment

- Before sorting, FE - FL were separated from plankton and debris. Normally, in each sample bottle, FE - FL were selected and checked two times by two researchers to prevent the number being lost.

- Number of FE - FL at each station as well as each family level have been identified and calculated in the same volume of sea water was 1000 m^3 (individual / 1000 m^3 sea waters = IN. / 1000 m^3 S.W.).

- FE - FL were observed to classify and done by using the stereo microscope. This device was attached with a camera in order to take the typical samples of FE - FL.

- Using the descriptions and classification keys, which were given in list of references to identify names of fishes, FE - FL that haven't been identified were preserved for future identification.

- A list of species composition was drawn up in order of alphabet to look up them easily.

- Readjusting data and making the report based on the general principles of research procedure on FE - FL of the model survey in 1978.

Results

Composition and abundance of FE - FL.

Collected samples of FE - FL in this survey cruise have been classified partly to species and genus and the most of them have been only classified to family levels. Table 2 shows a list of identified 78 families, 90 genera and 94 species, which occupied 22.66% total of FE and 99.35% of FL, were identified. Besides, 77.34% of FE and 0.65% of FL haven't been unidentified yet.

Table 1. Position and operating conditions of FE-FL sampling during between April 30 to May 29 1999 in the Vietnamese waters by M/V SEAFDEC.

St. No.	Date	Time		Position		Depth (m)	Volume of water passed net (m^3)		Number of samples were collected (Individuals)			
									Standard		Bongo	
		Start	Finish	Lat.(N)	Long.(E)		S.	B.	FE	FL	FE	FL
01	30/4/99	05.36	05.56	21°00'0	107°55'0	34(28)	1483	271	314	416	507	678
02	30/4/99	11.21	11.48	20°00'1	107°29'9	28(21)	2381	394	116	17	4607	651
03	30/4/99	18.12	18.38	19°59'9	106°29'3	28(20)	2515	394	0	9	856	173
04	01/5/99	00.01	00.28	19°00'2	105°59'5	26.5(20)	1916	374	81	329	867	1810
05	01/5/99	06.55	07.25	19°00'0	107°00'7	58(50)	2474	443	44	8	104	429
06	01/5/99	13.23	13.52	17°59'8	107°29'7	80(72)	1710	344	8	9	73	82
07	01/5/99	19.36	20.06	17°59'8	106°39'9	40(30)	2373	415	1	98	979	653
08	02/5/99	02.11	02.41	17°00'0	107°29'9	45(38)	1926	401	412	13	405	3619
09	02/5/99	06.13	06.43	16°35'0	108°00'6	75(65)	2712	485	38	30	8	234
10	02/5/99	13.33	14.03	17°00'3	109°00'1	107(100)	2048	409	10	7	51	147
11	03/5/99	05.52	06.20	16°01'4	109°58'5	847(100)	1873	426	149	11	34	63
12	03/5/99	21.29	21.58	16°00'4	108°59'9	104(96)	1950	477	32	13	44	168
13	04/5/99	01.57	02.25	16°00'6	108°30'6	42(32)	1516	433	7	212	709	1116
14	06/5/99	05.05	05.32	14°59'7	109°00'6	36(28)	2844	422	135	1	33	69
15	06/5/99	11.53	12.23	15°04'4	110°00'3	426(100)	2276	453	53	1	2	40
16	07/5/99	05.40	06.10	15°02'5	110°58'8	1230(100)	2179	325	37	10	6	58
17	08/5/99	05.50	06.20	14°06'5	111°56'5	2100(100)	3189	563	39	27	8	68
18	08/5/99	21.40	22.10	14°00'1	111°00'0	2200(100)	2390	461	0	13	5	55
19	09/5/99	06.18	06.48	14°10'7	109°58'9	653(100)	1820	392	24	14	2	59
20	10/5/99	06.04	06.34	13°59'9	109°29'1	143(100)	1964	343	6	13	8	102
21	10/5/99	11.37	12.07	13°00'2	109°30'0	134(100)	2064	469	5	3	3	276
22	10/5/99	16.05	16.35	12°59'7	109°59'2	1910(100)	2338	537	20	4	3	32
23	11/5/99	05.38	06.08	12°55'3	111°00'3	2697(100)	2156	489	20	6	2	37
24	12/5/99	08.36	09.06	13°00'0	111°59'5	3332(100)	2285	491	16	1	0	66
25	12/5/99	14.25	14.55	12°00'1	111°59'5	4117(100)	2186	343	26	4	2	39
26	13/5/99	14.07	14.37	12°00'2	111°00'0	2889(100)	2055	324	105	52	3	44
27	14/5/99	05.15	15.45	11°46'2	109°56'1	1734(100)	2373	467	25	88	2	30
28	14/5/99	18.11	18.39	11°59'0	109°25'1	110(100)	1742	381	9	33	15	128
29	17/5/99	16.21	16.51	11°00'2	108°59'9	72(62)	2522	342	237	60	56	98
30	18/5/99	05.29	05.59	11°00'0	110°00'7	648(100)	2396	450	26	32	32	99
31	18/5/99	13.28	13.58	10°59'7	111°01'0	2940(100)	1641	253	24	2	4	26
32	19/5/99	11.58	12.28	10°59'7	111°30'0	389(100)	1678	290	34	2	3	42
33	22/5/99	14.00	14.30	09°59'9	111°00'1	3385(100)	2181	358	11	15	4	32
34	21/5/99	11.58	12.28	09°59'9	111°00'3	1614(100)	2505	415	79	15	5	11
35	21/5/99	05.34	06.07	09°59'7	109°10'7	156(100)	2994	498	39	12	36	144
36	20/5/99	20.27	20.57	10°00'2	108°00'7	45.5(38)	2007	297	52	49	462	249
37	20/5/99	16.14	16.44	09°59'6	107°29'6	32(23)	2012	309	11	2	63	47
38	20/5/99	11.52	12.22	10°00'4	106°59'2	22(12)	1442	346	35	30	604	157
39	23/5/99	12.41	13.20	08°59'8	107°59'9	62(52)	1947	323	16	6	19	71
40	23/5/99	05.15	05.35	09°00'2	108°59'5	129(100)	2083	416	52	9	13	69
41	22/5/99	21.47	22.17	09°00'7	110°00'0	1967(100)	1860	392	6	11	1	40
42	26/5/99	15.20	15.50	08°01'2	109°49'9	628(100)	2015	398	30	408	1	93
43	25/5/99	08.24	05.54	08°00'1	109°00'4	147(100)	2499	399	35	12	33	183
44	25/5/99	00.33	01.03	07°59'7	108°00'6	79(71)	1491	350	36	47	26	203
45	26/5/99	20.21	20.51	06°59'7	107°30'5	61(52)	1804	399	11	31	26	166
46	27/5/99	00.56	01.26	06°59'9	107°00'4	51(44)	1656	314	3	39	94	156
47	24/5/99	17.14	17.44	07°59'6	107°00'4	42(35)	2203	409	4	1	129	162
48	23/5/99	19.50	20.20	08°59'9	106°59'6	33(25)	2035	359	3	33	38	246
49	24/5/99	03.00	03.29	09°00'3	106°00'5	20(12)	1667	251	5	339	53	283
50	24/5/99	10.10	10.40	08°00'0	106°00'0	33(25)	2334	403	162	98	224	548
51	27/5/99	08.40	09.09	06°59'9	105°59'9	44(36)	1956	400	37	22	83	117
52	27/5/99	15.46	16.16	06°59'4	104°59'6	51(43)	2311	439	17	49	21	56
53	27/5/99	22.54	23.24	07°59'7	105°00'7	34(26)	2031	364	2	269	21	377
54	28/5/99	06.31	07.01	07°59'7	104°00'2	26(17)	623	242	163	51	115	135
55	28/5/99	13.35	14.05	07°59'6	103°00'3	70(62)	2452	470	17	19	68	615
56	28/5/99	19.15	19.45	08°59'6	102°59'7	57(49)	1732	262	17	39	20	231
57	29/5/99	05.53	06.23	09°00'4	104°00'0	34(27)	846	80	6	75	12	46
58	29/5/99	10.01	10.30	09°00'1	104°30'5	23(15)	1944	165	0	22	1	50
Total:										**3241**	**11605**	**15678**

Note : In depth column, number in parenthes were depth to collect samples for Bongo net.

Table 2. Composition and total numbers of FE-FL were collected in the off-shore of Vietnam during between April 30 to May 29/1999 by M/V SEAFDEC.

Scientific name	English name	Number of FE-FL (Individuals)		% of total		Occurring in the net	
		FE	FL	FE	FL	B	S
1. Acanthuridae.	**Surgeom fishes**		**2**		**0.011**	+	+
2. Ambassidae.	**Perchletfishes**		**5**		**0.026**		+
Ambassis gymnocephalus Lac.	Bald glassy		5		0.026		+
3. Ammodytidae	**Sandlances**		**12**		**0.063**	+	+
4. Antennaridae	**Frog fishes**		**2**		**0.011**		+
Antennarius hispidus (Bl.-Schn.)	Shaggy angler		2		0.011		+
5. Apogonidae	**Cordinal fishes**		**144**		**0.761**	+	+
6. Atherinidae	**Silver sides**		**40**		**0.211**	+	+
7. Balistidae	**Trigger fishes**		**1**		**0.005**	+	
Abalistes stellaris (Bl.-Schn.)	Starry Trigger fish		1		0.005	+	
8. Belonidae	**Neetle fishes**		**9**		**0.048**		+
Tylosurus menanotus (Bleeker)	Blackfin needle fish		2		0.011		+
Tylosurua	Needle fish		1		0.005		+
9. Bothidae	**Lefleye flounders**		**245**		**1.295**	+	+
Arnoglossus elongatus Weber	Scald fish		20		0.106	+	
Arnoglossus	Scald fish		114		0.602	+	
Crossorhombus azureus Alcock	Bluespotted flounder		21		0.111	+	+
Crossorhombus			15		0.079	+	+
Psettina hananensis (Wu-Tang)			31		0.158	+	
P. iijimai (Jordan-Stark)			22		0.116	+	+
Psettina			6		0.032	+	+
Pseudorhombus	Flounder		17		0.090	+	+
10. Bregmacerostidae	**Codlets**		**913**		**4.826**	+	+
Bregmaceros atlanticus Goode	Atlantic cod		237		1.252	+	+
B. atripinnis Tickell	Blackfin cod		41		0.217	+	
B. macclellandi Thompson			635		3.356	+	
11. Brotulidae	**Brotulas**		**20**		**0.106**	+	+
Sirembo macmoratum (G.-Bcan)			1		0.011	+	
Sirembo			6		0.032	+	+
12. Callionymidae	**Dragonets**		**181**		**0.957**	+	+
Callionymus	Dragonet		22		0.116	+	+
13. Carangidae	**Carangids**		**1055**		**5.578**		+
Caranx	Jack		12		0.063	+	+
Carangoides	Cavalla		35		0.185	+	
Decapterus	Round scad		101		0.534		+
Naucrates ductor (Linnea)	Trevally		5		0.026	+	+
Selar crumenophthalmus (Bloch)	Big eye scad		91		0.481	+	+
Seriola	Trevally		5		0.026	+	
14. Carapidae	**Pearl fishes**		**2**		**0.011**	+	
15. Centrolophidae	**Black suffs**		**7**		**0.037**	+	+
Psenopsis anomala (Tem.-Schl.)	Wart perch		7		0.037	+	+
16. Champsodontidae	**Gaper**		**72**		**0.381**	+	+
Champsodon capensis Regan	Gaper		47		0.248	+	+
Ch. snyderi Franz	Gaper		25		0.132	+	+
17. Chauliodontidae.	**Viper fishes**	**5**	**2**	**0.034**	**0.011**	+	+
Chaulioddus sloani (Bl.-Schn.)	Viper fish	5	2	0.034	0.011	+	+
18. Chirocentridae.	**Wolfherrings**	**2**	**24**	**0.014**	**0.127**	+	+
Chirocentrus dorab Forskal	Dorab wolf herring	2	24	0.014	0.127	+	+

Table 2. (Continued).

Scientific name	English name	Number of FE-FL (Individuals)		% of total		Occurring in the net	
		FE	FL	FE	FL	B	S
19. Chlophthalmidae.	**Barracudas**		**2**		**0.011**	**+**	
Chlorophthalmus mento Garmen	Green eye		2		0.011	+	
20. Clupeidae.	**Sardines**	**300**	**787**	**2.068**	**4.160**	**+**	**+**
*Etrumeus mieropus (*Schl.)	Pacific round herring	119		0.820		+	+
Ilisha elongata (Bennett)	Chinese herring	13		0.090		+	
21. Congridae.	**Conger - eels**		**49**		**0.259**	**+**	**+**
22. Coryphaenidae.	**Dolphin fishes**		**3**		**0.016**		**+**
23. Cynoglossidae.	**Tongue soles**	**125**	**183**	**0.862**	**0.967**	**+**	**+**
Arelia bilineata (Lacepede)	Tongue sole		28		0.148	+	+
Symphurus orientalis (Bleeker)	Tongue sole		15		0.079	+	
Cynoglossus	Tongue sole		136		0.719	+	+
24. Dactynopteridae.	**Flying gurnards**		**18**		**0.095**	**+**	**+**
Dactylopterus orientalis (Cuvier)	Oriental flying gurnard		18		0.095	+	+
25. Diodontidae.	**Porcupine fishes**		**3**		**0.016**	**+**	**+**
26. Drepanidae.	**Sickle fishes**		**14**		**0.074**		**+**
27. Engraulidae	**Anchovies**	**1233**	**4504**	**8.499**	**23.81**	**+**	**+**
Stolephorus commersonii Lac.	Long jawed anchovy	22		0.152		+	+
S. heterolobus Ruppell	Short head anchovy	4		0.027		+	
S. zollengeri Bleeker	Buccaneen anchovy	1206		8.313		+	+
Stolephorus	Anchovy	1	4491	0.007	23.74	+	+
Thrissa	Thrissa		13		0.069	+	
28. Exocoetidae.	**Flying fishes**	**798**	**207**	**5.500**	**1.094**	**+**	**+**
Cheilopogon katoptron Bleeker	Yellow bandflying fish	441	52	3.040	0.275	+	+
Exocoetus volitan Linnea	Tropical two-wing	11		0.076		+	
Exocoetus	Flying fish	2	1	0.014	0.015	+	+
Hyrundichthys oxyocephalus(Bl)	Bong flying fish		38		0.200	+	
Hyrundichthys	Flying fish		17		0.090	+	+
Oxyporhamphus meristocytis P.		61	4	0.420	0.021	+	+
O. micropterus		183	58	1.261	0.306	+	+
Parexocoetus mento (Cuv.-Val.)	African sailfin flying	5	36	0.034	0.190	+	+
29. Fistularidae.	**Cornet fishes**	**34**	**10**	**0.234**	**0.053**	**+**	**+**
Fistularia petimba Lacepede	Red cornet fish	34	10		0.053	+	+
30. Gempylidae	**Snake mackerels**		**65**	**0.234**	**0.344**	**+**	**+**
Gempylus	Snake mackerel		56	0.234	0.296	+	+
Promethichthys prometheus(Cuv)			5		0.032	+	
Lepidocybium flavobrumneum	Escolar		4		0.021		+
31. Gerridae.	**Silver biddies**		**1**		**0.005**		**+**
Gerres filametosus Cuvier	Whipfin morra		0.005		0.005		+
32. Gobiidae.	**Gobies**		**3173**		**16.77**	**+**	**+**
33. Gonostomatidae.	**Gonostobid**		**59**		**0.312**	**+**	
Cyclothone			35		0.185	+	
Vinciguerria			3		0.016	+	
Maurolicus			6		0.032		
34. Hemirhamphidae.	**Half beak fishes**		**1**		**0.005**		**+**
*Hemirhamphus geogri(*Cuv-Val)	Half beak fish		1		0.005	+	+
35. Istiophoridae.	**Sail fishes**		**4**		**0.021**	**+**	
36. Labridae.	**Wrasses**		**107**		**0.566**	**+**	
37. Lactaridae.	**Falsetrevallies**		**3**		**0.016**	**+**	
Lactarius lactarius (Bl.-Schn.)	Falsetrevally		3		0.016	+	

Table 2. (Continued).

Scientific name	English name	Number of FE-FL (Individuals)		% of total		Occurring in the net	
		FE	FL	FE	FL	B	S
38. Leioglathidae	**Slipmount fishes**		**1778**		**9.398**	**+**	**+**
Gazza minutta (Bloch)	Toothelpony fish		262		1.385	+	
Leiognathus elogatus (Gunther)	Sleuderpony fish		29		0.153	+	+
Leiognathus	Pony fish		120		0.634	+	
39. Lethrinidae.	**Emperors**		**2**		**0.011**	**+**	
40. Lophiidae.	**Anglers**		**2**		**0.011**	**+**	**+**
Lophius setigerus Vahh	Black mounth angler		2		0.011	+	+
41. Lutjanidae.	**Snapper fishes**		**354**		**1.871**	**+**	
Lutjanus erythropterus Bloch	Red snapper		48		0.254	+	+
42. Melanotomatidae.	**Scaleles dragon.**		**7**		**0.037**	**+**	
Bathophilus			3		0.016	+	+
Eutomias			3		0.016	+	+
43. Menidae.	**Moon fishes**		**15**		**0.079**	**+**	**+**
Mene maculata (Bl.-Schn.)	Moon fish		15		0.079	+	+
44. Monacanthidae.	**Leather- Jackets**		**107**		**0.566**	**+**	**+**
Alutera monoceros (Obeck)	Unicorn file fish		17		0.090	+	
Monacanthus	File fish		1		0.005	+	
Stephanolepis japonicus (Til.)	File fish		89		0.470	+	
45. Mugillidae.	**Mullet fishes**		**51**		**0.270**	**+**	**+**
46. Mullidae.	**Goat fishes**		**1333**		**7.046**	**+**	**+**
Upeneus bensasi (Tem.-Schl.)	Bensasi goat fish		396		2.093	+	+
Upeneus	Goat fish		352		1.861	+	+
47. Muraenidae.	**Moray**		**6**		**0.032**	**+**	**+**
Gymnothorax	Moray		4		0.021		+
48. Muraenesotidae.	**Conger ells**	**4**	**11**	**0.028**	**0.060**	**+**	
49. Myctophidae.	**Lantern fishes**		**489**		**2.585**	**+**	**+**
*Diaphus mollis (*Taning)			32		0.169	+	
Diogenichthys atlanticus (Tan.)			22		0.116	+	
D. parnugus Bolin			140		0.740	+	
Benthosema surbobitane (Gil.)			11		0.060	+	
B. filulata (Gil.-Cramer)			6		0.032	+	
Benthosema.			5		0.026	+	
Centrabranchus andreae(Lutken)			1		0.005	+	
Ceratoscopelus maderensis(Low.)			31		0.164	+	
C. warmingi (Lutken)			64		0.338	+	
Hygophum hygomi (Lutken)			60		0.317	+	+
H. proximum Becker			16		0.085	+	+
H. reinhardti (Lutken)			1		0.005	+	
Myctophum asperum Rich.			13		0.069	+	
M. nitidulum Garman			20		0.106	+	
M. spinosum (Stein.)			5		0.026	+	
M. pristilepis (Gil.-Cramer)			3		0.016	+	
Myctophum			19		0.100	+	+
Symbolophorus boops (Rich.)			2		0.011	+	
S. evermanni (Gilbert)			10		0.053	+	
Symbolophorus			7		0.037	+	
50. Nemichthyidae.	**Threed eels**		**41**		**0.217**	**+**	
51. Nemipteridae.	**Threadfinbream**		**441**		**2.331**	**+**	**+**
52. Oncocephalidae.	**Bat fishes**		**1**		**0.005**	**+**	
Haliteua stellata Vahh	Starry hard fish		1		0.005	+	

Table 2. (Continued).

Scientific name	English name	Number of FE-FL (Individuals)		% of total		Occurring in the net	
		FE	FL	FE	FL	B	S
53. Ophichthyidae.	**Snake eels**	**197**	**5**	**1.365**	**0.026**	+	+
54. Paralipididae.	**Barracudinas**		**5**		**0.026**	+	
Lestidiops fascifium (Perr)	Barracudina		5		0.026	+	
55. Platicephalidae.	**Flatheadfishes**		**5**		**0.026**	+	
56. Pleuronectidae.	**Right eye flounders**	**3**	**19**	**0.021**	**0.100**	+	+
Brachypleura novaezeelandi(G.)	Largescale flounder		2		0.011	+	
Samaris cristatus Gray	Grayscrested		17		0.090	+	+
57. Pomacentridae.	**Damsel fishes**		**12**		**0.063**	+	+
58. Pomadasyidae.	**Grunters**		**82**		**0.433**	+	+
59. Priacanthidae.	**Big eye fishes**		**206**		**1.089**	+	+
60. Psettodidae.	**Sping turbot**		**3**		**0.016**	+	
Psettoides erumei (Bl.-Schn.)	Arrewtoothed		3		0.016	+	
61. Scorpaenidae.	**Scorpion fishes**	**74**	**153**	**0.510**	**0.809**	+	+
62. Scopelosauridae.			**5**		**0.026**	+	
63. Sciaenidae.	**Drums**		**137**		**0.724**	+	+
64. Scombridae.	**Mackerel fishes**		**603**		**3.187**	+	+
Acanthucybium solandri (Cuv.)	Wahoo		9		0.047	+	+
Scomberomorus guttatusBl.-Schl	Indo-pacific mackerel		91		0.481	+	+
S. commersonii (Lacepede)	Talang queen fish		60		0.317	+	+
Scomberomorus	Spanish mackerel		9		0.047	+	
Sarda orientalis (Tem.-Schl.)	Bonito		5		0.026	+	
Scomber japonicus (Houttuyn)	Cub mackerel		6		0.032	+	
Rastrelliger kanagurta (Cuv.)	Indian mackerel		145		0.766	+	
Rastrelliger	Mackerels		65		0.344	+	+
Auxis thazard (Lacepede)	Frigate tuna		7		0.037	+	
Euthynnus affinis (Cantor)	Easten litte tuna		124		0.655	+	
Katsuwonus pelamis (Linnea)	Skipjack tuna		41		0.217	+	+
Thunnus albacares (Bennett)	Yellow fin tuna		18		0.095	+	+
Th. obesus (Lowe)	Big eye tuna		16		0.085	+	+
Th. tongol (Bleeker)	Longtail tuna		6		0.032	+	+
Thunnus	Tuna		1		0.005	+	
65. Scaridae.	**Parrot fishes**		**59**		**0.312**	+	
66. Serranidae.	**Grouper fishes**		**186**		**0.983**	+	+
Epinephelus tauvina Forskal	Greasy grouper		35		0.185	+	+
Epinephelus	Grouper		43		0.227	+	+
Cephalopholis	Rosk cods		2		0.011	+	
67. Siganidae.	**Rabbit fishes**		**1**		**0.005**	+	+
68. Soleidae.	**Sole fishes**	**4**	**25**	**0.028**	**0.132**	+	+
Zebrias zebra (Bloch)	Zebra sole		22		0.116	+	
69. Sphyraenidae.	**Barracudas**		**175**		**0.925**	+	+
70. Syngnathidae.	**Sea horse fishes**		**9**		**0.048**	+	+
Hippocampus hixtris Kaup	Sea horse		7		0.037	+	+
Syngnathus drajong Bleeker	Pipe fish		2		0.011	+	
71. Schindleridae.	**Schindler fishes**		**14**		**0.074**	+	+
Schindleria praematuna Schl.			14		0.074	+	+
72. Synodontidae.	**Lizard fishes**	**348**	**159**	**2.392**	**0.841**	+	+
Saurida elongata (Tem.-Schl.)	Slender lizard fish	88	28	0.606	0.148	+	
S. tumbil (Bloch)	Greater lizard fish	5	20	0.034	0.106	+	
S. undosquamis (Richardson)	Brushtooch lizard	48	33	0.331	0.174	+	+
Synodus hoshinosis Tanaka	Lizard fish		6		0.032	+	
S. wariegatus Lacepede	Redl lizard fish	9	10	0.062	0.053	+	+
Trachinocephalus myops Forster	Snake fish	197	62	1.358	0.328	+	+

Table 2. (Continued).

Scientific name	English name	Number of FE-FL (Individuals)		% of total		Occurring in the net	
		FE	FL	FE	FL	B	S
73. Stomiastidae.	**Scaly dragom**		**2**		**0.011**		**+**
74. Tetrodontidae.	**Puffers**		**153**		**0.808**	**+**	**+**
Fugu	Puffer		7		0.037	+	+
Lagocephagus	Puffer		68		0.359	+	
75. Teraponidae.	**Theraponids**		**103**		**0.544**	**+**	**+**
Terapon theraps (Cuv.-Val.)	Largescaled theropon		56		0.296	+	+
76. Trichiuridae.	**Hairtails**	**159**	**82**	**1.096**	**0.433**	**+**	**+**
Trichiurus	Hairtail		82		0.433	+	+
77. Triglidae.	**Gurrads**		**26**		**0.137**	**+**	**+**
78. Uranoscopidae.	**Stargazers**		**1**		**0.005**	**+**	
Unidentified.		**11219**	**1221**	**77.34**	**0.645**		
Total		**14507**	**18919**	**100.0**	**100.0**		

Table2 showed that:

For FE : 22.66% of total FE samples was identified, belonging to 14 families, of which *Engraulidae* accounted for the highest number of total FE samples(8.50%), followed by *Exocoetidae*(5.50%); *Synodontidae*(2.40%); *Clupeidae*(2.07%); *Ophichthyidae*(1.3%); *Trichiuridae* and *Cynoglossidae*(0.86%).

For FL : There were 4504 individuals of FL of *Engraulidae* obtained in this survey cruise, accounted for 23.81% total of FL. And the following FL were *Gobiidae* (16.77%); *Leiognathidae* (9.49%); *Mullidae* (7.05%); *Carangidae* (5.59%); *Bregmacerostidae* (4.83%); *Clupeidae* (4.16%); *Scombridae* (3.19%); *Myctophidae* (2.60%); *Nemipteridae* (2.33%); *Lutjanidae* (1.87%); *Bothidae* (1.39%); *Priacanthidae* and *Tetrodontidae, Exocoetidae* (1.09%); *Serranidae* (0.98%); *Cynoglossidae* (0.97%); *Sphyraenidae* (0.92%); *Synodontidae* (0.84%); *Apogonidae* (0.76%); *Scorpaenidae* (0.81%); and *Sciaenidae* (0.72%). Only 22 families had number of FL that occupied 91.97% total of collected samples.

Table 2 also presented the difference of composition of families, genera and species in the SWL and OHWL. There were about over 50% number of families, genera and species occurring in the both water layers. The rest occurred in the either SWL or OHWL. These differences were shown in Table 3.

At each station, the composition of collected family, genus, species was very abundant, at least there were 6 and the highest 30 families appeared [Table. 4].

Table 4 showed that the survey cruise was conducted in peak of spawning season of fishes in Vietnamese sea waters, so that the abundance of number of family, genus, and species could be observed at all the research stations.

Based on the habit at conditions, 78 families were identified, belonging to 4 large ecological groups, namely:

- Pelagic fishes group, consists of 16 families such as: *Ambassidae; Atherinidae; Beloniidae; Centrolophidae; Carangidae; Chirocentridae; Clupeidae; Coryphaenidae; Engraunidae; Exocoetidae; Fistularidae; Hemirhamphidae; Istiophoridae; Menidae; Scombridae; Sphyraenidae* which accounted for 39.37% of total FL.

- Coral fishes group, consists of 13 families such as: *Balistidae; Carapidae; Diodontidae;*

Congridae; Muraenidae; Nemichthyidae; Labridae; Monacanthidae; Pomacentridae; Serranidae; Scaridae; Syngnathidae; Tetrodontidae which accounted for 3.88% of total FL

- Mesodemersal fishes group, consisted of 20 families such as: *Acanthuridae; Apogonidae; Dactylopteridae; Drepanidae; Gempylidae; Gerridae; Leiognathidae; Lethrinidae; Lutjanidae; Mugillidae; Mullidae; Nemipteridae; Priacanthidae; Pomadasyidae; Lactaridae; Sciaenidae; Siganidae; Synodontidae; Teraponidae; Trichiuridae* which accounted for 26.30% of total FL.

- Demersal fishes group, consisted of 29 families such as: *Ammodytidae; Antennaridae; Bothidae; Bregmacerostidae; Brotulidae; Callionymidae; Champsodontidae; Chauliodontidae; Chlophthalmidae; Cynoglossidae; Gobiidae; Gonostomatidae; Lophiidae; Melanotomatidae; Muraenesotidae; Myctophidae; Oncocephalidae;Ophichthyidae;Paralipididae; Platycephalidae; Pleuronectidae; Psettoididae; Scorpaenidae; Scopelosauridae; Soleidae; Schindleridae; Stomiastidae; Triglidae; Uranoscopidae* which accounted for 29.80% of total FL

In general, this division is only relatively, because some of fishes called pelagic fish, some time they go down to near bottom layer as some species belonging to the *Carangidae* or some of demersal fishes go down to live in the coral reef areas, etc. This occurrence is called the vertical migration or the change of ecological area. However, there is a relative concept of division to compare among them. By this division, the pelagic fish group comprised only 16 families, but its number of collected FL wassurvey area and survey period had been in a peak of spawning season of almost pelagic fishes, especially the species belonged to *Engraulidae,Clupeidae,Carangidae,Scombridae, Exocoetidae,* Mesodemersal and demensal fish families with the number of collected FL were approximately, accounted for 26.30% and 29.80% for each group. The coral reef fish group had the smallest number of FL, occupied only 3.88% total FL.

Distribution of FE-FL

The general trend of distribution of FE-FL in the Vietnamese sea waters in the survey period was concentrated along the coastal line and around islands or near the estuaries of the big rivers. FE usually concentrated with high density, FL distributed scattering, only some areas concentrated with high density. The density of FE-FL distribution in the North and South sea waters concentrated higher than in the Central sea waters.

The density of FE-FL distribution in the North sea water concentrated higher than in the South sea waters. For example, in the Northern sea waters, the density of FE-FL was high (over 1000 IN/ 1000 m^3 S.W), which occurred in the 4 main areas such as: around Bach Long Vi island; along the coastal line from Co To to Long Chau islands; along the coastal line from Ba Lat to Thuan An estuary; and the coastal area near Hoi An estuary.

The distribution density of FE which was 11700 FE / 1000 m^3 SW occurred in the area around Bach Long Vi island and of FL which was 9000 IN/1000m^3 SW occurred in the coastal areas from Con Co island to the Thuan An estuary.

The density of FE-FL distributed scattering in the South sea waters, the concentration of this area was not higher than the North sea waters. The density of FE-FL concentrated highly (over1000 IN./1000 m^3 S.W.), occurred in the sea waters: for FE from Southwest of Phu Quy island to Mekong estuaries, for FL from Mekong estuaries to the Southwest of Con Son island and from along the coastal line to the South of study area..

In the Central sea waters the distribution of FE-FL concentrated lower than other sea waters. The area having the highest density, obtained 500 IN. /1000 m^3 S.W. is in the area from Quy Nhon to Nha Trang [Fig.2 & 3].

Comparing with the density of FE-FL in the SWL and OHWL showed that: For SWL, the distribution density of FE-FL was not very abundant, the highest number of FE-FL obtained only 262 FE and 281 FL/1000 m^3 S.W. In the OHWL, the distribution density of FE-FL was always more

abundant than the SWL (higher than 44 times and 32 time to the distribution density of FE-FL, respectively). [Fig. 2, 3, 4 and 5].

The distribution density of FE-FL of some dominated fish families were presented in the Table 5 and 6.

Table 3. Difference of composition of families, genera and species in the SWL and OHWL.

	Number of family, genus and species occurred in the		
	Both SWL & OHWL	**Only SWL**	**Only OHWL**
Family	49	9	20
Genus	47	6	37
Species	45	4	46

Table 4. Number of family, genus, species was collected in each survey station.

Station No	Number of			Station No	Number of		
	Family	**Genus**	**Species**		**Family**	**Genus**	**Species**
01	20	11	9	30	28	19	13
02	16	7	5	31	13	14	13
03	17	8	3	32	17	24	20
04	15	16	14	33	12	12	10
05	28	15	13	34	6	10	10
06	20	11	8	35	28	23	18
07	28	21	13	36	26	18	16
08	26	25	17	37	14	12	9
09	30	18	12	38	19	9	8
10	26	15	11	39	22	20	18
11	17	14	11	40	18	18	20
12	28	21	14	41	13	13	11
13	24	16	9	42	23	27	20
14	15	7	4	43	22	21	16
15	9	10	9	44	29	22	18
16	18	18	16	45	25	18	19
17	21	17	15	46	17	12	9
18	16	18	10	47	13	7	7
19	19	17	12	48	20	8	6
20	22	12	11	49	23	15	9
21	18	17	9	50	23	14	14
22	22	19	13	51	19	14	11
23	12	11	9	52	17	14	9
24	13	13	12	53	25	13	9
25	12	15	13	54	24	10	8
26	23	27	19	55	25	13	11
27	16	16	14	56	25	13	9
28	20	11	6	57	15	9	9
29	27	14	12	58	14	7	4

Table 5. Mean abundance of the FL (Number under 1000 m^3 sea waters volume) and frequency occurred of some main families in survey sub-areas.

Order	Family	Number / 1000 m^3 S.W.			Frequency (%)		
		North	Central	South	North	Central	South
01	*Apogonidae*	2	5	11	23.08	27.27	69.56
02	*Bothidae*	22	2	13	69.23	54.54	82.61
03	*Bregmacerostidae*	24	14	66	76.92	63.64	69.56
04	*Callionymidae*	14	1	8	64.23	40.91	52.17
05	*Carangidae*	95	4	44	92.31	31.82	100.0
06	*Champsodontidae*	8	2	1	61.54	31.82	39.13
07	*Clupeidae*	37	very few	19	46.15	4.54	30.43
08	*Cynoglossidae*	22	1	6	92.31	22.72	47.83
09	*Engraulidae*	732	6	30	92.31	72.72	73.91
10	*Exocoetidae*	8	1	1	30.77	18.18	8.69
11	*Gempylidae*	9	1	very few	23.08	31.82	8.69
12	*Gobiidae*	227	37	173	100.0	72.72	100.0
13	*Labridae*	2	2	10	15.38	40.91	52.17
14	*Leiognathidae*	258	2	37	92.31	22.72	91.30
15	*Lutjanidae*	29	3	6	61.54	27.27	56.52
16	*Monacanthidae*	1	0	15	7.69	0	56.52
17	*Mullidae*	93	2	12	92.31	22.72	78.26
18	*Myctophidae*	4	42	9	23.08	95.45	30.43
19	*Nemipteridae*	59	2	4	92.31	13.64	21.74
20	*Pomadasyidae*	14	1	very few	61.54	13.64	8.69
21	*Priacanthidae*	14	1	8	38.46	36.36	52.17
22	*Scorpaenidae*	14	1	5	84.62	27.27	43.48
23	*Sciaenidae*	16	very few	5	30.77	9.09	34.78
24	*Scombridae*	67	6	17	84.62	68.18	69.56
25	*Serranidae*	3	1	13	61.54	27.27	73.91
26	*Sphyraenidae*	20	2	5	61.54	40.91	43.48
27	*Synodontidae*	13	2	7	76.92	31.82	43.48
28	*Tetrodontidae*	16	4	4	53.85	54.54	34.78
29	*Teraponidae*	2	1	7	15.38	9.09	26.09
30	*Trichiuridae*	2	-	8	23.08	-	21.74

Table 6. Mean abundance of the FE (Number under 1000 m^3 sea waters volume) and frequency occurred of some main families in survey sub-areas.

Order	Family	Number / 1000 m^3 S.W.			Frequency (%)		
		North	Central	South	North	Central	South
1	*Clupeidae*	4	1	12	23.08	13.64	13.04
2	*Engraulidae*	218	0	31	46.15	0	21.74
3	*Exocoetidae*	3	12	3	30.76	86.36	39.13
4	*Cynoglossidae*	0	0	16	0	0	17.39
5	*Synodontidae*	22	0	26	53.85	0	73.91
6	*Ophichthyidae*	5	very few	2	46.15	9.09	30.43
7	*Trichiuridae*	13	very few	3	46.15	9.09	30.43

These tables showed that:

For FE:

In the North sea waters, the highest average density of FE was *Engraulidae*, which occupied 218 FE/1000m^3 S.W. The following families was *Synodontidae* (22 FE), *Trichiuridae* (13 FE). But they just only appeared in 50% of study stations.

In the Central sea waters, *Exocoetidae* had the highest average density of FE of all, it occupied only 12 FE/1000m^3 S.W, the frequency of observation was 30.76%.

In the South sea waters, *Engraulidae* had the highest average density of FE of all, 31 FE/ 1000m^3 S.W, but the frequency of appearance occupied only 21.79%. The following families as *Synodontidae* 12 FE, frequency 73.91%, *Cynoglossidae* 16 FE and frequency 17.39%, *Clupeidae* 12 FE and frequency 13.04%.

For FL:

In the North sea waters, *Engraulidae* had the highest average density of FL of all, it obtained 732 FL/1000 m^3 S.W and the number of stations that collected samples of this family occupied 92.31%. The following families as *Leiognathidae* (288 FL and 92.31%), *Gobiidae* (226 FL and 100.0%), *Carangidae* (95 FL and 92.71%), *Mullidae* (59 FL and 92.31%), *Scombridae* (67 FL and 84.62%), *Nemipteridae* (59 FL and 95.45%).

In the Central sea waters, *Myctophidae* had the highest average density of FL of all, it obtained 42 FL/1000m^3 S.W and the frequency was 95.45%. The following families as *Gobiidae, Bregmacerostidae, Scombridae* (37, 14, 6 FL and 72.72%, 63.64%, 68.18%, respectively).

In the South sea waters, *Gobiidae* had the highest average density of FL of all, it obtained 173 FL/1000 m^3 S.W. The following families as *Bregmacerostidae* (66 FL and 69.56%), *Carangidae* (49 FL and 100.0%), *Leiognathidae* (37 FL and 91.30%), *Engraulidae* (30 FL and 73.19%), *Clupeidae* (9 FL and 30.43%), *Serranidae* (13 FL and 73.91 %), etc.

FE-FL of some dominant fish families

Engraulidae

In the coastal pelagic fishery of Vietnam, some species of Anchovy family (*Engraulidae*) have high economic value. Presently, there are about 33 species belonging to 6 genera of Anchovy family [MoF(1996)]. In this survey, 1,233 FE and 4,504 FL of Anchovy family were collected, which accounted for 8.5% of total collected FE and 23.82% of total FL of all species, this is the highest number of not only FE but also FL of collected fish species. We initially identified FE of 3 species *Stolephorus commersonii*; *Stolephorus heterolobus; Stolephorus zollengeri* and FL of *Stolephorus* and *Thrissa* [Table 2].

Diagnostic features

FE of Anchovy have elongated elliptical shape, size ranged from 0.8 to 1.8 mm x 0,5 to 0.8 mm. Egg membrane is smooth and transparent except for *Stolephorus commersonii* has a small knob in one side. Egg of Anchovy has yolk-sphere with turtle-shell shaped. Egg of two species *Stolephorus commersonii* and *Stolephorus zollengeri* have no oil globule in yolk; or there is only one oil globule in yolk, such as egg of *Stolephorus heterolobus* (egg size is bigger 1.5 - 1.8mm x 0.6-0.7mm) and another species (egg size's smaller 1.1-1.3mm x 0.6-0.7mm)[Fig. 33].

The FL of Anchovy family are small, long with small head and lower jaw shorter than upper jaw. Body depth before anus is the same. Head and opercle are spineless. All fins have no spine rays, no adipose fin, specific swimming bladder. Anus is in the back half of body. From the tip of snout to anus is about 60% of total body length. Black pigment distribute along with intestinal tube, or on the lower edge of body. Black pigment also scatters on the caudal fin. The number of muscle-segment varies among different genus; *Stolephorus* 26-28 + 16-20, *Thrissa* 29 - 32 + 16 - 22. The character of FL of Anchovy family to distinguish from Herring fish family is the beginning place of anal fin base that is usually equal or before the end place of dorsal fin base in horizontal straight of body. The number of muscle-segment after anus is often a lot (16-20).

The FE-FL distribute widely in the survey area. The occurrence frequency is 77.59%.The high concentration occurred only in the North and sparse in the Central (maximum 19 IN/1000m^3 S.W.).

In the Northern waters: the FE distribute with high density from 500 – 791 FE/ /1000m^3 S.W in 2 regions: From Southwest of Bach Long Vy island to the coastal line between Long Chau island and Ba Lat estuary, and the out side area of Cu Lao Cham island. The density of FL is repeatedly with density of FE but trend to appear in the area along coastal line to South , particular in the Southeast of Con Co island to Thuan An mouth, the density of FL up to 6,663 FL/1000m^3 S.W.

In the South sea area, the FE distribute mainly in the coastal area; from Vung Tau to Dai mouth (624 FE/1000m^3 S.W). The FL scatter all over the survey area. In the Southwest area of Tho Chu island, the density is 210 FL/1000m^3 S.W.[Table 7 & Fig. 6]

Table 7. Mean abundance of the FE-FL(Number under 1000 m^3 sea waters) and frequency occurred of some genus, species of Anchovy family in the survey sub-areas.

Genus, species	North		Central		South	
	Mean density	Frequency (%)	Mean density	Frequency (%)	Mean density	Frequency (%)
Stolephorus	734.0	12.30	5.4	67.27	32.3	69.57
S. heterolobus	0.8	15.38	0	0	0	0
S. zollengeri	182.7	53.85	0	0	31.2	17.39
S. commersori	4.8	15.38	0	0	0	0
Thrissa	0	0	1.4	22.73	0	0

Clupeidae

The species of Herring fish family are also important to the pelagic capture fisheries in Vietnam such as: Lift net with light, gill net for sardine, purse seine ... Now, in the sea of Viet Nam, there are about 56 species belonging to 18 genera of Herring fish family.[MoF (1996)].The collected number of FE-FL samples of Herring family are 300 and 787 ; respectively and accounted for 2.07% and 4.16% of total collected FE-FL.

Diagnostic features

The FE of Herring fish family are spherical with smooth membrane, without cling substances. The diameter of egg ranges from 1.0–2.5 mm. The big eggs have large yolk crack. They are big yolk–spheres, turtle shell shape. Yolk of *Etrumeus micropus* egg do not contain oil globule (diameter of *Etrumeus micropus* egg from 1.23–1.35mm), or one oil globule in yolk of *Ilisha elongata* egg (diameter from 2.1–2.5 mm, diameter of oil globule from 0.35–0.40mm, black pigment appear on oil globule) or egg of some other species have many oil globules such as *Anodontostoma chacunda* [Mito, S. (1960)].

The FL are all tiny, elongated and small head, head and opercle lack of spine. All fins not to be supported by rigid rays. From the tip of snout to the anus is about 80% of total body length. Black pigment appears on intestinal tube. The FL of Herring are the same with the FL of Anchovy fish at first glance. The muscle- segment from 39–62 . The distinguished character from FL of Anchovy is the beginning of anal fin base always after the end of dorsal fin base. The muscle number after the anal is about 6–15 [Fig. 33].

Eggs of Herring fish distribute widely in North and South sea areas. We hardly collected any samples in the Central area, but at the 19th station we collected 5 FL/1000m^3 S.W and at the 20th station 17 FE /1000m^3 S.W.

In the North sea area, the density of FE-FL from 112 to 495 IN/1000m^3 S.W occurred in coastal area from Co To island to Ba Lat estuary.

In the South sea area, the density from 100–179 IN/1000m^3 S.W in area of Me Kong estuaries and from 200-218 IN/1000m^3 S.W in area of Dinh An estuary to Southwest area of Con Son island.[Fig. 7]

Exocoetidae

Flying fish are the most typical pelagic species in the sea area of Viet Nam. There are about 24 species belonging to 7 genera of Flying fish family [MoF(1996)].

In this survey, we collected 798 FE and 207 FL of Flying fish; about 5.5% and 1.09% of total collected FE-FL. We initially classified 6 species of 5 genus [Table 2].

Diagnostic features

Egg of Flying fish is spherical. Diameter of egg ranges from 1.4 – 3.3 mm, it varies from different species. Membrane of egg is transparency, colorless. The egg membrane of *Exocoetus volitan* is smooth, shiny, but egg membrane of *Oxyporhamphus microptesus* and *O. meristocystys* cover with short spines (0.05 – 0.07mm), *Cheilopogon katoptron* with spine knot 0.3 –0.5 mm on the membrane surface, *Parexocoetus mento* membrane with 10 – 12 stings distribute equally on the surface, one of which is bigger and longer . The egg membrane of *Hyrundichthys oxycephalus* has 2 sets of sting in 2 poles, that one is about 15-18 short stings (3cm) and another 8-10 longer ones (6cm).In the development of embryo, the embryo has many black - brown pigment, in radial, or rounded shape on embryo and yolk sac, that is also a character to classify out. The embryo is usually short and big. The pectoral and pelvic fin develop rapidly when the embryo is still in egg.

The FL of Flying fish are often short, big and rather round. The anus located behind body. From the tip of snout to anus is about 70% total body length. Fins develop quickly especially for pectoral and pelvic ones. Black and black-brown distribute all over the body. The lower jaw is longer than the upper one. [Fig.34].

The FE-FL of Flying fish distribute widely in survey area. The maximum is 59 IN/1000 m^3 S.W. The occurrence frequency in Central sea waters is higher than in the North and the South [Table 8 and 9]

Scombridae

The Mackerel fish family is an important economic pelagic family in Viet Nam not only in quantity but also in quality. All of them are pelagic migrants. Now 32 species of 13 genera are recorded in Viet Nam sea area [MoF.(1996)]. There were 603 individuals of Mackerel FL obtained during the cruise with length from 3.0-13.7 mm, about 1.39% of total obtained FL. During the cruise, 74 individuals were collected in the SWL and 529 individuals in the OHWL from 42 stations. The specimens were identified which comprise of 12 species of 9 genera [Table 2].

Diagnostic features

The FL is elongated, flat in two sides, the highest depth of the body is usually near the head. The anus is located in the middle of body. The tail is slender towards the end. Mouth is large, many sharp teeth. The edge of stomach near the tail has many, little, or without radial black pigment, that is the character to identify. There are many muscle-segment arranged closely, it varies from different genera. For example *Scomber* and *Rastrelliger*: 30 – 31; *Scomberomorus*: 49 – 52; *Sarda* : 45; *Acanthucybium*: 64; *Thunnus*: 40 –41; *Euthynnus* and *Auxis*: 38 – 39; *Katsuwonus*: 39 - 40 ...[Fig.35].

The FL distribute widely in the survey area. The density in the North is often higher than the South and the Central. They usually distribute with high density (100 – 182 IN/ 1000 m^3 S.W) from areas of Me - Mat islands to Con Co island and Thuan An mouth. In the South and the Central area, the highest density was recorded only to 100 IN/1000m^3 S.W [Table 10 &11].

Table 8. Mean abundance of the FE-FL(Number under 1000 m^3 sea waters) and frequency occurred of some species of Flying family in the survey sub-areas.

Genus, species	North		Central		South	
	Mean density	Frequency (%)	Mean density	Frequency (%)	Mean density	Frequency (%)
Cheilopogon katoptron	0.9	38.46	4.6	86.36	2.1	43.48
Exocoetus volitan	0	0	0.4	9.09	0.9	13.04
Exocoetus	0	0	0.2	9.09	0	0
Hyrundichthys oxycephephalus	7.5	23.08	0	0	0	0
Hyrundichthys	0.2	7.7	0.3	4.5	0	0
Oxyporhamphus micropterus	0.3	30.77	2.6	77.27	0.8	34.78
Oxy. meristocystis	0.1	7.7	0.6	22.73	0.6	8.69
Parexocoetus mento	0.4	15.38	0.5	27.27	0.2	21.74
Exocoetidae	2.3	15.38	0.7	54.54	0.2	13.04

Table 9. Abundance and distribution FE-FL of some species of Flying fish Exocoetidae in the Vietnamese waters.

Ck: *Cheilopogon katoptron*; **Ev**: *Exocoetus volitan*; **E**: *Exocoetus sp.;* **Ho***: Hyrundichthys oxyocephalus;* **H***: Hyrundichthys sp.;* **Omi***: Oxyporhamphus micropterus;* **Ome***: O. meristocystys;* **Pm***: Parexocoetus mento;* **Exo***: Exocoetidae.*

Species	Ck.	Ev.	E.	Ho.	H.	Omi.	Ome.	Pm.	Exo.
Station	**North**								
1	x			x x		x			
2	x								
3						x			
4				x x					x x
5									
6							x	x	
7				x x				x	
8									
9	x				x	x			
10	x					x			
12	x								x
13									
14									
	Central								
11	x x					x x	x		x
15	x						x		
16	x					x	x		x
17	x					x x	x	x	x
18			x						
19	x					x			x
20			x						
21									
22	x					x			x
23	x					x	x		
24	x					x			
25	x					x			
26	x x					x x		x	x
27	x					x			x
28	x					x			
30	x					x		x	x
31	x					x x			x
32	x	x				x		x	x
33	x								x
34	x x	x				x		x	x
41	x					x			
42	x x				x	x x		x	

Table 9. (Continued).

Species	Ck.	Ev.	E.	Ho.	H.	Omi.	Ome.	Pm.	Exo.
Station No	**South**								
29	x								x
35	x	x				x		x	x
36		x						x	
37									
38									
39	x					x			x
40	x					x x			
43	x					x			
44	x					x			
45	x					x			
46									
47									
48								x	
49									
50								x	
51									
52	x	x				x			
53	x								
54	x								
55						x	x		
56							x	x	
57									
58									

Note: Number of FE-FL /1000 m^3 sea waters. x: 1-10; xx: 11-100.

Table 10. Mean abundance of the FL (Number under 1000 m^3 sea waters volume) and frequency occurred of some species of Scombridae in the survey sub-areas.

Species	North		Central		South	
	Mean density	**Frequency (%)**	**Mean density**	**Frequency (%)**	**Mean density**	**Frequency (%)**
Acanthucybium solandri	1.2	23.08	0.1	4.54	3.2	43.48
Scomberomorus guttatus	11.7	30.77	0.1	4.54	0.7	8.70
S.commersonii	3.8	15.38	0.4	4.54	0.9	4.35
Scomberomorus spp.	0.4	7.69	0	0	0	0
Sarda orientalis	0	0	0.5	4.54	0	0
Scomber japonicus	0	0	0.6	13.64	0	0
Rastrelliger kanagurta	14.0	30.77	0.1	4.54	6.9	17.39
Rastrelliger spp.	13.5	30.77	0.2	4.54	0.9	4.35
Auxis thazard	0	0	0	0	0.6	8.70
Euthynnus affinis	18.7	15.38	1.2	13.64	2.1	26.08
Katsuwonus pelamis	0	0	1.4	27.27	0.8	17.39
Thunnus albacares	0	0	1.1	31.82	0.3	4.35
Thunnus obesus	1.9	7.69	0.1	4.54	0	0
Thunnus tongol	0.4	7.69	0	0	0	0
Thunnus spp.	0.2	7.69	0	0	0	0

Table 11. Abundance and distribution FL of some species of Scombridae in the Vietnamese waters were collected from April 30 to May 29 / 1999.

As: *Acanthucybium solandri*; **Sg**: *Scomberomorus guttatus*; **Sc**: *S. commersonii*; **S:** *Scomberomorus sp*.; **So**: *Sarda orientalis*; **Sj**: *Scomber japonicus*; **Rk**: *Rastrelliger kanagurta*; **R**: *Rastrelliger sp*.; **At**: *Auxis thazard*; **Ea**: *Euthynnus affinis;* **Kp**: *Katsuwonus pelamis;***Ta**: *Thunnus albacares;***To**: *Thunnus obesus;***Tt**: *Thunnus tongol;* **T**: *Thunnus sp.*

Species	As	Sg	Sc	S	So	Sj	Rk	R	At	Ea	Kp	Ta	To	Tt	T
Station	North														
1							x x								
2															
3															
4	x	x x	x x				x x			xxx					
5								x x			x				
6													x		
7		x x						xxx							
8	x	x x					x x			x x					
9														x	
10			x x	x				x x							
12								x					x	x	
13	x	x x					x x								
14															x
	Central														
11	x				x x								x		
15											x	x			
16											x x	x			
17										x	x				
18												x		x	
19												x		x	
20		x	x												
21						x									
22															
23			x			x									
24															
25			x x										x		
26			x							x x			x		
27			x									x			
28															
30										x	x	x			
31											x x	x			
32						x		x			x	x			
33			x									x			
34			x												
41															
42		x					x								
	South														
29										x x					
35				x x								x			
36			x					x x	x						
37															
38		x	x				x x								
39		x x					x				x x				
40			x				x		x		x				
43															
44			x							x	x				
45		x	x x							x	x				
46		x	x												
47															
48		x									x				
49															
50		x								x					
51		x								x					
52								x							
53	x	x													
54		x													
55		x x					x x								
56		x													
57		x x													
58															

Note: Number of FL / 1000 m^3 sea waters. x:1-10; xx: 11-100; xxx: 101-182.

Carangidae

In the Carangids fish family, there were 62 species, belonging of 17 genera recorded [MoF (1996)], of which *Decapterus* is usually caught in high productivity by pelagic fisheries, such as: Purse seine, lift net with light and bottom trawl.

In this cruise, we collected 1055 FL of Carangids fish family, identified 2 species 6 genera, with body length from 2.5 – 12.5 mm, about 5.58% of total FL. During the cruise, 188 individuals were collected in the SWL and 867 individuals in the OHWL, from 42 stations.

Diagnostic features

The FL of Carangids fish are in many shapes, but generally they are elongate, flat in two sides. The highest depth is right after the head. The anus is lied in the second half of body, the head is big, with large mouth, the opercle has two specific spine lines. The pigment distribute in line on two sides with radiate form, black or brown. There are about 24 – 26 muscle-segments. [Fig. 37].

The FL of this family occur mainly along coastal range of the North and widely in the South. The Central is very sparse and in small quantity. The density is from 100 – 500 IN/1000 m^3 S.W in Southwest of CoTo island, Northeast of Mat island, out side area of Cu Lao Cham island and the Dinh An estuary. [Table 12, Fig. 8]

Table 12. Mean abundance of the FL(Number under 1000m^3 sea waters volume) and frequency occurred of some species of Carangidae in the survey sub-area.

Species	North		Centre		South	
	Mean density	Frequency (%)	Mean density	Frequency (%)	Mean density	Frequency (%)
Caranx	0.2	7.69	0	0	0	0
Carangoides	1.5	7.69	0	0	0	0
Decapterus	8.3	30.77	0.1	15.38	0.3	8.69
Naucrates ductor	0.4	7.69	0	0	0.1	8.69
Selar crumenophthalmus	1.6	15.38	0.2	76.92	4.9	34.78
Seriola	0.4	7.69	0	0	0.5	8.69
Carangidae	102.3	92.30	3.5	31.82	45.7	100.0

15% of total bottom caught fishes. [Le Trong Phan (1980)]. There are about 16 species belonging to 8 genera [MoF (1996)].

During the cruise, we collected 348 FE and 159 FL, about 2.39% of total FE and 0.84 of total FL, of which 5 FE and 24 FL were collected in the SWL from 13 stations, 343 FE and 135 FL in the OHWL from 37 stations. We initially classified 6 species of 3 genera. [Table 2].

Diagnostic features

Eggs are spherical, diameter from 1.01 – 1.34 mm. The yolk is identical, no oil globule. There are 2 styles of egg membrane: One is smooth like *Saurida undosquamis, Saurida elongata* and the second is six-vein style, in each tip of a vein has one short spine like egg of *Trachinocephalus myops, Saurida tumbil* and *Synodus variegatus.*

The FL are small, long and large mouth. Anus lied at the near end of the body with long and big intestinal tube. The quantity of pigment is depend on each species or developing stage. The number of muscle segment varies from species: 41-61 [Fig. 36]. The morphological characters is described briefly in Table 13.

Table 13. Diagnostic features of FE-FL of some species of Synodontidae.

Species	Diameter of egg (mm)	Structure of egg membrane	Number of muscle segment	Quantity of pigment at intestinal tube
Trachinocephalus myops	1.07-1.21	six-vein style has spine (0,02mm)	31-33+19-22	4 - 6
Saurida tumbil	1.01-1.11	six-vein style has spine (<0,01mm)	35-36+17-18	3-6 (equally big size)
Saurida undosquamis	1.26-1.34	smooth	26-27+21-22	3 - 6
Saurida elongata	1.26-1.28	smooth	29-30+22-26	1 - 4
Synodus variegatus	1.15-1.26	six-vein style has spine very small	58 - 61	10 - 12
Synodus hoshinosis	_	_	54 - 57	7 - 8

Table 14. Abundance and distribution of FE-FL of some species of Synodontidae in the Vietnamese waters were collected from April 30 to May 29 / 1999.

Tm*: Trachinocephalus myops;* **St***: Saurida tumbil;* **Su***: Saurida undosquamis;* **Se***: Saurida elongata;* **Sv***: Synodus variegatus;* **Sh***: Synodus hoshinosis.*

Species	Tm	St	Su	Se	Sv	Sh
Station No	**North**					
1	x x x		x			
2	x x x					
3						
4	x	x x				
5			x x	x		
6			x			
7	x		x x	x		
8	x		x			
9			x x			
10	x x					
12	x					x
13	x x					
14						
	Central					
11						
15						
16						
17						
18						
19						
20					x	
21	x				x	x
22	x					
23						
24						
25	x					
26						
27						
28						
30						
31						
32						
33						
34	x					
41			x			
42	x				x	

Table 14. (Continued).

Species	Tm	St	Su	Se	Sv	Sh
	South					
29	x x					
35	x				x	
36	x x			x x		
37	x x	x			x	
38				x x	x	
39	x			x x		
40	x	x	x	x		
43	x x			x x		
44	x x			x x	x	
45	x			x x	x x	
46	x x x					
47	x x			x x		
48	x					
49	x			x x		
50	x			x		
51	x x			x x		
52	x			x x		
53	x		x	x x		
54						
55	x x			x		
56				x		
57						
58						

Note: Number of FE-FL / 1000 m^3 sea waters. x: 1-10; xx: 11-100; xxx: 101-170.

The distribution of FE-FL occured mainly in two sub-regions of North and South. The Central sub-region is rarely observed. The major species is *Trachinocephalus myops* from 101-170 IN/1000 m^3 S.W from CoTo island to Bach Long Vi island and the beyond end of South sub-region. Saurida elongata, distributed denssity is from 11-100 IN/1000 m^3 S.W widely in South sub-region.[Table 14].

Leiognathidae

18 species of *Leiognathidae* belonging to 2 genera were recored in Vietnamese waters. [MoF (1996)].

Two species *Gazza minutta* and *Leiognathus elongatus* are in small number, the rest are only in family level. [Table 2].

Diagnostic features

FL of *Leiognathidae* family are slender, short with large mouth. The parietal elongate in saw shape, opercle has 2 spine lines. The anus lied in the before half of the body, black pigment distribute closely in under edge of caudal body.

They distribute in coastal area of South and North sub-region with density from 500 – 1750 IN / 1000m^3 S.W. They occur from Co To island and along coastal line to areas of Me-Mat islands; and Southwest area of Con Co island [Fig. 9]

Mullidae

They are the main species in all bottom hauls. In the sea of Vietnam, there are about 24 species belonging to 4 genera [MoF. (1996)]

During the cruise, we obtained 133 FL with length from 2.1 – 18.5mm, about 7.05% of total FL, of which 396 individuals belong to *Upeneus bensasi* and 352 individuals are *Upeneus* , the rest are in family level. We collected 740 individuals in SWL from 34 stations and 593 individuals in OHWL at 35 stations. [Table 2].

Diagnostic features

The FL of this family are small, elongate. Head and opercle have no spine. The anus lied in the

before half of the body. The quantity of muscle segment is about 24 (10+14). The big ones have two dorsal fins. The second fin is usually symmetrical to anal fin. The black pigment is in small round dotted line distributed sparsely on under edge of caudal body [Fig. 38]

The FL occur widely in survey area. In the SWL, the occurence frequency is about 56.62 %,in the OHWL it is 60.34%.

The density is high in hte North sub-region with maximum of 201-500 IN/1000 m3 S.W. In the South sub-region the highest is 11-101 IN/10003 S.W.[Fig.10]

Nemipteridae

In the Sea of Vietnam, ther were 33 species of 2 genera recorded [MoF(1996)]. During the cruise, we collected 441 individuals of Nemipteridae,about 2.33 % of total FL, of which 81 individuals were in the SWL at 11 stations and 360 individuals in the OHWL at 30 stations.

The distribution density is high in sub-region of the North and sparse in the South and the Central.[Fig. 11].

Gobiidae

Currently, there were 93 species belonging to 42 genera recorded [MoF(1996)]. However, not many of them are economic value. They distribute widely from the coastal brackish water areas to far islands and deep areas.

During the cruise, we collected 3173 FL with average length from 2.5 to 8.5 mm, about 16.77% of total obtained FL, of which 319 individuals were in the SWL at 20 stations and 2858 individuals in the OHWL at 53 stations. All specimens are identified in family level.

Diagnostic features

The FL of *Gobiidae* are tiny, elongate, small head and mouth. Opercle lack of spine, anus is in the middle of the body, intestinal tube is big and short, big bladder. The dorsal fin is symmetrical to anal one. At the under edge of caudal body, there are clearly some radial pigment. [Fig.39].

The distribution of FL is equally to all over the survey area. The distributed density is in Fig. 12.

Bregmacerostidae

The species of *Bregmacerostidae* are tiny and have not economic value. Up to now, there were 3 species of 1 genus [MoF(1996)].

During the cruise, 913 individuals were obtained, with length from 2.5 to 32.3mm, about 4.83% of total FL, of which *Bregmaceros macclellandi* is the dominant species. We got in the SWL 59 individuals at 17 stations and in the OHWL 593 individuals at 28 stations. *Bregmaceros atlanticus* was collected 3 FL in the SWL at 2 stations and 6 individuals in the OHWL at 1 stations. For *B. atripinnis* 6 FL in the SWL at 1 stations and 41 FL in the OHWL at 2 stations.

Diagnostic features

The FL are usually tiny, long and flat. Mouth is rather large. The tip of head often has one spine elongated to be a small string. The pelvic fin is rather big and the dorsal fin is symmetrical to anal fin, with soft rays. The black dotted or radial pigment cover all over the body. The quantity of muscle segment ranges from 47 – 58. The number of anal fin ray (A), dorsal fin ray (D) and muscle segment (M) varies from different species, e.g. *B. macclellandi* M: 52 – 58, A: 58 – 69 (62-66), D: 57-65 (58-61); *B. atlanticus* M: 54-55, A: 58-69 (62-66), D: 47-56 (50-54). [Fig. 40].

The FL distribute widely in the survey area. However, *B. atripinnis* occur only in open area of Tonkin Gulf. *B. macclellandi* tend to occur in the coastal area. *B. atlanticus* tend to occur in the open sea, deep sea areas [Fig. 13].

Myctophidae

They comprise the species living offshore and deep area. All of them are not economic value. Presently, there were about 4 species belonging to 5 genera, which have been recorded by Tran Dinh (1981). This data is not enough due to their habitat is living in deep sea and offshore areas.

During the cruise, 489 individuals were collected with their length is from 3.1 – 12.6 mm, about 2.59% of total FL. 7 individuals were in the SWL at 4 stations and 482 individuals in the OHWL at 31 stations. Initially, 17 species of 8 genera were classified [Table 2].

Diagnostic features

The FL are in small shape, elongate and flat with large mouth. The head and opercle lacks of spine. The eye is elliptical shape but gradually turn in to oval shape in the development. They have adipose fin after the dorsal fin. The pigment is black or brownish colour, round or radial shape. It distribute in order by rule on the body, which varies from different species. [Fig. 41].

The distribution of FL occurs in Central sub-region, in open sea and deep sea areas. The density is sparse [Table 15].

Lutjanidae

In the sea waters of Viet Nam, presently, there are about 52 species belonging to 14 genera [MoF(1996)].

During the cruise, we collected 354 individuals, about 1.87% of total FL. There were 123 individuals in the SWL at 23 stations and 222 in the OHWL at 29 stations. *Lutjanus erythropterus* were collected in the SWL 2 individuals at 1 station and 80 individuals in the OHWL at 13 stations. The distribution of larvae was shown in Fig.14.

Priacanthidae

There are 9 species belonging to 3 genera of this family in Vietnamese waters, now. [MoF (1996)]. In this survey, we collected 206 specimens, with average length from 3.2 – 10.8 mm, about 1.09% of total FL. There were 62 specimens collected in the SWL at 7 stations and 144 individuals in the OHWL at 25 stations. The density of distribution was shown in Fig.15.

Bothidae

The species of *Bothidae* are bottom associated ones. Their characters are for bottom living. There are about 43 species belonging to 12 genera identified [MoF(1996)].

During the cruise, 245 individuals were collected, with body length range from 3.0 – 18.1 mm, about 1.3% of total FL, of which 11 individuals are in the SWL at 8 stations and 234 individuals in the OHWL at 40 stations.

Diagnostic features

The FL of this family are thin, high and flat towards the dorsal and pelvic. The dorsal is usually from the tip of head to the caudal fin. The anal fin elongate from the end of the anus to near caudal fin. All dorsal and caudal fins have many soft rays. The brown-black radial shape of pigment distribute on the lower and upper edge of the body. The gut is long and can be rolled up in 2 folds.[Fig.42].

The FL are observed widely in all sea areas, but are abundant in coastal areas [Table 16].

Table 15. Abundance and distribution of FL of some species of Myctophidae in the Vietnamese waters were collected from April 30 to May 29 / 1999.

Dia*: Diaphus;* **Dio***: Diogenichthys;* **Ben***: Benthosema;* **Cera***: Ceratoscopelus;* **Hygo***: Hygophum;* **Myc***: Myctophum;* **Sym***: Symbolophorus*.

Species	Dia	Dio.	Ben.	Cera.	Hygo.	Myc.	Sym.
Station No	**North**						
1							
2							
3							
4							
5							
6							
7							
8							
9						x	
10							
12					x x	x	
13						x	
14							
	Central						
11					x x	x	x x
15		x x			x x	x x	
16		x	x x		x x	x x	
17		x x			x x	x	x
18		x x		x x	x x	x	x
19		x x	x	x x	x		
20		x			x		
21				x	x	x	
22		x		x		x	
23		x x	x x	x	x		
24		x x		x	x	x	x x
25		x x	x x		x	x	x
26	x	x	x	x x	x	x	
27		x x	x	x x	x		
28							
30					x		
31		x x		x	x	x x	
32	x	x	x		x	x	x
33	x x	x x		x	x		x
34		x		x			x
41	x x	x x		x	x	x	
42	x	x		x	x	x	
	South						
29	x			x			
35	x	x x		x x	x	x	
36				x			
37							
38							
39	x	x					
40	x	x x			x	x x	
43	x x	x x		x		x	
44	x	x		x x			
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							

Note: Number of FL/1000m^3 sea waters. x: 1-10; xx: 11-100.

Table 16. Abundance and distribution of FL of some species of Bothidae in the Vietnamese waters were collected from April 30 to May 29 / 1999.

Ae: *Arnoglossus elongatus;* **Arno***: Arnoglossus;* **Ca***: Crossorhombus azureus;* **Cros***: Crossorhombus sp.;* **Ph***: Psettina hananensis;* **Pi***: Psettina iijimai;* **Pset***: Psettina;* **Pseu***: Pseudorhombus.*

Species	Ae.	Arno.	Ca.	Cros.	Ph.	Pi.	Pset.	Pseu.
Station	**North**							
1		x						
2								
3								
4		x x						
5					x			
6							x	
7								
8		x x	x x		x x			x x
9					x			x
10					x			
12		x	x					
13		x x				x		x
14								
	Central							
11								
15				x				
16		x						
17								
18	x							
19	x				x			
20								
21		x						
22		x		x			x	
23		x		x				
24								
25								
26		x						
27		x			x			
28								
30							x	
31								
32					x			
33								
34								
41		x						
42		x						x
	South							
29					x			
35		x						
36		x x	x x		x		x	
37						x		
38								
39		x						
40						x		
43		x				x		
44		x x					x	
45		x				x x		
46	x	x						
47						x		
48				x				
49						x		
50	x x							
51		x						x
52				x				
53		x		x			x	
54		x				x		
55		x x		x				
56		x x					x	
57								
58								

Note: Number of FL /1000 m^3 sea water . x: 1-10; xx: 11-100; xxx: 101-200.

Cynoglossidae

The *Cynoglossidae* fish family comprises of benthods due to their morphological features. 27 species belonging to 4 genera were identified in Vietnamese sea waters. [MoF(1996)].

During the cruise, we collected 125 FE and 183 FL, about 0.86% of total FE and 0.97% of total FL, of which 7 FE at 4 stations and 4 FL at 2 stations were in the SWL, 118 FE at 4 stations and 179 FL at 28 stations were in the OHWL. We initially identified 2 species and 3 genera. The rest are in family level. [Table 2].

Diagnostic features

Eggs of *Cynoglossidae* are spherical, diameter ranges from 0.7 – 0.9 mm. The yolk crack is narrow, yolk contain from 7 – 36 oil globules with diameter from 0.02 – 0.08 mm, In the development of embryo, the embryo and yolk have many black pigment.

The FL are thin. Fins is from tip of head to anus. The dorsal, caudal and anal fins are not clearly divided. The first rays of dorsal fin (usually about 2) are longer than other. The pigment is black or brown in dotted or radial form. [Fig. 43].

The distribution of FL is all over the North and South sub-regions. The density is shown in Fig. 17.

Serranidae

Serranidae comprise of many economic species not only in high productivity but also in quality. Some species of *Serranidae* are the important subjects of marine and brackish water culture such as species of genus *Epinephelus*.

In Vietnamese waters, now there are about 68 species belonging to 17 genera [MoF(1996)].

During the survey, 186 individuals were collected with average length from 2.6 - 18.0 mm. 33 specimens in the SWL at 10 stations and 153 specimens in the OHWL at 31 stations were collected. *Epinephelus tauvina* was collected 1 FL in the SWL and 36 FL in the OHWL at 13 stations.

Diagnostic features

The body of FL of *Serranidae* are robust, oblong-oval to rather elongate, in two sides. The highest depth is right after the head. The anus is lied in the middle of body. The head is big with large mouth, sharp teeth. Opercle has 2 long spine lines. Some species of this fish family, the second spine ray of dorsal fin and the first spine ray of ventral fin are elongated in the growth. These spine rays of *E. tauvina* reach the maximum in length at 30th day then shorten little by little. [Nguyen, D. V. & Son, D. M. (1996)] [Fig. 44].

The density of distribution is shown in Fig.16.

Sphyraenidae

They are the pelagic species, migrating vertically daily. In the sea waters of Viet Nam, there are 10 species of 1 genus [MoF(1996)].

During this cruise, we collected 175 FL, with average length from 3.8 – 6.6 mm. 12 individuals in the SWL at 6 stations and 163 FL in the OHWL at 27 stations were collected.

Diagnostic features

The FL are elongate, big head, large mouth with sharp teeth. Anus is in the behind half of the body. The pigments on the body are black dotted ones, about 26 muscle segments.

The FL distribute widely over the survey area. The density is shown in Fig. 18.

Trichiuridae

In the sea area of Vietnam, there are 6 species belonging to 3 genera [MoF.(1996)].

During this survey, we collected 159 FE and 82 FL, about 1.1% of total FE, and 0.43% of

total FL. 66 FE at 2 stations, 6 FL at 3 stations in the SWL and 93 FE at 15 stations, 76 FL at 16 stations in the OHWL were collected.

The distribution of FE-FL occurs mainly in North and South sub-regions. The density iin Fig. 19.

Gempylidae

Now, there are about 8 species belonging to 7 genera of *Gempylidae* have been recorded. [MoF(1996)].

During the cruise, we collected 65 FL, only *Promethichthys prometheus* were collected from both in the SWL and OHWL. The *Lepidocybium flavobrumneum* and genus *Gempylus* were collected only in the OHWL. The distribution of FL occurs in the open area of Tonkin Gulf and the Central sub-region [Fig. 20].

Some other fish families

Some other fish families such as: *Apogonidae, Callionymidae, Labridae, Monacanthidae, Pomadasyidae, Sciaenidae, Scorpaenidae, Teraponidae, Tetrodontidae*, which only collected in small number of FL. They are shown in Table 17.

The distribution and density are in Fig. 21, 22, 23, 24, 25, 26, 27, 28 and 29.

Table 17. Some information on FL of some fish families were collected from April 30 to May 29/ 1999 in the Vietnamese waters by M/V SEAFDEC.

Order	Family	% of total	In the SWL		In the OHWL	
			Quantity of FL	Number of station occur	Quantity of FL	Number of station occur
1	*Apogonidae*	0.76	0	0	144	25
2	*Callionymidae*	0.96	34	7	147	30
3	*Labridae*	0.57	4	2	103	23
4	*Monacanthidae*	0.57	6	3	101	15
5	*Pomadasyidae*	0.43	2	1	80	13
6	*Sciaenidae*	0.72	12	2	125	14
7	*Scorpaenidae*	0.81	20	8	133	27
8	*Teraponidae*	0.54	32	4	71	10
9	*Tetrodontidae*	0.81	4	3	149	27

Discussion.

Species composition.

Up to now, 2085 species, 717 genera, 198 families and 32 orders of marine fishes of Vietnam have been found [MoF(1996)].

Comparing with the above-mentioned number, the species composition which was found through studying on FE-FL in this cruise was very small. However, many fish species belonging to the fish groups of Chondropterian, living near the coastal area, and the estuaries, this collect sampling, they could not be collected. On the other hand, the period of collecting FE-FL lasted within one month, that's why the abundance of number of species composition was not enough because each species spawns by a different season.

Above-mentioned results showed that within one month of collecting specimens of FE -FL, 78 families, 90 genera and 94 species were presented. This result also indicated that there were a lot of species spawned in this period and each research station at least 6 families and the most 30 families were caught.

Over 100 species, belonged to 36 families, have been recorded in the list of economical fishes of Vietnamese waters by the Ministry of Fisheries (1996). Comparing the list of economical fishes of Vietnamese waters with the list of FE-FL have been identified, 32 families are the same. Except some of families as *Polymenidae, Ariidae, Sillagidae, Rachycentridae,* they are fishes groups living near the coastal and estuary areas and not to appear in this survey cruise.

Nguyen Huu Phung (1971) presented a list of 38 families, 27 genera and 43 species during study on FE-FL in the Tonkin Gulf.

Do Van Nguyen (1981) presented a list of 95 families, 90 genera and 85 species during study on FE-FL from Nghia Binh to Minh Hai sea areas.

Comparing result of study work on M/V SEAFDEC with previous authors showed that: A lot of objects living near the coastal areas and at the estuaries were not recorded in this survey cruise, such as families of *Ariidae, Polymenidae, Elopidae, Salangidae,* and genera of *Clupanodon, Setypinna, Coilia, Chanos,* etc. But a lot of the objects living in the off-shore waters, and open sea were recorded in this survey cruise such as families of *Myctophidae, Melanotomatidae, Gonostomatidae, Istiophoridae, Gempylidae*, and some of species belonging to *Exocoetidae*.

Some fishes, which live in the deep sea, haven't been recorded in the list of marine fishes of Vietnam yet, [MoF(1996)], as *Myctophidae, Melanotomatidae*.Tran Dinh (1981) have been recorded 5 genera, 4 species belonging to *Myctophidae*. This number is much less than the present fish species. This is easy to understand, because fish species living in the deep areas have small body and always stay in the deep water layer, therefore some fishing gears can not use to catch them as trawl, gill net, long line, etc. To collect samples of this fishes, the oblique haul in the deep water layer has been used and some families, genera, species, living in the deep sea, have been added in the list of marine fishes of Vietnam by the study on FE-FL.

Comparing on the species composition of this survey cruise with Termvidchakorn's research (1999) and by the same method of sampling in the Western sea waters of Sabah, Sarawak and of Brunei Darussalam, which are opposite the Southern sea waters of Vietnam. This indicated that the structure of composition is relatively similar but it is less than in the number of species composition.

Distribution o f FE-FL.

FE-FL were distributed widely in the study area. General tendency, the density of distribution concentrates in the near the coastal areas and around the islands more abundant than in the offshore water and open sea. For all dominate fishes, the density of distribution of the North and South sea waters normally concentrates higher than of the Central sea waters, except *Myctophidae* and *Exocoetidae* families, density of distribution of both these families concentrate in the Central sea waters more abundant than in the North and South sea waters.

This is suitable with the previous studies in the Western coastal areas of the Tonkin Gulf (1977) and in the Nghia Binh-Minh Hai sea waters (1981) of Do Van Nguyen and the studies in Vietnamese sea waters (1994) of Nguyen Huu Phung. [Fig. 30, 31 and 32].

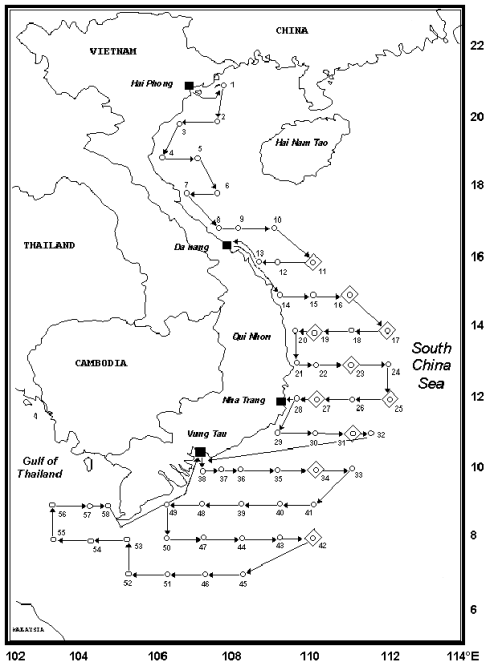

Fig. 1. Location of sampling stations and sub-area.

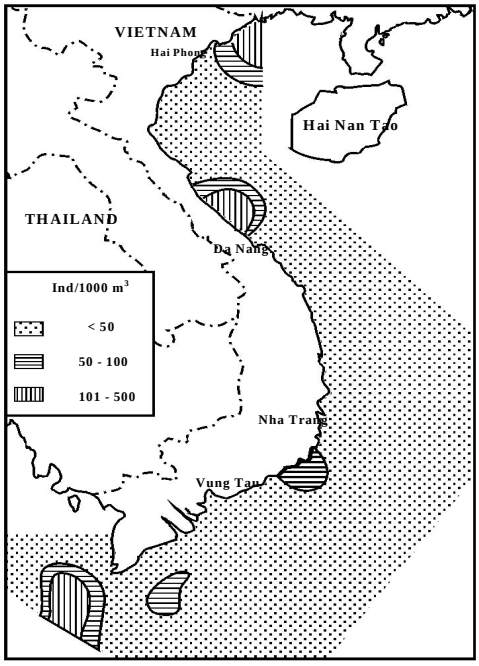

Fig. 2. Abundance and distribution of total fish eggs obtained from the surface haul in Vietnamese waters during April 30 - May 29/1999 by M/V SEAFDEC.

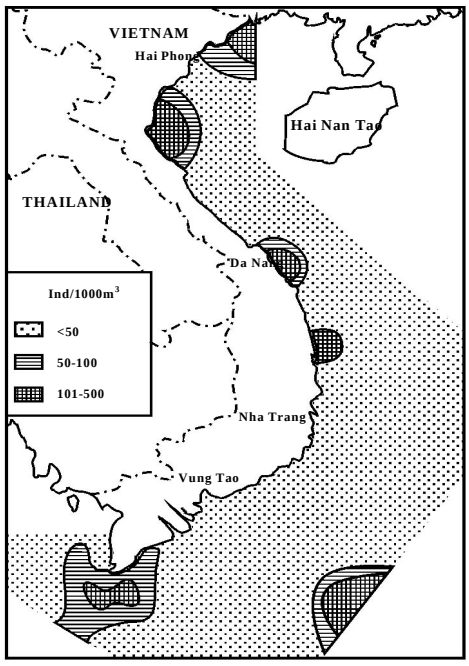

Fig. 3. Abundance and distribution of total fish larvaes obtained from the surface haul in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

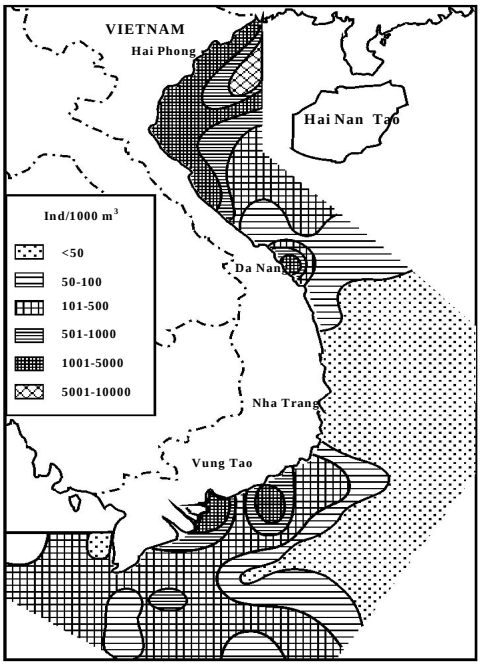

Fig. 4. Abundance and distribution of total fish eggs obtained from the oblique haul in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

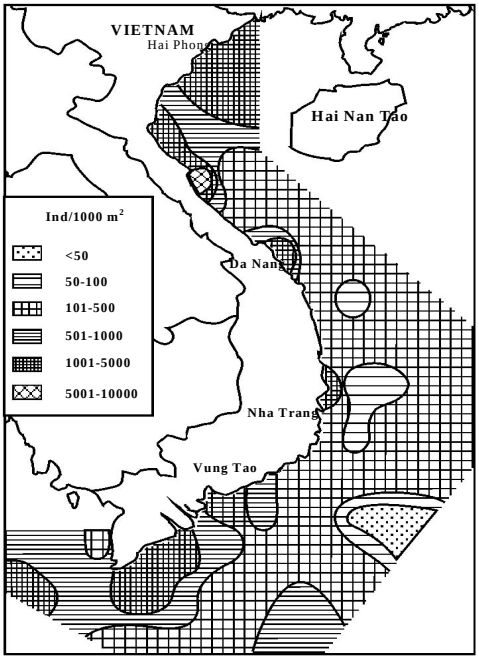

Fig. 5. Abundance and distribution of total fish larvae obtained from the oblique haul in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

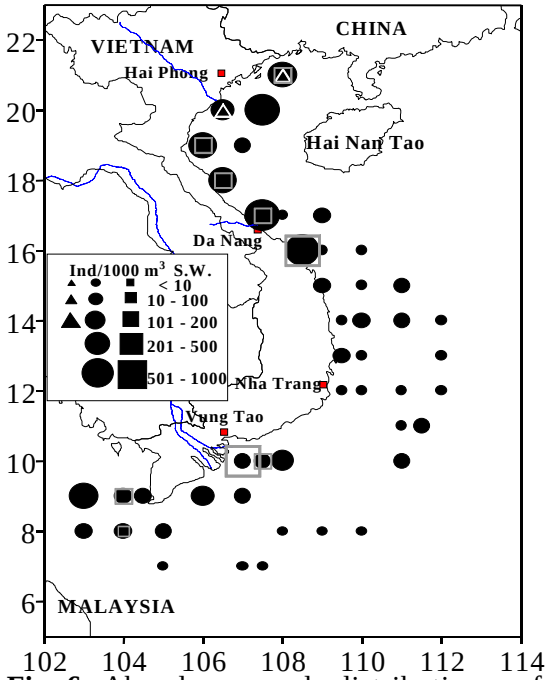

Fig. 6. Abundance and distribution of *Engraulidae* fish eggs and larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Stolephorus* ▲ *S. commersonii*

■ *S. zollengeri*

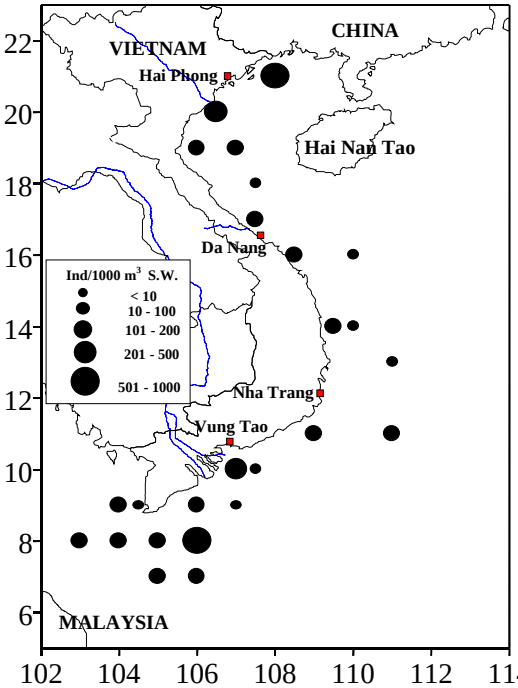

Fig. 7. Abundance and distribution of *Clupeidae* fish eggs and larvae obtained in Vietnam Waters during April 30 - May 29/1999 by M/V SEAFDEC.

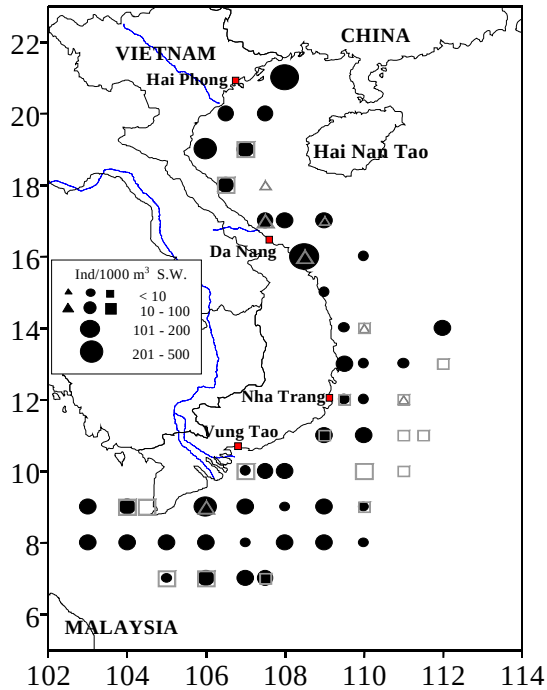

Fig. 8. Abundance and distribution of *Carangidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Carangidae* ▲ *Decapterus*

■ *Selar crumenophthalmus*

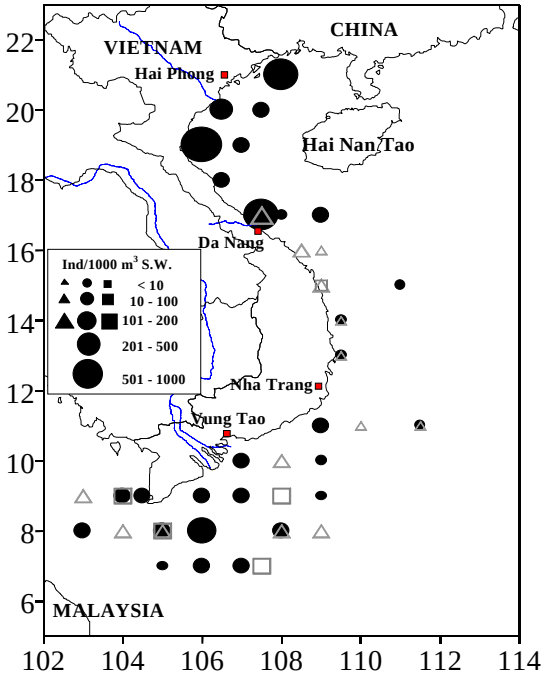

Fig. 9. Abundance and distribution of *Leiognathidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Leiognathus* ▲ *Gazza minutta*

■ *L. elongatus*

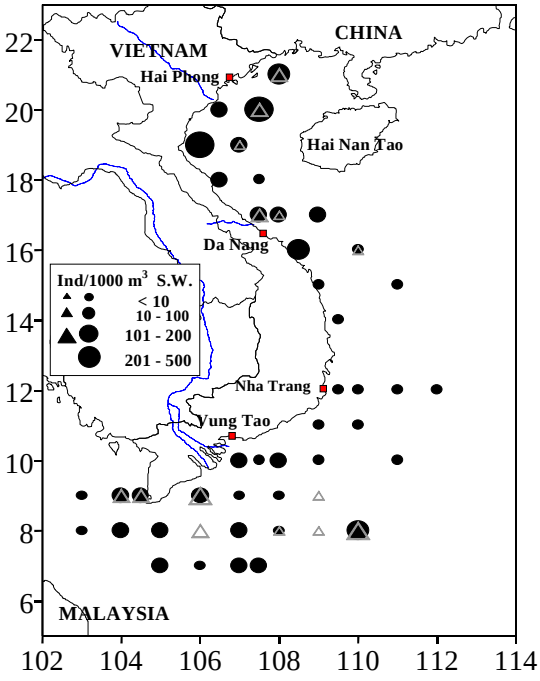

Fig. 10. Abundance and distribution of *Mullidae* fish eggs and larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Mullidae* ▲ *Upeneus bensasi*

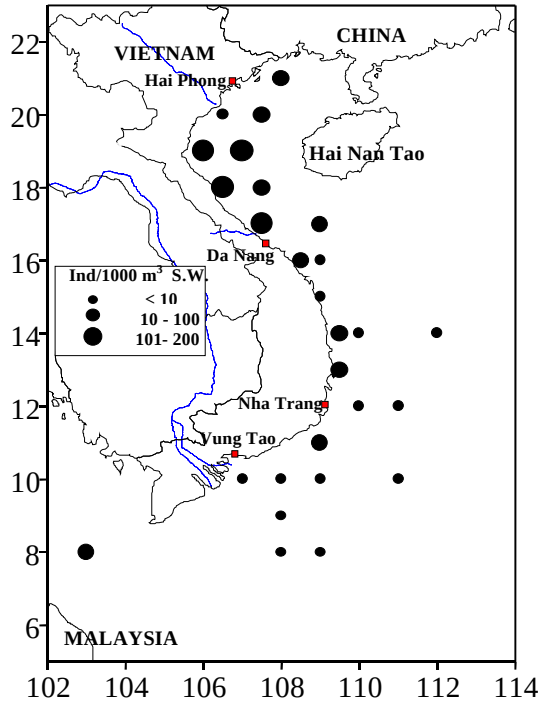

Fig. 11. Abundance and distribution of *Nemipteridae* fish larvaes obtained in Vietnamese Waters during April 30-May 29/1999 by M/V SEAFDEC.

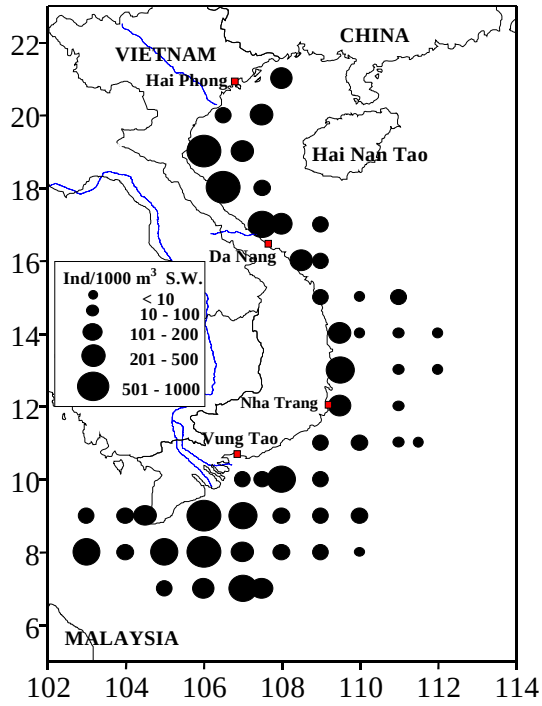

Fig. 12. Abundance and distribution of *Gobiidae* fish larvaes obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

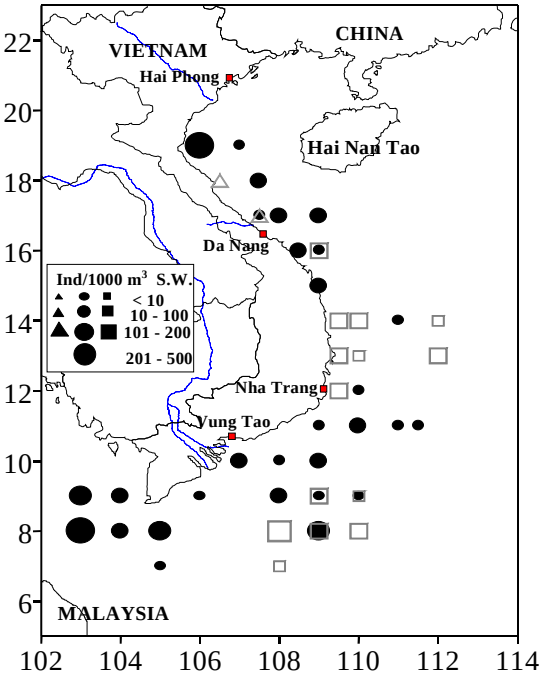

Fig. 13. Abundance and distribution of *Bregmacerostidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999.

● *Bregmaceros macclellandi*
■ *B. atripinnis* ▲ *B. atlanticus*

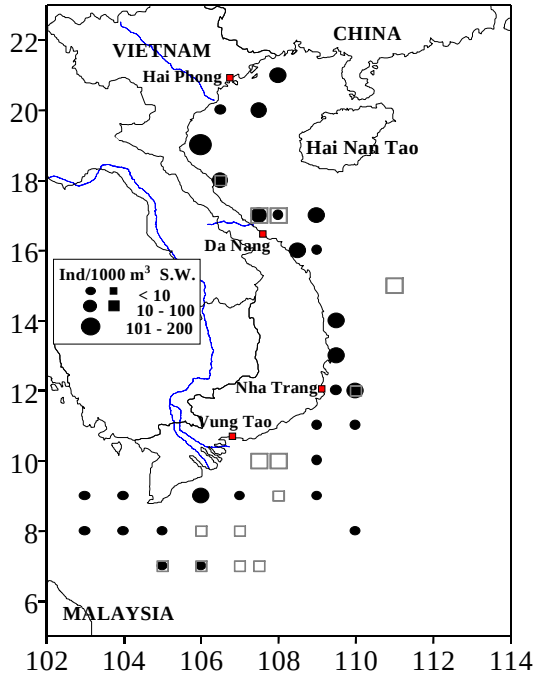

Fig. 14. Abundance and distribution of *Lutianidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999.

● *Lutjanidae* ■ *L. erythropterus*

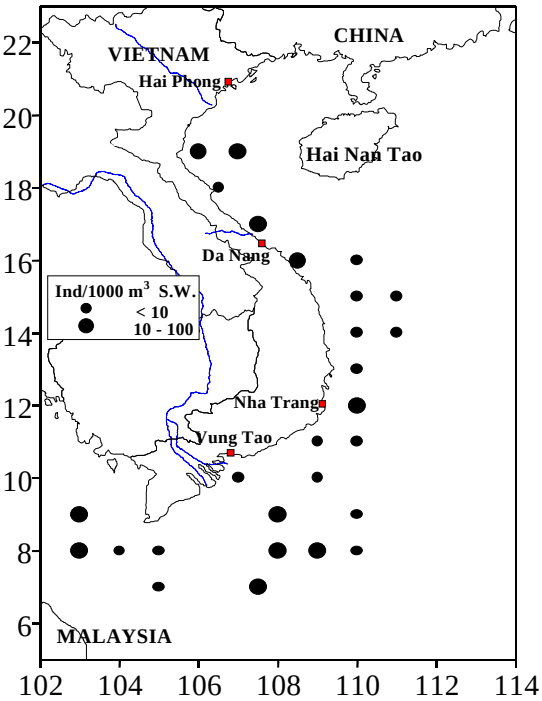

Fig. 15. Abundance and distribution of *Priacanthidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

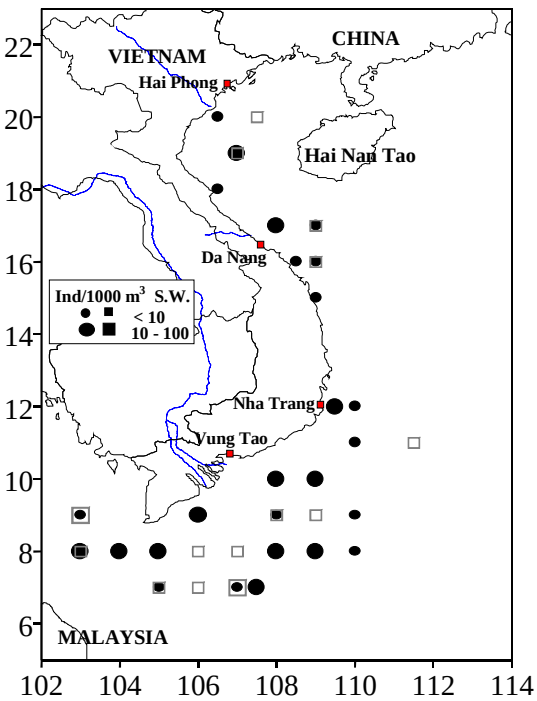

Fig. 16. Abundance and distribution of *Serranidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Seranidae* ■ *Epineplulus taurina*

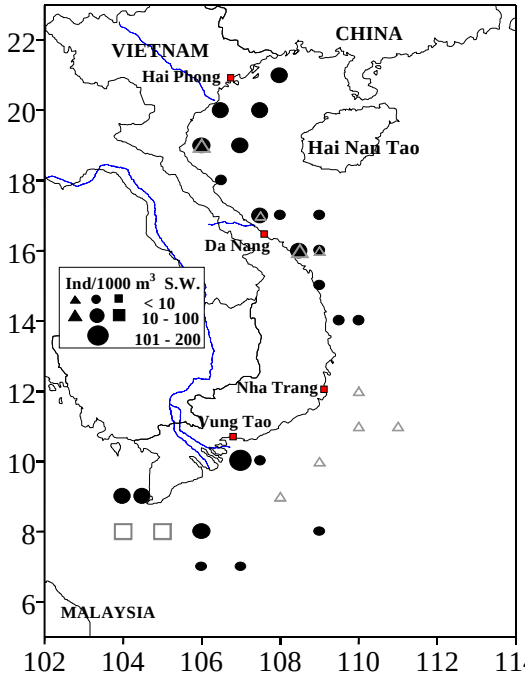

Fig. 17. Abundance and distribution of *Cynoglossidae* fish eggs and larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Cynoglossidae* ▲ *S. orientalis*

■ *Arelia bilibeata*

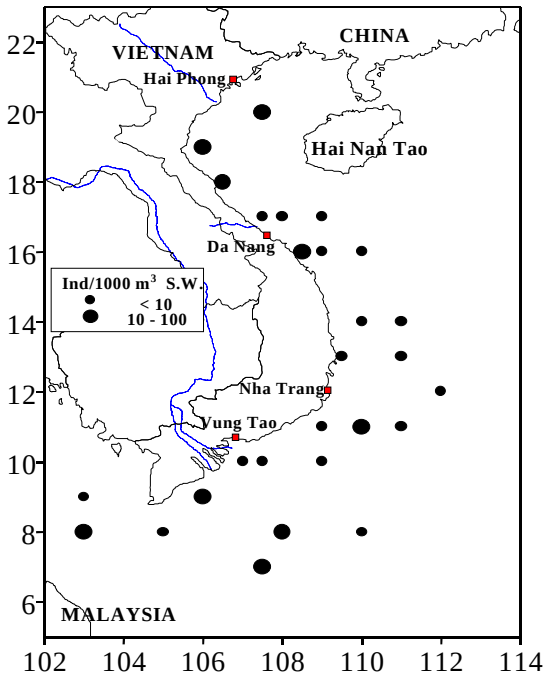

Fig. 18. Abundance and distribution of *Sphyaenidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

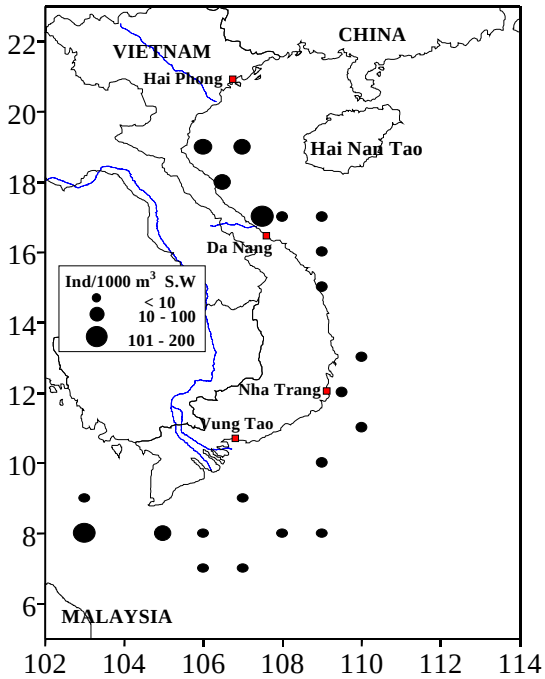

Fig. 19. Abundance and distribution of *Trichiuridae* fish eggs and larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC

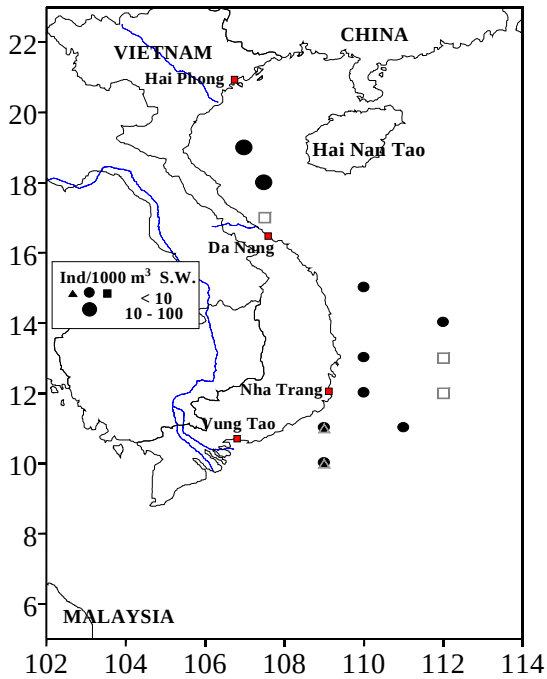

Fig. 20. Abundance and distribution of *Gempylidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

● *Gempylidae* ▲ *L. flavobrumneum*

■ *Promethichthys prometheus*

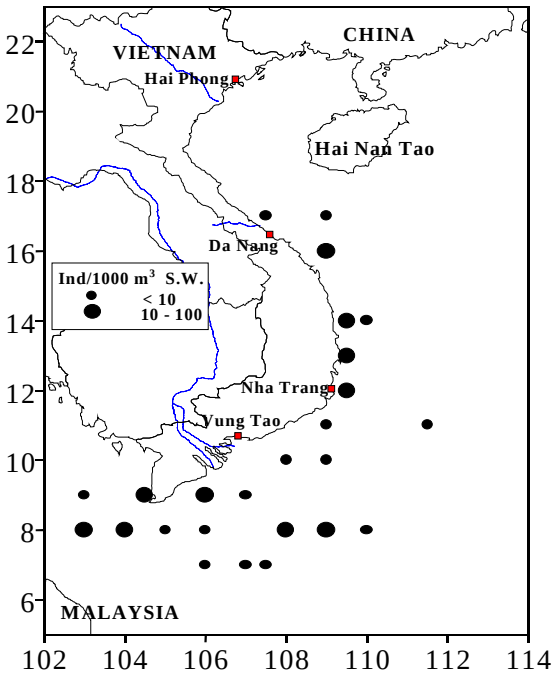

Fig. 21. Abundance and distribution of *Apogonidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

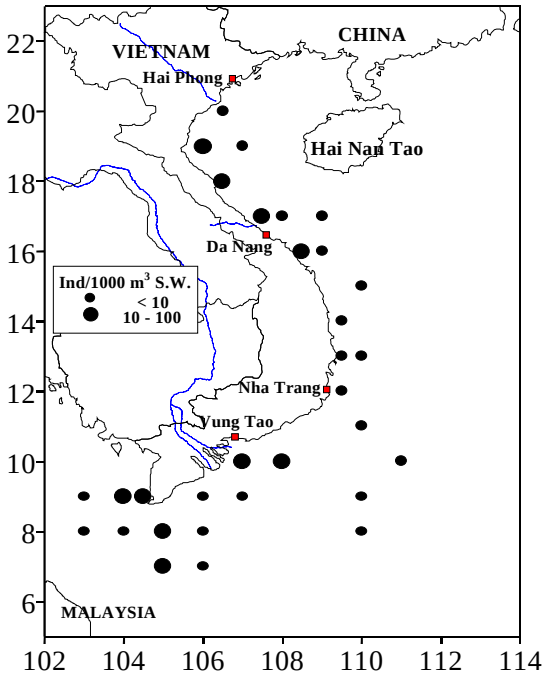

Fig. 22. Abundance and distribution of *Callionymidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

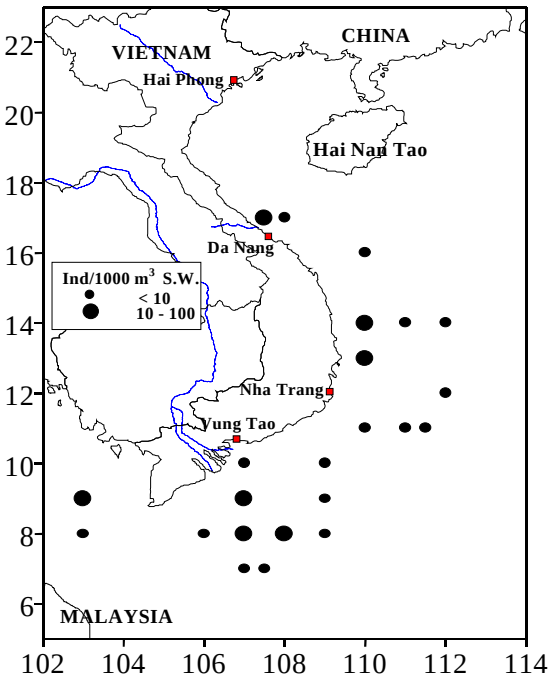

Fig. 23. Abundance and distribution of *Labridae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

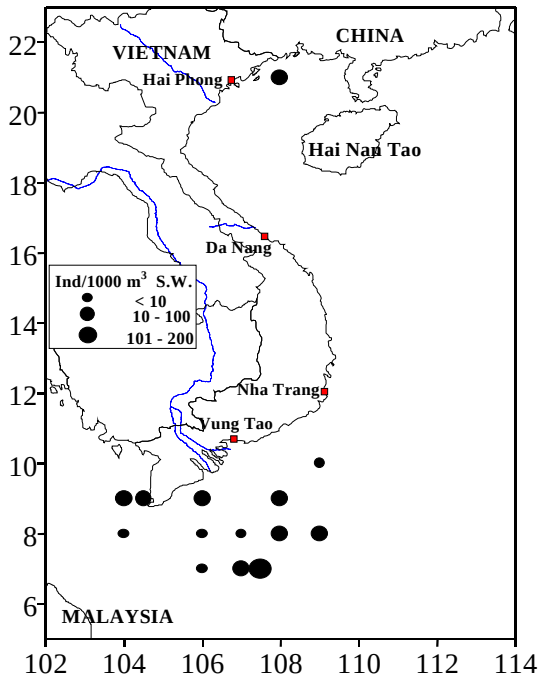

Fig. 24. Abundance and distribution of *Monacanthidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

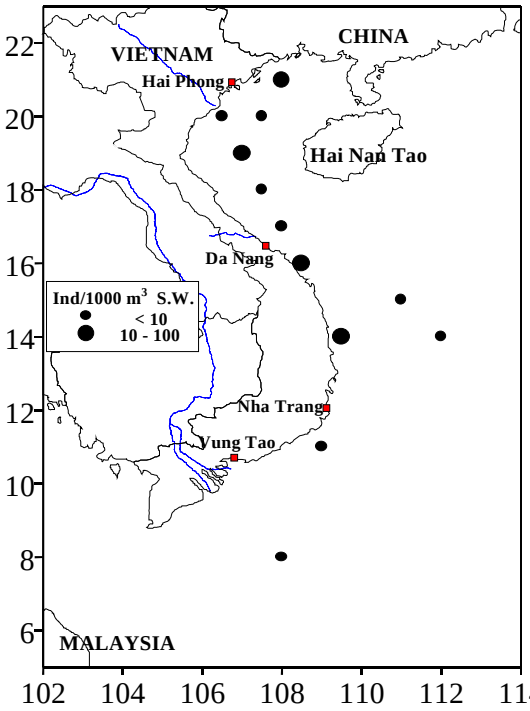

Fig. 25. Abundance and distribution of *Pomadasyidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

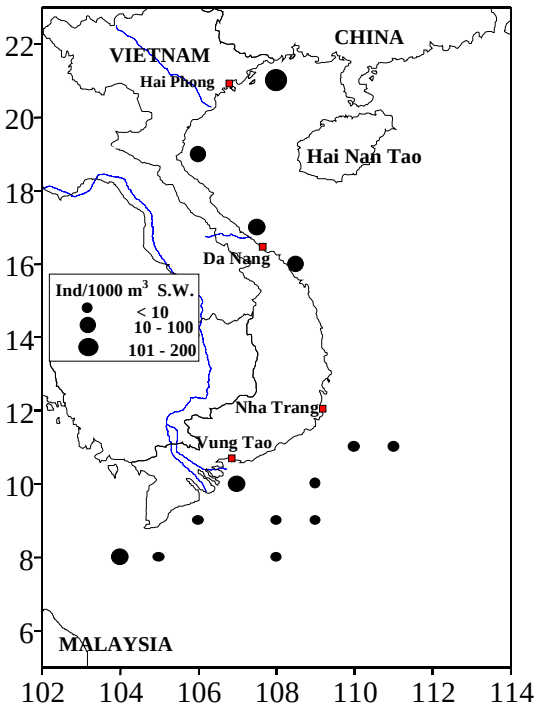

Fig. 26. Abundance and distribution of *Sciaenidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

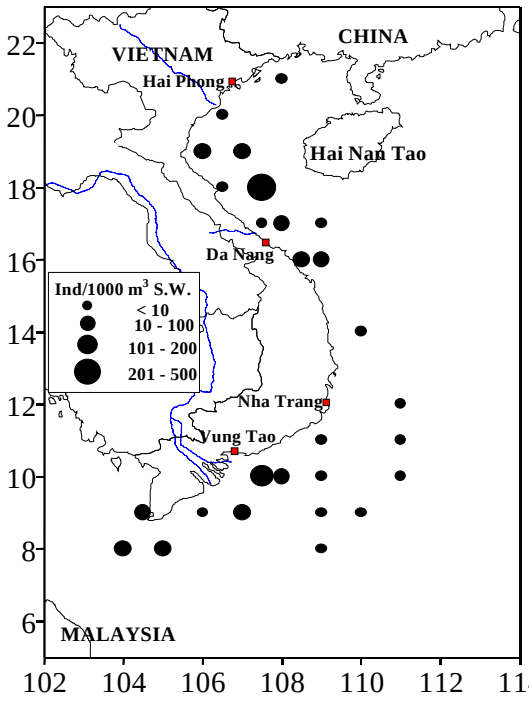

Fig. 27. Abundance and distribution of *Scorpanidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

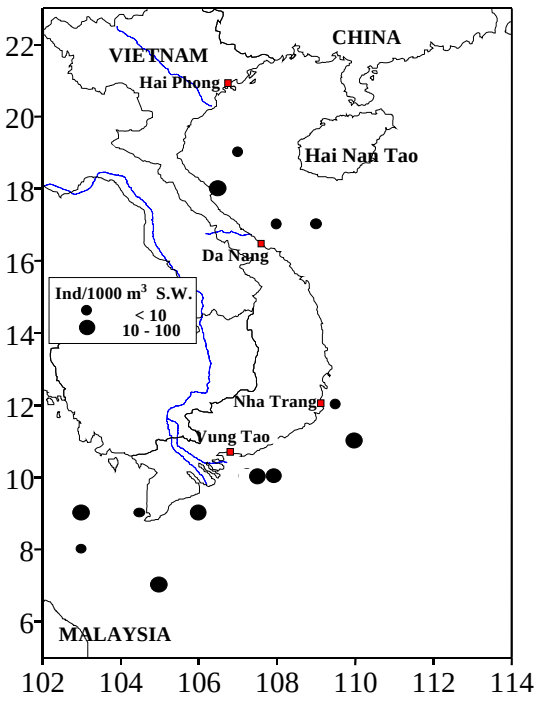

Fig. 28. Abundance and distribution of *Teraponidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

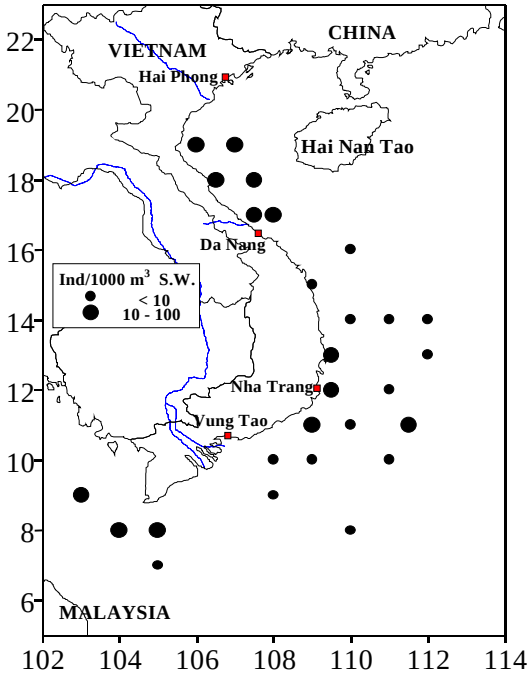

Fig. 29. Abundance and distribution of *Tetrodonidae* fish larvae obtained in Vietnamese Waters during April 30 - May 29/1999 by M/V SEAFDEC.

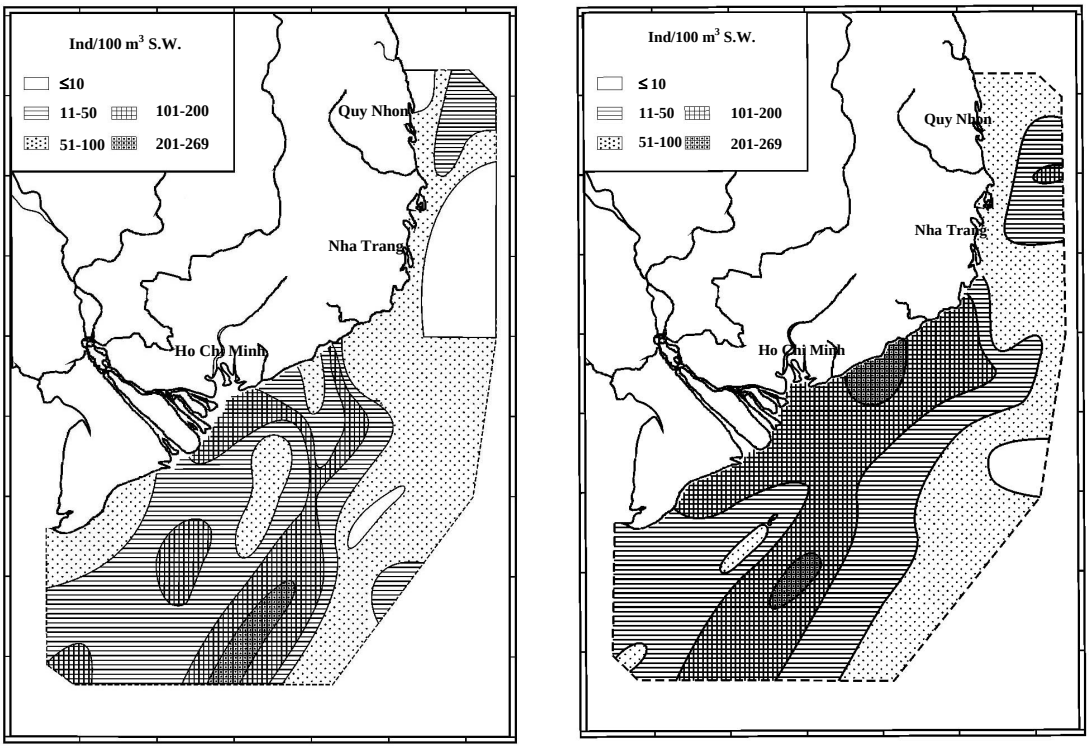

Fig. 30. Abundance and distribution of total fish eggs (a) and larvae (b) obtained during May 1979 in the area from Nghia Binh to Minh Hai provinces (by Do Van Nguyen 1977)

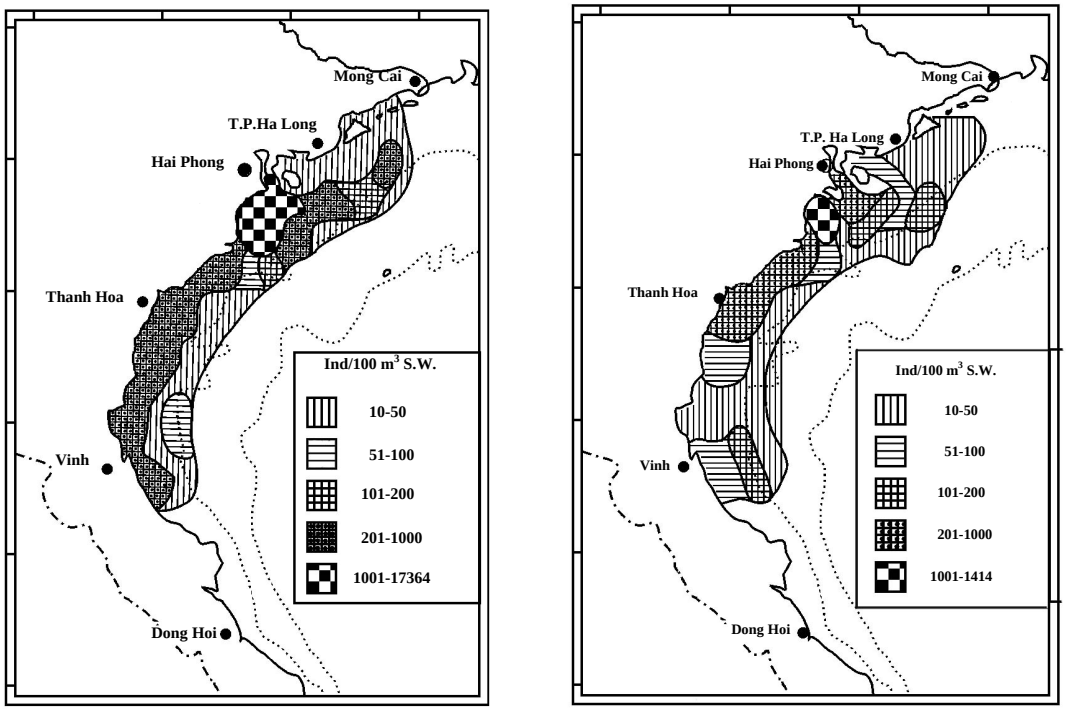

Fig. 31. Abundance and distribution of total fish eggs (a) and larvae (b) obtained during May/1976 in the coastal area from Mong Cai to Cua Sot (by Do Van Nguyen 1977).

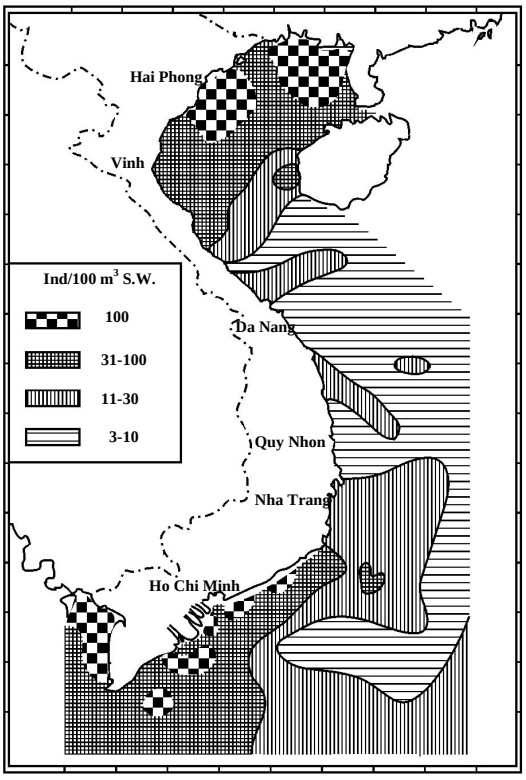

Fig. 32. Mean abundance and distribution of total larvae obtained during 1994 in the Vietnamese Waters (Nguyen Huu Phung 1994).

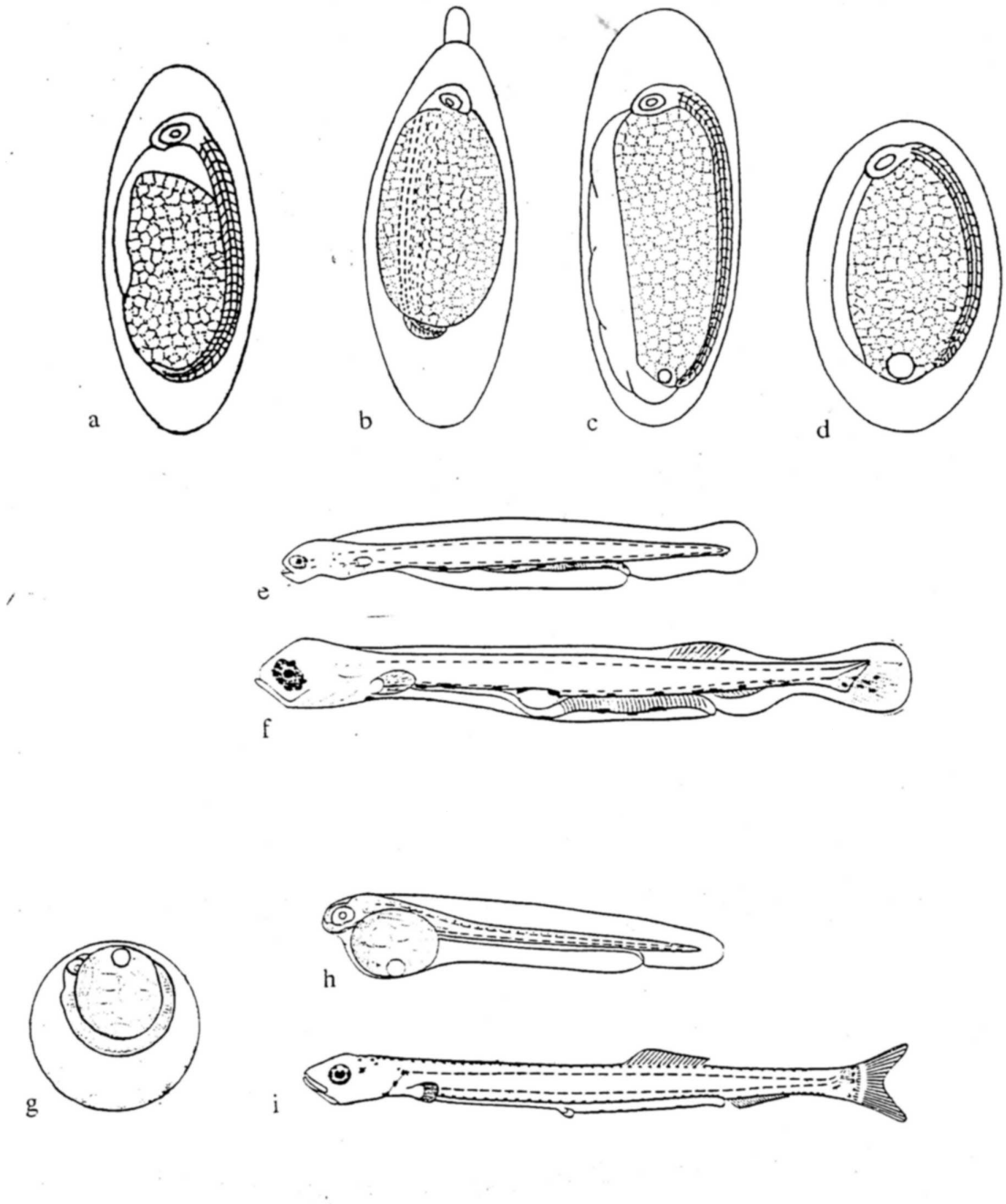

Fig. 33. The fish eggs and larvae of Engraulidae and Clupeidae
a. Egg of *Stolephorus zollengeri* (Blecker)(1.32-0.58 mm).
b. Egg of *S. commersonii* (Lac.)(1.62x0.66 mm)
c. Egg of *S. heterolobus* (Ruppell)(1.58x0.60 mm)
d. Egg of *Stolephorus sp*. (By N.H. Phung)(1.14-0.68 mm)

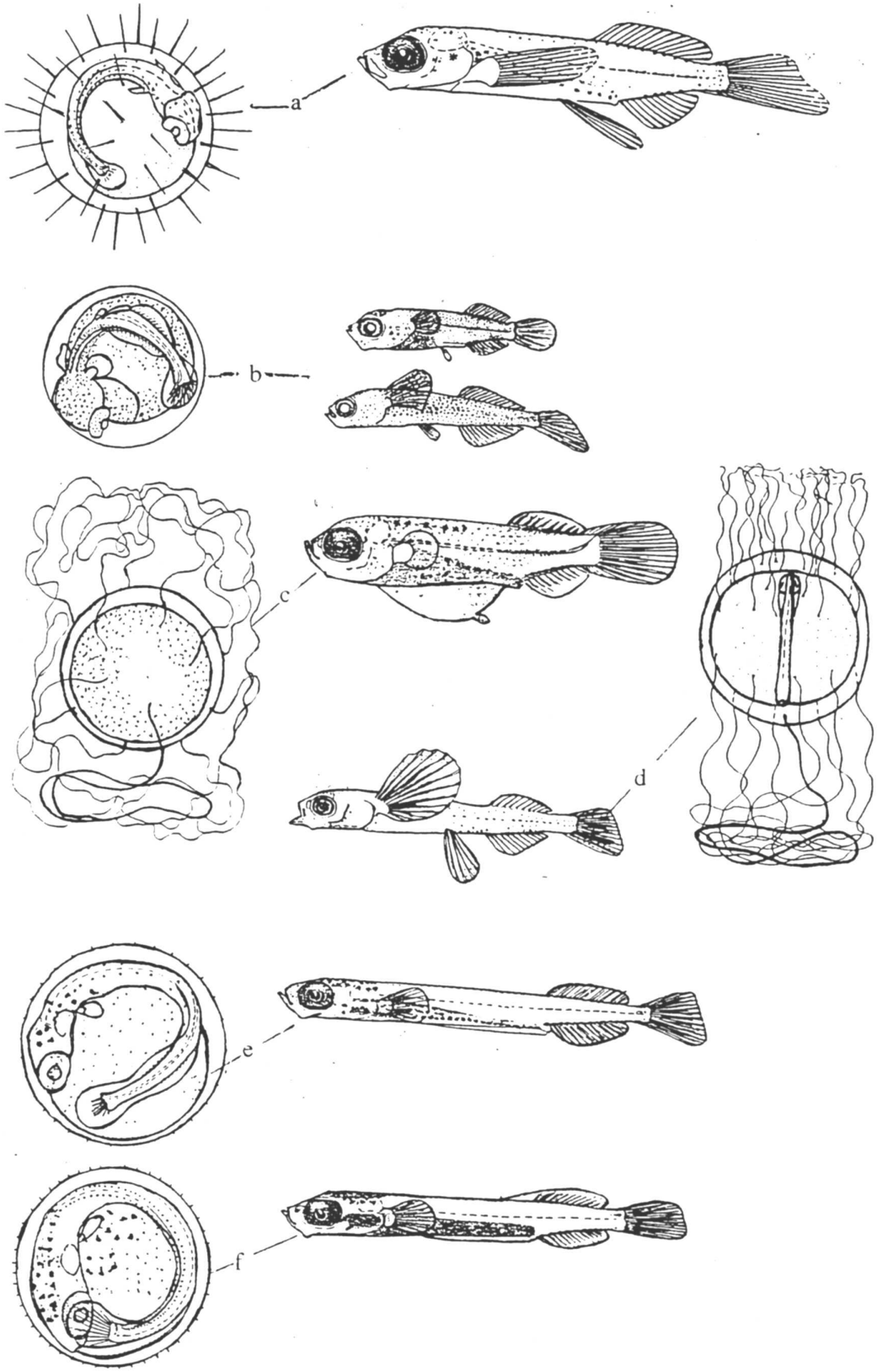

Fig. 34. The fish eggs and larvae of Exocoetidae.
a. *Cheilopogon katoptron*; b. *Exocoetus volitan*; c. *Parexocoetus mento*;
d. *Hyrundichthys oxycephalus*; e. *Oxyporhamphus meristocystis*; f. *O. micropterus*.

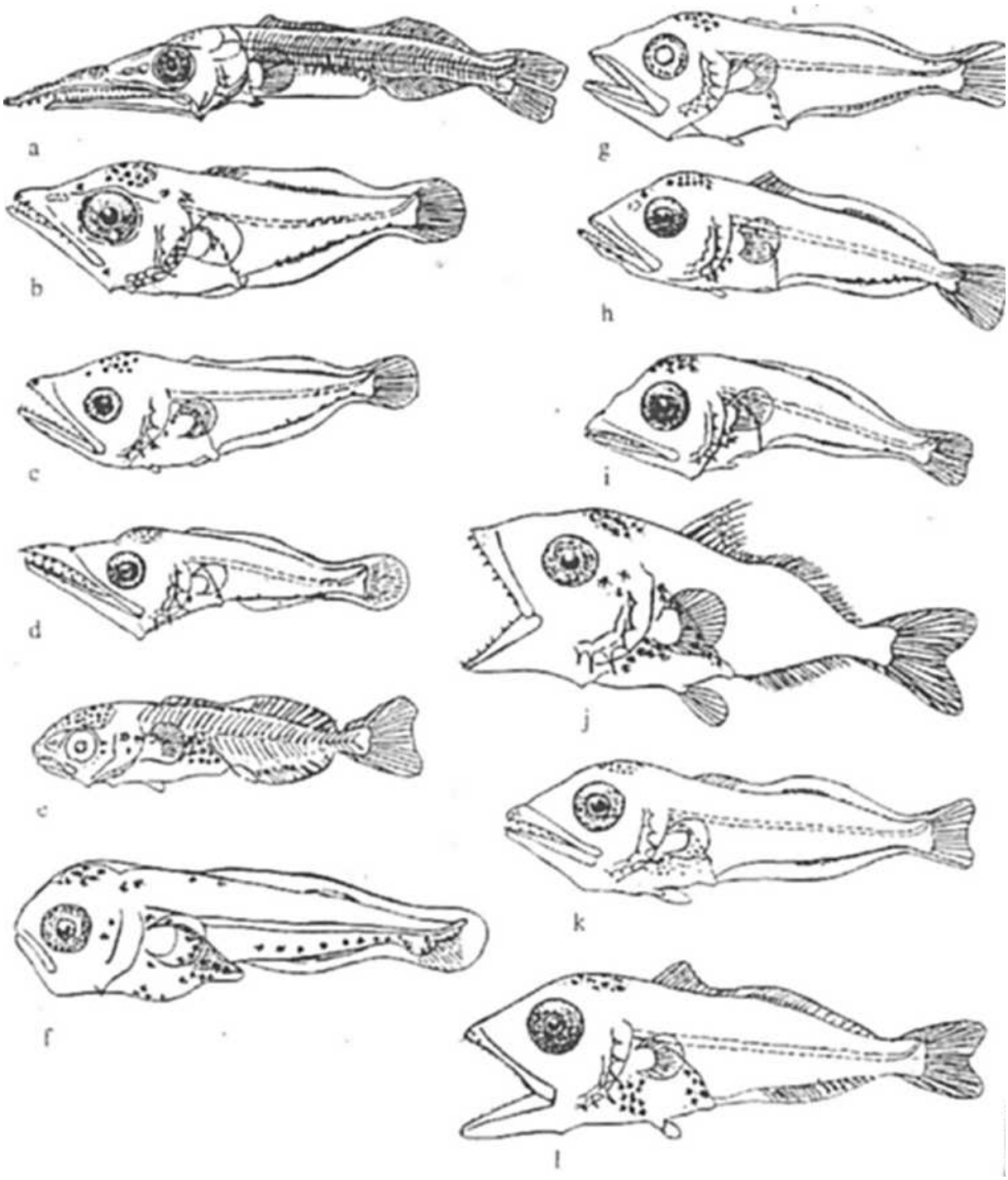

Fig. 35. Some fish larvae of Scombridae.
a. *A. solandri* (7.5 mm); b. *S. guttatus* (5.8 mm); c. *S. commersonii* (5.5 mm);
d. *S. Orientalis* (5.5 mm); e. *S. japonicus* (5.4 mm); f. *R. kanagurta* (6.3 mm);
g. *A. thazard* (5.7 mm); h. *E. affinis* (6.1 mm); i. *K. pelamis* (5.3 mm);
j. *T. albacares* (7.0 mm); k. *T. obesus* (6.1 mm); l. *T. tongol* (7.2 mm)

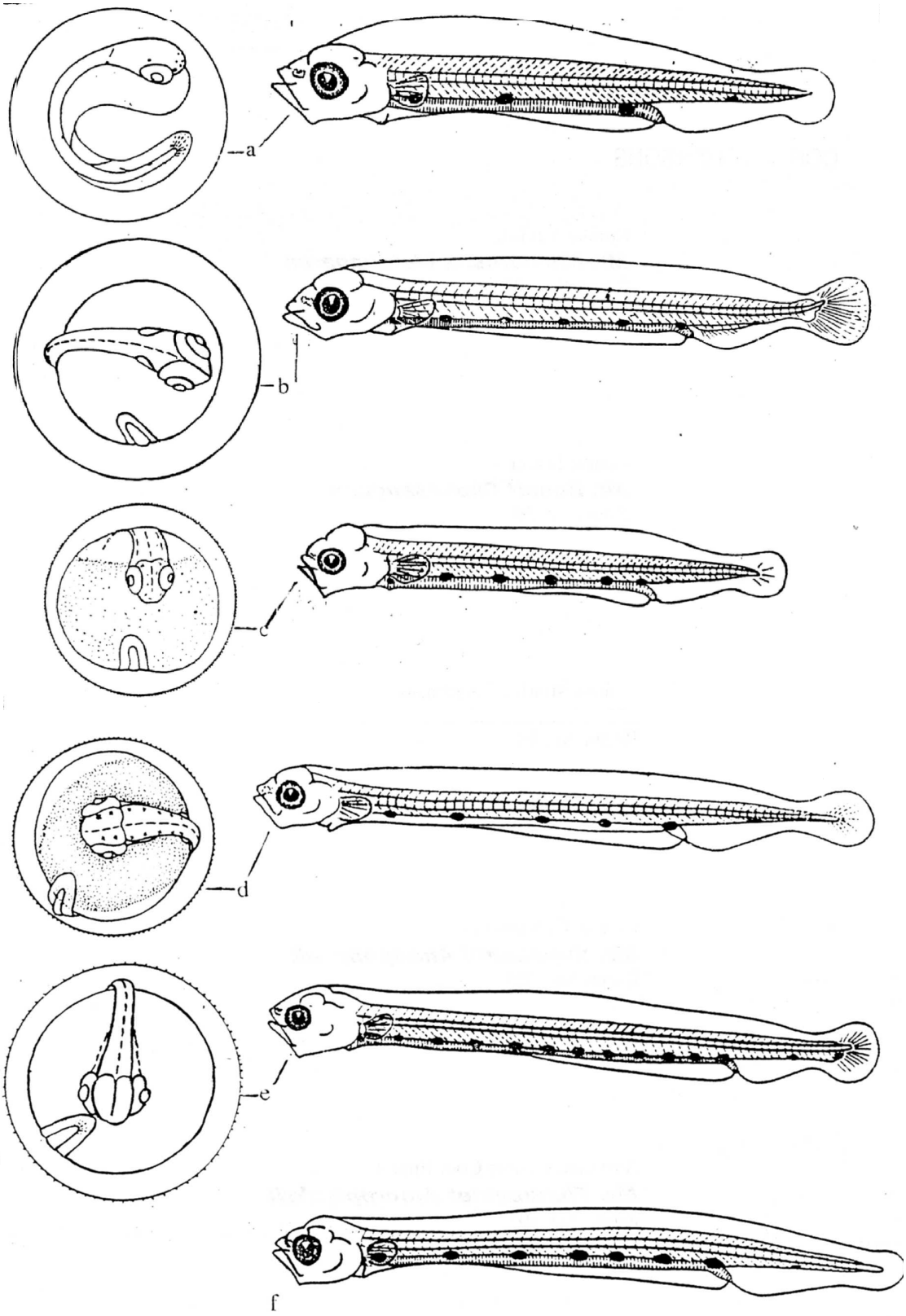

Fig. 36. The fish eggs and larvae of Synodontidae.
a. *Saurida elongata* b. *S. undosquamis*; c. *S. tumbil*; d. *Trachinocephalus myops*; e. *Synodus variegatus*; f. *S. hoshinosis*

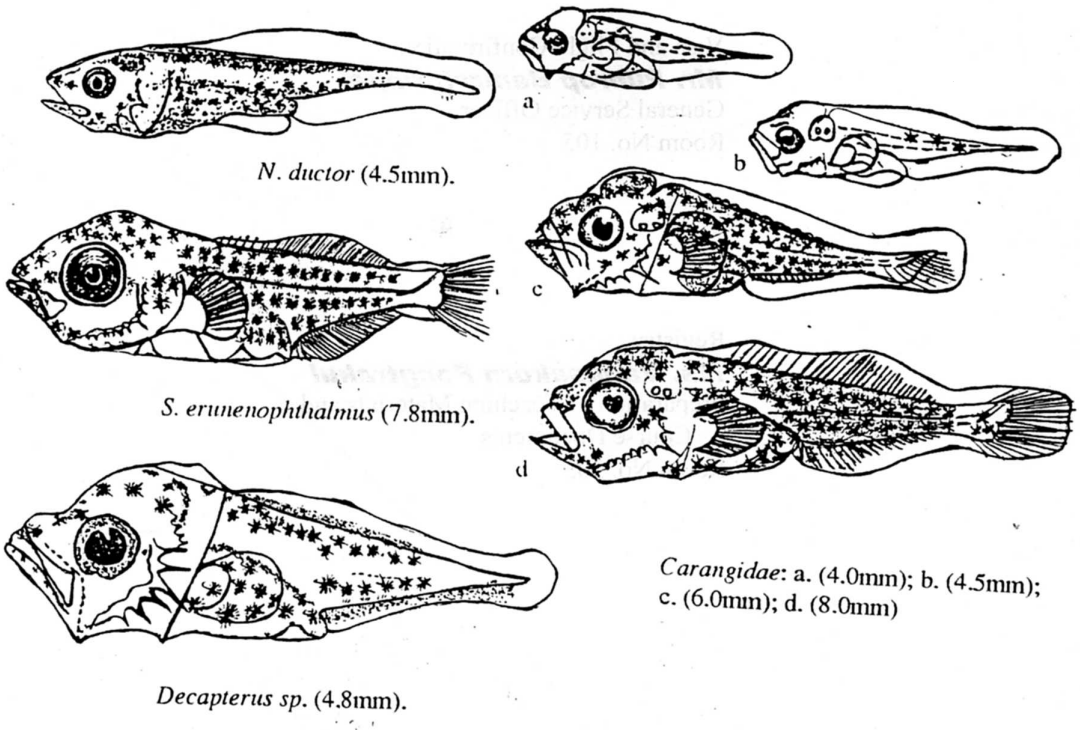

Fig. 37. Some fish larvae of Carangidae.

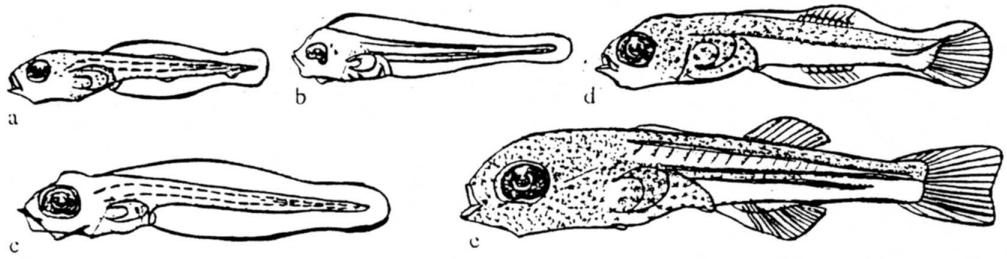

Fig. 38. Some fish larvae of Mullidae.
a. (3.2 mm); b. (3.5 mm); c. 4.0 mm); d. (6.1 mm); e. (10.2 mm)

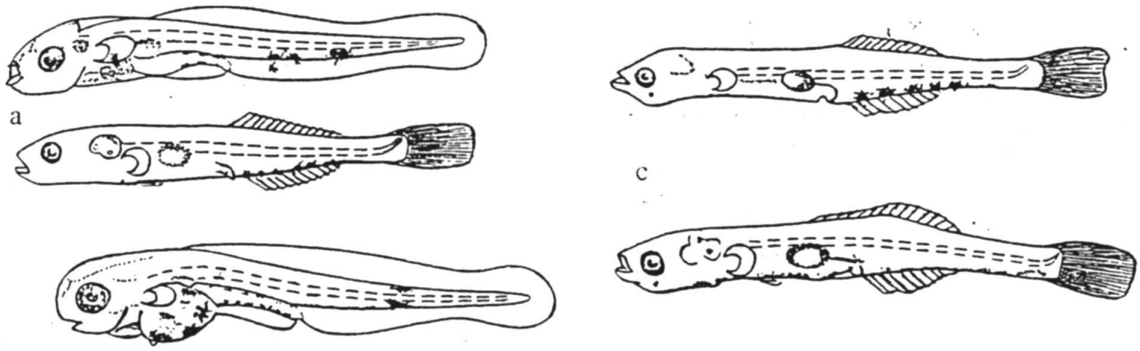

Fig. 39. Some fish larvae of Gobiidae.a. (3.3 mm); b. (5.3 mm); c. (8.0 mm)

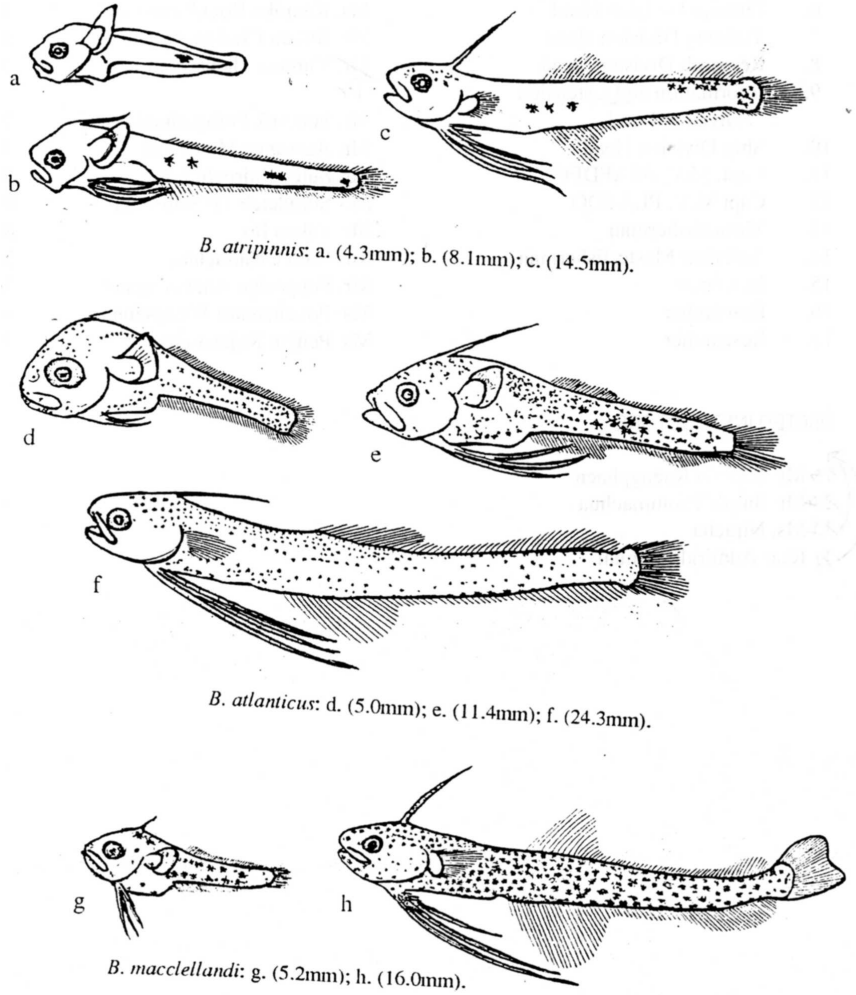

Fig. 40. Some fish larvae of Bregmacerostidae.

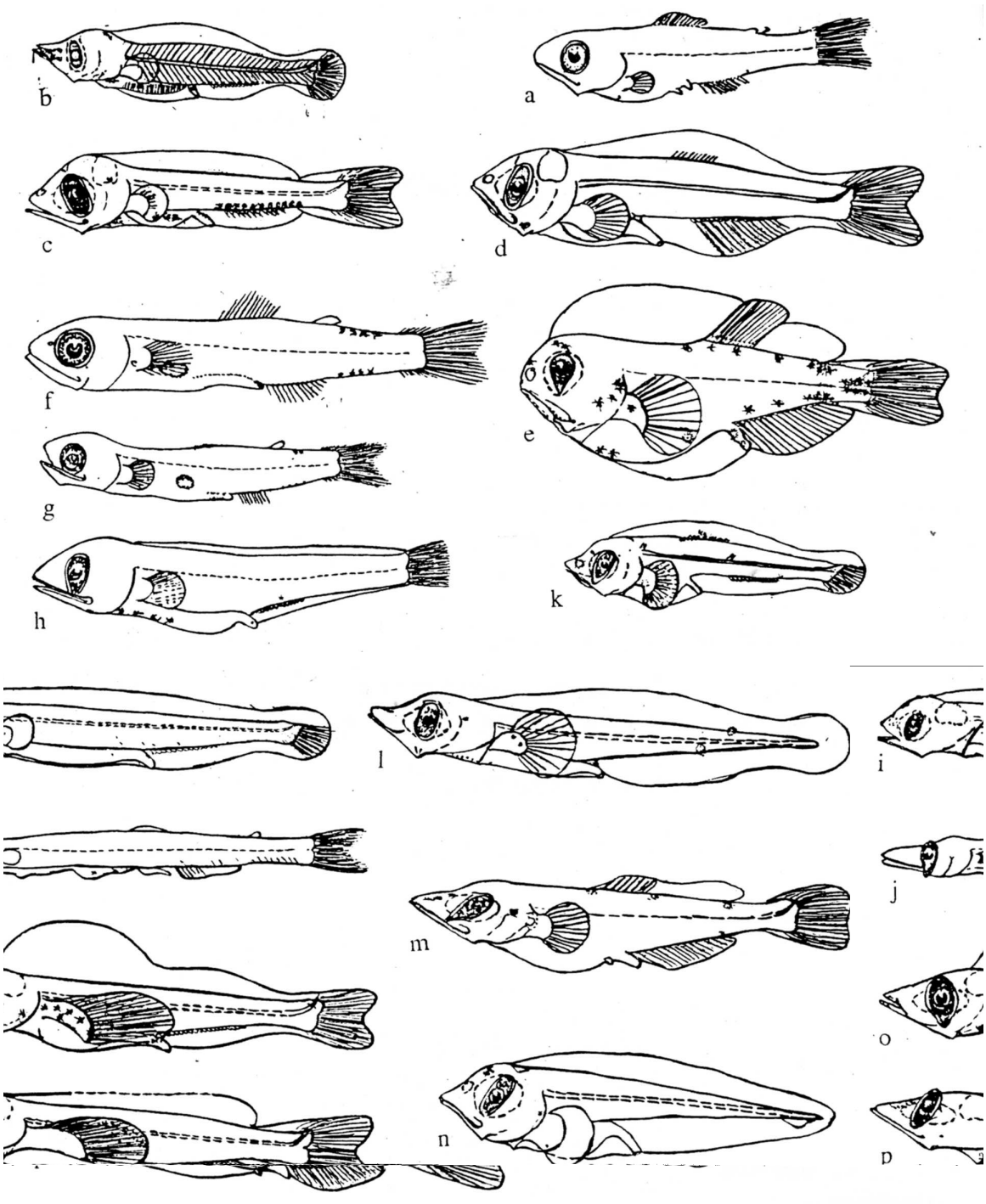

Fig. 41. Some fish larvae of Myctophydae.
a. *D. mollis* (5.1 mm); b. *D. atlanticus* (4.8 mm); c. *D. parnugus* (5.7 mm);
d. *B. surbobitale* (6.8 mm); e. *C. andreae* (6.3 mm); f. *C. maderensis* (6.8 mm);
g. *C. warmingi* (5.2 mm); h. *H. hygoni* (6.2 mm); i. *H. proximum* (6.5 mm);
j. *S. reinhardti* (6.3 mm); k. *M. asperum* (7.3 mm); l. *M. nitidulum* (7.3 mm);
m. *M. spinosum* (6.3 mm); n. *M. pristilepis* (5.7 mm); o. *S. boops* (7.3 mm);
p. S. evermanni (7.5 mm).

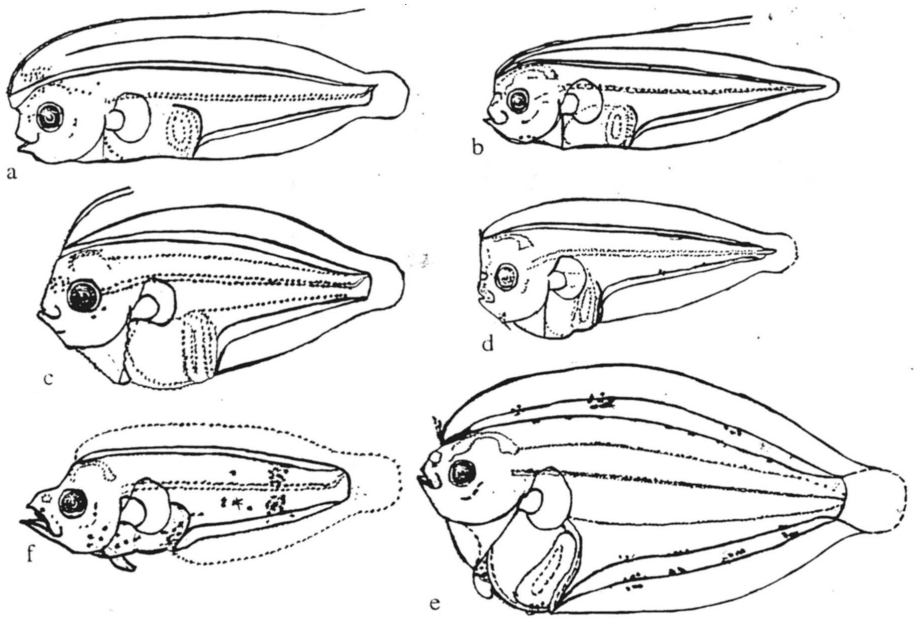

Fig. 42. Some fish larvae of Bothidae.
a. *A. elongatus* (8.3 mm); b. *Aronglossus sp*. (5.3 mm); c. *C. azureus* (6.9 mm);
d. *P. iijimai* (5.0 mm); e. *P. hananensis* (7.8 mm); f. *Psuedorhambus sp*. (8.2 mm).

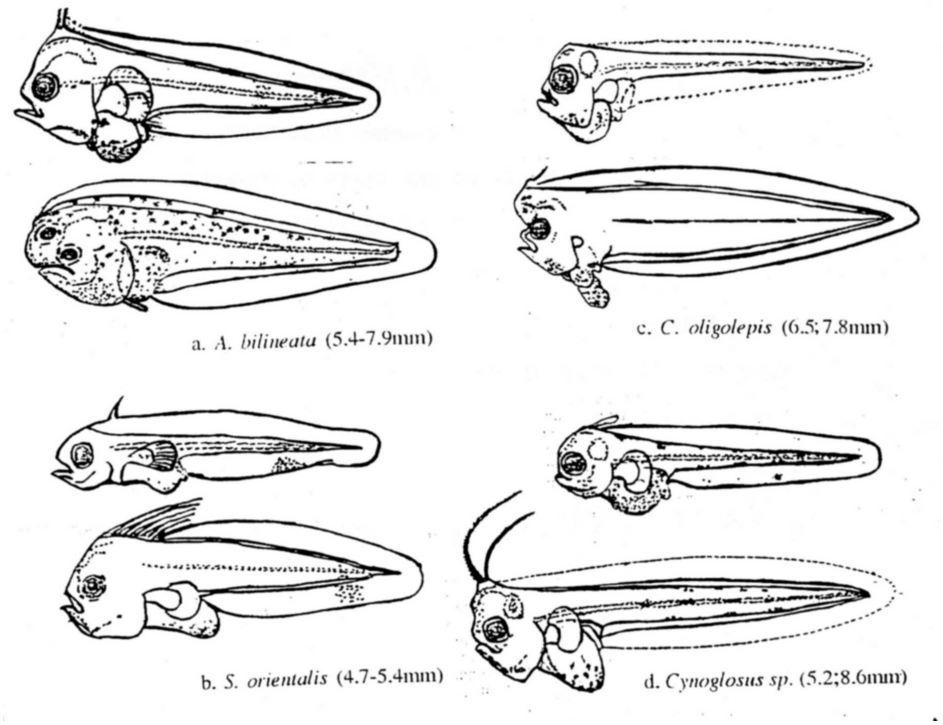

Fig. 43. Some fish larvae of Cynoglossidae.

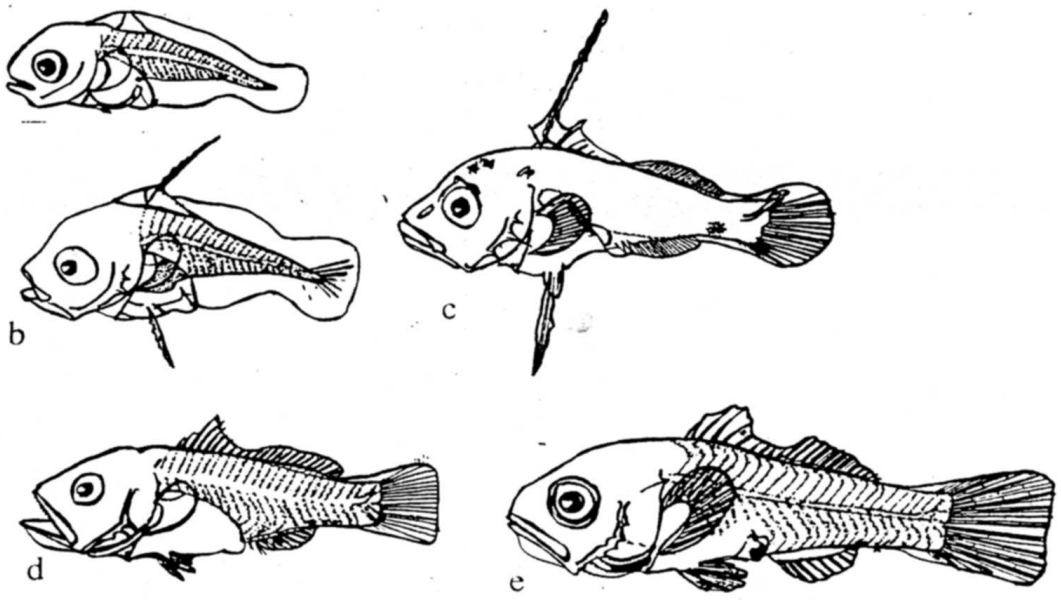

Fig. 44. Some fish larvae of Serranidae.
a. Epinephelus tauvina (2.2 mm); b. (2.6 mm); c. (4.2 mm);
d. Serranidae (4.3 mm); e. (5.6 mm).

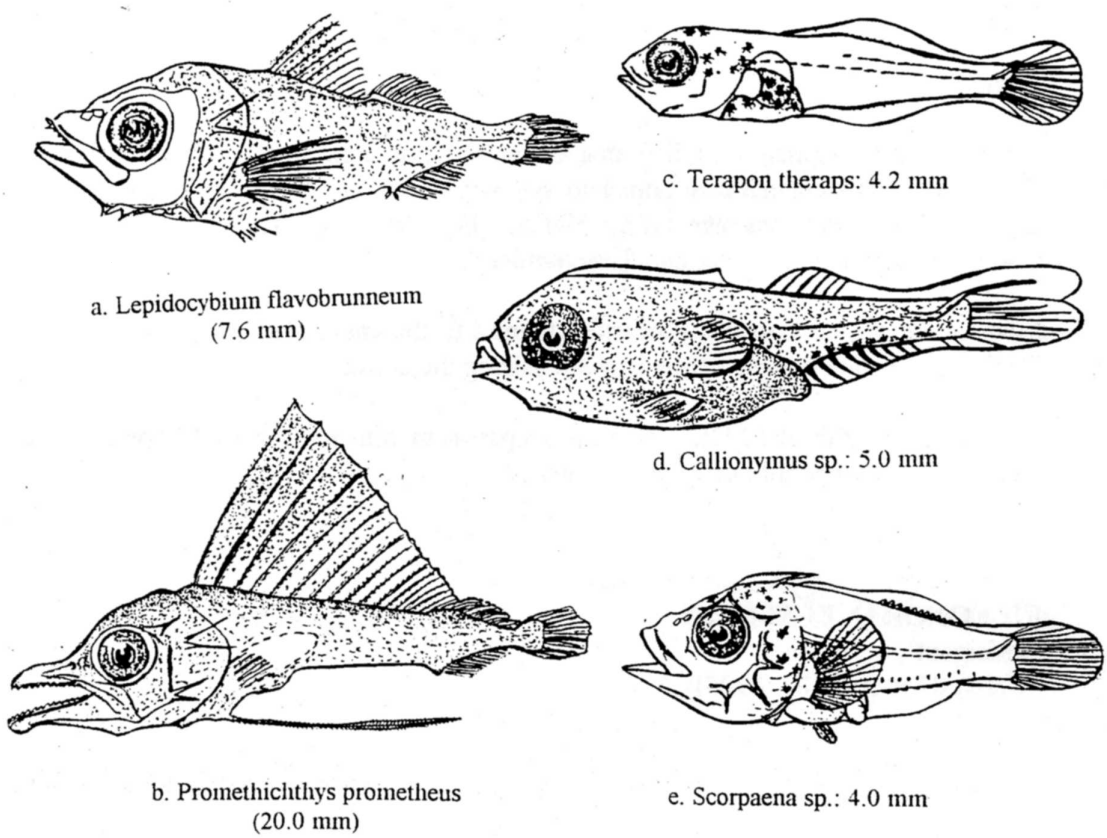

Fig. 45. The larvae of some fish families.
Gemylidae; Teraponidae; Callionymidae; Scorpaenidae.

Conclusions

At first, 78 families, 90 genera and 94 species of FE-FL have been identified, family *Engraulidae* occupied the highest number of all, 85% of total FE and 23.8% of total FL.

During survey species composition which occurred to spawn was very abundant. At each study station, at least 6 families and highest 30 families occurred.

The most abundant fish species, which spawned during survey, was pelagic fishes, obtained 39.37% of total FL.

The density of concentration of FE-FL along the coastal area and around the islands were abundant more than the offshore water and deeper water or open sea.

Comparing between FE and FL, the density and distribution of FE usually concentrated more abundant than of FL.

The density of distribution of FE-FL in the Northern adjacent area is the most abundant of all, follows to the Southern adjacent areas, the Central adjacent area is the least abundant.

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Appendix. **Geographycal position of some islands, estuaries, and provinces (in order from North to South).**

Order	Name	Lattude (N)	Longtude(E)
1	Mong Cai (Quang Ninh)	$21^0 32'$	$107^0 58'$
2	Co To islands	$20^0 58'$	$107^0 45'$
3	Long Chau islands	$20^0 37'$	$107^0 08'$
4	Ba Lat mouth	$20^0 17'$	$106^0 32'$
5	Bach Long Vi island	$20^0 08'$	$107^0 43'$
6	Me island	$19^0 24'$	$105^0 55'$
7	Mat island	$18^0 49'$	$105^0 57'$
8	Cua Sot mouth	$18^0 27'$	$105^0 56'$
9	Con Co island	$17^0 10'$	$107^0 22'$
10	Thuan An mouth	$16^0 33'$	$107^0 38'$
11	Da Nang city	$16^0 03'$	$108^0 11'$
12	Cu Lao Cham island	$15^0 57'$	$108^0 30'$
13	Hoi An mouth	$15^0 54'$	$108^0 22'$
14	Quy Nhon (Nghia Binh)	$13^0 46'$	$109^0 10'$
15	Nha Trang city	$12^0 15'$	$109^0 08'$
16	Phu Quy island	$10^0 34'$	$108^0 51'$
17	Vung Tao city	$10^0 22'$	$107^0 05'$
18	Cua Dai mouth	$10^0 11'$	$106^0 48'$
19	Dinh An mouth	$9^0 33'$	$106^0 17'$
20	Tho Chu island	$9^0 16'$	$103^0 25'$
21	Con Son island	$8^0 46'$	$106^0 41'$
22	Ca Mau (Minh Hai)	$8^0 36'$	$104^0 12'$