

## THE FISH EGGS AND LARVAE IN COASTAL WATERS OF KHANH HOA PROVINCE

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**ABSTRACT** This paper is aimed to present the result of the survey carried out along the coastal waters of Khanh Hoa province at 27 stations in July 2001.

There were great number of fish eggs and larvae in studied waters: 464.01 eggs/100m<sup>3</sup> and 32.34 larvae/100m<sup>3</sup>. The fish eggs and larvae occurred in all stations of the investigated areas. The high quality was in Van Phong - Ben Goi, Binh Cang and Cam Ranh bays.

The species composition of fish eggs and larvae in this area was relatively diverse. The fish eggs of genus (Stolephorus) occupied 29.11% and the larvae of Gobies (Gobiidae): 30.45%, the next Anchovy (Stolephorus): 28.26%, family (Carangidae): 4.19%, Callionymidae: 4.19%, Clupeidae: 3.10%, Leiognathidae: 2.10%, Bothidae: 1.91% and other families occupied less than 1%.

## TRỒNG CÁI VÀ CÁI BỐ ĐỒI VÙNG VỂN BỜ BIỂN TỈNH KHÁNH HOA

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**TÓM TẮT** Bài báo này dựa trên kết quả nhiều tra nước tiến hành tại 27 trạm dọc theo vùng vịnh bờ biển tỉnh Khánh Hòa trong tháng 7 năm 2001.

Mật độ trứng cá và cái bố đồi khai cao trong vùng nghiên cứu: trung bình 464,01 trứng/100m<sup>3</sup> và 32,34 cái bố đồi/100m<sup>3</sup>, trứng có mật độ cao ở nhiều tầng mặt con cái bố đồi ở nhiều tầng nước.

Tại các trạm nhiều tra đều có thể thu được trứng cá và cái bố đồi, nồng tập trung nhất ở vùng vịnh Vạn Phong - Bến Gò, vịnh Bình Cang và vịnh Cam Ranh.

Thành phần loài trứng cá và cái bố đồi khai phong phú, trứng cá chủ yếu là giống Cá Côm (Stolephorus) chiếm đến 29,11%. Con cái bố đồi là họ Cá Bống (Gobiidae) chiếm 30,45%, giống Cá Côm (Stolephorus): 28,26%, họ Cá Khe (Carangidae): 4,19%, họ Cá Nấm Lúa (Callionymidae): 4,19%, họ Cá Trích (Clupeidae): 3,10%, Họ Cá Liệt (Leiognathidae): 2,10%, họ Cá Bùn Vó (Bothidae): 1,91%. Các họ cá khác chiếm tỷ lệ thấp dưới 1%.

### I. INTRODUCTION

In recent years, the increasing fishery, aquatic culture and marine

tourism activities have impacted on the marine ecosystems such as coral reefs, mangrove forests and lagoons that decreased the fish yield of Khanh Hoa

province. In that fact, it is necessary to carry out the researches in order to update information of coastal waters and service the suitable development of coastal zone, specially the fishery of Khanh Hoa province in next years. From the proposition of Office of Aquatic Produce, we carried out a general investigation along coastal waters from Dai Lanh to Cam Ranh in which the research on the fish eggs and larvae is an essential part.

## II. MATERIAL AND METHOD

The investigation was realized at 27 sites in July (11 - 23) 2001 along the coastal waters from Dai Lanh to Cam Ranh. The farthest station is about 10 miles from shore (Fig. 1). We used two net kinds: A net with 0.5 mm of mesh size and 0.5 m<sup>2</sup> of the rectangular mouth (TM net) was towed across horizontal surface about 15 minutes and a net with 0.5 mm of mesh size and 0.5 m<sup>2</sup> of the circular mouth (DV - 80 net) was towed vertically above bottom (one meter) to surface waters. At seven continuous stations of 24 hours (six hours did one time) at the mouth of Van Phong bay (3 stations), Binh Cang bay (3 stations) and Cam Ranh bay (one station) we used only by vertical net (DV-80 net) (Fig. 1). These depend on regulation of tide. Specially, at Van Phong and Binh Cang bays we did at 16h, 22h, 04h, 10h and Cam Ranh bay at 07h, 13h, 19h and 01h. The net was used with the flowmeter to measure the water volumes (cubic meter).

The samples were preserved by 5% formalin. They were taken to the laboratory of the Institute of Oceanography, then we sorted fish eggs and larvae separately. We used the microscope for identification.

The identification was based on H.C. Delsman (1920 - 1938), S. Mito (1960 - 1963), M. Okiyama (1988), J.M. Leis (1983, 1989), J.D. Hardy (1978), Neira, F.J., A.G. Miskiewiez, and T. Trnski (1998). The average density of fish eggs and larvae was determined by individuals per 100m<sup>3</sup>.

## III. RESULT AND DISCUSSION

### 1. Quantity and density of fish eggs and larvae

In July 2001 we collected 20570 eggs and 1100 larvae. 18871 eggs and 349 larvae were collected by TM net and 668 eggs and 120 larvae were collected by DV-80 net. Average density of TM net was 531.65 eggs and 10.15 larvae per 100<sup>3</sup> and DV -80 net was 379.41 eggs and 54.60 larvae per 100<sup>3</sup> (Tab. 1, Figs 1, 2). Specially, there were 1031 eggs and 631 larvae collected by DV-80 net at seven continuous stations. Average density was 446.85 eggs and 237.24 larvae per 100m<sup>3</sup> (Tab. 3). However the density of fish eggs and larvae was so much standard deviation in TM - net and DV - net in samples. By the calculation of the mean density, with 95% confidence limits of observation of a small sample (n = 27), the confidence interval of the mean density was determined and it is shown in table 1. This fact is evolved the fluctuation of the density of stations in Khanh Hoa coastal waters.

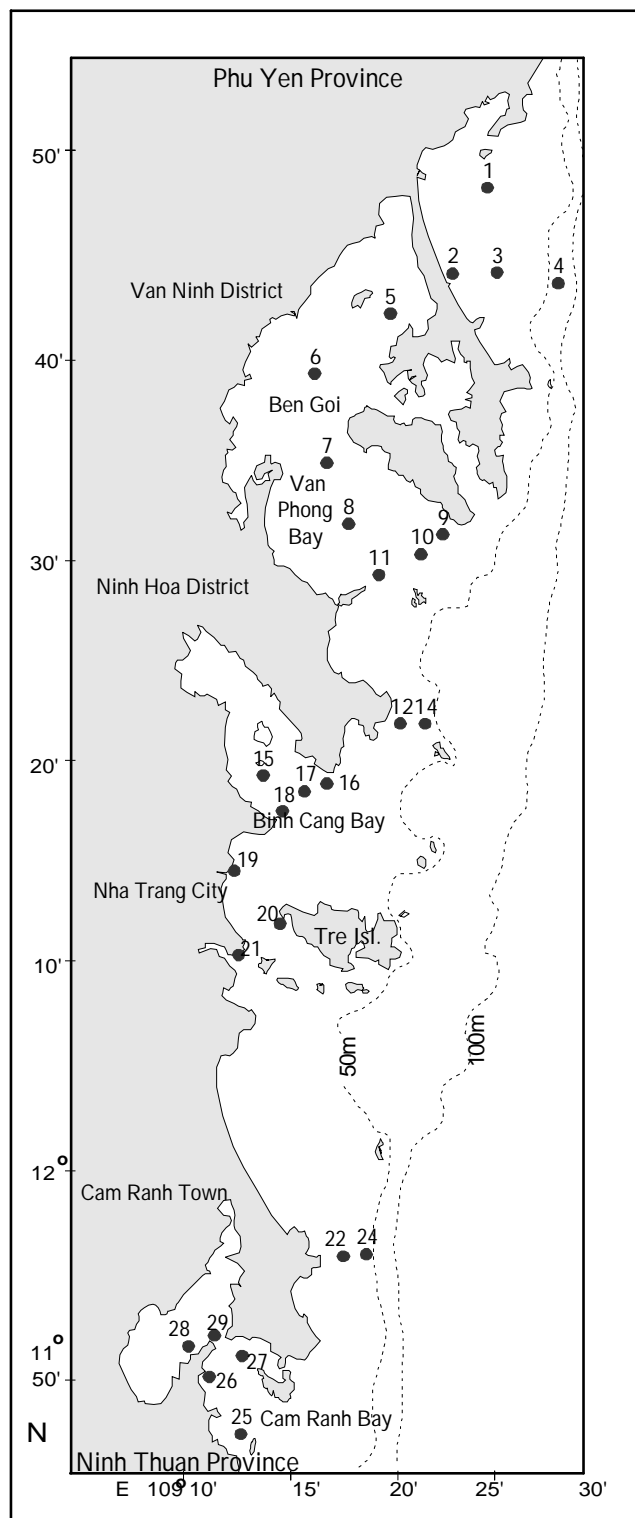
The comparison from abundance of this area was considered with Phan Thiet bay in August 1999. The average densities of fish eggs and larvae of TM-net in Nha Trang bay were appropriately half number in Phan Thiet bay where is similar in shape and characteristic. The average density of fish eggs and larvae in Van Phong - Ben Goi bays in Apr. 1982, Aug. 1983

and Feb. 1984 was poorer than that in Jul. 2001. However, average density of eggs of DV- 80 net in coastal waters of Khanh Hoa was five times higher than of Tonkin Gulf and coastal waters from

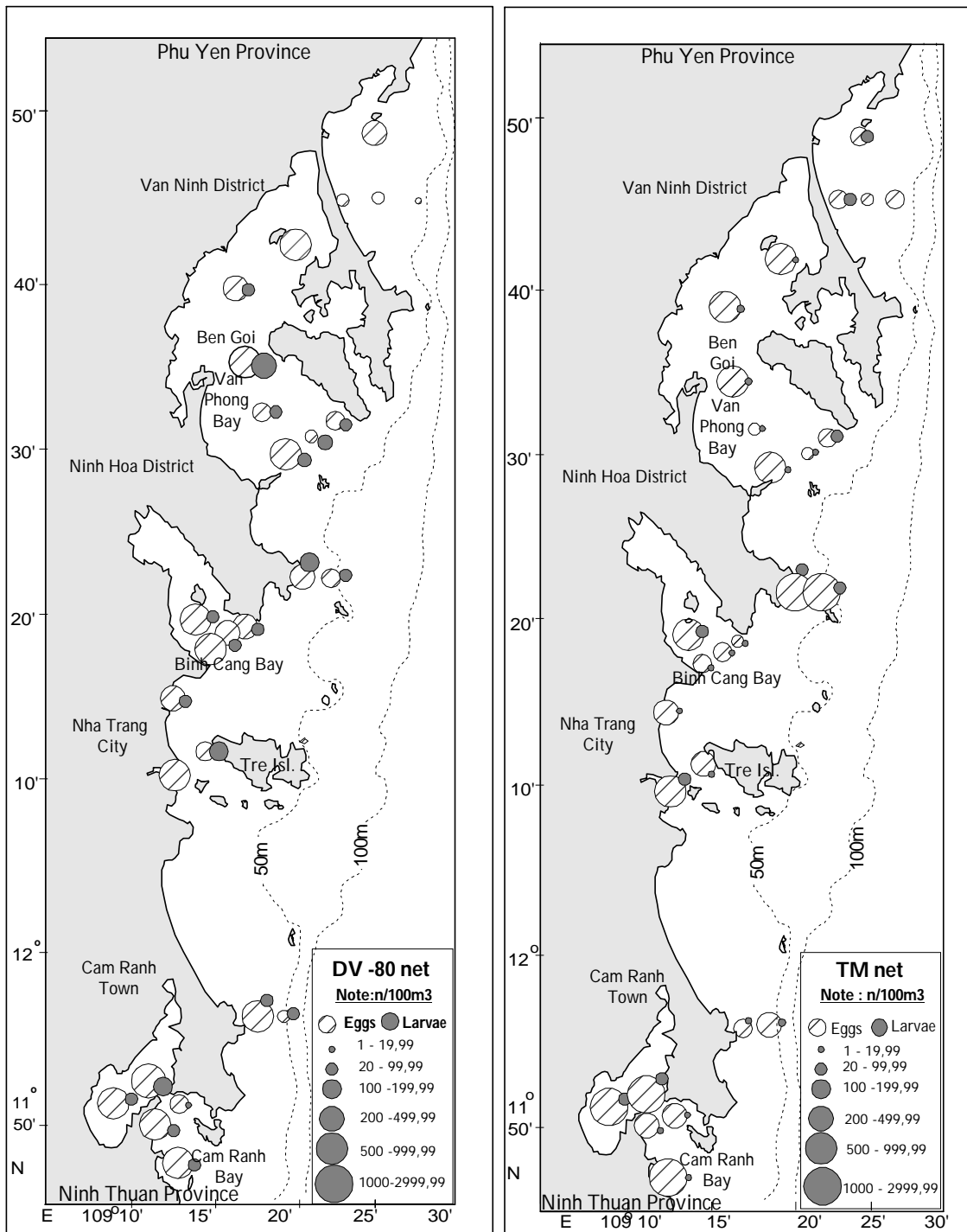
Ca Mau to Kien Giang provinces (Tab. 2). Since then, suggesting that the coastal waters of Khanh Hoa province is the spawning ground of many fish species in July.

**Tab. 1:** Density of fish eggs and larvae at stations in Khanh Hoa coastal zone in July 2001

No. stations	Latitude	Longitude	Individuals per 100m <sup>3</sup>			
			DV -80 net		TM net	
			Eggs	Larvae	Eggs	Larvae
1	12 <sup>0</sup> 49'498	109 <sup>0</sup> 24'230	221.05	0.00	139.56	11.71
2	12 <sup>0</sup> 45'014	109 <sup>0</sup> 22'826	75.00	0.00	205.12	12.53
3	12 <sup>0</sup> 45'111	109 <sup>0</sup> 24'982	80.00	0.00	32.17	0.00
4	12 <sup>0</sup> 44'878	109 <sup>0</sup> 27'787	13.33	0.00	120.44	0.00
5	12 <sup>0</sup> 43'029	109 <sup>0</sup> 19'946	600.00	0.00	544.42	2.43
6	12 <sup>0</sup> 40'050	109 <sup>0</sup> 16'007	380.00	20.00	554.11	8.53
7	12 <sup>0</sup> 35'945	109 <sup>0</sup> 16'950	800.00	220.00	577.00	1.29
8	12 <sup>0</sup> 32'898	109 <sup>0</sup> 17'995	100.00	30.00	51.30	3.21
9	12 <sup>0</sup> 32'031	109 <sup>0</sup> 22'059	128.00	88.00	197.23	11.60
10	12 <sup>0</sup> 31'031	109 <sup>0</sup> 21'005	56.00	112.00	67.64	2.42
11	12 <sup>0</sup> 30'008	109 <sup>0</sup> 19'047	800.00	40.00	527.07	1.81
12	12 <sup>0</sup> 22'977	109 <sup>0</sup> 20'060	458.82	176.47	1148.38	17.94
14	12 <sup>0</sup> 22'965	109 <sup>0</sup> 21'344	231.11	26.67	1515.72	12.75
15	12 <sup>0</sup> 20'011	109 <sup>0</sup> 13'963	700.00	66.67	522.58	42.89
16	12 <sup>0</sup> 19'985	109 <sup>0</sup> 16'967	352.94	94.12	84.90	5.54
17	12 <sup>0</sup> 19'340	109 <sup>0</sup> 15'865	323.08	30.77	113.22	1.03
18	12 <sup>0</sup> 18'375	109 <sup>0</sup> 14'815	511.11	0.00	188.36	9.64
19	12 <sup>0</sup> 15'425	109 <sup>0</sup> 12'346	280.00	80.00	251.15	6.02
20	12 <sup>0</sup> 13'184	109 <sup>0</sup> 14'084	173.33	120.00	297.01	5.95
21	12 <sup>0</sup> 11'085	109 <sup>0</sup> 12'687	500.00	0.00	795.64	24.32
22	11 <sup>0</sup> 56'235	109 <sup>0</sup> 18'719	600.00	80.00	154.47	1.54
24	11 <sup>0</sup> 56'069	109 <sup>0</sup> 17'579	45.83	37.50	280.22	7.01
25	11 <sup>0</sup> 47'289	109 <sup>0</sup> 12'870	333.33	22.22	2346.89	5.97
26	11 <sup>0</sup> 50'072	109 <sup>0</sup> 11'063	680.00	40.00	399.15	7.69
27	11 <sup>0</sup> 51'132	109 <sup>0</sup> 12'984	180.00	10.00	246.22	3.06
28	11 <sup>0</sup> 51'990	109 <sup>0</sup> 9'983	980.00	20.00	1363.84	24.57
29	11 <sup>0</sup> 52'588	109 <sup>0</sup> 11' 774	640.00	160.00	1630.64	42.81
Mean density			379.37	54.61	531.65	10.15
Mean interval (confidence limit: 95%)			271.57 - 487.16	30.82 - 78.39	301.66 - 761.63	5.59 - 14.70
Standard deviation			272.43	60.12	581.25	11.51
The coefficient of variation (CV)			71.81%	110.09 %	109.33 %	113.40 %



**Fig. 1:** The sites of sampling in coastal waters of Khanh Hoa province in July 2001



**Fig. 2:** Distribution of fish eggs and larvae in coastal waters of Khanh Hoa province in July 2001

## 2. Egg and larval distribution

Eggs and larvae occurred at all stations. Eggs collected by TM net were more than by DV-80 net. Eggs were

more concentrated at the stations in Van Phong - Ben Goi (5, 6, 7, 8, 11) and Binh Cang (15, 16, 17, 18) and Cam Ranh bays (25, 26, 28, 29) and two stations further Van Phong opening

(stations 12, 14) (Fig. 2). The distribution of larvae was similar to that of eggs in Van Phong, Binh Cang and Cam Ranh bays, but larvae collected by DV-80 net were more than by TM net). The abundance of eggs and

larvae was also found at the stations in the Cai and Cua Be estuaries. In general, eggs and larvae concentrated in Van Phong - Ben Goi, Binh Cang and Cam Ranh bays.

**Tab. 2:** The comparison of average density of fish eggs and larvae in some marine areas of Vietnam

Marine areas	Month/ year	Net kinds	Average density (Ind./100m <sup>3</sup> )	
			Eggs	Larvae
Tonkin Gulf [5, 6, 11]	Dec. 1960	DV - 80	83.00	95.00
Coastal waters from Ca Mau to Kien Giang provinces [8]	April -May 1982	DV - 80	199.00	158.00
Phan Thiet bay (Binh Thuan province) [14]	Aug. 1999	TM	1193.60	81.20
	Oct. 1999	TM	497.80	3.20
	Feb. 2000	TM	284.10	163.40
Van Phong - Ben Goi bay [1]	April 1982, Aug.1983 and Feb.1984	DV - 80	81.0	11.0
Coastal waters of Khanh Hoa province	Jul. 2001	TM	531.60	10.08
		DV - 80	379.41	54.60

**Tab. 3:** The distributions of eggs and larvae in coastal waters of Khanh Hoa Province

Region	Sum of stations	Average density of TM net		Average density of DV - 80 net	
		Eggs	Larvae	Eggs	Larvae
Along the coastal line and around islands	8	449.51	7.93	215.64	40.08
Van Phong - Ben Goi bay	7	359.82	4.47	409.14	72.86
Binh Cang bay	4	227.26	14.77	471.78	47.89
Nha Trang bay	3	447.93	12.10	317.78	66.67
Cam Ranh bay	5	1197.35	16.42	562.67	50.44

At the continuous stations of Van Phong bay (9, 10, 11), Binh Cang bay (16, 17, 18) and Cam Ranh bay (29) the samples collected alternately six times of one station throughout 24 hours (six hours make one time). The result showed high density of eggs in Van Phong bay (524.16 eggs/100m<sup>3</sup>), in Binh Cang bay (570.98 eggs/100m<sup>3</sup>)

and Cam Ranh bay (402 eggs/100m<sup>3</sup>) (Tab. 4).

### 3. Fluctuation of fish eggs and larvae density over day and night at the continuous stations

At the transects of Van Phong (sts: 9, 10, 11) and Binh Cang bays (sts: 16, 17, 18), the fish eggs and larvae concentrated from 22:00 hours of

the midnight to 4:00 hours of the next morning, and at Cam Ranh bay the fish eggs and larvae concentrated from

1:00 hour in the morning to 13:00 hours in the afternoon and the peak of larvae was at 7.00 hours (Tab. 4).

**Tab. 4:** The peak of fish eggs and larvae density (Ind. per 100m<sup>3</sup>) at continuous stations by DV – 80 net

No. station	Sum eggs	Sum larvae	16.00 h		22.00 h		4.00 h		10.00 h	
			Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae
9	74	174	152.00	72.00	168.00	984.00	144.00	248.00	128.00	88.00
10	66	144	136.00	104.00	168.00	288.00	168.00	648.00	56.00	112.00
11	293	51	410.00	50.00	860.00	50.00	860.00	370.00	800.00	40.00
Average densities			232.67	75.33	398.67	440.67	390.67	422.00	328.00	80.00
16	159	53	588.24	152.94	517.65	258.82	411.76	117.65	352.94	94.12
17	175	74	353.85	123.08	953.85	600.00	1061.54	384.62	323.08	30.77
18	103	39	644.44	266.67	177.78	422.22	955.56	177.78	511.11	0.00
Average densities			528.84	180.89	549.76	427.02	809.62	226.68	395.71	41.63
29*	161	96	640.00	160.00	430.00	60.00	150.00	360.00	390.00	380.00

Remark: \* At this station samples were collected at 7.00 h, 13.00 h, 19.00 h and 1.00 h

#### 4. The composition of fish eggs and larvae

33.71% of the egg total were identified (TM-net: 34.0%, DV –80 net: 24.7%). The TM net: the major composition of fish eggs was *Stolephorus* occupied 30.98% (Red Anchovy (*Stolephorus zollingeri*): 30.7%, Short Headed Anchovy (*S. heterolobus*): 0.27%, Indian Anchovy (*S. indicus*) only 0.026%), *Synodontidae* occupied 1.5%, other families were less than 1%. The DV-80 net: the fish eggs were similar to the TM net, Anchovy eggs were high: 18.26% (Red Anchovy *S. zollingeri*: 14%, Short Headed Anchovy *S. heterolobus*: 3.5%). The egg of *Scaridae* and *Clupeidae* occupied more than 3.4% (Tab. 5 and Fig. 2).

The identified quantity of fish larvae was more than fish eggs about

81.6%, among which, TM net was 62.43% and DV - 80 NET was 89.7%. The TM net: the highest density was larvae of *Gobiidae*: 18.78%, Anchovy (*Stolephorus*): 14.7%, *Carangidae*: 10.12% (Tab. 6). In DV – 80 net that were also similar to the TM net. *Gobiidae* was major that occupied 35.83%, next Anchovy (*Stolephorus*): 35% (Tab. 5).

As a whole, fish eggs and larvae in Khanh Hoa coastal waters were simpler than that of Phan Thiet province. The predominance was the groups of pelagic fish, such as Anchovy (*Stolephorus*), *Clupeidae*, *Carangidae*; *Leiognathidae*... This result was correspondent with some former studied results on composition and density of fish eggs and larvae in studied area.

**Tab. 5:** Composition of fish eggs in coastal waters of Khanh Hoa province in July 2001

Name	Surface - water (TM net)	Vertical (DV –80 net)	Continuous sts (DV –80 net)	Sum of inds	%
Anguiliformes	27	1	3	31	0.15
Stolephorus indicus	5	5	5	15	0.07
S. zollingeri	5792	93	102	5987	29.11
S. heterolobus	51	24	136	211	1.03
Clupeidae	119	10	78	207	1.01
Scaridae	112	24	24	160	0.78
Myctophidae	1	0	0	1	0.00
Cynoglossidae	25	0	0	25	0.12
Synodontidae	284	8	6	298	1.45
Unknown	12455	503	677	13635	66.29
Sum individual	18871	668	1031	20570	

**Tab. 6:** Composition and quantity of fish larvae in coastal waters of Khanh Hoa province in Jul. 2001

Name	Surface - water (TM net)	Vertical (DV –80 net)	Continuous stations (DV –80 net)	Sum of inds	%
Stolephorus sp.	51	42	217	310	28.26
Blennidae	3	0	0	3	0.27
Atherina sp	2	0	6	8	0.73
Antennaridae	1	0	0	1	0.09
Leiognathidae	0	4	19	23	2.10
Balistidae	3	2	1	6	0.55
Clupeidae	11	1	22	34	3.10
Gonostomatidae	3	0	1	4	0.36
Dactylopteridae	0	0	1	1	0.09
Callionymidae	4	8	34	46	4.19
Theraponidae	1	0	0	1	0.09
Sillago sp.	1	0	0	1	0.09
Scorpaenidae	1	0	5	6	0.55
Carangidae	35	0	11	46	4.19
Apogonidae	3	0	5	8	0.73
Nemipteridae	4	1	3	8	0.73
Serranidae	0	0	2	2	0.18
B. maclellandi	1	3	2	6	0.55
Platycephalidae	0	0	1	1	0.09
Mugilidae	2	0	0	2	0.18
Labridae	0	0	3	3	0.27
Mullidae	6	0	0	6	0.55
Myctophidae	3	1	2	6	0.55
Ambassis sp.	8	0	0	8	0.73
Gobiidae	65	43	226	334	30.45
Bothidae	9	1	11	21	1.91
Tetraodontidae	2	1	0	3	0.27
Unknown	130	13	59	202	18.41
Sum individuals	349	120	631	1100	100



#### IV. CONCLUSION

1. In the coastal waters of Khanh Hoa province in July 2001 there were high concentrations of fish eggs and larvae (379.4 eggs and 54.6 larvae per 100 m<sup>3</sup>). This result was higher than that of the sea area from Nghia Binh to Ca Mau provinces, but it was less than that of coastal waters of Binh Thuan province.

2. The distribution of fish eggs and larvae occurred at all stations, but they were more concentrated in Van Phong, Binh Cang and Cam Ranh bays.

3. The major compositions of fish eggs in studied area in July were Anchovy (*Stolephorus*) occupied 30.21% (Red Anchovy (*Stolephorus zollingeri*): 29.11%, Short Headed Anchovy (*S. heterolobus*): 1.03%, Indian Anchovy (*S. indicus*): 0.07% of the total), next Synodontidae (1.45%), Clupeidae (1.01%). As for larvae, Gobiidae occupied 30.45%, Anchovy (*Stolephorus*): 28.26%, Callionymidae and Carangidae occupied 4.19% respectively, Clupeidae (3.1%), Leiognathidae (2.1%) of the total.

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