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

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ABSTRACT

The samples of 58 stations in Vietnamese Waters were collected by M.V.SEAFDEC on 21 April - 5 June 1999. Thirty-seven groups of zooplankton were found in this study. Copepoda was the most abundance followed by Chaetognatha and Ostracoda. Biomass varied from 0.21-7.29 ml/m^3 (average 1.03 ± 1.22 ml/m^3). Station 56 has the highest biomass. Abundance varied from 99-2,365 ind/m^3 (average 580 ± 527 ind/m^3). Station 58 has the highest abundance due to high number of Chaetognatha, polychaete, *Lucifer* spp., Thecosomes and Echinodermata larvae. Whereas Station 19 has the lowest abundance. Cephalopod paralarvae were concentrated. They were classsified into 15 genera belonging to 11 families: *Sepia* sp., *Inioteuthis* sp, *Loligo* spp., *Enoploteuthis* sp., *Abralia* sp., *Watasenia* sp., *Onychoteuthis* sp., *Ctenopteryx sicula*, *Nototodarus* sp., *Sthenoteuthis oualaniensis*, *Thysanoteuthis rhombus* , *Liocranchia* sp., *Teuthowenia* sp., *Octopus defilippi*, *Octopus* Type A, *Octopus* Type B, *Octopus* Type C and *Tremoctopus* sp. *Sthenoteuthis oualaniensis* found to be most abundance followed by *Octopus* Type B and *Enoploteuthis*. *Sthenoteuthis oualaniensis* found mostly in the middle part of Vietnamese waters especially in the oceanic zone.

Key words: zooplankton, abundance, biomass, Vietnamese Waters, cephalopod paralarvae

Introduction

Marine zooplankton plays a key role in the food chains of the sea as they transfer energy from phytoplankton to higher trophic levels. Numerous studies have shown that small zooplankton (e.g. copepods, tintinnids, cladocerans, larval molluscs) are important component of larval fish food [Hould & Lovdal (1982), [Balbontin *et al.* (1986)], [Anderson (1994)]. Hence, variation in the availability of these organisms has been hypothesized to be related to the larval survival and the subsequent recruitment to the adult population of marine fishes [Cushing (1975)].

Marine plankton of Vietnamese waters was investigated since the beginning of 19 the century [Shirota (1966) referred to Rose, 1926)]. Many papers reported about composition, distribution and classification of plankton in Vietnam [Hamon (1956), [Shirota (1966)] and [Alvarino (1967)]. Some studied on the relationship between amount of zooplankton and feeding rate of fish [Shirota (1967a)] or zooplankton and environment [Shirota (1967b)]. The purpose of the present investigation is to describe the zooplankton community in Vietnamese Waters and provide an estimation of abundance, composition, biomass and their distribution. Besides, cephalopod paralarvae will be concentrated.

Materials and Methods

The samples of 58 stations in Vietnamese Waters were collected by M.V.SEAFDEC on 21

April - 5 June 1999 (Table 1 & Fig. 1). Plankton was collected using 0.33 mm mesh net attached to 60 cm diameter bongo frames. A flowmeter was attached within the aperture of the net to measure the amount of water filtered. At each station a 30 minutes oblique tow of the bongo net was made while the ship cruises at 2 knots. The depth of the haul was 5-7 meters above the sea bottom for the station that the depth was less than 100 meters and 100 meters for the station that the depth was over 105 meters. The samples were preserved in 10 % buffer formalin-seawater immediately. In the laboratory, the displacement volume of total zooplankton was measured after large gelatinous zooplankton had been removed. The samples were subsampled with Falsom Plankton Splitter and then count to taxon. Data on biomass and abundance were standardized per cubic metre. Cephalopod paralarvae were sorted out and identified to species level. The classification of cephalopod paralarvae was based on Kubodera and Okutani (1981), Okutani (1966 and 1968), Okutani and Mc Gowan (1969), Sweeney *et al* (1992), Tsuchiya *et al* (1991), Yamamoto and Okutani (1975) and Young and Harman (1985).

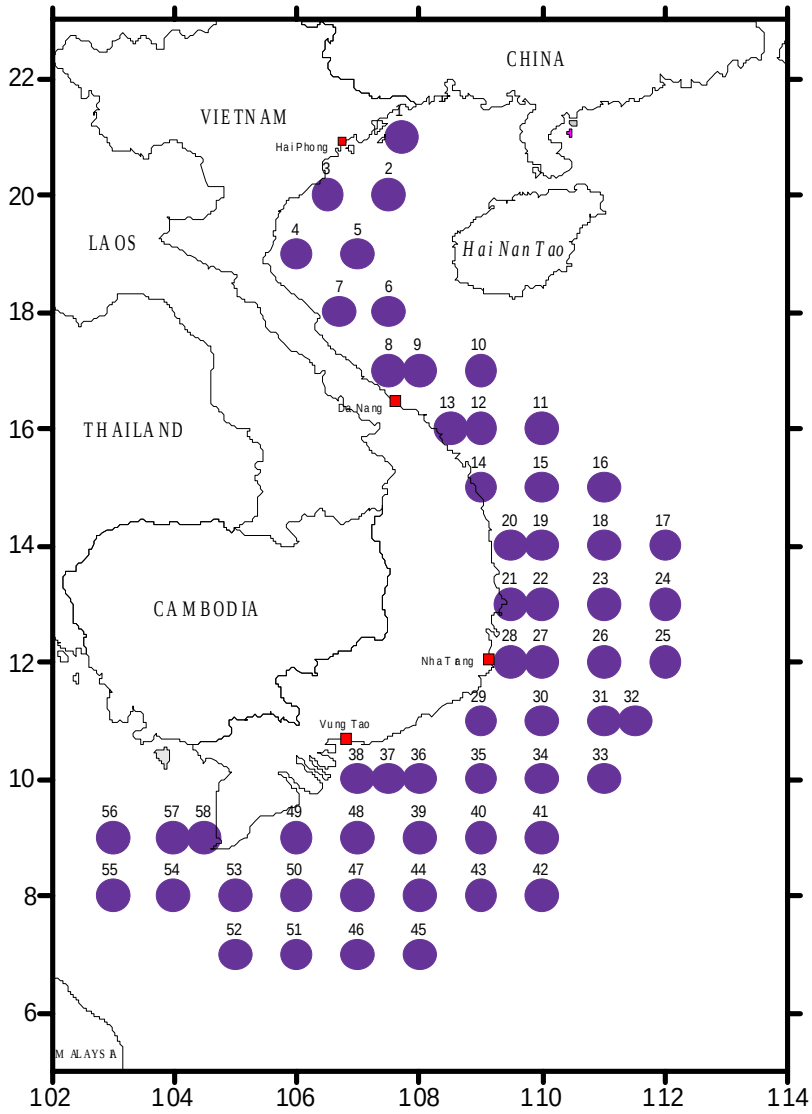

Fig. 1. Location of sampling stations.

Table 1. Information of all survey stations in the Vietnamese waters.

St.	Date	Time	Water Depth	St.	Date	Time	Water Depth
1	30/4/99	0536-0556	34	30	18/5/99	0529-0559	645
2	30/4/99	1121-1148	27	31	18/5/99	1328-1358	2790
3	30/4/99	1812-1838	28	32	19/5/99	1158-1228	4267
4	1/5/99	0001-0029	27	33	22/5/99	1400-1430	3370
5	1/5/99	0655-0725	58	34	21/5/99	1158-1228	1589
6	1/5/99	1323-1352	80	35	21/5/99	0534-0607	155
7	1/5/99	1936-2006	38	36	20/5/99	2027-2057	45
8	2/5/99	0211-0241	45	37	20/5/99	1614-1644	31
9	2/5/99	0613-0643	73	38	20/5/99	1152-1222	21
10	2/5/99	1333-1403	107	39	23/5/99	1241-1320	62
11	3/5/99	0552-0620	847	40	23/5/99	0515-0535	133
12	3/5/99	2129-2158	104	41	22/5/99	2147-2217	1856
13	4/5/99	0157-0225	40	42	25/5/99	1520-1550	647
14	6/5/99	0505-0532	35	43	25/5/99	0824-0854	147
15	6/5/99	1153-1223	463	44	25/5/99	0033-0103	78
16	7/5/99	0540-0610	1220	45	26/5/99	2021-2051	61
17	8/5/99	0550-0620	2200	46	27/5/99	0056-0026	56
18	8/5/99	2140-2210	1481	47	24/5/99	1714-1744	42
19	9/5/99	0618-0648	642	48	23/5/99	1950-2020	33
20	10/5/99	0604-0634	140	49	24/5/99	0300-0329	20
21	10/5/99	1137-1207	133	50	24/5/99	1010-1040	32
22	10/5/99	1605-1635	1997	51	27/5/99	0840-0909	44
23	11/5/99	0538-0608	2697	52	27/5/99	1546-1616	51
24	12/5/99	0836-0906	3335	53	27/5/99	2254-2324	34
25	12/5/99	1425-1455	4150	54	28/5/99	0631-0701	25
26	13/5/99	1407-1437	2880	55	28/5/99	1335-1405	70
27	14/5/99	0515-0545	1737	56	28/5/99	1915-1945	56
28	14/5/99	1811-1839	110	57	29/5/99	0553-0623	34
29	17/5/99	1621-1651	72	58	29/5/99	1001-1030	23

Results

Biomass and abundance of zooplankton

Biomass and abundance of total zooplankton were shown in Table 2 and 3. Biomass varied frim 0.21-7.29 ml/m^3 (average 1.03±1.22 ml/m^3). Station 56 has the highest biomass. Abundance varied from 99-2365 no/m^3 (average 580±527 ind/m^3). Station 58 has the highest abundance due to high number of Chaetognatha, polychaete, *Lucifer* spp. Thecosomes and Echinodermata larvae. While Station 19 has the lowest abundance.

Thirty-seven groups belonging to 11 phylum of zooplankton were found in this study. Copepods were the most abundance and found at all stations, comprising 46.1 % of the zooplankton population. The following groups were Chaetognatha and Ostracoda, comprising 7.6% and 7.1% of total zooplankton respectively. Mollusca formed 12.9 % of total zooplankton population. Veliger of Bivalvia was 43.7% of mollusc group. Gastropoda, including veliger, Heteropod, Thecosomata, Gymnosomata and Nudibranchia, were 35.3 % of mollusc group. Cephalopod paralarvae forming only <0.1 % of total zooplankton population and found to be common in this area. Fish egg and larvae, shrimp larvae and stomatopod larvae were also found to be very common and comprising 0.8 %, 2.4 % and 0.2 % of zooplankton respectively. Ctenophora, Gymnosomata, nudibranchia, phyllosoma larvae, pyrosomata, amphioxus and platyhelminthes found to be rare and comprising <0.1 % of zooplankton population in this study area. The total number and percentage of major groups of zooplankton were shown in Table 4. The average abundance and frequency of occurrence of zooplankton were shown in Table 5 and 6.

Table 2. Biomass of zooplankton (ml./m^3) in Vietnamese waters.

Station	biomass	Station	biomass	Station	biomass	Station	biomass
1	0.94	16	0.66	31	0.49	46	0.38
2	0.47	17	0.30	32	0.47	47	1.61
3	0.48	18	0.34	33	0.68	48	0.82
4	0.70	19	0.21	34	0.49	49	3.21
5	1.07	20	0.44	35	0.6	50	0.46
6	0.97	21	0.39	36	1.63	51	1.54
7	1.22	22	0.44	37	1.47	52	1.07
8	1.82	23	0.38	38	0.47	53	1.05
9	1.95	24	0.38	39	0.96	54	0.68
10	0.72	25	0.58	40	0.53	55	0.86
11	0.37	26	0.40	41	0.99	56	7.29
12	1.21	27	0.47	42	0.93	57	5.96
13	1.70	28	0.40	43	0.31	58	2.43
14	0.94	29	0.56	44	0.78		
15	0.41	30	0.56	45	0.29		

Table 3. Total abundance of zooplankton (ind/m^3) inVietnamese waters.

Station	abundance	Station	abundance	Station	abundance	Station	abundance
1	1,833	16	210	31	195	46	235
2	512	17	154	32	207	47	382
3	381	18	122	33	280	48	635
4	712	19	99	34	217	49	2,207
5	656	20	283	35	365	50	340
6	550	21	352	36	265	51	744
7	895	22	141	37	1,240	52	512
8	1,004	23	202	38	1,194	53	899
9	1,456	24	196	39	788	54	447
10	479	25	312	40	324	55	421
11	186	26	229	41	475	56	1,793
12	284	27	234	42	416	57	1,991
13	1,218	28	199	43	203	58	2,365
14	577	29	246	44	438		
15	269	30	330	45	131		

Table 4. Total number and percentages of major groups of zooplankton in Vietnamese waters at 58 stations.

Taxon	Total	Percentage within group	Overall percentage
I. Coelenterata	919.9	-	2.7
A. Medusae	95.5	10.4	0.3
B. Siphonophora	824.4	89.6	2.4
II. Ctenophora	7.3	-	<0.1
III. Mollusca	4350.2		12.9
A. Bivalvia - veliger	1900.6	43.7	5.7
B. Gastropoda			
1. Veliger	1534.5	35.3	4.6
2. Heteropod	148.9	3.4	0.4
3. Thecosomata	751.5	17.3	2.2
4. Gymnosomata	5.8	0.1	<0.1
5. Nudibranchia	0.2	<0.1	<0.1
C. Cephalopoda - paralarvae	8.6	0.2	<0.1
IV. Arthropoda	22262.2	-	66.2
A. Cladocera	1027.2	4.6	3.1
B. Ostracoda	2385.6	10.7	7.1
C. Copepoda	15740.9	70.7	46.1
D. Cirripedia,larvae	102.2	0.5	0.3
E. Amphipoda, Isopoda, Cumacea	190.9	0.9	0.6
F. Decapoda	2407.3	10.8	7.2
1. Lucifer spp.	1170.1	5.3	3.5
2. Brachyuran	315.6	1.4	0.9
3. Caridea and Penaeidae larvae	801.8	3.6	2.4
4. Phyllosoma larvae	3.3	<0.1	<0.1
5. Anomuran	116.5	0.5	0.3
G. Stomatopod larvae	63.0	0.3	0.2
H. Mysidacea	55.1	0.2	0.2
I. Euphausiacea	290.0	1.3	0.9
VI. Chaetognatha	2569.4	-	7.6
VII. Chrodata	1947.6	-	5.8
A. Thaliacea	1159.6	59.5	3.4
B. Larvacea - *Oikopleura* spp.	508.2	26.1	1.5
C. Pyrosomata	2.6	0.1	<0.1
D. Amphioxus	0.6	<0.1	<0.1
E. Fish egg and larvae	276.6	14.2	0.8
VIII. Invertebrate larvae (Cyphonautes, Actinotroch, polychaet larvae, brachiopod, echinodermata)	1557.2	-	4.6
IX. Other (platyhelminthes)	2.4	-	<0.1
Grand total	33615.9	-	100

Table 5. Taxonomic list of zooplankton found in Vietnamese waters.
The average abundance of zooplankton : + + + = > 10 ind/m^3
+ + = 6- 10 ind/m^3
+ = 0-5 ind/m^3

Taxon	Abundance	Taxon	Abundance
Medusae	+	Shrimp larvae	+++
Siphonophora	+++	Phyllosoma larvae	+
Ctenophora	+	Anomura larvae	+
Platyhelminthes	+	Stomatopoda larvae	+
Cyphonautes,larvae	+	Bivalve larvae	+++
Actinotrocha,larvae	+	Gastropod larvae	+++
Chaetognatha	+++	Heteropoda	+
Polychaeta	+	Naked Pteropod	+
Cladocera	+++	Shelled Pteropoda	+++
Ostracoda	+++	Nudibranchia	+
Copepoda,larvae	+++	Cephalopod larvae	+
Cirripedia,larvae	+	Echinodermata larvae	+++
Amphipoda	+	Thaliacea	+++
Isopoda	+	Larvacea	++
Mysidacea	+	Pyrosomata	+
Cumacea	+	Amphioxus larvae	+
Euphausiacea	+	Brachiopoda larvae	+
Lucifer spp.	+++	Fish eggs	+
Brachyura larvae	++	Fish larvae	+

Table 6. Taxonomic list of zooplankton found in Vietnamese waters.
Frequency of occurrence : R = Rare, C=Common, VC =Very Common

Taxon	Frequency	Taxon	Frequency
Medusae	VC	Shrimp larvae	VC
Siphonophora	VC	Phyllosoma larvae	R
Ctenophora	R	Anomura larvae	VC
Platyhelminthes	R	Stomatopoda larvae	VC
Cyphonautes,larvae	C	Bivalve larvae	VC
Actinotrocha,larvae	R	Gastropod larvae	VC
Chaetognatha	VC	Heteropoda	VC
Polychaeta	VC	Naked Pteropod	C
Cladocera	VC	Shelled Pteropoda	VC
Ostracoda	VC	Nudibranchia	R
Copepoda,larvae	VC	Cephalopod larvae	C
Cirripedia,larvae	VC	Echinodermata larvae	VC
Amphipoda	VC	Thaliacea	VC
Isopoda	R	Larvacea	VC
Mysidacea	VC	Pyrosomata	C
Cumacea	R	Amphioxus larvae	R
Euphausiacea	VC	Brachiopoda larvae	R
Lucifer spp.	VC	Fish eggs	VC
Brachyura larvae	VC	Fish larvae	VC

At the neritic zone, it showed high biomass and abundance of total zooplankton as well as many groups such as bivalve larvae, gastropod larvae, fish eggs, *Lucifer* spp., medusae, stomatopod larvae, brachyura larvae, shrimp larvae, thecosomata. Some groups have high number at oceanic zone such as Cephalopod paralarvae, Oikopleura, Pyrosomata, and Amphioxus. (Appendix A)

If we separated Vietnamese waters into three part, the upper part (from Hi Phong to Da Nang), the middle part (from Da Nang to Vung Tao) and the lower part (below Vung Tao). The upper part and the lower part showed the highest biomass and abundance of total zooplankton. Most of zooplankton showed the same trend except Amphioxus, Platyhelminthes and Pyrosomata.

The abundance of cephalopod paralarvae

Cephalopod paralarvae were concentrated. They were classified into 15 genera from 11 families. The list of the classification of cephalopod paralarvae was shown in Appendix B. *Sthenoteuthis oualaniensis* found to be most abundance (294 ind/1000m^3) followed by *Octopus* Type B (236 ind/1000m^3) and *Enoploteuthis* (169 ind/1000m^3). *Sthenoteuthis oualaniensis* found mostly in the middle part of Vietnamese waters especially in the oceanic zone. Number of cephalopod paralarvae was shown in Appendix C.

Discussion

The biomass and abundance of zooplankton in Vietnamese waters in this investigation was higher than in the Gulf of Thailand and the east coast of Peninsular Malaysia and Sabah, Sarawak and Brunei Darussalam waters in the same period [Jivaluk (1999[1], 1999[2])]. At the upper part and the lower part of Vietnamese waters where the water depth was less than 200 meters (neritic zone), high biomass and abundance were found. This result coincided with Santhankumari (1991) who found the standing stock was relatively high in the neritic zone of the west coast of India. Fallahi (1993) also found the decreasing of plankton abundance from the littoral zone to pelagic zone in the southern part of Caspian Sea. It was concluded that the upper part and the lower part of Vietnamese waters are more productive than the middle part in this study. Especially in the area below Vung Tao (Station 58) where is a Mekong Delta. The water run off brings a lot of nutrient to the sea and make high productivity in that area. This is true also in the Gulf of Thailand whereas Sudara and Udomkit (1984) found that the major factor influencing the distribution of zooplankton seems to be the amount of nutrients available.

There are many other abiotic and biotic factors which influencing on zooplankton abundance. Temiyavanich (1984) noted that zooplankton abundance had significant correlation to the phytoplankton. Santhankumari (1991) observed standing stock of zooplankton in West Coast of India and found that maximum zooplankton production was noticed with the low temperature and low DO during post-monsoon season. Besides, salinity also affected the zooplankton community structure. Ranta and Vuorinen (1990) concluded that in the Seili area, northern Balti Sea, long-term salinity fluctuation coincided with changes in the meso-plankton community. Difference species and species group correlated differently with the salinity change.

Copepods were the main contributors in the present observation followed by Chaetognatha and Ostracoda. This also holds true for the most zooplankton communities sampled in the world ocean [Wimpenny (1966) and [Omori and Ikeda (1976)]. Hould & Lovdal (1982) shown that copepods are important component of larval fish food. Not only copepod, other small zooplankton (e.g. tintinnids, cladocerans, eggs and larval stages of crustaceans, larval molluscas and unicellular organisms) were also important for fish larvae as well [Nagasawa (1993)] and [Anderson (1994)]. Besides, Barange (1989) concluded that the highest abundance of fish larvae were found between the surface and the thermocline - coinciding with denser concentrations of zooplankton biomass. But in this

investigation found no clear relation between fish larvae and the amount of copepod. Same evidence was found by Sameoto(1972). He found no significant correlation between biomass of copepods and the estimated abundance of herring larvae.

Shirota (1966) investigated marine plankton of South Vietnam. He found 763 species of 13 phylum of marine zooplankton. In this study found thirty-seven groups belonging to 11 phylum. Although species composition was not studied. Geographical diversity gradients obtained in this study, based on the groups at the primary sorting level, will serve to give an idea of geographical distributions of animal communities.

Numerous studies point out that zooplankton was affected on fisheries. Jakob *et.al.* (1981) noted that the peak periods in the zooplankton biomass were found to coincide with the peak seasons of pelagic fisheries. Suseelan et al. (1985) found that pelagic fish catch, consisting mostly of anchovies and lesser sardines, showed clear peaks, closely following the primary and secondary peaks of zooplankton. Krisshnapillai (1981) also found that the fish catch/hour was maximum in October which was the most productive month of the zooplankton. In this investigation, we studied only once a year. If we study every month and collect the fish catch/ hour at the same area, we might see some relation between fish catch and zooplankton biomass.

The investigation on cephalopod paralarvae showed that 15 genera belonging to 11 families were found. Some were economic species, found in neretic and oceanic area such as *Sepia* sp., *Loligo* spp. and *Sthenoteuthis oualaniensis*. Some genera occurred only oceanic area such as *Abralia* sp., *Watasenia* sp., *Onychoteuthis* sp., *Ctenopteryx sicula, Nototodarus* sp., *Thysanoteuthis rhombus*?, *Liocranchia* sp., and *Teuthowenia* sp., Duc (1997) reported new data on the cephalopod fauna of Vietnam Sea. He found 69 species of cephalopod belonging to 24 genera, 14 families, 3 orders. Some genera of this investigation were not found in the list of Duc (1997) may be because of the ecology of cephalopod paralarvae itself. They may float over the ocean by the current. Most of deep-sea cephalopod paralarvae act as pelagic zooplankton and swim near surface. After getting older they will stay in the deeper water. Another possible thing is that the way to collect deep-sea samples may not suitable so the adult specimens were never been found.

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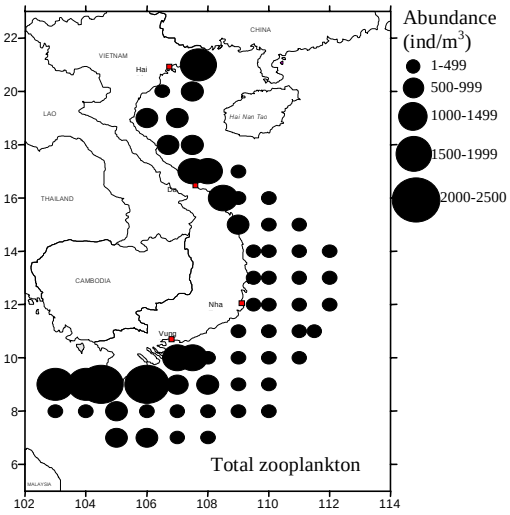
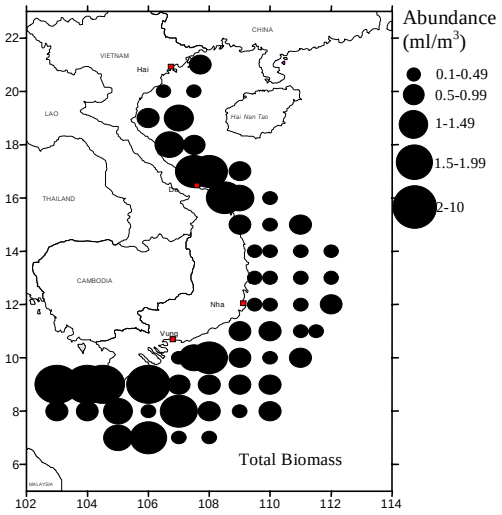
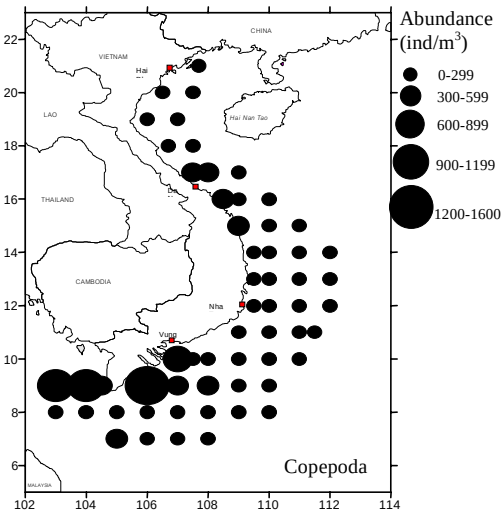
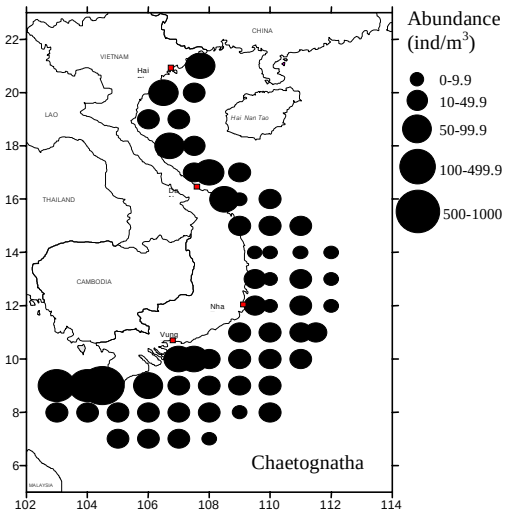
Appendix A1

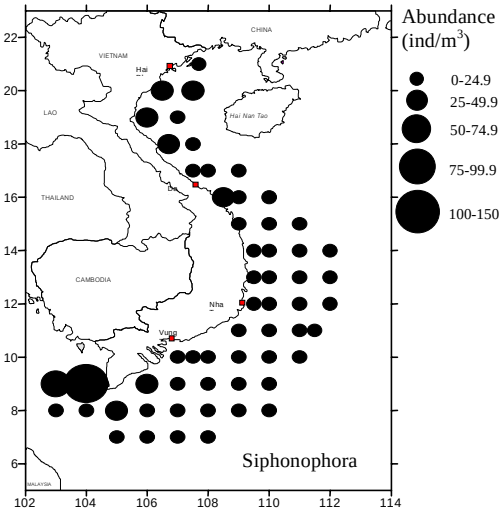
Distribution and abundance of total zooplankton, total biomass, Copepod, Chaetognatha, Siphonophora and Cladocera of Vietnamese waters from 21 April - 5 June 1999.

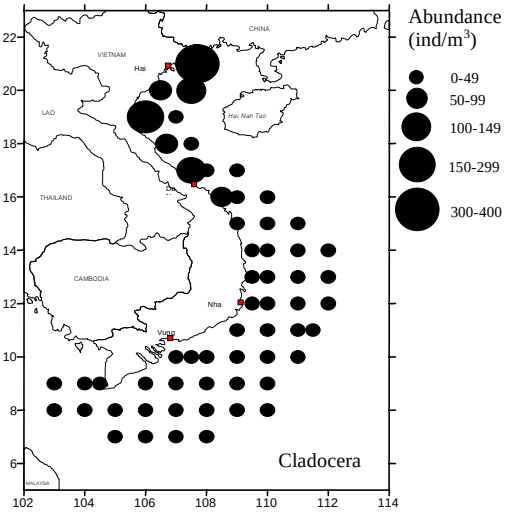






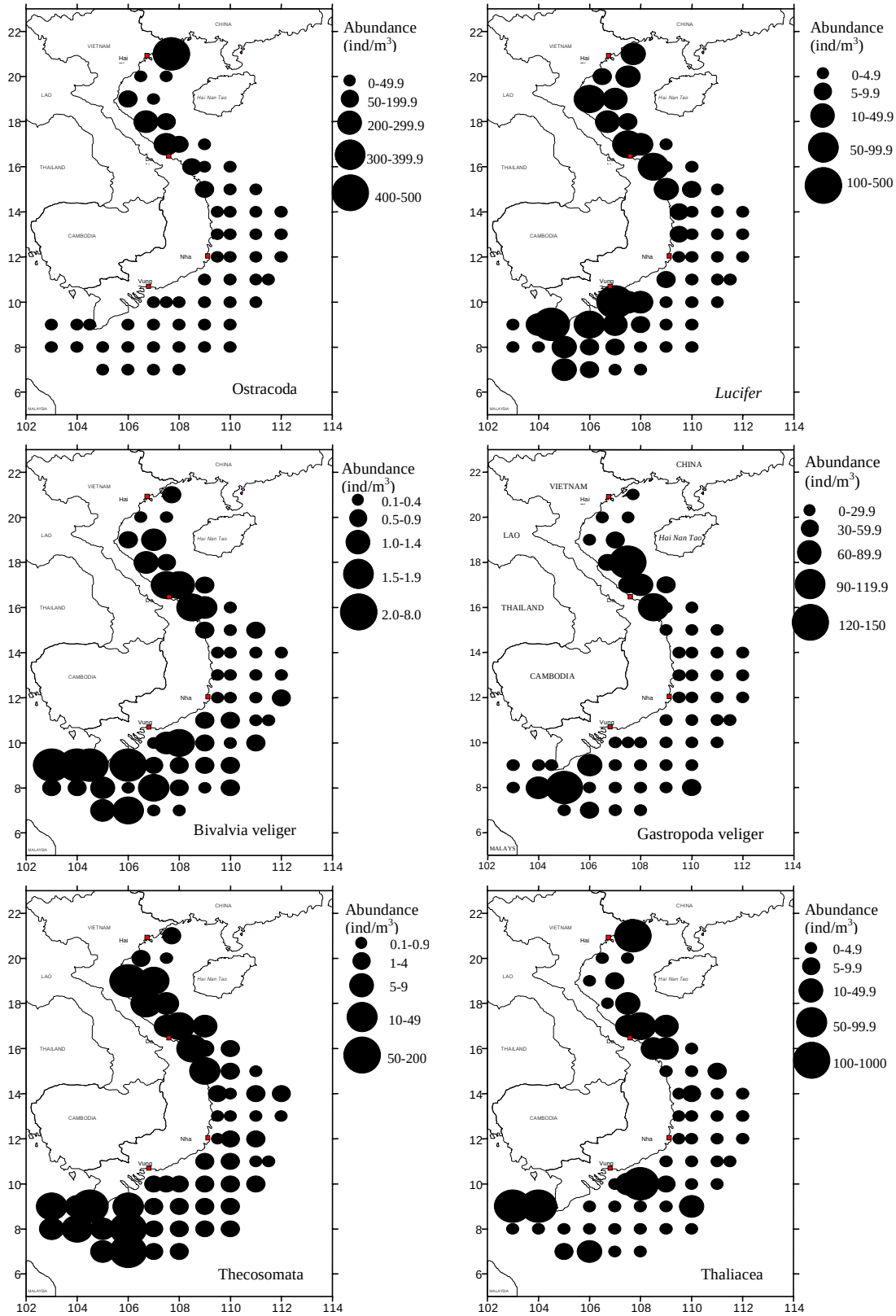






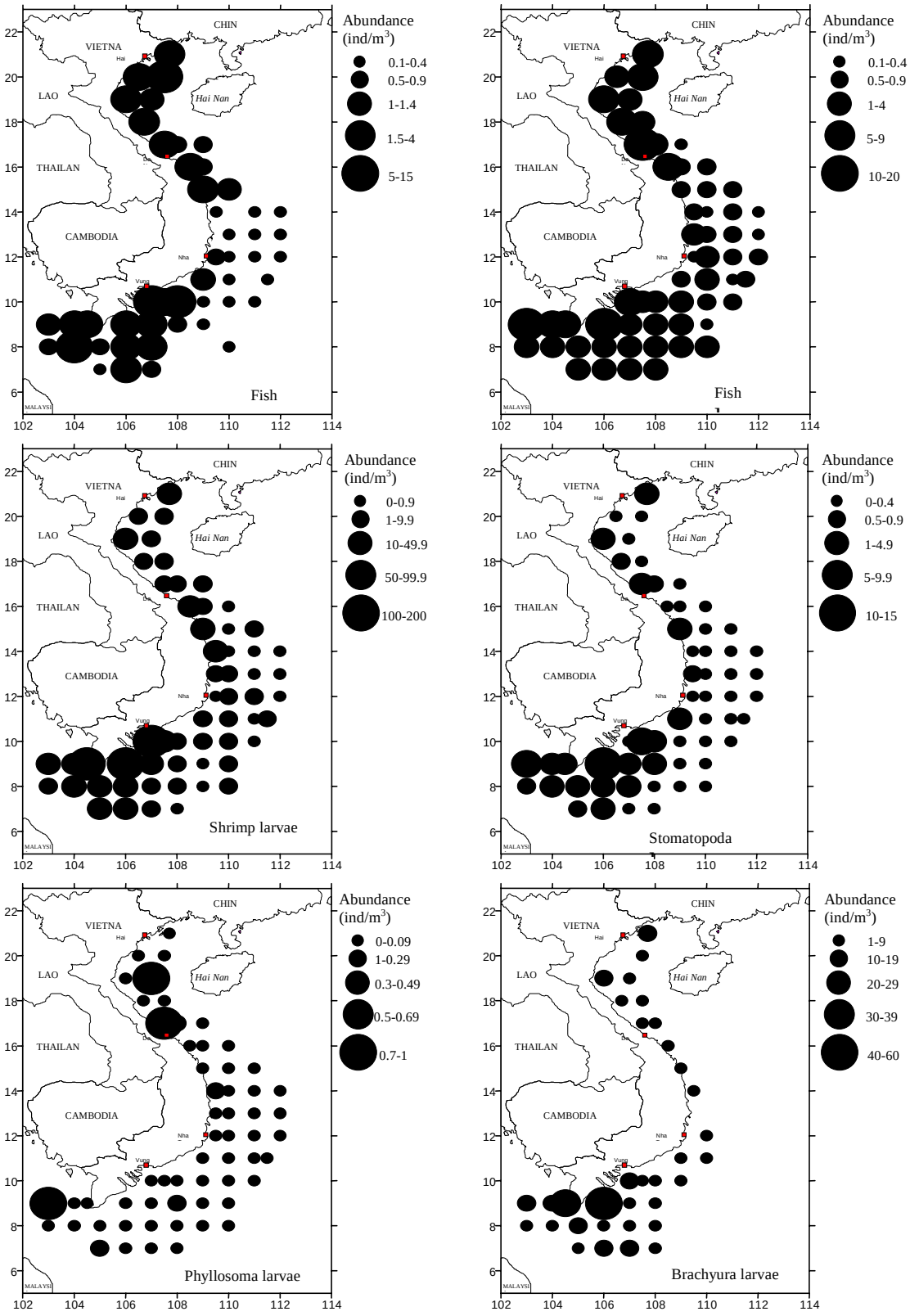
Appendix A2

Distribution and abundance of Ostracoda, *Lucifer* spp.Bivalvia veliger, Gastropoda veliger, Thecosomata and Thaliacea of Vietnamese waters from 21 April-5 June 1999.



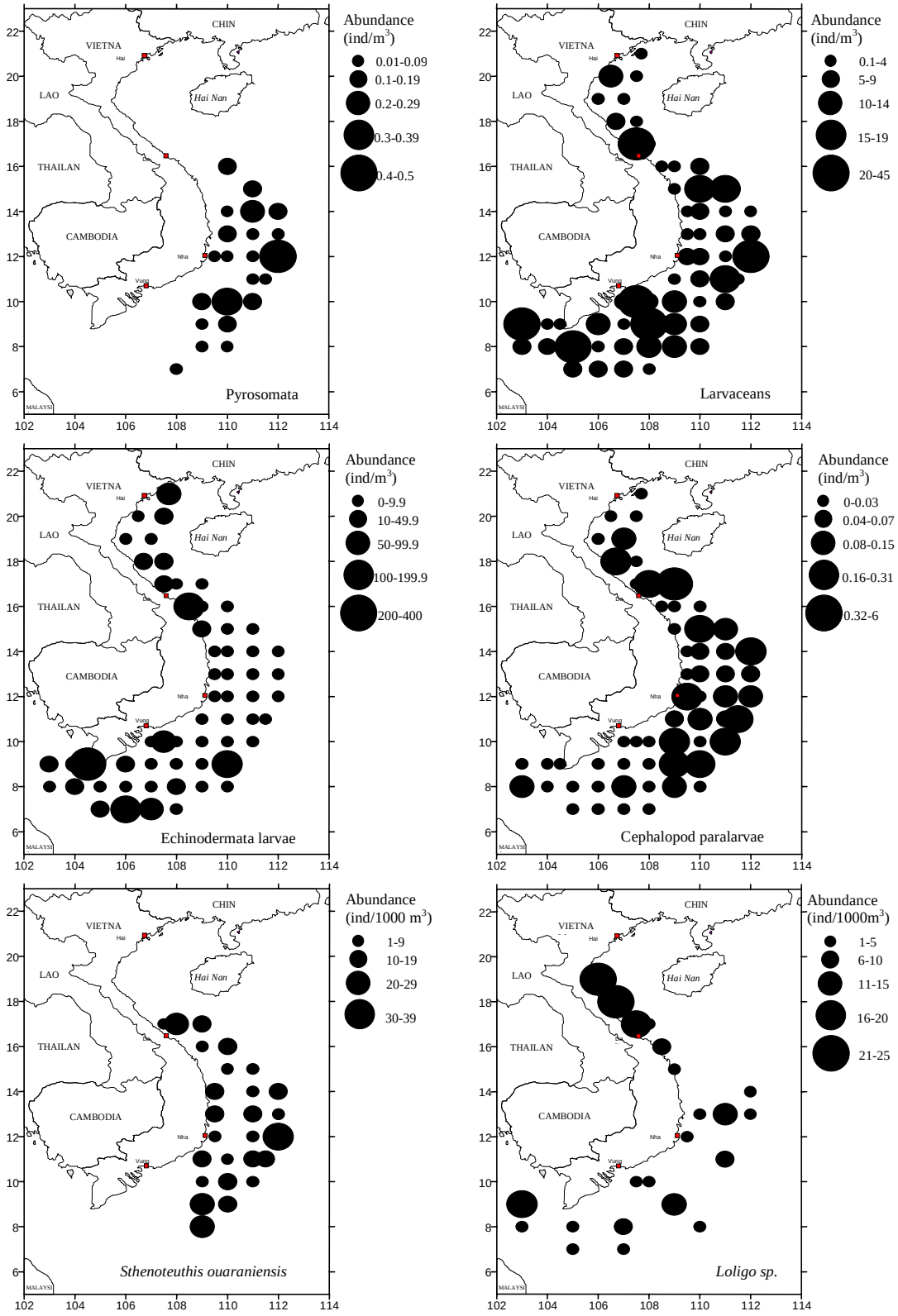
Appendix A3

Distribution and abundance of fish egg, fish larvae, shrimp larvae, Stomatopoda larvae, Phyllosoma larvae and Brachyura larvae of Vietnamese waters from 21 April-5 June 1999.



Appendix A4

Distribution and abundance of Pyrosomata, Larvaceans,Echinodermata larvae, Cephalopod paralarvae, *Sthenoteuthis ouaraniensis* and *Loligo* sp. of Vietnamese waters from 21 April -5 June 1999.



Appendix B

Cephalopoda paralarvae species list

Class Cephalopoda cuvier, 1798
Subclass Coleoida Bather, 1888
Superorder Decebrachia Stolley, 1919
Order Sepiida Naef, 1916
Family Sepiidae Keferstein, 1866
Sepia sp. Linnaeus, 1758
Order Sepiolida (non sensu Fioroni, 1981)
Family Sepiolidae Leach, 1817
Subfamily Sepiolinae Leach, 1817
Inioteuthis sp. Verril, 1881
Order Teuthida Naef, 1916
Suborder Myobsida Orbigny, 1845
Family Loliginidae Steenstrup, 1861
Subfamily Loligininae Naef, 1921
Loligo spp. Schneider, 1784
Suborder Oegopsida Orbigny, 1845
Family Enoploteuthidae Pfeffer, 1900
Enoploteuthis sp.Orbigny, 1839
Abralia sp. Gray, 1849
Watasenia sp. Ishikawa, 1913
Family Onychoteuthidae Gray, 1849
Onychoteuthis sp. Lichtenstein, 1818
Family Ctnopterygidae Grimpe, 1922
Ctenopteryx sicula AppellÖf, 1899
Family Ommastrephidae Steenstrup, 1857
Subfamily Todarodinae Adam, 1960
Nototodarus sp. Pfeffer, 1912
Subfamily Ommastrephinae Steenstrup, 1857
Sthenoteuthis oualaniensis Lesson, 1830
Family Thysanoteuthis
Thysanoteuthis rhombus Troschel, 1857
Family Cranchiidae Prosch, 1849
Subfamily Cranchiinae Prosch, 1849
Liocranchia sp. Pfeffer, 1884
Subfamily Taoniinae Pfeffer, 1912
Teuthowenia sp. Chun, 1910
Superorder Octobrachia Fioroni, 1981
Order Octopoda Leach, 1818
Family Octopus Cuvier, 1797
Octopus defilippi Verany, 1851
Octopus Type A
Octopus Type B
Octopus Type C
Family Tremoctopodidae Tryron, 1879
Tremoctopus sp. Delle Chiaje, 1830

Appendix C

Number of Cephalopod paralarvae per 1000 m^3 at 58 stations of Vietnamese Waters during 21 April -5 June 1999.

	Stations														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Sepia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inioteuthis sp.	0	0	0	0	0	0	0	0	2	2	0	4	2	0	0
Loligo spp.	0	0	0	22	0	0	21	20	2	0	0	0	7	5	0
Enoploteuthis sp.	0	0	0	0	0	9	0	0	0	0	14	0	0	0	22
Abralia sp.	0	0	0	0	0	0	0	0	18	0	7	0	0	0	0
Watasenia sp.	0	0	0	0	0	0	0	0	0	7	0	0	0	0	13
Onychoteuthis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Ctenopteryx sicula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nototodarus sp.	0	0	0	0	0	0	0	0	10	0	5	0	0	0	0
Sthenoteuthis oualaniensis	0	0	0	0	0	0	0	5	28	11	14	4	0	0	6
Thysanoteuthis rhombus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liocranchia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Teuthowenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octopus defilippi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octopus Type A	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0
Octopus Type B	4	0	0	0	0	0	0	5	6	7	5	4	0	0	41
Octopus Type C	0	0	0	0	0	0	0	0	2	2	0	2	0	0	2
Tremooctopus sp.	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
unknown	0	0	0	0	0	0	0	0	2	0	0	4	0	0	6
Total	4	0	0	22	0	9	24	29	71	31	44	21	10	5	97

	Stations														
	16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Sepia sp.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Inioteuthis sp.	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Loligo spp.	0	4	0	0	0	0	2	12	2	0	0	0	2	0	0
Enoploteuthis sp.	6	0	0	0	0	0	0	0	2	11	57	6	0	0	0
Abralia sp.	0	0	0	2	0	0	0	0	8	0	0	0	0	0	0
Watasenia sp.	0	2	2	7	0	0	5	2	4	0	12	0	2	0	0
Onychoteuthis sp.	12	22	0	0	9	0	2	6	10	11	6	0	2	0	4
Ctenopteryx sicula	21	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Nototodarus sp.	0	5	0	0	0	0	0	4	0	6	0	0	0	2	0
Sthenoteuthis oualaniensis	3	14	2	0	12	13	0	10	8	31	6	0	5	11	2
Thysanoteuthis rhombus	0	5	0	0	0	0	0	2	0	3	0	0	0	0	0
Liocranchia sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Teuthowenia sp.	0	0	0	0	0	0	0	6	0	3	0	0	0	0	0
Octopus defilippi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octopus Type A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Octopus Type B	0	2	8	0	12	4	0	0	2	0	0	2	2	2	2
Octopus Type C	0	0	0	0	0	0	2	0	0	0	3	0	0	0	2
Tremooctopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unknown	0	2	0	0	0	0	0	4	4	0	3	0	0	4	0
Total	41	58	13	12	33	17	11	52	39	65	87	8	15	20	13

Appendix C (Continued).

	Stations														
	31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Sepia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inioteuthis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loligo spp.	8	0	0	0	0	3	4	0	0	12	0	3	0	0	0
Enoploteuthis sp.	0	0	0	12	6	0	0	0	0	9	0	0	7	0	0
Abralia sp.	0	3	5	5	2	0	0	0	0	7	0	3	0	0	0
Watasenia sp.	8	3	11	0	0	0	0	0	0	0	0	8	0	0	0
Onychoteuthis sp.	0	0	8	0	0	0	0	0	0	7	7	0	2	0	0
Ctenopteryx sicula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nototodarus sp.	8	0	0	0	0	0	0	0	0	5	2	0	0	0	0
Sthenoteuthis oualaniensis	15	10	5	12	8	0	0	0	0	26	12	0	20	0	0
Thysanoteuthis rhombus	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0
Liocranchia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Teuthowenia sp.	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0
Octopus defilippi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Octopus Type A	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Octopus Type B	0	0	0	0	4	0	0	3	9	2	0	0	0	19	2
Octopus Type C	0	0	0	0	2	0	0	0	0	0	0	0	0	7	0
Tremooctopus sp.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
unknown	15	3	13	2	0	0	0	0	0	5	0	0	0	4	0
Total	53	20	53	31	26	3	4	3	9	76	22	13	32	30	5

	Stations													
	46	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**total**
Sepia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Inioteuthis sp.	0	0	0	0	0	3	0	0	0	0	0	0	0	17
Loligo spp.	3	10	0	0	0	0	2	3	0	2	18	0	0	165
Enoploteuthis sp.	0	0	0	0	0	0	0	0	0	8	0	0	0	169
Abralia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	60
Watasenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	86
Onychoteuthis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	116
Ctenopteryx sicula	0	0	0	0	0	0	0	0	0	0	0	0	0	22
Nototodarus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	47
Sthenoteuthis oualaniensis	0	0	0	0	0	0	0	0	0	0	0	0	0	294
Thysanoteuthis rhombus	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Liocranchia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Teuthowenia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	19
Octopus defilippi	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Octopus Type A	0	0	0	0	0	0	0	3	0	0	11	0	5	28
Octopus Type B	6	0	6	0	0	5	11	8	13	4	11	25	0	236
Octopus Type C	3	0	0	0	0	0	4	0	0	4	4	0	0	40
Tremooctopus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	4
unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	72
Total	12	10	6	0	0	8	18	13	13	19	43	25	5	1400