Microplankton on Distribution in the South China sea, Area II: Sarawaw, Sabah and Brunei Darussalam Waters

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ABSTRACT

Collaborative cruises in the South China Sea around the coast of Sarawak, Brunei and Sabah were conducted in the premonsoon (October, 1996) and the postmonsoon (June, 1997) periods on board MV SEAFDEC. The microplankton from 79 sampling stations consisted of more than 200 taxa consisting predominantly of blue green algae (3 species), diatoms (> 90 species), dinoflagellates (> 70 species) and microzooplankton (> 20 groups). Among the microplankton collected, three species of blue green (*Trichodesmium erythraeum, T. thiebautii, Richelia* sp.) and numerous diatom species were dominant. The dominant diatom species comprised of *Chaetoceros diversum, C. peruvianum, C. laciniosus, Thalassionema frauenfeldii, Bacteriastrum comosun, Coscinodiscus* sp. and *Rhizosolenia alata*; while those of dinoflagellates consisted of *Ceratium fusus, C. arcuatum, C. teres, Protoperidinium* sp., *Protoceratium* sp., *Ceratocorys* sp. and *Alexandrium* sp. The genera *Chaetoceros, Rhizosolenia, Bacteriastrum* and *Ceratium* were found to contain a wide range of species. The total microplankton densities ranged from 0.74 x 10^6 to 7.94 x 10^6 individuals / m^3 and from 0.16 x 10^6 to 1.25 x 10^6 individuals / m^3 during the premonsoon and postmonsoon periods respectively. The presence of the dinoflagellate species of *Ceratium, Protoperidinium* and *Alexandrium* were detected in considerable amounts at coastal and intermediate middle waters of the South China Sea. Blooms of *Rhizosolenia alata* and *Trichodesmium* sp. occurred during the premonsoon period. The microzooplankton consisted of more than 20 species dominated by copepod nauplii (> 50% of total microzooplankton count), radiolerians, foraminiferas and protozoans; most of the zooplankton species were dominant in nearshore and intermediate middle waters of the South China Sea.

Introduction

Published works on studies of plankton and other related organisms of the Malaysian waters in the South China Sea are scanty. Qualitative studies of plankton in the Malaysian coastal waters, especially the Malacca Straits have been conducted by Sewell (1933), Wickstead (1961) and Pathansali (1968). Primary productivity in the same location had been carried out by Doty *et al.* (1963); however, a detailed study of the species community structure, distribution and abundance of plankton in such waters had been lacking. Studies by Shamsudin (1988) in the South China Sea around coasts of Johore, Terengganu and Kelantan found that majority of the phytoplankton found were diatoms which comprise of numerous species of *Bacteriastrum, Chaetoceros, Rhizosolenia* and *Pleurosigma*. The blue green, *Trichodesmium erythraeum* was found in abundance in tropical waters (Chua & Chong, 1973). Studied on plankton (Shamsudin 1987, Shamsudin & Baker 1987, Shamsudin *et al.* 1987, Chua & Chong 1973) had raised questions about the qualitative and quantitative seasonal availability of these organisms as sources of food for those organisms higher up in the food chain and the relative production of these organisms in various study sectors of the South China Sea.

Studies by Chua and Chong (1973) in the Malacca Straits showed that the distribution and abundance of pelagic species especially the small tuna (*Euthynus affinis*), chub makerel (*Rastrelliger* sp.) and anchovies (*Stolephorus* sp.) were related to the density of phytoplankton. Physico-chemical factors may influence the distribution and abundance of phytoplankton. These factors consisted of temperature, salinity, dissolved oxygen, turbidity, current and nutrient concentration (nitrate, phosphate, ammonium and silicate).

In the present study, the microplankton community structure has been analysed during the pre and postmonsoon periods (October 1996, June 1997) in the Sarawak, Sabah and Brunei waters of the South China Sea. The species community structure patterns, distribution, composition and species abundance at various study sectors of the South China Sea during the two seasons were estimated.

Methods

Study Area

The study area covers an area which extends from the eastern Sarawak waters (Lat. 2^{o} 18.4 E; Long. 109^{o} 35.4'N) to the northern tip of Sabah covering the Sabah waters (7^{o} 9.6'E; 115^{o} 51.9' N) of the South China Sea . The estimated study area is ca 8100 nautical square miles (ca 25100 sq. km) covering the economic exclusive zone (EEZ) of Malaysian sea of the South China Sea. The sea cruise track followed a zig-zag manner starting from the eastern coastal Sarawak waters and ended up at the northern end of Sabah waters covering a total of 79 sampling stations.

Sampling Method & Preparation

The research survey were carried out in October 1996 and June 1997 whereby seventy nine stations were identified during the survey. Vertical plankton net of mesh size 56 µm was hauled at a speed of 1 m/s from 40 m (twice the depth of the 1% surface illumination) to the surface. The net diameter is 45 cm and length 92 cm. Samples at various depths using Van Dorn water sampler (20 litres) were also taken to quantify the microplankton population which also include some of the microzooplankton. This is to compensate the error which might arise from plankton escaping the net plankton. During sampling the plankton also included some zooplankton that might be caught in the water sampler and net plankton at the same time. The net plankton was hauled vertically at very slow speed (to avoid plankton avoidance of the plankton net) at every stations. The samples were preserved in 10% formalin. The microplankton fractions of the samples were examined for species composition and abundance. A quantitative study of the microplankton was carried out using an inverted microscope (Vollenweider *et al.* 1974; Tippett 1970; Shamsudin 1987, 1993, 1994, 1995; Shamsudin & Shazili 1991; Shamsudin & Sleigh 1993, 1995; Shamsudin *et al.* 1987, 1997).

The microplankton cells were routinely examined with a Nikon microscope using a x 10 eyepiece and a x 40 bright field objective. Difficult specimens were examined under a x 100 oil immerson objective. Where it was necessary for a detailed identification, samples were treated by boiling and washing in 10% HCI (Tippett, 1970) to clean diatom frustules in order to show up their ultra fine structure for identification purposes, employing the scanning electron microscope (SEM) technique. The samples which had been fixed and preserved in absolute alcohol, were then mounted on (SEM) stubs with double-sided cellotape. The stubs with adhering samples were then coated with an alloy (gold with pelladium) before being observed under the scanning electron microscope (Barber & Haworth, 1981). Algal were identified with reference to Palmer & Keely (1900), Cleve (1901, 1904), Gran (1912), Pascher (1914, 1915 & 1925), Hustedt (1930), Sewell (1933), Handey (1933, 1964), Fritsch (1935), Cummins & Mulryan (1937), Cupp (1943), Cleve-Euler (1944), Crossby & Wood (1959), Winstead (1961), Banse (1964), Patrick & Reimer (1968), Shirota (1966), Newell & Newell

(1973), Taylor (1976), Taylor & Seliger (1979) and Barber & Haworth (1981).

An index of the composition of the plankton community in the aquatic habitat is given by calculating the diversity index (H) and evenness (J) of the community structure using the Shannon-Weiner (1949) index. The formula for calculating Shannon-Weiner (diversity) index (H) is :

$H = P_i \log_2 P_i$, Where $P_i = n_i/N$

n_i = The number of individuals of the i th species

N = The total number of individuals

The diversity index can measure species richness (H) and species evenness (J)

$J = H/\log_2 S$ - (ii), S is the number of species

Statistical Analysis

Analysis of variance can be used to assess the relative importance of different sources of variation, e.g. between sites, between dates, etc., but it may be necessary to transform the data before analysis of variance tests are applied. One way analysis of variance can be imployed when comparisons are made between a number of independent random samples, one sample from each population. All counts must be classified in the same manner, but the number of counts in the various samples can be different (Elliott, 1977).

Coefficients of similarity are simple measures of the extent to which two habitats have species (or individuals) in common (Southwood, 1978). Essentially, such coefficient can be of two types, as given below, and both types reflect the similarity in individuals between the habitats.

(i) Jaccard $Cj = j / (a + b-j)$

(ii) Sorensen $Cs = 2j / (a+b)$

where a, b are the total individuals sampled in habitat a and b respectively, and j is the sum of the lesser values for the species common to both habitats (Southwood, 1978). In habitats where one or few species have high dominance the coefficients under-estimate the contributions of the moderately common species which may be more stable indicators of the characteristic fauna of an area while the rare species have little impacts (Southwood, 1978). It is apparent that Cs is greater than Cj and the inequality reduces as j approaches the magnitude of 1/2 (a+b).

The microplankton can be classified into species assemblages or associations in cluster analysis on species sampled from the nearshore and offshore stations according to their preference on environmental conditions using the unweighted pair group average (UPGA) Pearson correlation index (Pielou, 1984; Ludwig & Reyholds, 1988).

Results and Discussion

The microplankton during the pre and post monsoon survey cruises consisted of more than 200 taxa consisting predominantly of blue green algae (3 species), diatoms (> 90 species) and dinoflagellates (> 70 species) (Tables 1 & 2, see Appendix). Three species of blue greens (*Trichodesmium erythraeum, T. thiebautii, Richelia* sp.) as well as several species of diatoms and dinoflagellates were dominant. The dominant diatom species comprised of *Chaetoceros diversum, C. peruvianum, C. laciniosus, Thalassionema frauenfeldii, Rhizosolenia alata, R. hebatata, R. styliformis, Bacteriastrum comosun, B. varians, B. hyalimum, Coscinodiscus* sp. and *Rhizosolenia alata*; while those of dinoflagellates consisted of *Ceratium fusus, C. teres, C. areuatum, Protoperidinium* sp., *Protoceratium* sp., *Ceratocorys* sp. and *Alexandrium* sp (Tables 2 & 3). The genera *Chaetoceros, Rhizosolenia, Coscinodiscus, Bacteriastrum* and *Ceratium* were found to contain a wide range of species. The total microplankton densities ranged from 0.74 x 10^6 to 7.94 x 10^6 individuals / m^3 and from 0.16 x 10^6 to 1.25 x 10^6 individuals / m^3 during the premonsoon and postmonsoon periods respectively (Fig. 1). There was an increase of about one order of magnitude in the total cell population during the premonsoon as compared to the post monsoon season. The diversity index H values ranged from 1.7 to 4.8 with usually high values in the coastal stations during both seasons (Fig. 2). The J evenness index values were usually directly proportional to the H values.

The maps from Figs. 3.1 a & b show the total cell population density during the pre and post monsoon period during the cruise survey with lesser population density in the latter. Two distinct patches of high cell population density were observed near the Rajang river mouth and offshore waters to the north of Sarawak during the premonsoon. A broad strip of water mass rich in microplankton was observed in the middle Sarawak waters of the South China Sea during the postmonsoon. It is noted that two patches of *Trichodesmium* bloom occurred near the Rajang river mouth and offshore waters to the north of Sarawak (Figs. 3.2 a & b). The dinoflagellate bloom was dense at the Rajang river mouth during the pre monsoon period while it was scattered during the postmonsoon (Figs. 3.3 a & b). An elongated narrow strip of *Thalassionema* bloom was observed along the coast of Sarawak during the premonsoon while two small patches of *Thalassionema* bloom was seen during the postmonsoon (Figs. 3.4 a & b). An isolated *Rhizosolenia* bloom was seen in the middle waters to the north of Brunei during the postmonsoon (Figs. 3.5 a & b). The species of *Trichodesmium* and *Rhizosolenia* were dominant species during the pre and post monsoon periods; numerous small patches of different species of *Chaetoceros, Thalassionema* and *Bacteriastrum* are also found (Figs. 3.6 a & b) during the study period.

Microplankton population at various sectors

Sampling stations can be grouped into at least 5 sectors with respect to their similarities in species composition using cluster analyses on 79 stations by mean of the unweighted pair group average (UPGA) Pearson index analyses (Fig. 4). The identified sectors comprised of a) Sarawak coastal waters (SCW), b) Sarawak middle water (SMW), c) Offshore Sarawak waters (OSW), d) Eastern Sabah waters (ESW) and e) Western Sarawak waters (WSW). The mean population densities at various stations of the 6 sectors (data from various stations from each sector were pooled together) were high during the premonsoon with values ranging from 0.74 x 10^6 to 7.94 x 10^6 /m^3 with Sarawak coastal waters sector having the highest values (Figs. 5 - 9). The trend in the mean densities at the 5 sectors during the post monsoon was similar to that of the premonsoon; however the values were much lower during the postmonsoon, ranging from 0.16 x 10^6 to 1.25 x 10^6 /m^3.

The major microplankton species at the Sarawak middle waters sector during premonsoon comprised of *Rhizosolenia calcar-avis, Chaetoceros lorenzianus, Coscinodiscus* sp., *Trichodesmium erythraceum* and *Ceratium fusus* with values ranging from 794 to 9.7 x 10^5/m^3. The copepod nauplii had a moderate value of 6.31 x 10^4/m^3 (Fig. 5). Microplankton species during the premonsoon were

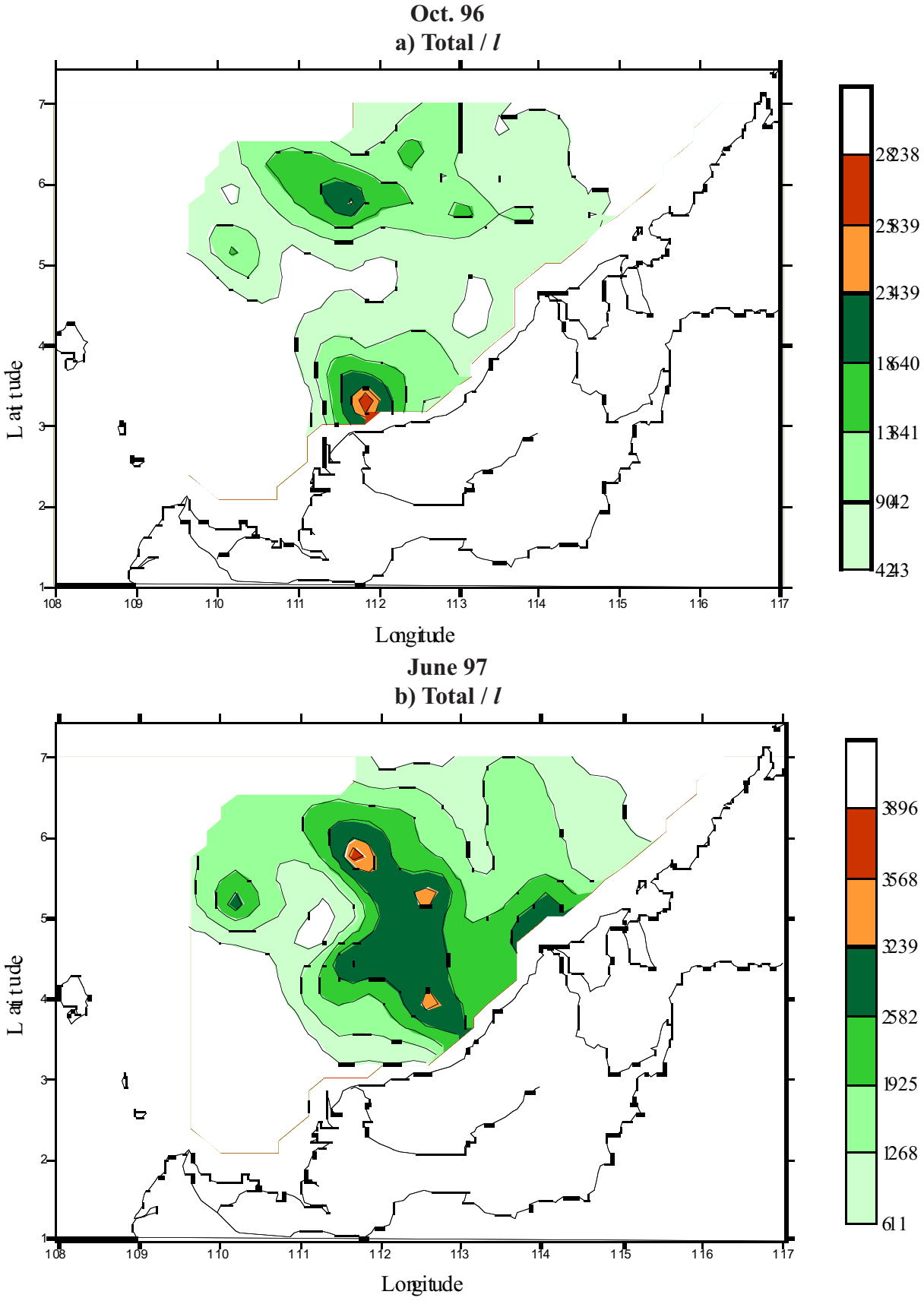

Fig. 3.1 Total cell density (L^{-1}) of microplankton cell population during the (a) pre and (b) post monsoon period of the cruise survey (October 1996 and June 1997).

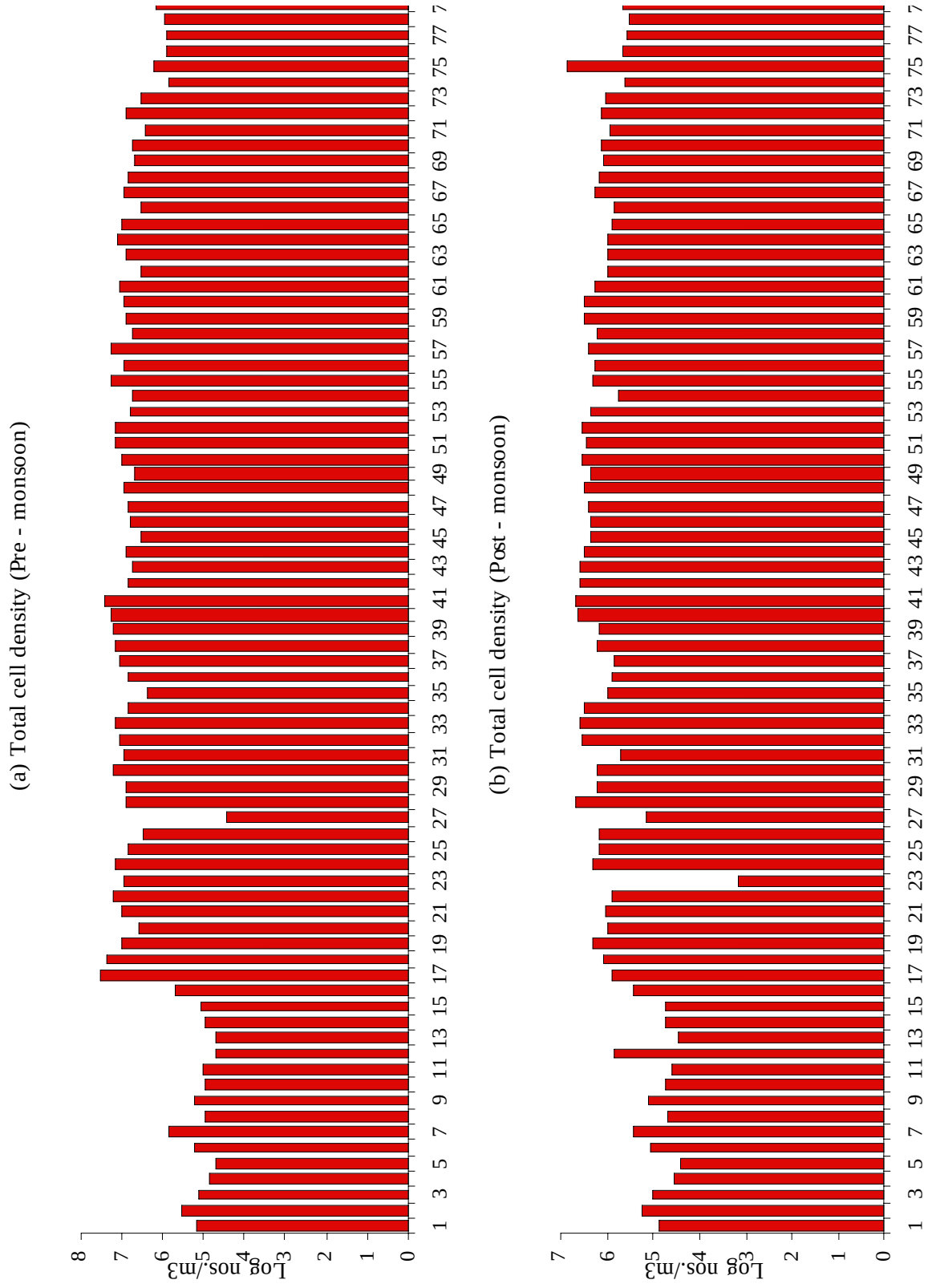

Fig. 1 Total cell densities (log nos./m^3) at different stations during the pre and post - monsoon period (Oct. 1996 / June 1997 respectively) in Sabah - Sarawak waters of the South China Sea.

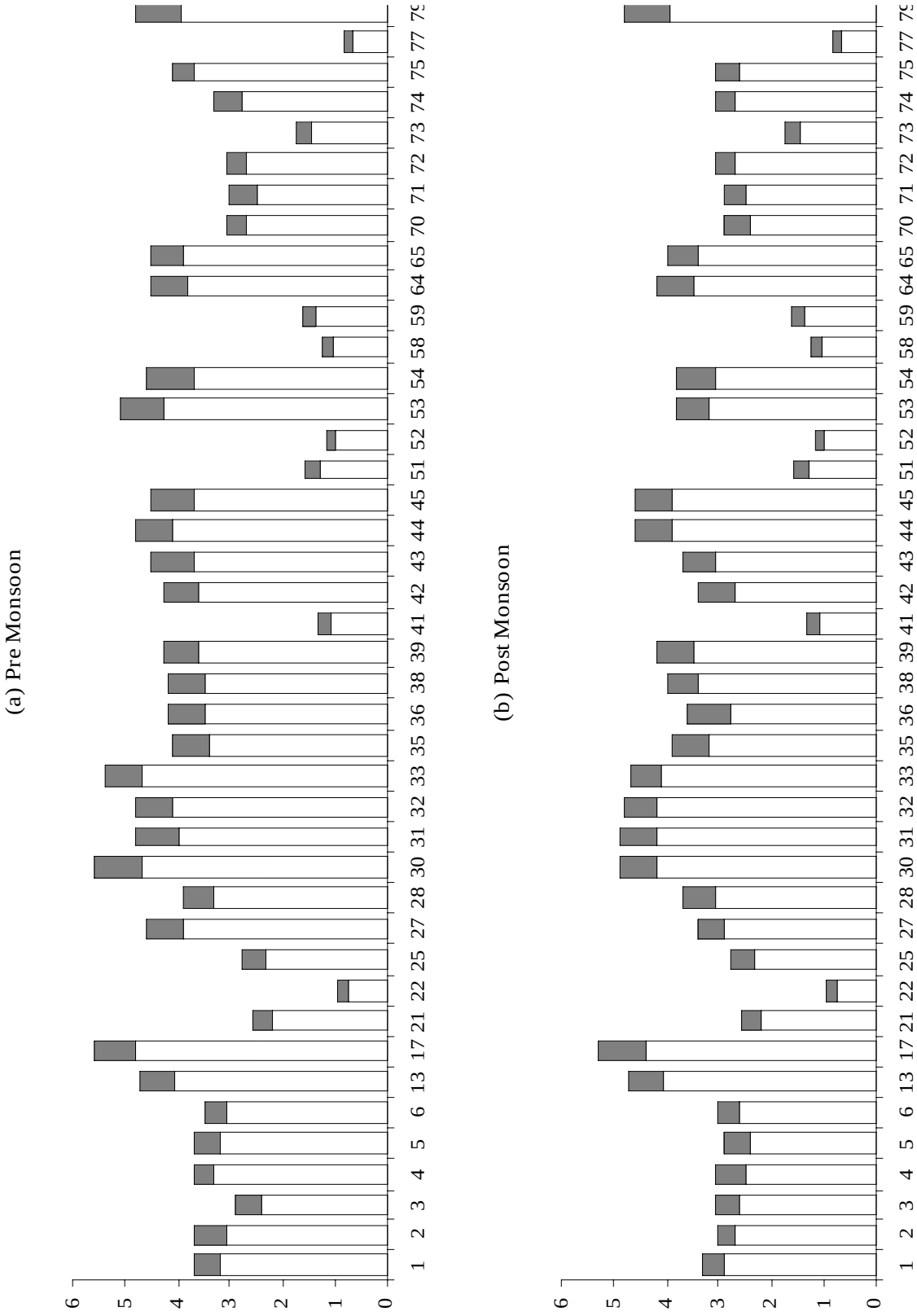

Fig. 2 The diversity (H) and evenness (J) indices of various station in the Sarawak - Sabah waters of the South China Sea during (a) pre monsoon and (b) post monsoon season.

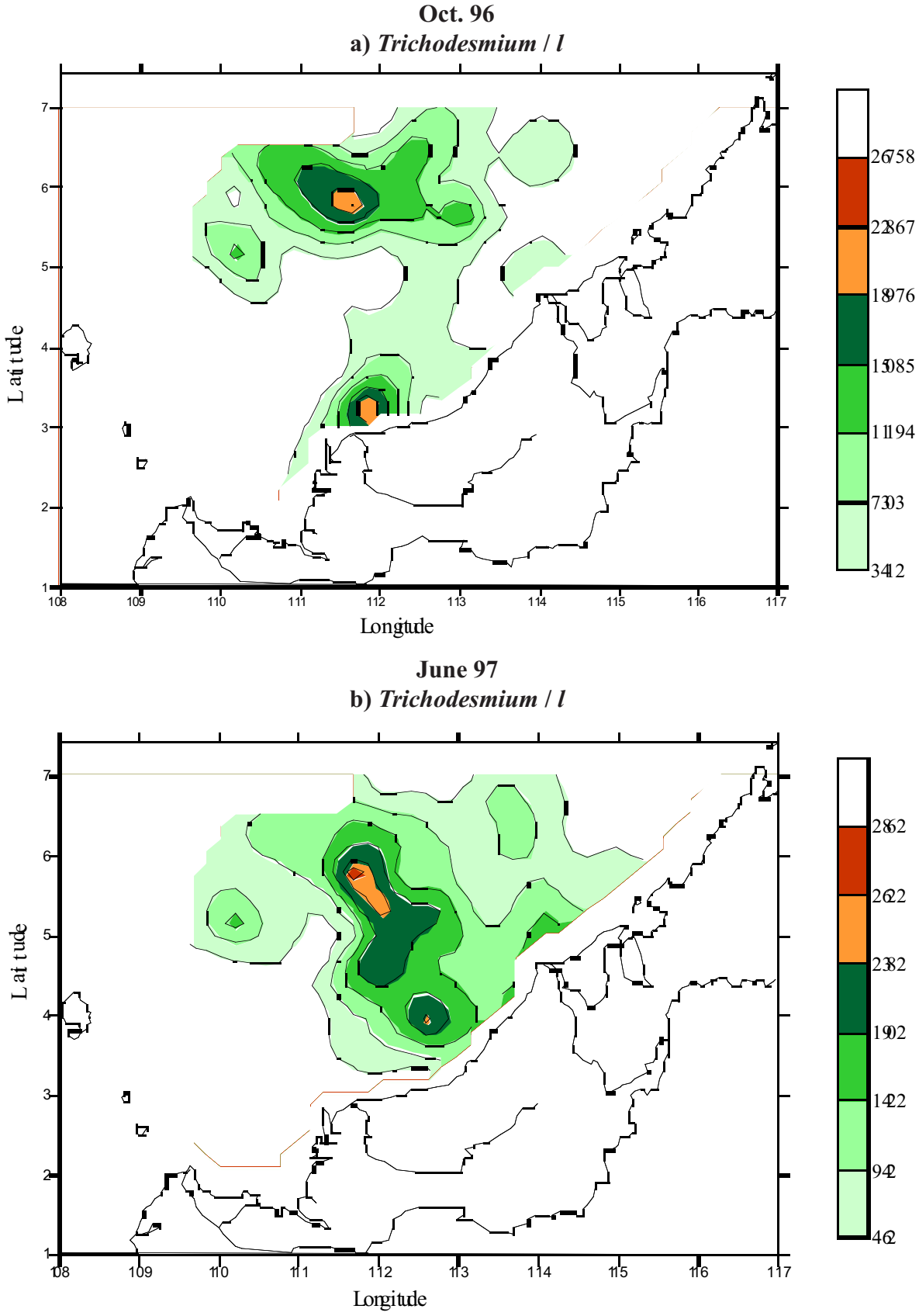

Fig. 3.2 *Trichodesmium* population density (L^{-1}) during the (a) pre and (b) post monsoon period of the cruise survey (October 1996 and June 1997).

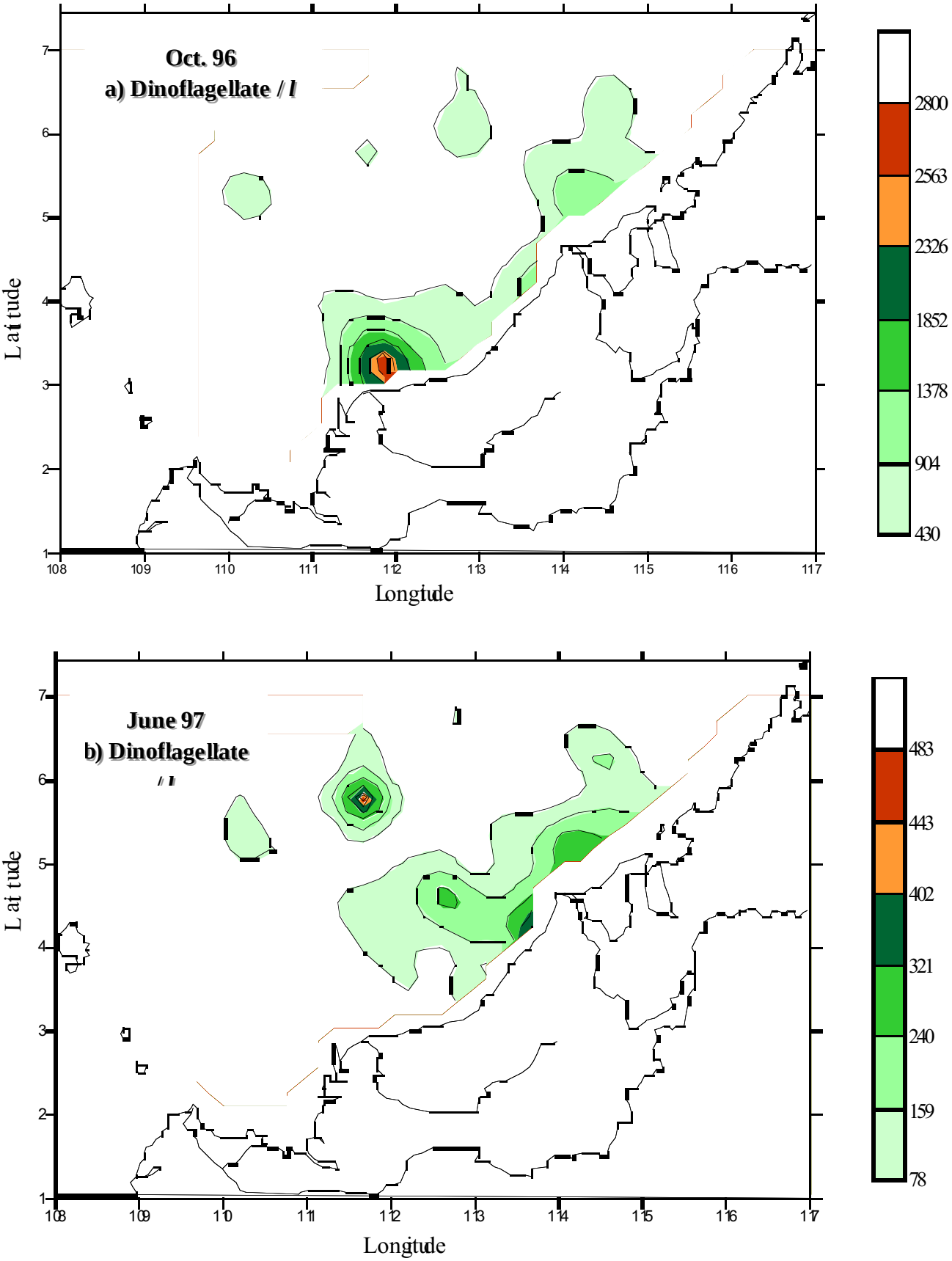

Fig. 3.3 Dinoflagellate population density (L^{-1}) during the (a) pre and (b) post monsoon period of the cruise survey (October 1996 and June 1997).

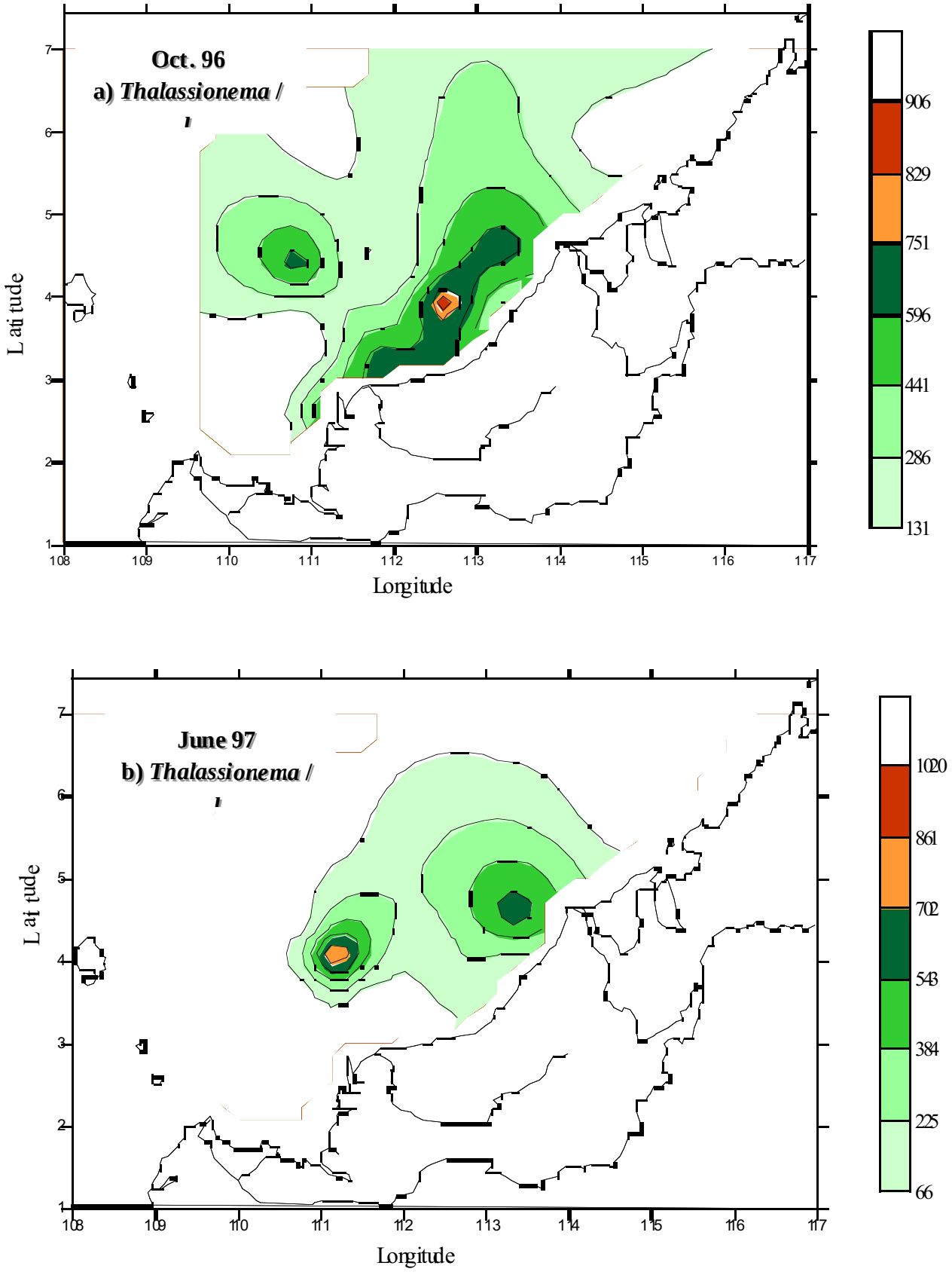

Fig. 3.4 *Thalassionema* population density (L^{-1}) during the (a) pre and (b) post monsoon period of the cruise survey (October 1996 and June 1997).

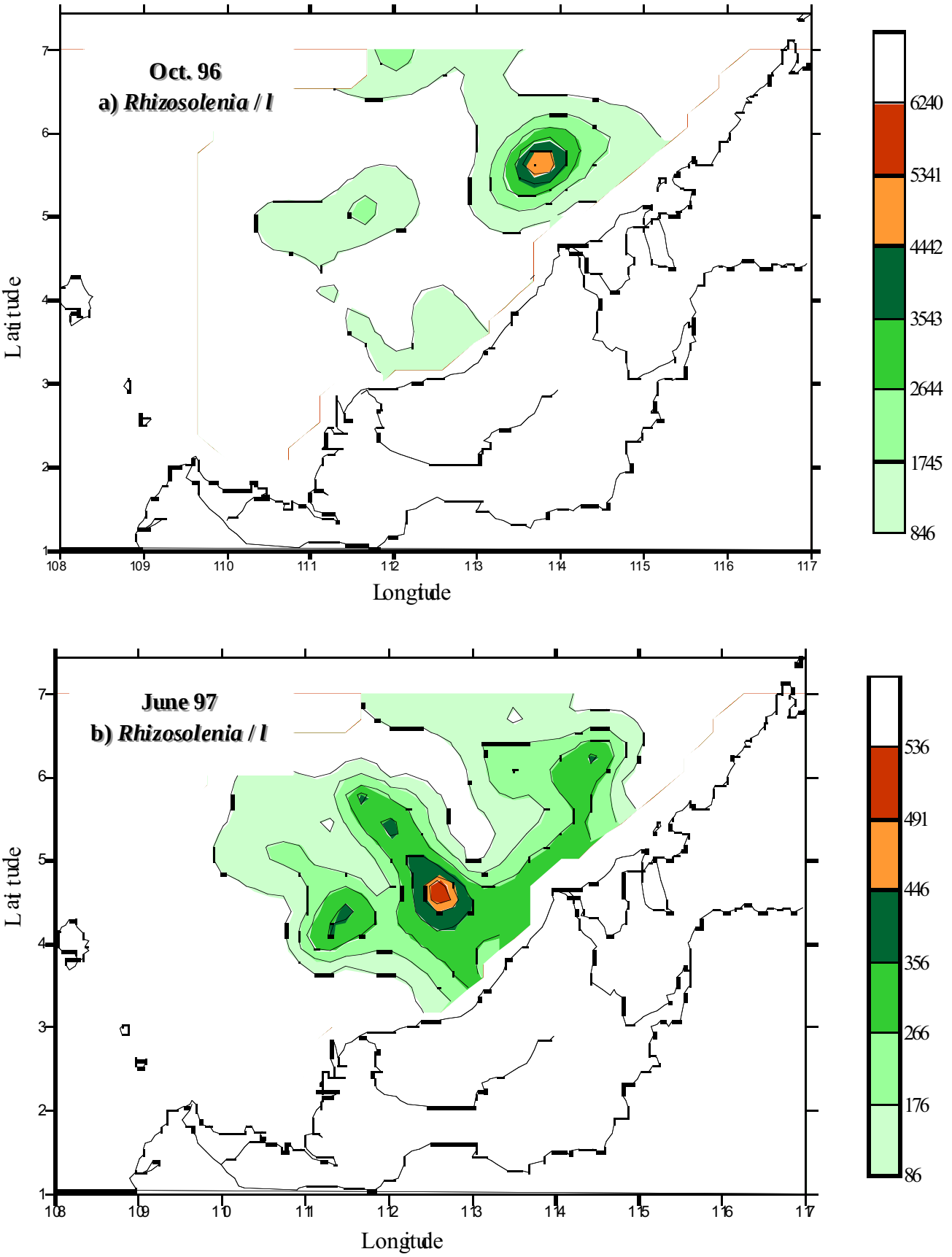

Fig. 3.5 *Rhizosolenia* population density (L^{-1}) during the (a) pre and (b) post monsoon period of the cruise survey (October 1996 and June 1997).

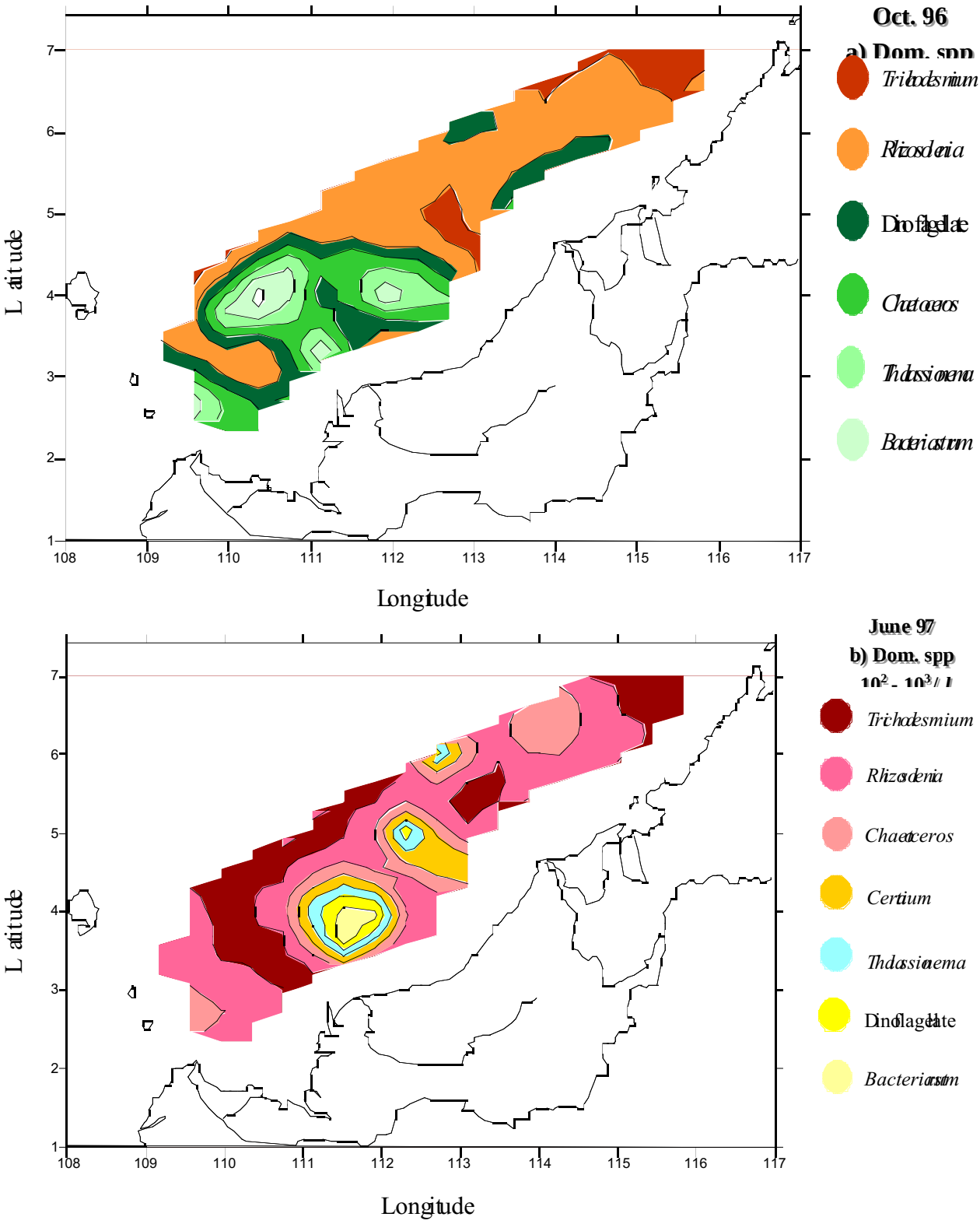

Fig. 3.6 Dominant microplankton species during the (a) pre and (b) post monsoon period of the cruise survey (October 1996 and June 1997).

present in higher concentrations than those during the postmonsoon.

The mean total population densities in the Sarawak middle waters were 5.01 x 10^6 and 7.9 x $10^5/m^3$ during the pre and postmonsoon seasons respectively (Fig. 6). During the premonsoon the blue green, *Trichodesmium erythraeum* reached its peak bloom at concentration of 1.99 x $10^6/m^3$ (> 30% of its total cell density); however, this species was again detected during the postmonsoon with a lower value (6.3 x $10^5/m^3$). *Rhizosolenium hebatata, Bacteriastrum* sp., *Chaetoceros lorenzianum, Thalassionema frauenfeldii* were dominant diatoms present during the premonsoon with values ranging from 1.9 x 10^3 to 2.51 x $10^5/m^3$. *Coscinodiscus* sp. and *Thalassionema frauendeldii* were present only during the premonsoon. Four species or *Rhizosolenia* (*R. alata, R. hebatata, R. styliformis* and *R. calcar - avis*) were also present with values ranging from 3.98 x 10^4 to 5.01 x $10^5/m^3$. *Tintinnopsis* sp. and copepod nauplii were high during the premonsoon.

Trichodesmium bloom (comprising of *T. erythraeum* and *T. thiebautii*) occurred in offshore Sarawak waters with its peak density value of 2.24 x $10^6/m^3$ (>20% of total cell density) (Fig. 7). The bloom occurred during both monsoons. *Rhizosolenia hebatata* was the only dominant diatom present during the premonsoon. Species of *Ornithocerus* and *Peridinium* were present with values ranging from 6.31 x 10^4 to 11.5 x $10^4/m^3$. Fair amounts of *Richelia* sp., *Climacodium* sp., *Ceratium macroceros* and *C. fusus* also occurred during the two seasons. The mean total cell density of the post monsoon was 28% that of the premonsoon.

Chaetoceros macroceros and *Trichodesmium erythraeum* were dominant species in the eastern Sabah waters with mean densities of 1.58 x 10^5 $/m^3$ and 3.54 x $10^5/m^3$ respectively; however both the species were present in lower concentrations during the postmonsoon (Fig. 8). *Protocentrum* sp., *Dinophysis* sp. and *Thalassionema nitzschoides* were present during the postmonsoon; however *Chaetoceros macroceros, Ceratium furca* and copepod nauplii were found during both seasons. *Protoperidinium* sp. was present in considerable concentration during the post monsoon. The mean total cell densities in this sector were 1.58 x 10^6 and 2.50 x $10^5/m^3$ during the pre and postmonsoon seasons respectively.

The fifth sector was identified for those stations around the western nearshore Sarawak waters. During the premonsoon, the diatoms (*Rhizosolenia alata, Chaetoceros lorenzianum, Bacteriastrum delicatilum*) and the blue greens (*Trichodesmium erythraeum* and *T. thiebautii*) were dominant with values ranging from 2.51 x 10^3 to 1.38 x $10^3/m^3$ (Fig. 9). Copepod nauplii were present during both seasons with values ranging from 150 to $1150/m^3$. The mean total cell densities were 1.99 x 10^5 and 1.58 x $10^5/m^3$ during the pre and postmonsoon seasons respectively.

Microplankton assemblages and associations

The results from Fig. 10 illustrate that the microplankton species during the premonsoon comprised of at least seven species assemblages or associations in cluster analysis on 57 species sampled from the nearshore and offshore stations according to their preference on environmental conditions using the unweighted pair group average (UPGA) Pearsons index analyses. The species assemblages consisted of group A (*Chaetoceros coarctatum, Thalassionema fraeufeldii, Bacteriastrum delicatulum*); group B (*Trichodesmium erythraeum, Ceratium arcuatum*); group C (*Thalassionema fraeunfeldii, Chaetoceros lorenzianun*); group D (*Rhizosolenia hebatata, Chaetoceros laciniosus, C. decipiens, Ceratium longissinum*); group E (*Rhizosolenia styliformis, R. robusta, R. bergonii, R. alata*); group F (*Thalassionema thiebautii, Chaetoceros peruvianum, Ceratium teres, C. fusus*)(Table 3).

During the post monsoon period, cluster analysis of 51 species sampled from the 79 stations shows that there was a change in species assemblages or associations. At least 7 species associations according to their preference on environmental conditions (Fig. 11, Table 3). The species assemblages consisted of group A (*Ceratocorys* sp., *Bacteriastrum hyalinum, Nitzshia frigida*); group B (*Thalassionema fraeunfeldii, Nitzschia seriata, Rhizosolenia stolterforthii, Chaetoceros lorenzianum*);

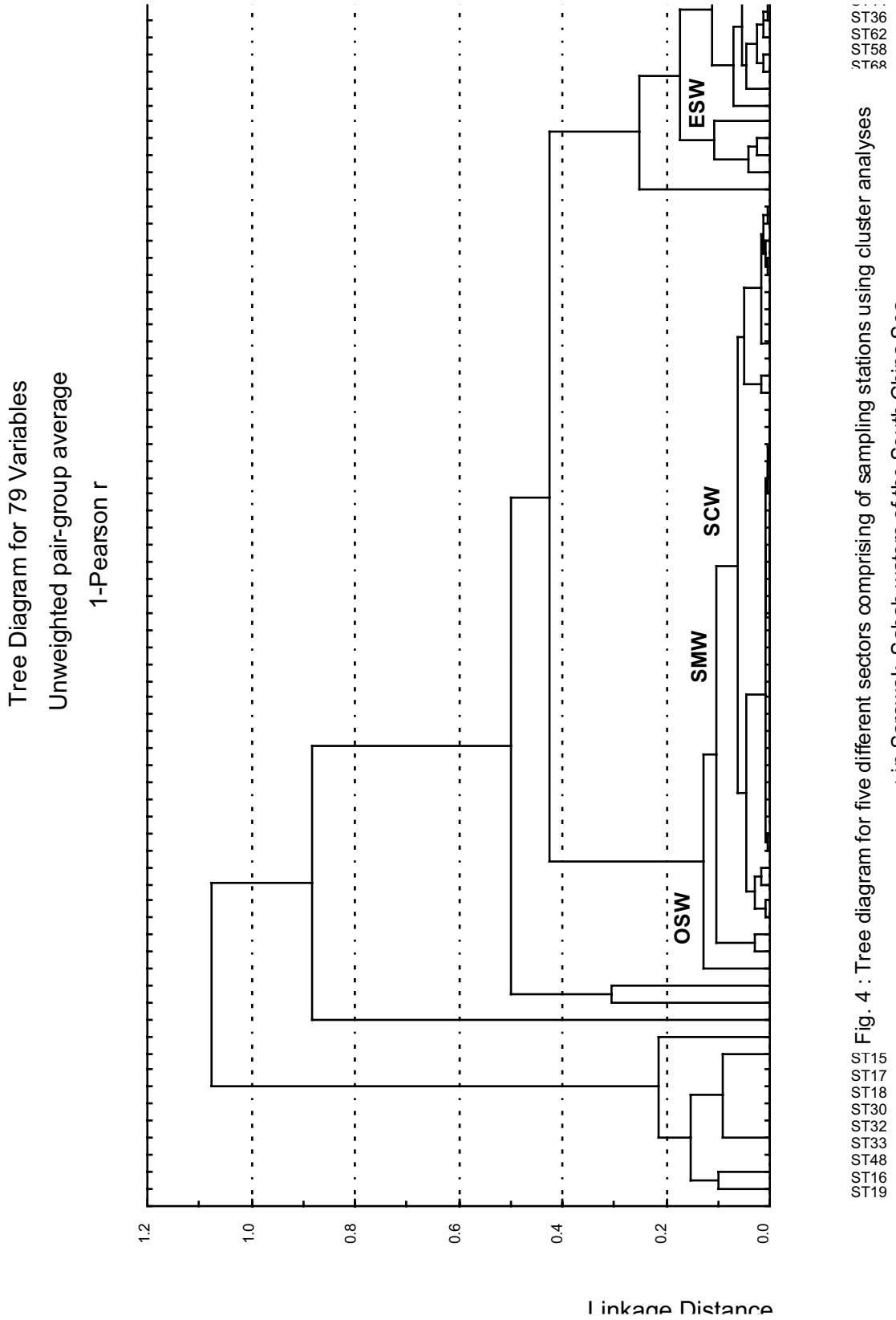

Fig. 4 : Tree diagram for five different sectors comprising of sampling stations using cluster analyses in Sarawak, Sabah waters of the South China Sea.

Fig 4

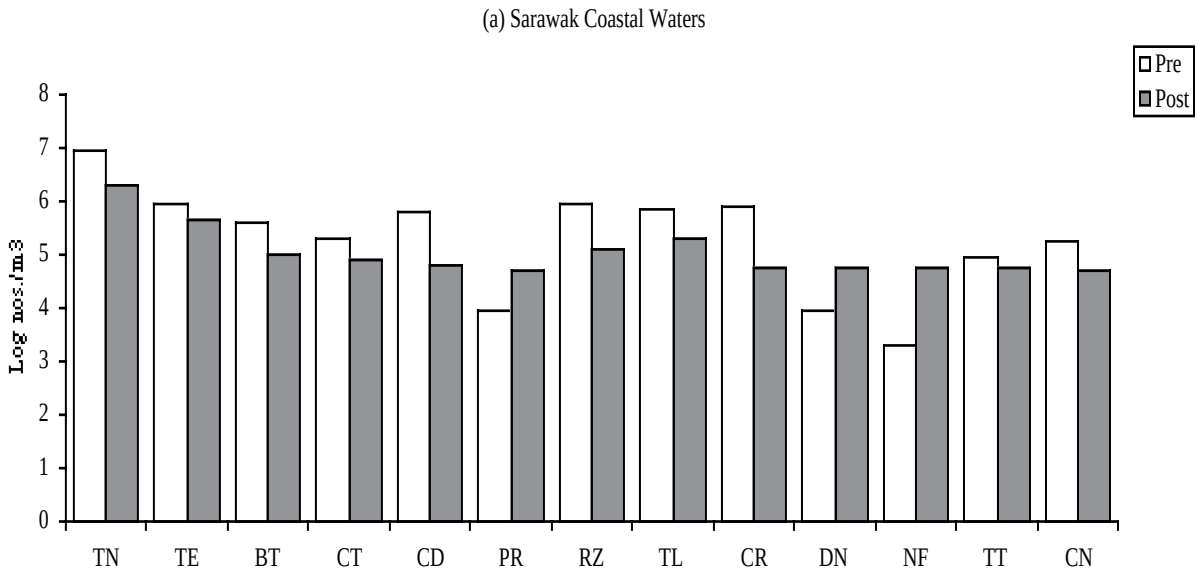

Fig. 5 Cell densities (log nos./m^3) of various microplankton species at stations nearby Sarawak Coastal Waters during pre and post monsoon seasons. (TN-total cell, TE-*Trichodesmium erythraeum*, BT-*Bacteriastrum cosmosum*, CT-*Chaetoceros lorenzianum*, CD-*Coscinodiscus debilis*, PR-*Peridinium* sp., RZ-*Rhizosolenia calcar-avis*, TL-*Thalassionema frauenfeldii*, CR-*Ceratium fusus*, DN-*Dinophysis* sp., NF-*Nitzchia frigida*, TT-*Tintinnopsis* sp., CN-Copepod nauplii).

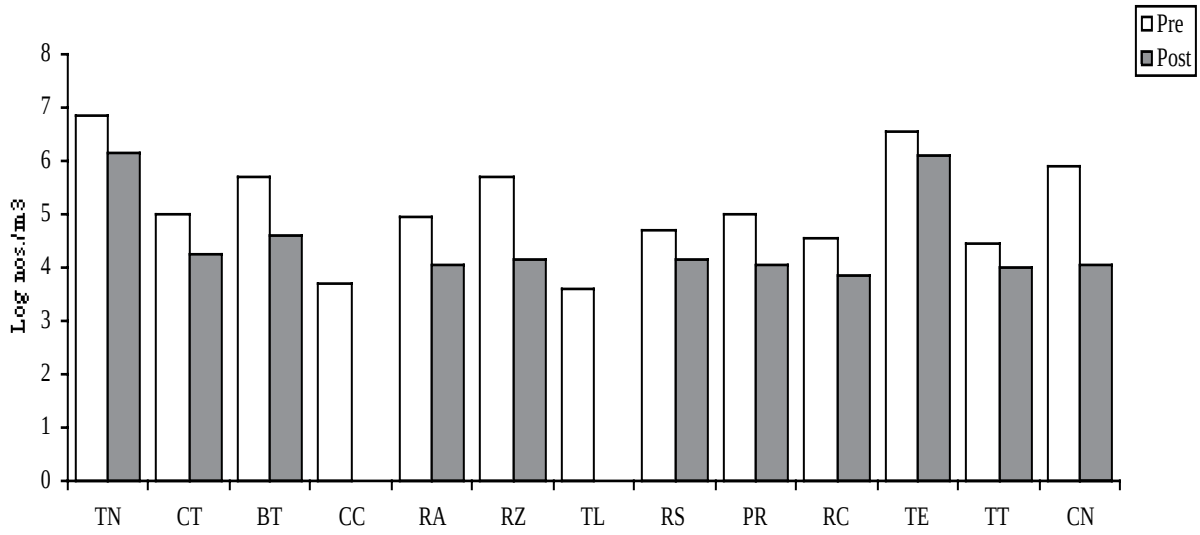

Fig. 6 Cell densities (log nos./m3) of various microplankton species at stations in Sarawak Intermediate Middle Waters of the South China Sea during pre and post monsoon seasons. (TN-total cell, CT-*Chaetoceros lorenzianum*, BT-*Bacteriastrum delicatulum*, CC-*Coscinodiscus* sp., RA-*Rhizosolenia alata*, RZ-*Rhizosolenia hebatata*, TL-*Thalassionema frauenfeldii*, RS-*Rhizosolenia styliformis*, PR-*Peridinium* sp., RC-*Rhizosolenia calcar-avis*, TE-*Trichodesmium erythraeum*, TT-*Tintinnopsis* sp., CN- Copepod nauplii).

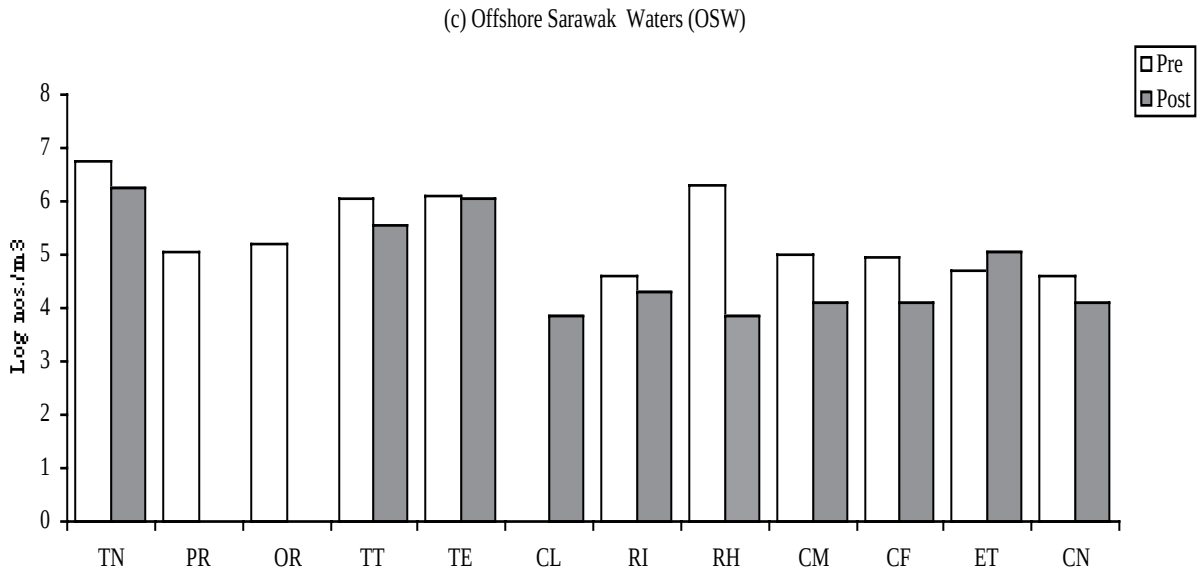

Fig. 7 Cell densities (log nos./m3) of various microplankton species at stations in Offshore Sarawak waters of the South China Sea during pre and post monsoon seasons. (TN. total cell, PR-*Peridinium* sp., OR-*Ornithocerus* sp., TT-*Trichodesmium thiebautii*, TE. *Trichodesmium erythraeum*, CL-*Climacodium* sp., RI-*Richelia* sp., RH-*Rhizosolenia hebatata*, CM-*Ceratium macroceros*, CF. *Ceratium fusus*, ET-*Eutintinus* sp., CN. Copepod nauplii)

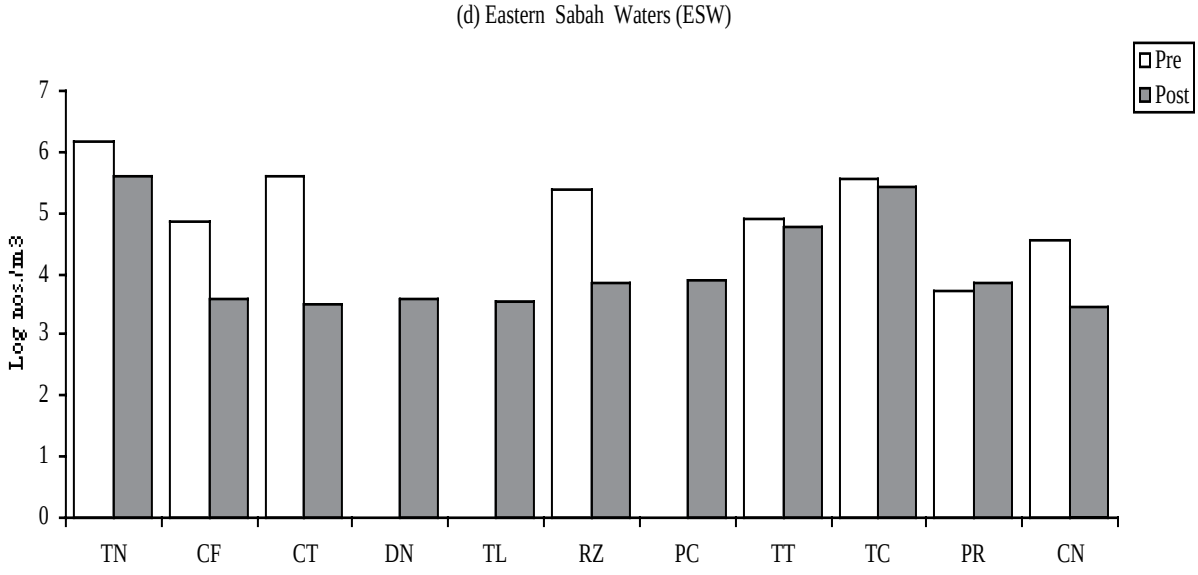

Fig. 8 Cell densities (log nos./m3) of various microplankton species at stations in Eastern Sabah waters of the South China Sea during pre and post monsoon seasons. (TN-total cell, CF-*Ceratium furca*., CT-*Chaetoceros macroceros*, DN-*Dinophysis*, TL-*Thaliassionema nitzschoides*, RZ-*Rhizosolenia*, TT-*T. thiebautii*., TC-*Trichodesmium erythraeum*, PR-*Protoperidinium* sp., CN-Copepod nauplii).

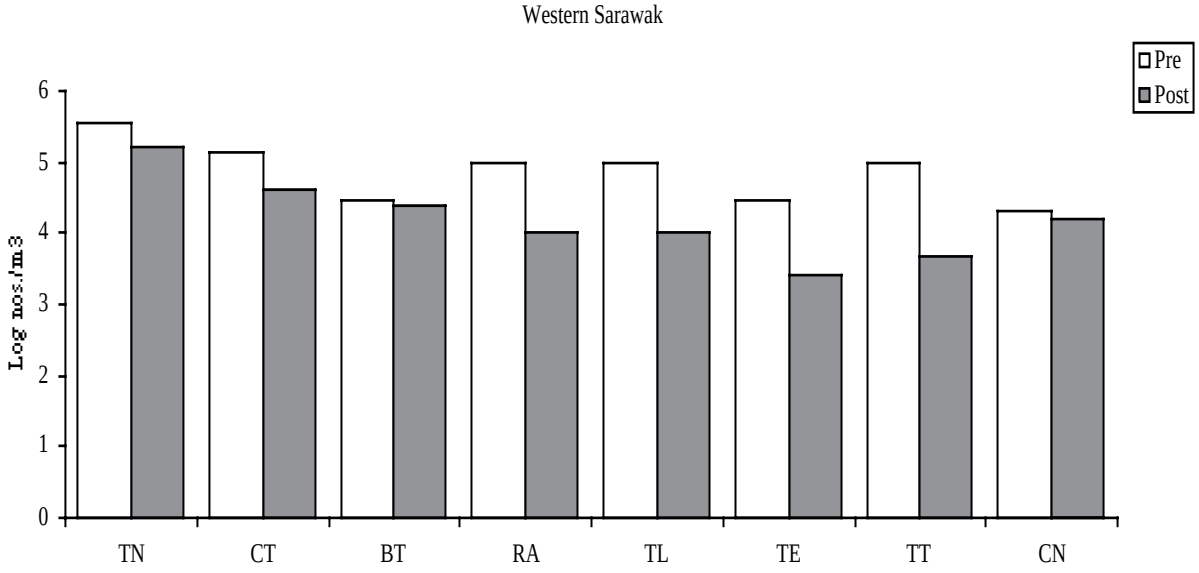

Fig. 9 Population densities (log nos./m^3) of various microplankton species at stations in Western Sarawak Waters of the South China Sea during pre and post monsoon seasons. (TN-total cell, CT-*Chaetoceros lorenzianum*, BT-*Bacteriastrum delicatulum*, RA-*Rhizosolenia alata*, TL-*Thalassionema frauenfeldii*, TE-*Trichodesmium erythraeum*, TT-*T. thiebautii* sp., CN-Copepod nauplii).

group C (*Richelia* sp., *Rhizosolenia clevei, Peridinium* sp., *Pleurosigma* sp., *Climacodium* sp.); group D (*Trichodesmium erythraeum, T. thiebautii, Protoperidinium* sp., *Hemialus* sp.); group E (*Rhizosolenia habatata, Globigerina* sp., *Chaetoceros decipiens*); group F (*Chaetoceros comosum, Ceratium fusus, C. teres*).

Earlier studies by Shamsudin *et al.* 1987 in the Malaysian waters of the South China Sea showed that the microphytoplankton from 16 oceanographic stations consisted predominantly of diatoms and blue green algae. The bulk of the diatom species consisted of *Chaetocerus, Rhizosolenia, Melosira, Thalassiothrix, Dactyliosolen* and *Guinardia*. Another diatom species, *Planktoniella* was present only at stations further offshore from the coast. However, other diatom species which were also present included those species of *Bacteriastrum, Asterionella, Fragilaria, Nitzschia, Skeletonema*, *Coscinodiscus* and *Pleurosigma*. More than 30 major species of diatom have been identified. The genera *Coscinodiscus, Chaetocerus* and *Rhizosolenia* were found to contain a wide range of species. The Cyanophyta comprised of only a few species among which *Trichodesmium thiebautii* and *T. erythraeum* were present in abundant.

Other studies of microplankton in Malaysian waters including the Straits of Malacca had been conducted by Sewell (1933), Winstead (1961), Pathansali (1968), Chua & Chong (1973), Shamsudin (1987, 1993, 1994, 1997) and Shamsudin & Shazali (1991). Most of these studies were carried out at certain predetermined time and location; however, the present study was carried out during the pre and postmonsoon periods. An increase in the diversity value could be due to an increased number of species or even distribution of individuals per species as described by Gray (1981). In reality, such community organisation is constantly acted on by biological and physical factors in many different ways to produce, perhaps a different organisation in the future as a response to such environmental changes. When a bloom occurs, only a few microplankton species will predominate and thus effect or influence the number of species or the even distribution of individual species.

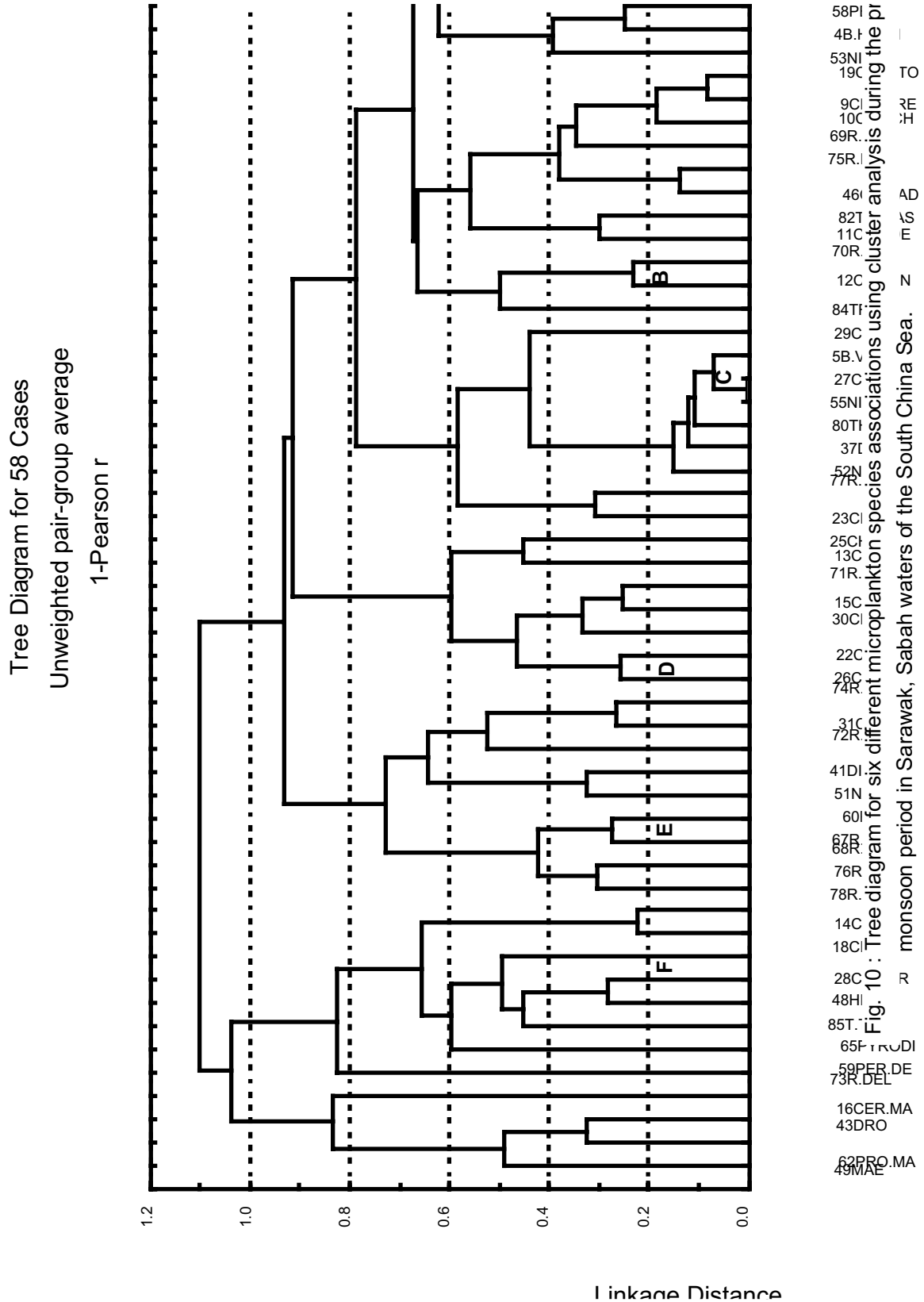

Fig. 10 : Tree diagram for six different microplankton species associations using cluster analysis during the pr monsoon period in Sarawak, Sabah waters of the South China Sea.

Fig. 10

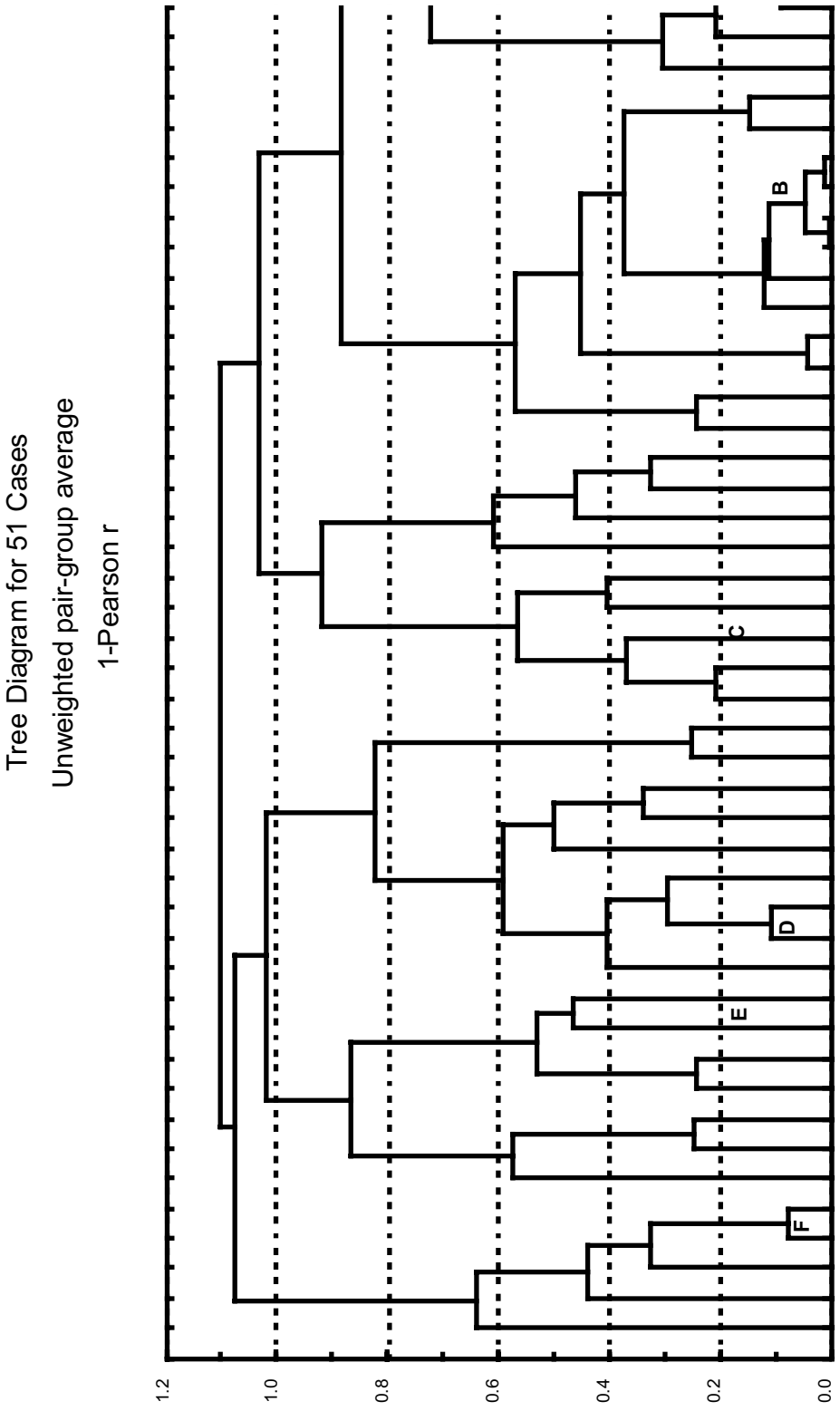

Fig. 11 : Tree diagram for six different microplankton species associations using cluster analyses during the post monsoon p
Sarawak, Sabah waters of the South China Sea.

Fig. 11

Microzooplankton population

Microzooplankton species consisted of more than 20 different groups with several dominant species namely, copepod nauplii (> 50% of the total microzooplankton count); Chaetognatha larvae (5%), Ciliophora (4%) and Foraminifera (2-3%) (see Appendix 2). The Ciliphora consisted of a few genera (*Tintinnopsis, Distephanus, Tintinnus, Favella, Dictyocha, Tomopteris, Xystonella, Xystonellopsis, Codonellopsis*) while Foraminifera consisted of *Globigerina* and *Tretomphalus* species (considered to be indicator tropical species). *Amphisolenia* (Peridinidae) and *Ceratocorys* species were detected in considerable amount in nearshore stations. Namerous *dinoflagellates (Dinophysis favus, D. norvegicas, D. triposolnia, Ornithocercus* sp., *Peridinium brochii, P. depressum, P. subpyriformes, Podolampas* sp., *Prorocentrum* sp., *Pyrocystis fursiformis, P. lunula, Pyrophacus horologium, Rhabdonella* sp.) were found in middle Sarawak waters of the South China Sea.

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REFERENCE

Barber H.G. & Haworth E.Y. (1981). A Guide to the Morphology of the Diatom Frustule. FSA Scient. Publ. no. 44. Ambleside. Freshwater Biological Association, 35 p.

Chua T.E. & Chong B.J. (1973). Plankton Distribution in the Straits of Malacca and Its Adjacent Waters. Special symposium on Marine Science, Dec. 1973, Hong Kong.

Cleve P.T. (1901). Plankon from the Indian Ocean and Malay Archipelago. K. Sv. Vet. Ak. Handl. Vol. 35 No. 5. 57 p.

Cleve P.T. (1904). Plankton of the South African Seas. Marine Inverstigation in South Africa, Vol. III. 45 p.

Cleve-Euler A. (1944). Die diatomeen als quartargeologische Indikatoren. Geologiska Foreningens i Stockholm Forhandlingar, 66(3) : 383-410.

Crosby L.H. & Ferguson Wood (1959). Studies on Australian and New Zealand Diatoms. II. - Normally Euphotic and Benthic Genera. Trans. Roy. Soc. New Zealand Vol. 86, part 1, 58 p.

Cummins A.B. & H. Mulryan (1937). Diatomite, Industrial Minerals and Rocks. Published by the American Institute of Mining and Metallurgical Engineers, pp. 243-260.

Cupp E.E. (1943). Marine Plankton Diatoms of the West Coast of North America, Bykk, Scruoos Ubst. Oceanography, Vol. 5, No. 1, 237 p.

Doty H.S., Soeriaatmadja R.E. & Sogiarto A. (1963). Observations on the Primary Marine Productivity of Northern Indonesian Waters. Marine Research in Indonesian 5; 1-25.

Elliot J.M. (1977). Some Methods for the Statistical Analysis of Benthos Invertebrates. Freshwater Biology Station Science Publication No. 25; 316 p.

Fritsch F.E. (1935). The Structure and Reproduction of the Algae. Vol. I. London and New York, Cambidge University Press, xvii + 791 pp.

Gran H.H. (1912). Pelagic Plant Life. In Depths of the Ocean, J. Murray and J. Hjort. London, Macmillan and Co., Chapter 6, pp. 307-386.

Gray J.S. (1981). The Ecology of Marine Sediments. An introduction to the structure and function of benthic communities. Cambridge University Press 185 p.

Hendey NI. (1964). An Introductory Account of the Smaller Algae of British Coastal Waters. Post V Bacillariophyceae (Diatoms) Fishery Investigation Series IV 317 p.

Hustedt F. (1930). Bacillariophyta (Diatom). In Die Sasswasser-flora Mitteleuropas 10 (Pascher, A.,

editor), 1-466. Jena. 122 p.
Ludowig J.A. & Reynolds J.F. (1988). Statistical Ecology - Primer on Methods and computing, John Wiley new York 317 p.
Markina N.O. (1972). Special Features of Plankton Distribution Around Northern Coasts of Australia During Different Seasons of 1968-1969, TINRO v. 81, 1-18.
Newell G.E. & Newell R.C. (1973). Marine Plankton. Hutchinson educational Ltd. 244 p.
Palmer T.C. & Keeley F.J. (1900). Structure of the Diatom Girdle. Proceedings of the Academy of Natural Sciences of Philadelphia, 52: 465-479.
Pasher A. (1914). Chlorophyceae 111. In Die Sasswasser-flora Deutschlands, Osterreichs Und Der Schweiz 6. 1-250. Jena. 120 p.
Pasher A. (1915). Einzellige Chlorophyceengattungen Unsicherer Stellung Die Sasswasser-flora Deutschlands, Osterreichs Und Der Schweiz, Heft 5, 206 et seq. 110 p.
Pasher A. (1925). Cyanophyceae. In Sasswasser-flora Deutschlands, Osterreichs Und Der Schweiz 12. 1-481. Jena. 114 p.
Pathansali D. (1968). Some observations on the distribution of Chaetognatha, west of Penang Island. Publications of the Sato Marine biological laboratory Japan 15; 391-397.
Patrick R. & Reimer CIW. (1968). The Diatom of the United States Exlusively of Alaska and Hawaii. Vol. I Philladelphia. 540 p.
Pielou E.C. (1984). The Interpretation of Ecological Data. Wiley NY 125 p.
Semina G.I. (1967). Phytoplankton, Pacific Ocean. Biology of the Pacific Ocean. B.I. plankton, M. pp.
Sewell S.R. (1933). Marine Copepoda from Malay States. Bulletin of the Raffles Museum, Singapore 8; 65 p.
Shannon C.E. & Weaver W. (1949). The Mathematical Theory of Communication. Illinois Press, Urbana, III. 117 p.
Shamsudin L. & Bakar M.G. (1987). The Microzooplankton (including dinoflagellate and Foraminifera) of Sarawak Waters of South China Sea In: Matahari Expedition 1987 (ed.) AKM. Mohsin et al., FPSS, UPM : 109 - 114.
Shamsudin L. (1987). Microplankton Distribution in the Coastal Waters of Port Dickson. In : Proceedings of the 10th Seminar of the Malaysian Society of Marine Science. Sasekumar, A. *et al.* (Eds) University Malaya special publication 23-29.
Shamsudin L. & Shazili N.A.M (1991). Microplankton Bloom in a Brackish Water Lagoon of Terengganu. Environmental Monitoring and Assessment 19: 287-294.
Shamsudin L. (1993). Biochemical Composition and Fatty Acid Content of Zooplankton from Tropical Lagoon for Larval Rearing. Journal Archives Internationales de Physiologie, de Biochemie et de Biophysique, 1993, 101: 1-4.
Shamsudin L. & Sleigh M.A. (1994). Seasonal Changes in Composition and Biomass of Epilithic Algal Floras of a Chalk Stream and a Soft Water Stream with Estimates of Production. Hydrobiologia 273 (3) 131 - 146.
Shamsudin L. (1994). Food Values of Indigenous Zooplankton from the South China Sea on the East Coast of Peninsular Malaysia. Journal of the World Aquaculture Society. 25 (2) 208-231.
Shamsudin L. (1995). Lipid and Fatty Acid Content in Microplankton Bloom from Tropical Fish Ponds. Archives Internationales de Physiologie, Biochemie et Biophysique 103 (5) 21-27.
Shamsudin L. & Sleigh M.A. (1995). Seasonal Changes in Composition and Biomass of Epiphytic Algae on the Macrophyte Ranunculus Penicillatus is a Chalk Stream with Estimates of Production and Observation on the Ephytes of Cladophora Glomerata. Hydrobiologia 306: 85-95.
Shamsudin L., Yusof M., Azis A. & Shukri Y. (1997). The Potential of Certain Indigenous Copepod Species as Live Food for Commercial Fish Larval Rearing. Aquaculture 151: 351-356.
Shamsudin L., Kamal S. & Samo K. (1987). The Microzooplankton of Sarawak Waters of the South

China Sea In : Matahari Expedition 1987 (ed.) AKM Mohsin *et al.*, FPSS, UPM : 99-108.
Southwood, TRE. (1978). Ecological Methods Cambridge 210 p.
Taylor F.J.R. (1976). Dinoflagellates from the International Indian Ocean Expeditions. A report on material collected by the R.V. Anton Brunei 1963-1964. Stuttgant 227 p.
Taylor D.L. & Seliger H.H. (1979). Toxic Dinoflagellate Bloom In: Proceedings of the 2nd International Conference on Toxic. Dinoflagellate Blooms Lewis M. Carrie (Ed.) Key Bicayre Florida 31 Oct. - Nov. 1978, 497 p.
Tippett R. (1970). Artificial Surfaces as a Method of Studying Populations of Benthic Micro-algae in Freshwater. Br. phycol. J. 5, 189-199.
Shirota A. (1966). The Plankton of South Vietnam - Fresh water and Marine Plankton. Oversea Technical Cooperation Agency Japan 464 p.
Vollenweider R.A., Talling J.F. & Westlake D.F. (1974). A Manual on Methods for Measuring Primary Production in Aquatic Environments, IBP Handbook No. 12. Blackwell, Oxford, 2nd. edn. 225 p.
Wickstead J.H. (1961). A Quantitative and Qualitative Study of some Indo-West Pacific Plankton. Colonial Office Fisheries Publication. 16, Her Majesty's Stationery Office, London. 47 p.
Zemova V.U. (1964). Distribution of Phytoplankton in the Tropical Parts of the Western Pacific Ocean. Tr. ION USSK, 4. 65.

Table 1 The number of species in the genera of the microplankton population in Sabah and Sarawak waters of the South China Sea during the study period (* Dominant)

	Genus	Number of species
1	Bacillariophyceae (Diatom)	
	Asteromphalus	2
	**** Bacillaria***	**1**
	Compylodiscus	4
	Cerataulina	3
	Climacodium	2
	Corethron	1
	Dactyliosolen	2
	Ditylum	2
	** Eucampia*	2
	** Fragilaria*	1
	** Guinardia*	3
	** Gyrosigma*	4
	** Hemiaulus*	3
	** Hemidiscus*	2
	** Lauderia*	2
	Leptocylindrus	2
	** Nitzschia*	8
	Odentella	2
	** Planktoniella*	2
	Pseudoguinardia	2
	**** Skeletonema***	**1**
	** Thalassiosira*	5
	Triceratium	1
2	Dinophyceae	
	Alexandrium	2
	Amphisolenia	4
	**** Ceratium***	**28**
	**** Ceratocorys***	**2**
	**Dinophysis*	5

	Genus	Number of species
2	Dinophyceae	
	Goniodoma	2
	** Gonyaulax*	4
	** Noctiluca*	1
	**** Ornithocercus***	**5**
	Palacroma	5
	****Podolampas***	**4**
	Prorocentrum	3
	**** Protoperidinium***	**5**
	Pyrophalus	2
3	Cyanophyceae	
	Trichodesmium	**2**
4	Dictyochaceae	
	Dictyocha	4
	Procentrum	1
	Pyrocystis	**3**
5	Microzooplankton	
	Globigerina	1
	Codonella	1
	Tintinnopsis	**2**
	Favella	**1**
	Tintinnus	1
6	Larvae/nauplii	
	Chaetognatha	-
	Ostracoda	-
	Siphonophora	-
	Gastropod	-

Table 2. Dominant microplankton species at various sectors in Sabah and Sarawak waters of the South China Sea during the study period.

Sector	Monsoon	
	Pre	Post
Sarawak coastal waters (SCW)	***Trichodesmium erythraeum***	***Trichodesmium erythraeum***
	Ceratium furca	***Thalassionema fraunfeldii***
	Rhizosolenia stoleterfothii	*Thalassionema nitzschoides*
	Chaetoceros lorenzianus	*Rhizosolenia stolterfothii*
		Bacteriastrum varians
		Chaetoceros lorenzianum
Western Sarawak waters (WSW)	***Trichodesmium erythraeum***	***Trichodesmium thiebautii***
	Rhizosolenia alata	***Trichodesmium erythraeum***
	Coscinodiscus sp.	*Thalassionema nitzschoides*
		Thalassionema delicatulum
		Rhizosolenia alata
Offshore Sarawak waters (ESW)	***Trichodesmium erythraeum***	***Trichodesmium erythraeum***
	Rhizosolenia alata	***Trichodesmium thiebautii***
	Coscinodiscus sp.	*Rhizosolenia hebatata*
	Peridinium sp.	*Bacteriastrum hyalinum*
		Chaetoceros didynum
Eastern Sabah waters (ESW)	***Trichodesmium erythraeum***	***Trichodesmium erythraeum***
	Rhizosolenia alata	***Ceratium furca***
		Peridinium depressum
		***Protocentrum* sp.**
		Rhizosolenia alata
Intermediate Middle Sarawa waters (IMSW)	***Trichodesmium erythraeum***	***Trichodesmium erythraeum***
	Rhizosolenia alata	***Trichodesmium thiiebautii***
	***Pleurosigma* sp.**	***Rhizosolenia hebatata***
	Chaetoceros lorenzianus	***Bacteriastrum hyalium***
		Bacteriastrum varians

Table 3. Species association in Sabah and Sarawak waters of the South China Sea during the pre and post monsoon period

Group	Monsoon	
	Pre	Post
A	*Chaetoceros coarctatum*	*Ceratocorys* sp.
	Thalassionema fraeufeldii	*Bacteriastrum hyalinum*
	Bacteriastrum delicatulum	*Nitzschia frigida*
B	*Trichodesmium erythraeum*	*Thalassionema fraeunfeldii*
	Ceratium arauatum	*Nitzschia seriata*
		Rhizosolenia stolterforthii
		Chaetoceros lorenzianum
C	*Thalassionema fraeunfeldii*	*Richelia* sp.
	Chaetoceros lorenzianum	*Rhizosolenia clevei*
		Peridinium sp.
		Pleurosigma sp.
		Climacodium sp.
D	*Rhizosolenia hebatata*	*Trichodesmium erythraeum*
	Chaetoceros laciniosus	*Trichodesmium thiebautii*
	Chaetoceros decipiens	*Protoperidinium*
	Ceratium longissinum	*Hemialus* sp.
E	*Rhizosolenia styliformis*	*Rhizosolenia hebatata*
	Rhizosolenia robusta	*Globigerina* sp.
	Rhizosolenia bergonii	*Chaetoceros decipiens*
	Rhizosolenia alata	
F	*Trichodesmium thiebautii*	*Chaetoceros comosum*
	Chaetoceros peruvianum	*Ceratium fusus*
	Ceratium teres	*Ceratium teres*
	Ceratium fusus	

Appendix 1 The taxonomic list of Microzooplankton identified from Sarawak and Sabah watersSouth China Sea (* Dominant)

1 Class, Cyanophyceae; Order Hormogoneae; Family Osciliatoriaceae;
**** Trichodesmium erytheraeum*** **Ehrenberg**
T. thiebautii Gom.

2 Pylum Bacillariphyceae (Diatom)
Actinophychus undulatus Ralfs
Actinocyclus Ehrenberg
Asterolampra marylandica Ehrenberg
Asteromphalus elegans Greville
A. heptactis Ralfs
A. flabellatus Greville
Bacillaria paxillifera O.F. Muller
Bacteriastrum comossum Pavillard
* *B. delicatulum* Cleve
B. elegans Pavillard
B. elongatum Cleve
* *B. hyalinum* Lauder
B. mediaterraneum Pavillard
B. minus Lauder
* *B. varians* Lauder
Biddulphia dubia Cleve
B. longicrucia Greville
* *B. mobilensis* Bailey
B. regia Ostenfeld
B. sinensis Grevillae
Campylodiscus biangulatus Hantsch
C. daemelianus Grun
C. echeneis Ehrenberg
C. ornatus Grun
C. undulatus Grevillae
Cerataulina Bergonii
C. Compacta Ostenfeld
C. pelagica (Cleve) Hendey
C. coarctatum Lauder
Chaetoceros affinis Lauder
C. brevis Schutt
C. compressum Lauder
C. constrictum Gran
C. costatus Pavillard
* *C. curvisetum* Cleve
C. dadayi Pavillard
C. debile Cleve
* *C. decipiens* Cleve
C. densum Cleve
C. denticulatum Lauder
C. decipiens Cleve
* *C. didymum* Ehrenberg
* *C. distans* Ehrenberg
* *C. diversus* Cleve
C. hispidum Brightwell
C. indicum Koosten
* *C. laciniosus* Schutt
C. latderi Rafts
C. lauderi Reefs
C. leavis Leuduger - Fortimorel
C. messanensis Castracane
C. paradoxum Cleve
C. pendulus Karsten
* *C. peruvianum* Brightwell
* *C. pseudocurvisetum* Mangin
C. setaceum Jorg
C. siamense Ostenfeld
C. sumatranum Karsten
C. tetrastichon Cleve
C. tripos Nitsch
C. weissflogii Schutt
Climacodium biconcavum Cleve
C. frauenfeldianum Grunow
Corethron hystrix Henden
C. pelagicum Brun
Coscinodiscus asteromphalus Ehrenberg
* *C. concinus* W. Smith
* *C. centralis* Grunow
* *C. curvatulus* Grunow
* *C. debilis* Ehrenberg
* *C. gigas* Ehrenberg
C. granii Gough
C. janischii Schmidt
* *C. jonesianus* (Greville) Ostenfeld
C. lineatus Ehrenberg
C. marginatus Ehrenberg
C. nitidus Gregory
C. nobilis Grunow
C. nodulifer Schmidt
C. occulus rividis Ehrenberg
C. perforatus Ehrenberg
C. radiatus Ehrenberg
C. Rothii Grunow
C. stellaris Roper
C. subtilis Ehrenberg
C. weilesii Gran & Angst
Cylindrotheca closterium Ehrenberg
Dactyliosolen blavyanus H. Peragallo
D. fragilissinum (Bergon) Hasle
Detonula pumila (Castracane) Gran
Ditylum brightwelii (West) Grunow
D. sol Grunow
Eucampia cornuta (Cleve) Grunow
E. zodiacus Ehrenberg
Fragilaria interrmedia Grunow
Guinardia cylindrus (Cleve) Hasle
G. flaccida (Castriacane) H. Peragallo
G. striata Stolteriotn Hasle
Gossleriella tropica Schutt
Gyrosigma acuminatum Rabh
G. balticum Cleur
G. Strigile Smith
Halicotheca thamensis Grunow
Hemiaulus hauckii Grunow
H. indicus Karsten
H. membranacea Cleve
H. sinensis Greville
* ***Hemidiscus cuneiformis*** Wallich (Indicator sp.)
H. hardmanianus
Lauderia annulata Gran
L. borealis Gran
Leptocylindrus danicus Cleve
L. mediterraneus (H. Peragallo) Hasle
Lithodesmium undulatum Ehrenberg
Navicula **sp.**
* ***Nitzschia closterium*** W. Smith

Appendix 1 Continue

N. closterium W. Smith
N. hungarica Grun
N. lanceolata W. Smith
N. longissima Gran
N. longissima var. reversa W. Smith
N. paradoxa Gmelin
N. pacifica Cupp
N. plana W. Smith
N. pungens Cleve
N. seriata Cleve
N. sigma W. Smith
N. sigma var intercedens Grun
N. spectavilis Ralfs
N. vitrea Norman
N. bicapitata Cleve
Odontella mobiliensis (Bailey) Grunow
O. sinensis (Greville) Grunow
Planktoniella blanda A. Schmidt
P. sol (Wallich) Schutt
Pleurosigma affine Gran
P. angulatum W. Smith
P. coompactum Grew
* *P. elongatum* W. Smith
P. fasciola W. Smith
P. intermedium W. Smith
P. nicobaricum Gran
P. Normanii Ralfs
P. pelagicum Perag
P. rectum Donkim
P. rigidum Brun
P. salinarum Gran
Pseudoguinardia recta Von Stesen
P. pungens Grunow & Cleve Hasle
* ***Rhizosolenia acuminata*** Gran
* *R. alata* Brightwell
R. bergonii H. Peragallo
R. clevei Ostenfeld
R. castracanei H. Perag
R. curvata Zacharias
* *R. calcar-avis* M. Schutze
R. formosa H. Peragallo
R. cylindrus Cleve
R. hyaline Ostenfeld
R. delicatula Cleve
R. imbricata Brightwell
R. hesetata Gran
R. robusta Norman
R. delicatula Cleve
R. setigara Brightwell
R. styliformis Brightwell
* ***Skeletonema costatum*** (Greville) Cleve
Stephanopyxis palmeriana Greville
Striatella **sp.**
Surirella **sp.**
* ***Thalassionema frauenfeldii*** Grunow
T. nitzschioides Grunow
Thalassiosira bingensis Takano
T. dipporocyclus Hasle
T. eccentrica (Ehrenberg) Hasle
T. oestrupii (Ostenfeld) Hasle
* *T. subtilis* (Ostenfeld) Gran
Triceratium favus Ehrenberg

3 Phylum Dinophyceae (Dinoflagellate)

Family : Peridiniidae

Alexandrium fraterculus (Balech)
A. tamiyavanichi Balech
Amphidoma steini Schill
Amphisolenia bidentata Schroder
A. thrinax Schutt
A. globifera Stein
A. scnauinsianaii Lemmermann
Ceratium axiale Kofoid
C. arietinum Cleve
* *C. breve* Schroder
C. biceps Gourret
C. belone Cleve
C. condillans Jorgensen
C. candelabrium Ehrenberg Stein
C. contortum Gourret
C. carriense Gourret
C. declinatum (Karsten) Jorgensen
* *C. deflexum* (Kofoid) Jorgensen
C. dens Ostenfeld & Schmidt
C. falcatum (Kofoid) Jorgensen
C. furca Ehrenberg
C. fusus Ehrenberg
* *C. gibberum* Gourret
* *C. gravidum* Gourret
C. hexacanthum Gourret
C. horridum (Cleve) Gran
C. inflatum (Kofoid) Jorgenden
C. kofoidii Jorgensen
C. longissinum Gran
C. limulus Gourret
C. lunula (Schimpe) Jorgensen
* *C. macroceros* (Ehrenberg) Vanholf
* *C. massiliense* (Gourret) Karsten
* *C. platycorne* Daday
* *C. pentagonum* Gourret
C. pulchellum Schroder
C. symmetricum Paviilard
* *C. teres* Kofoid
C. trichoceros (Ehrenberg) Kofoid
C. tripos (O.F. Muller) Nitzsen
C. vulture Cleve
Ceratocorys norrida Stein
C. horrida Stein
C. gourreti Paulsen
Corythodinium resseratum Stein
Loebiich Jr. & Loebiien
Dinophysis homunculus Stein
D. caudata Sabille - Kent
D. hastata Stein
D. infundibula Schiller
D. miles Cleve
D. ovum Schutt
D. schuettii Murray & Whitting
D. tripos Gourret
Diplopsalis lenticulata Berg
Goniodoma polyedricum Pouchet
G. spaericum Murr. & Whitt
Gonyaulax digitale (Pouchet) Kofoid
G. gluptorhynchus Murray & Whitting
G. polygramma Stein
G. spinifera Clapareda & Lachmann
Gynmodinium **sp.**
Gyrodinium **sp.**
Kofoidinium **sp.**
Noctiluca scintillans Macartney
Ornithocercus magnificus Stein
O. thumii A. Schmidt
Pxytoxum scolopax Stein
O. milneri Gran

Appendix 1 Continue

O. tesselatum Stein
Phalacroma acutoides Balech
P. doryphorum Stein
P. favus Kofoid & Micherner
P. mitra Schutt
P. parvulum Schutt
P. rapa Stein
P. rudgei Murray & Whitting
Podolampas bipes Stein
P. elegans Schutt
P. palmipes Stein
P. spinifera Okamura
Prorocentrum compressum (Bailey)
P. micans Ehrenberg
P. sigmoides Bohm
*** *Protoceratium spinulosum***
Protoperidinium conicum (Gran)
* *P. brochii* Balech
P. crassipes (Kofoid) Balech
P. depressum (Bsiley) Balech
P. diabolus (Cleve) Balech
P. divergents (Ehrenberg) Balech
P. elegans (Cleve) Balech
P. globulum (Stein) Balech
* *P. grande* (Kofoid) Balech
P. hirobis (Abe') Balech
P. latispinum (Mangin) Balech
P. leonis (Pavillard) Balech
P. murrayi (Kofoid) Balech
* *P. oceanicum* (Vanhoff) Balech
P. okamurai (Abe') Balech
P. ovum (Schiller) Balech
P. pallidum (Ostenfeld) Balech
P. paulseni (Pavillard) Balech
P. Pellucidum Bergn
P. puanerense (Schreaser) Balech
P. spinuiosum (Schiller) Balech
P. stenii (Jorgensen)
P. thorianum (Paulsen) Balech
Pyrophacus horologium Stein
P. stein (J. Schiller) Wall & Dale
Scripsiella trochoidea (Stein) Balech

4 Family : Dictyochaceae
(Phulum Protozoa)
Class : Mastogophora
Order : Chrysomonadina
Dictyocha fibula Ehrenberg
D. fibula var stapedia Heack
D. fibula var major Rampi
Family : Procentridae
Procentrum micans Ehrenberg
Family : Phytodinidae
*** *Pyrocystis elegans*** Murray
(Indicator sp.)
P. fusiformis Murray
P. hamulus var imacqualis Schrober
P. noctulica Murray