



**THE MFRDMD/SEAFDEC FIRST REGIONAL WORKSHOP ON  
REMOTE SENSING OF PHYTOPLANKTON**

**Kuala Terengganu, Malaysia, 17-18 November, 1998**

SEAFDEC/MFRDMD/WS/98/WP. 2

**TECHNICAL REPORT**

**BACKGROUND OF PLANKTON I:  
BIOLOGY OF PLANKTON**

By:

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CRUISE 1 & 2

**Summary of the results of the MV SEAFDEC Survey Cruise: Sept/Oct 1995 (Pre-monsoon) – Apr/May 1996 (Post-monsoon); Gulf of Thailand and East Coast of Peninsular Malaysia.**

- **Bloom/Red Tide:** Single species dominant/diffuse/occurrence unpredictable.
- **> 290 taxa:** 2 genera (2 species) blue green algae; 45 (110) diatoms; 25 (70) dinoflagellates.
- **Pre monsoon:** 9 species dominant:  
Blue green algae (1):  
*Trichodesmium (Oscillatoria) erythraeum*  
Diatom (8):  
*Chaetoceros lorenzianum*,  
*C. pseudocurvisetum*  
*C. compressum*  
*Thalassionema frauenfeldii*  
*T. nitzschoides*  
*Coscinodiscus jonesianus*  
*Bacillaria paxillifera*  
*Bacteriastrum comosum*
- **Post monsoon:** 15 species dominant:  
Diatom :  
*Chaetoceros* spp. (7)  
*Th. frauenfeldii*  
*Pseudosolenia calcal-avis*  
*Bacteriastrum comosum*  
*Proboscia (Rhizosolenia) alata*  
*Pleurosigma*  
*Skeletonema costatum*  
*Cylindrothecca (Nitzschia) closterium*  
Blue green algae:  
*Trichodesmium erythraeum*  
Dinoflagellates:  
*Ceratium fusus*  
*Alexandrium tamarense/famiyanicai* (17-20 cell per litre in the Gulf of Thailand)  
*Amphisolenia bidentata*  
*Dinophysis hastata*  
*Gymnodinium / Gyrodinium / Kofoidinium / Noctiluca*  
*Ornithocercus magnificus / Oxytoxum / Phalacroma*  
*Prorocentrum / Protoperidinium / Pyrophacus / Scripsiella trochiodea*  
*Pyrodinium bahamense*

## Nanodiatom

- 150 species (< 20µm) 10 genera ?new record
- Dominant species *Minidiscus comicus* Takano; *M. trioculatus* Hasle; *Navicula climacospheniae* Booth; *Thalassiosira tenera* Proschkinae-Larenko
- Size fractionated nanodiatom biomass/productivity 60-75%/40-60% respectively.
- 6-8 x 10<sup>4</sup> cell/l at depth 30m.

(B.Huang et al. 15<sup>th</sup> IDS Perth Australia)

## Diatom – Ship Ballastwater

- Global transport (ballast water) 10 billion tonnes/year
- Transfer harmful bacteria/toxic diatom-dinoflagellate / seaweed / molluscs etc.
- Nonindigenous => ecological/environmental damage worldwide.
- Cultural ballast species => *Chaetoceros*, *Detonula*, *Ditylum*, *Heptacylindrus*, *Skeletonema*, *Thalassiosira* (have resting spores).
- Similarly small pennate *Amphora*, *Navicula*, *Nitzschia* survive in dark (5 weeks), spores.
- Pseudo-nitzshia, amnesic shellfish poisoning (ASP), paralytic shellfish poisoning (PSP)
- *P. fraudulata/lineata/turgidula/subpacificica* – toxic?
- *P. multiseriata* / *P. australis* / *P. seriata* / *P. pungens* / *P. pseudodelicatisoma* / *P. cuspidata*

## Phytoplankton classification

- Bloom / Red Tide – single species dominant / diffuse or patch / occurrence unpredictable.
- *Skeletonema costatum* bloom 10<sup>6</sup> cell/l => 1 mg chlorophyll a.
- Oceanic / neritic plankton
- Meroplankton – temporarily members of plankton community (e.g. Bivalves)
- Holoplankton – permanent
- Euryhaline / Stenohaline
- Allochthonous – imported into ecosystem; Autochthonous – within.
- Nutrient availability – eutro/meso/oligotrophic
- Pelagic/open sea plankton
- Epipelagic (0-150 m) / meso (150-1000 m) / bathy (1000-4000 m) / abyssopelagic (4000-6000).
- Microphytoplankton and microzooplankton – 20-200 µm
- Macroplankton (200-2000 µm) / megaplankton (>2000 µm)
- Nanoplankton – 2-20 µm / Ultrananoplankton (<2 µm)
- Maximum photosynthetic activity occurred among 5-50 µm species.

## Statistical analyses

### Shannon-Wiener (Diversity) Index (H); Species richness

$$H = \sum P_i \log_2 P_i$$

$P_i = n_i / N$ , where  $n_i$  = number of individuals of  $i$ th species

### Species Evenness Index (J)

$$J = H / \log_2 S$$

### Similarity Index (C)

Jaccard,  $C_j = j / (a+b-j)$

Sorensen,  $C_s = 2j / (a+b)$

### Species assemblages / association in cluster analysis

- According to their preference on environmental conditions using UPGA (unweighted pair group average).

### Canonical correspondence analysis (CCA)

- Species-environment correlation measures the strength of the relationship between the environmental variables and species for each ordination.
- End of each vector is related to high values for the quadrant adjacent to pH axis, acidic furthest away.

Seawater properties of Southeast Asia

$$1 \text{ W / m}^2 = 5 \text{ } \mu\text{mol/m}^2/\text{s}^2 = 250 \text{ lux; Fluorometer F; Chl a} = 0.0146 \text{ F} + 0.0037$$

No.	Parameters	Gulf of Thailand	Johore offshore South China Sea	Sarawak Water (SCS)
1	Chl a mg/m <sup>3</sup>	0.11	0.13	0.12
2	NO <sub>3</sub> μg at/l	0.069	0.21	0.18
3	PO <sub>4</sub> μg at/l	0.066	0.51	0.47
4	NH <sub>4</sub> <sup>+</sup> μg at/l	5	4	6
5	Light μmol/m <sup>2</sup>			
	Surface	8.2	10.0	9.0
	5 m	1.2	4.0	3.5
	50 m	0.2	0.4	0.3
6	Net PS gC/m <sup>2</sup> /y	120	170	150
7	Chl max. layer (CML) (meters)	3	10	-
8	Max depth	51	70	300
9	O <sub>2</sub> ml/l	4.4	4.2-4.5	-
10	Temp./Salinity	28.9 (32.9)	28-29 (28.4)	-
11	PH/alkalinity	8.12 (8.1 meq.)	8.07 (8.05)	-
12	DIC MM/l	1.9-2.0	1.96	-

CRUISE 3 & 4

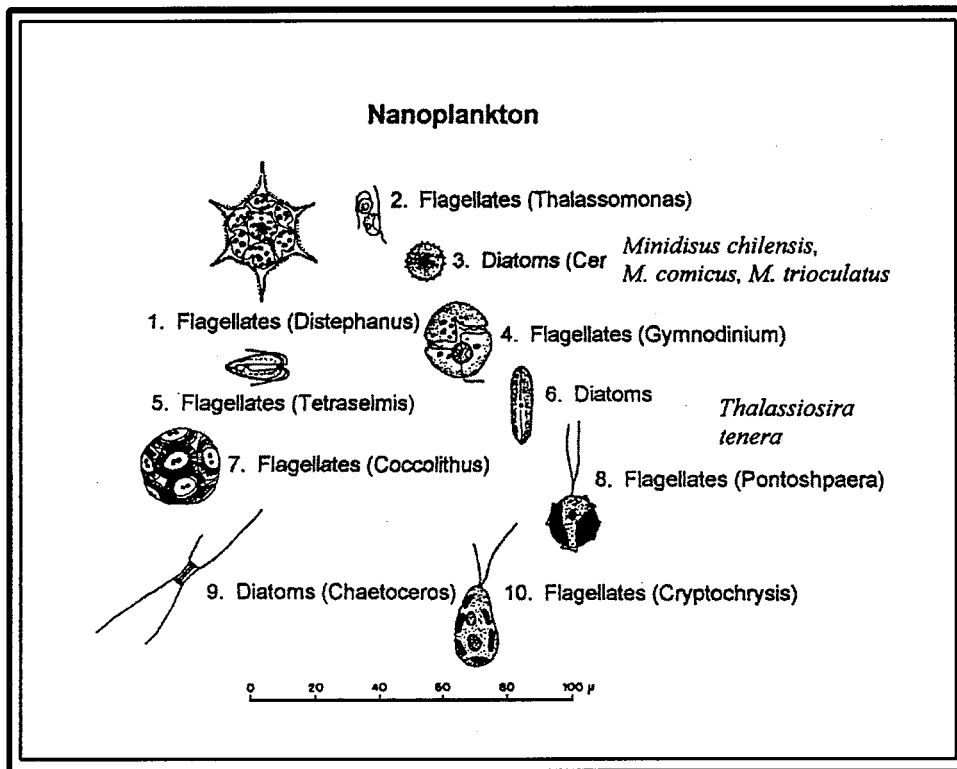
Sarawak-Sabah-Brunei Waters

Dinoflagellate

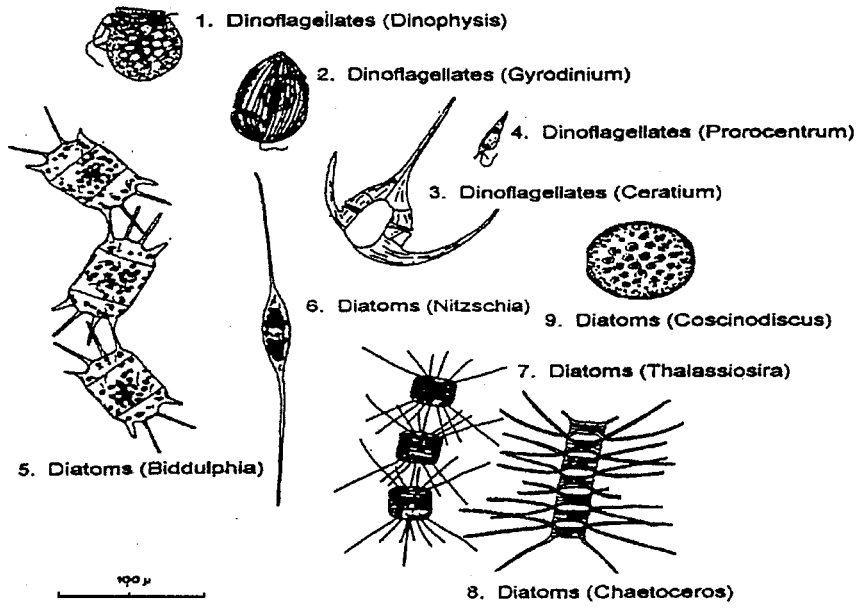
- Gymnodiniale  
*Amphidinium / Gymnodinium / Glenodinium*
- *Alexandrium*
- *Amphisolenia bidentata*
- Dinophysiaceae  
*Ceratocorys horrida / Dinophysis monunculus / Mitra*
- *Prorocentrum*
- *Pyrocystis fusiformis / lunula / noticula*
- Peridinales  
*Ceratium fusus / furca / gibberum / macroceros / tripos*  
*Peridinium depressum / pentagonum / sphaericum*  
*Phalacroma sp.*  
*Podolampas bipes*  
*Protoperidinium inflatum / tenuissimum*  
*Pyrophacus horologium / stenii*  
*Triposolenia truncata*

Others

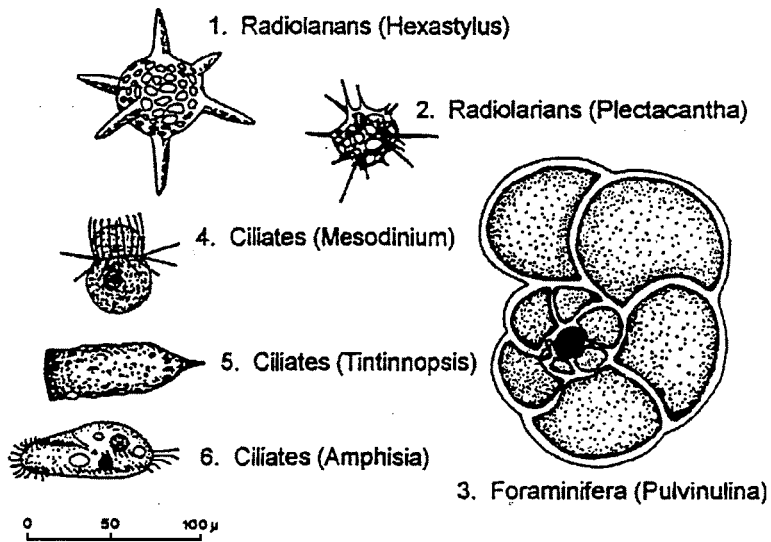
- Cyanophyceae, Family: Oscillatoriaceae  
*Richelia intracellularis* / *Trichodesmium* (*Oscillatoria*) *erythraeum* / *thebautii*
- Chrysophyceae  
*Dictyocha*
- Foraminifera
- Globigerinidae  
*Globigerina bulloides* / *Globigerinella* / *Globigerinoides conglabata*  
*Sphaeroidinella* / *Tretomphalus bulloides*

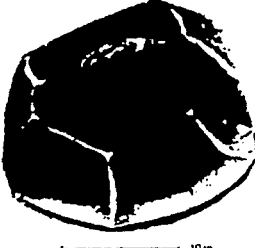
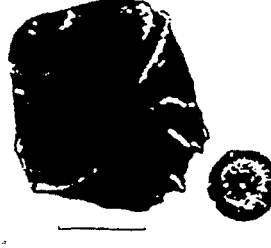



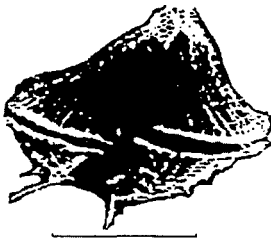
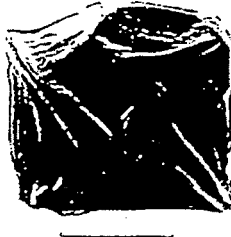

### Microphytoplankton

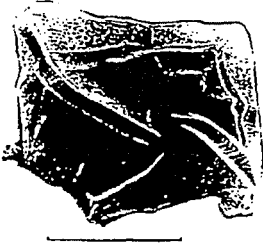
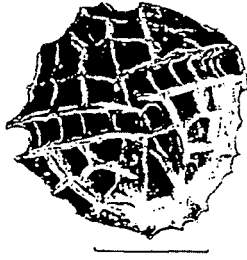



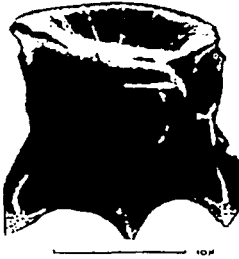
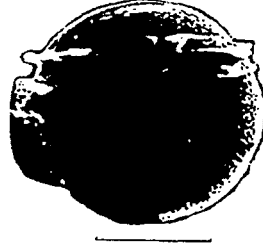
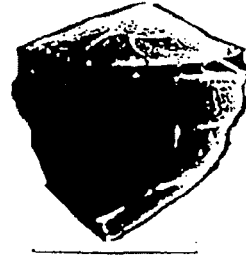
### Microzooplankton



GONYAULACACEAE	GONYAULACACEAE	GONYAULACACEAE
		
1. <i>Pyrodinium bahamense</i> Plate	2. <i>Gonyaulax polyedra</i> Stein	3. <i>G. polygramma</i> Stein

GONYAULACACEAE	GONYAULACACEAE	PERIDINIACEAE
		
4. <i>Gonyaulax</i> sp	5. <i>Protogonyaulax tamarensis</i> Taylor	6. <i>Protoperidinium quinquecorne</i> Abe

PERIDINIACEAE	PROTOCENTRACEAE	CERATOCERACEAE
		
7. <i>P. pentagonum</i> Gran	8. <i>Protoceratium spimilosum</i> Schiller	9. <i>Ceratocorys horrida</i> Stein

PERIDINIACEAE	PROTOCENTRACEAE	CERATOCERACEAE
		
10. <i>Ornithocercus magnificus</i> Stein	11. <i>Dinophysis</i> sp.	11. <i>Orytoxum</i> sp.