รายงานวิจัยฉบับสมบูรณ์

โครงการ ความสัมพันธ์ของสังคมแพลงก์ตอนกับปัจจัยทางสิ่งแวดล้อมในคลองขนอม หาดขนอม หมู่เกาะทะเลใต้ จ.นครศรีธรรมราช

ดร.สุปิยนิตย์ ไม้แพและนางสาวพรรณี สอาดฤทธิ์
คณะวิทยาศาสตร์ มหาวิทยาลัยสงขลานครินทร์

สนับสนุนโดยโครงการพัฒนาองค์ความรู้และศึกษานโยบายการจัดการทรัพยากรชีวภาพในประเทศไทยและมูลนิธิโททาล (TOTAL FOUNDATION) และ บริษัทโททาล อีแอนด์พี ไทยแลนด์ (TOTAL E&P THAILAND)

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The Plankton community in the relation to the environmental factors along Kanom canal, Kanom beach, Mo Ko Thale-Tai, Nakhon Si Thammarat

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Abstract

The present study aimed to examine plankton species diversity along Kanom Canal, Kanom beach, Mo Ko Thale-Tai, Nakhon Si Thammarat Province. Samplings were carried out covering 15 stations starting from Cho water fall to Kanom canal and around five islands of Mo Ko Thale-Tai (Wang nok, Wang nai, Rap, Tan and Mudsum) during October 2006 and September 2007. A total of 184 phytoplankton taxa in three Divisions were recorded. The most diverse Division was Chromophyta, comprising of Class Bacillariophyceae 41 genera (104 taxa), Class Dinophyceae 17 genera (51 taxa) and Class Dictyochophyceae 1 genus (2 taxa). Moreover, it was obviously shown that *Bacteriastrum* spl, *Chaetoceros diversus* and *Chaetoceros lorenzianus* were the high frequently found taxa throughout sampling periods. However, based on the density, *Bacteriastrum* spl dominated phytoplankton of all stations sampled through out sampling period (7.27×10^7 ind./l). In addition, it showed the highest density in March 2007 ($1.17 \times 10^6 \pm 2.21 \times 10^6$ ind./l) followed by October 2006 ($8.80 \times 10^5 \pm 1.28 \times 10^6$ ind./l) and September 2007 ($8.68 \times 10^5 \pm 6.24 \times 10^5$ ind./l), respectively. Moreover, 61 taxa in 11 Phylum of zooplankton were recorded. Arthropoda was the most diverse phylum, comprising of 24 taxa. Of which, nineteen were the members of the Copepoda. Based on the density, nauplius of crustacean dominated zooplankton at all stations over the sampling period (1,316.67-5,293.02 ind./l). In addition, it showed the highest density in January (5,297±8,387 ind./l), March (4,662±6,315 ind./l) and September 2007 (3,437±4,279 ind./l), respectively. However, beside nauplius of crustacean, *Tintinnopsis orientalis* and *Codonellopsis ostenfeldi* also showed high density at all times during sampling period. Environmental factors differed from headwater, Kanom canal and Mu Ko Thale-Tai but the amount of each factors, especially nutrients, turbidity, DO are over standard though the turbidity was relatively high in Kanom canal and some parts of Koh Wang nai, Wang nok and Koh Tan.

These results showed the good sign that Mu Ko Thale-Tai is a good nursery are and still rich of the marine organisms. However, for sustainable use, their water quality and general environmental factors need to be conserved in proper conditions as at the moment. Moreover, in order to explain the trophic relations at Mu Ko Thale-tai, more information on the association between plankton community and others ecosystem such as seaweed, seagrass and coral are necessary. Of which, such knowledge can be used to produce the whole ecosystem guidelines to regulate and manage them in a sustainable approach in the future.

Key words: plankton, diatoms, dinoflagellates, copepods, Kanom, Mo Ko Thale-Tai

Introduction

Biodiversity is a concept that covers the total genetic diversity, species diversity and ecological diversity of an ecosystem (Southwood & Handerson, 2000). It has a relationship with ecosystem functioning, which has emerged as a major scientific issue today and experiments have also confirmed that increasing species diversity frequently enhances ecosystem functioning (Henry *et al.,* 2001). In addition, the interest in biodiversity and ecosystem functioning has grown from environmental concern, for example, the potential ecological consequence of the present and future loss of biodiversity caused by the increased impact of human activities on natural and managed ecosystems (Loreau, 2000; Kempton, 2002).

Kanom Beach and Mo Ko Thale-Tai are located in an area in its original condition but which potentially could be disturbed in the near future. In addition to high local income from increasing tourism, this area is also a rich source of high-profit seafood especially fish and shrimp. Approximately 828,802 tons per year are fished along the coast of Nakhon Si Thammarat Province which generates an income of 2 billion Baht per year (Nakhon Si Thammarat fishery office, 2003). In aquatic ecosystems, the community structure and the ecological role of plankton are issues of fundamental concern to productivity, and particularly aquatic fauna production. In view of zooplankton grazing activities and their role in nutrient recycling, they potentially exert both subtle and gross effects on phytoplankton populations, which in turn have a prime bearing on water quality (Mavuti, 1990). Moreover, zooplankton are important food items for the young, and some adults, of many species of fish, which represents an important component of the human diet in our country. During a study of the fisheries resources of Lake Turkana in 1971-1975, Ferguson (1982) showed that zooplankton contributed up to 90% of the diet of at least six species of pelagic fish in the lake. The diet of *Alestes minutes* was restricted entirely to zooplankton. All stages of *A. baremose* fed principally on large adult zooplankton, particularly *Tropodiaptomus neumani.* The postlarval stages of *Engraulicypris stellae* thrived on *copepod nauplii* from open water areas of the lake. Mavuti (1990) also confirmed that in Lake Naivasha zooplankton contributed significantly to the diet and production of juvenile fish. Additionally, the results of Mavuti (1990) in addition to others (Leveque & Saint-Jean, 1983; Robinson & Robinson, 1973) bear witness to the fact that seasonal changes in the abundance and rate of organic production do occur in tropical lakes. The changes are, however, erratic rather than seasonally regular and depend on fluctuations in prevailing environmental factors, particularly rainfall and the subsequent input of essential nutrients into lakes. Thus, in order to explain the ecological role of plankton as a food source for marine animals, the study of plankton communities along freshwater and estuarine areas is required as they are the nursery resources of marine animals.

Taking all the above into consideration, in the present study the plankton community will be analyzed to establish its diversity, composition and ecological role in the fishery areas along Kanom Canal, Kanom beach and South Sea Islands.

Objectives

1. To analyse plankton species diversity along Kanom Canal, Kanom beach, Mo Ko Thale-Tai, Nakhon Si Thammarat Province
2. To analyse the plankton community in the relation to environmental factors along Kanom Canal, Kanom beach, Mo Ko Thale-Tai, Nakhon Si Thammarat Province

Materials and methods

Sampling sites

Sampling were carried out during October 2006 and September 2007 along Kanom canal to Kanom beach, Mo Ko Thale-Tai, covering 15 stations (figure 1). The selected sampling sites were representative of the variety of the habitats.

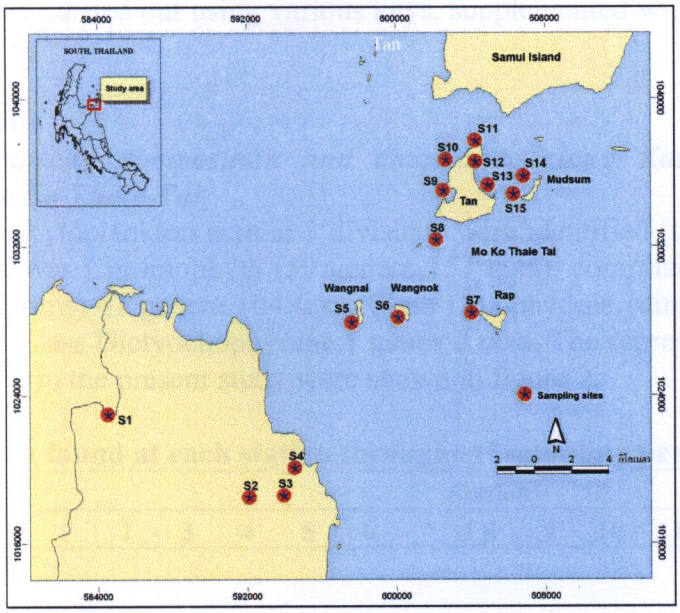


Figure 1 Sampling sites

Plankton sampling

Phytoplankton and zooplankton samples were quantitatively collected in October 2006, January 2007, March 2007, June 2007, July, 2007 and September 2007 at each station by filtering 50 liters of water via standard plankton nets of mesh size 20 and 60 μm, respectively. Species diversity at each station was based on samples qualitatively collected in a tow net of mesh size 20 and 60 μm for phytoplankton and zooplankton, respectively. After capture, samples were immediately preserved in 4% formalin.

Environmental measurements

Physical factors

A number of physical factors were measured at each site including temperature, light intensity, turbidity, transparency and depth. Temperature and light intensity were measured using regularly calibrated meters. Transparency and the depth (±1 cm) were estimated.

Chemical factors

pH, conductivity, dissolved oxygen and salinity were measured using regularly calibrated meters. Total phosphate, nitrite, nitrate, ammonia and silicate were analyzed following the standard methods (Strickland & Parsons, 1972; Parsons *et al.*, 1984).

Biological factors

Chlorophyll was measured using the Trichromatic method (Strickland & Parsons, 1972; Parsons *et al.*, 1984).

Investigation of the plankton specimens

Samples were transported to the laboratory for sorting, identification and enumeration. Phytoplankton samples were identified and counted with a Sedgwick-Rafter Slide under a compound microscope. Zooplankton samples were removed under a stereo binocular microscope at low magnification. Specimens were mounted on a slide in glycerin for identification and counting under a compound microscope. The identifications were carried out using various keys, supplemented with up-to-date literatures.

Results and discussions

The phytoplankton species composition and abundance along Kanom canal, Kanom beach and Mo Ko Thale-Tai

A total of 184 phytoplankton taxa in 3 divisions were identified (table 1). The most diverse Division was Chromophyta (59 genera 157 taxa), comprising of Class Bacillariophyceae (diatoms) 41 genera 104 taxa, Class Dinophyceae (dinoflagellates) 17 genera 51 taxa and Class Dictyochophyceae 1 genus 2 taxa. The representatives of phytoplankton recorded in the present study were shown in figure 2.

Table 1 Phytoplankton found at each station throughout sampling period.

Taxa	Station														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Division Cyanophyta															
Class Cyanophyceae															
Anabaena sp.												+			
Oscillatoria erythraeum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oscillatoria sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oscillatoria sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oscillatoria sp.3	+														
Oscillatoria sp.4	+														
Oscillatoria sp.5	+														
Chroococcus sp.1	+														
Chroococcus sp.2	+														
Lyngbya sp.1	+														
Lyngbya sp.2	+														
Merismopedia sp.	+														
Richelia intracellularis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Division Chlorophyta															
Class Chlorophyceae															
Closterium sp.1	+														
Closterium sp.2	+														
Cosmarium sp.1	+														
Cosmarium sp.2	+														
Pediastrum sp.1	+														
Pediastrum sp.2	+														
Pediastrum sp.3	+														
Scenedesmus sp.1	+														
Scenedesmus sp.2	+														
Class Euglenophyceae															
Euglena sp.1	+														
Euglena sp.2	+														

Table 1 (continued)

Taxa	Station														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Euglena sp.3	+														
Trachelomonas sp.1	+														
Trachelomonas sp.2	+														
Division Chromophyta															
Class Bacillariophyceae															
Actinoptychus senareus			+	+	+			+	+	+	+	+	+	+	+
Actinoptychus sp.		+	+	+			+	+	+		+	+		+	+
Achnanthes longipes		+	+	+	+	+			+	+			+		
Amphora sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Amphora sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Asterionella japonica			+	+	+	+	+	+	+		+	+	+	+	+
Bacillaria sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Bacillaria sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Bacteriastrum sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Bacteriastrum sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Bacteriastrum sp.3		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Campylodiscus sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Campylodiscus sp.2		+	+	+	+	+	+	+	+		+	+	+	+	+
Chaetoceros aequatorialis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros borealis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros coarctatus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros decipiens		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros diversus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros lorenzianus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros rostratus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chaetoceros sp.1		+	+	+	+	+	+		+	+	+	+	+	+	+
Chaetoceros sp.2		+	+	+	+	+	+	+		+	+	+	+	+	+
Chaetoceros sp.3			+	+	+	+	+	+	+	+		+	+	+	+
Climacosphenia sp.					+			+	+	+	+	+	+	+	
Cocconeis scutellum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cocconeis sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Corethon sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	
Coscinodiscus granii		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Coscinodiscus sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Coscinodiscus sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cyclotella sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cyclotella sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dactyliosolen sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dactyliosolen sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ditylum sol		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ditylum sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Diploneis sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Diploneis sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Eucampia cornuta		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Eucampia zodiacus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Eucampia sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Eunotia sp.1	+														

Table 1 (continued)

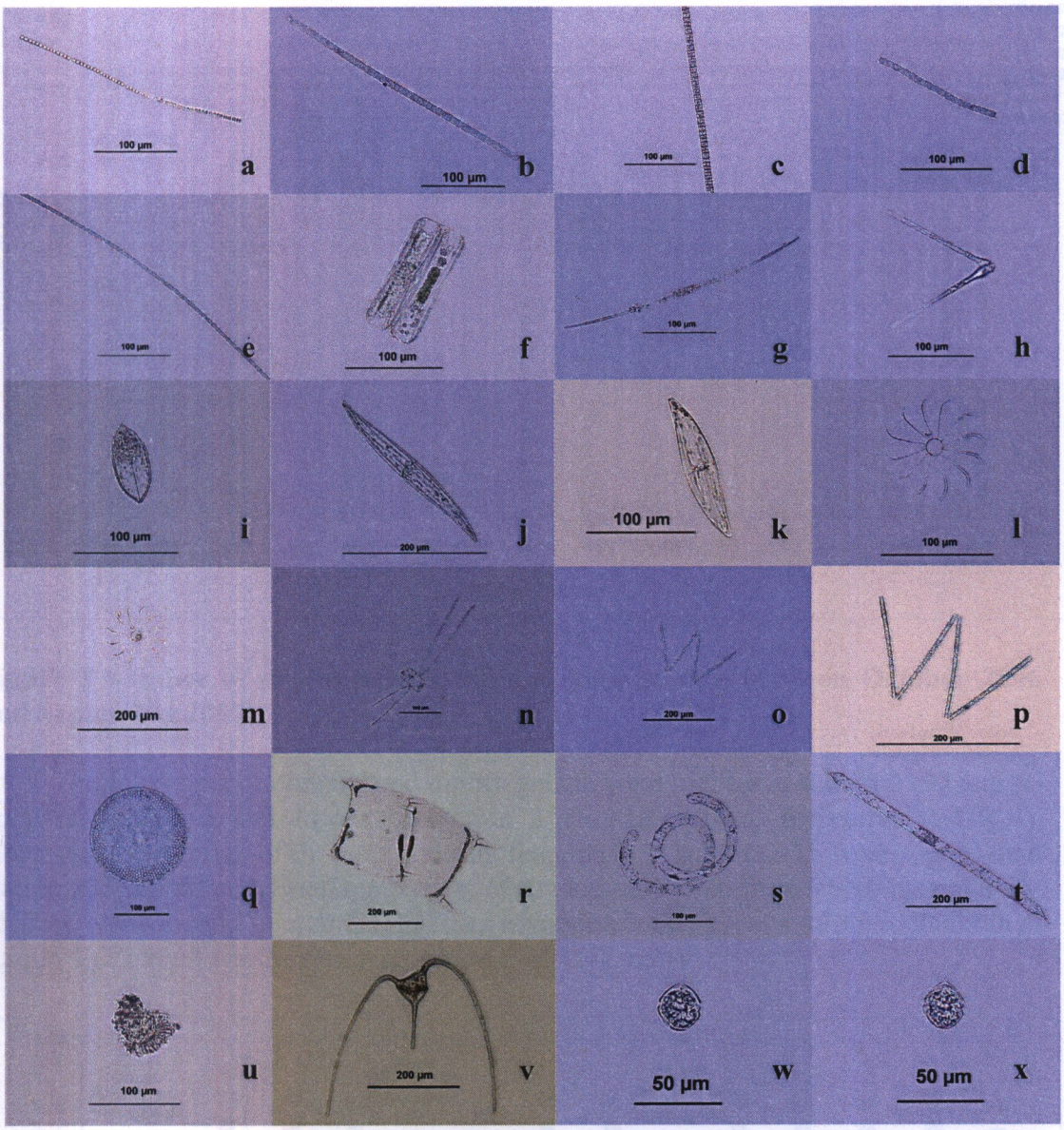
Taxa	Station														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eunotia sp.2	+														
Guinardia cylindrus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Guinardia delicatula		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Guinardia sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hemiaulus hauckii		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hemiaulus sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Leptocylindrus sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Leptocylindrus sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Licomphora sp.1		+	+	+	+	+	+	+	+	+	+	+		+	+
Licomphora sp.2			+	+	+	+	+	+		+	+			+	+
Mastogloia sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Mastogloia sp.2		+	+	+	+	+	+	+	+		+	+	+	+	+
Melosira dubia		+	+	+	+	+		+	+	+	+	+	+	+	+
Melosira moniliformis		+	+	+	+	+		+	+	+	+	+	+	+	
Navicula sp.1	+														
Navicula sp.2	+														
Navicula sp.3		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Navicula sp.4		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nitzschia longissima		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nitzschia sp.1	+														
Nitzschia sp.2	+														
Nitzschia sp.3		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nitzschia sp.4		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Odontella aurita		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Odontella mobiliensis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Odontella sinensis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Palmeria hardmaniana		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Palmeria sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Paralia sulcata		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Paralia sp.		+	+	+	+	+	+	+	+		+	+	+	+	+
Pleurosigma directum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pleurosigma sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pleurosigma sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pleurosigma sp.3		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Proboscia sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Proboscia sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pseudo-nitzschia pungens		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pseudo-nitzschia sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia decipiens		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia formosa		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia pungens		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia robusta		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia styliformis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhizosolenia sp.3		+	+		+	+		+	+	+	+	+	+	+	+
Stephanopyxis palmeriana			+	+		+	+	+	+	+	+	+	+	+	+

Table 1 (continued)

Taxa	Station														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Skeletonema costatum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Skeletonema sp.		+	+	+	+		+	+	+	+	+		+	+	+
Surirella sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Surirella sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Triceratium favus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Triceratium sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Trigomium altermans			+	+			+	+	+		+	+	+		+
Thalassionema sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassionema sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassiosira sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassiosira sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassiosira sp.3		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassiosira sp.4		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassiothrix sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Thalassiothrix sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Class Dinophyceae															
Alexandrium tamiyavanichi		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Amphisolenia sp.1			+			+	+	+	+	+	+	+			+
Amphisolenia sp.2			+	+	+			+	+	+		+			+
Ceratium deflexum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium dens		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium falcatum		+	+	+	+	+		+	+	+	+	+	+	+	+
Ceratium furca		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium fusus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium macroceros		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium pentagonum			+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium tripos		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceratium sp.1	+	+													
Ceratium sp.2	+														
Dinophysis caudata			+	+	+	+	+	+	+		+	+	+	+	+
Dinophysis miles			+	+	+	+			+	+	+	+	+	+	+
Diplopsalis sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Diplopsalis sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Diplopsalopsis sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Diplopsalopsis sp.2		+	+	+	+	+		+	+	+	+	+	+	+	+
Goniodoma polyedricum		+	+	+	+	+		+	+	+	+		+	+	+
Gonyaulax digitale		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Gonyaulax polygramma			+	+	+	+	+	+	+	+	+	+	+	+	+
Gonyaulax spinifera		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Gonyaulax sp.			+	+	+	+	+	+	+	+	+	+	+	+	+
Lingulodinium polyedrum			+	+	+	+	+	+	+	+	+	+	+	+	+
Orinthocercus sp.1			+	+	+	+	+	+	+	+	+	+	+	+	+
Orinthocercus sp.2			+	+	+	+	+				+		+	+	+
Peridinium quinquecorne		+	+	+	+		+	+	+	+	+	+	+	+	
Peridinium sp.1	+														
Peridinium sp.2	+														
Peridinium sp.3	+														

Table 1 (continued)

Taxa	Station														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phalacroma sp.1			+	+	+	+	+		+	+	+	+	+	+	
Phalacroma sp.2			+		+	+				+	+	+	+	+	
Podolampas bipes		+	+	+		+	+	+		+	+	+	+		+
Podolampas elegans		+	+	+	+	+	+	+	+	+	+	+	+	+	
Prorocentrum micans		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium abei		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium depressum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium divergens		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium conicum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium leonis		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium pellucidum		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium subinerme		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium stenii		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium sp.1		+	+	+	+		+	+	+	+	+	+	+	+	+
Protoperidinium sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protoperidinium sp.3		+	+	+	+	+			+	+	+	+	+	+	
Pyrophacus stenii		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pyrophacus sp.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Scrippseilla sp.1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Scrippseilla sp.2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Class Dictyochophyceae															
Dictyocha fibula		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dictyocha speculum			+	+	+	+			+			+	+	+	
Total	**33**	**131**	**149**	**146**	**145**	**142**	**136**	**142**	**145**	**141**	**146**	**146**	**145**	**145**	**140**



Figures 2a-x: The representatives of phytoplankton from Mo Ko Thale-Tai recorded in the present study: a) *Anabaena* b-c) *Oscillatoria* d-e) *Lyngbya* f) *Achnanthes* g) *Nitzschia* h) *Asterionella* i) *Navicula* j-k) *Pleurosigma* l-m) *Bacteriastrum* n) *Chaetoceros* o-p) *Climacosphenia* q) *Coscinodiscus* r) *Odontella* s) *Guinardia* t) *Rhizosolenia* u) *Dinophysis* v) *Ceratium* w-x) *Gonyaulax.*

Phytoplankton taxa number was highest at station 3 (149 taxa) and lowest at station 1 (33 taxa). The number at other stations varied widely from 131-146 taxa between October 2006 and September 2007 (Table 1).

Number of phytoplankton taxa was highest in June 2007 at station 4 (120 taxa) and lowest in July 2007 at station 1 (19 taxa). However, phytoplankton taxa number varied widely throughout sampling period. Phytoplankton taxa number was lowest at station 1 ranging from 19-31 taxa while other stations displayed ranging from 49-120 taxa (fig.3).

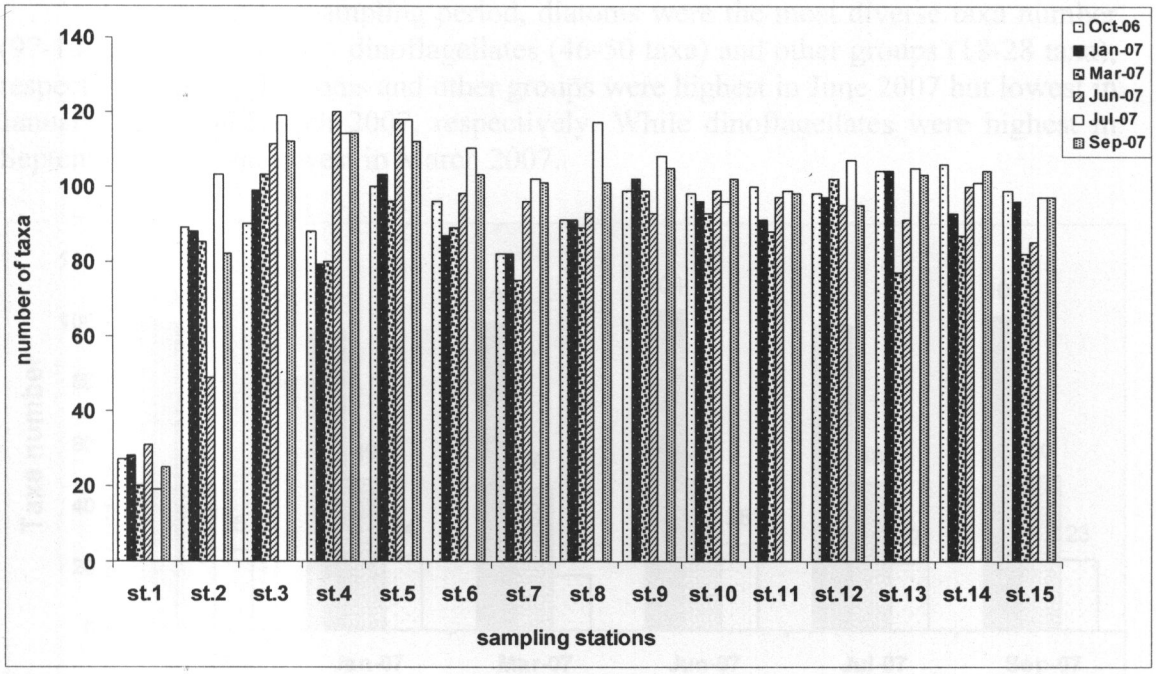


Figure 3 number of phytoplankton taxa at each station between October 2006 and September 2007

Number taxa of diatoms and dinoflagellate were highest at station 3 (97 and 46 taxa, respectively) and lowest at station 1 (6 and 5 taxa, respectively) (fig.4). However, the number of diatoms and dinoflagellates in station 2-15 were higher than station 1. Diatoms and dinoflagellates at other stations varied from 91-96 taxa and 35-45 taxa, respectively. In contrast, the taxa number of other groups of phytoplankton at station 1 (22 taxa) was higher than station 2-15 (5-7 taxa).

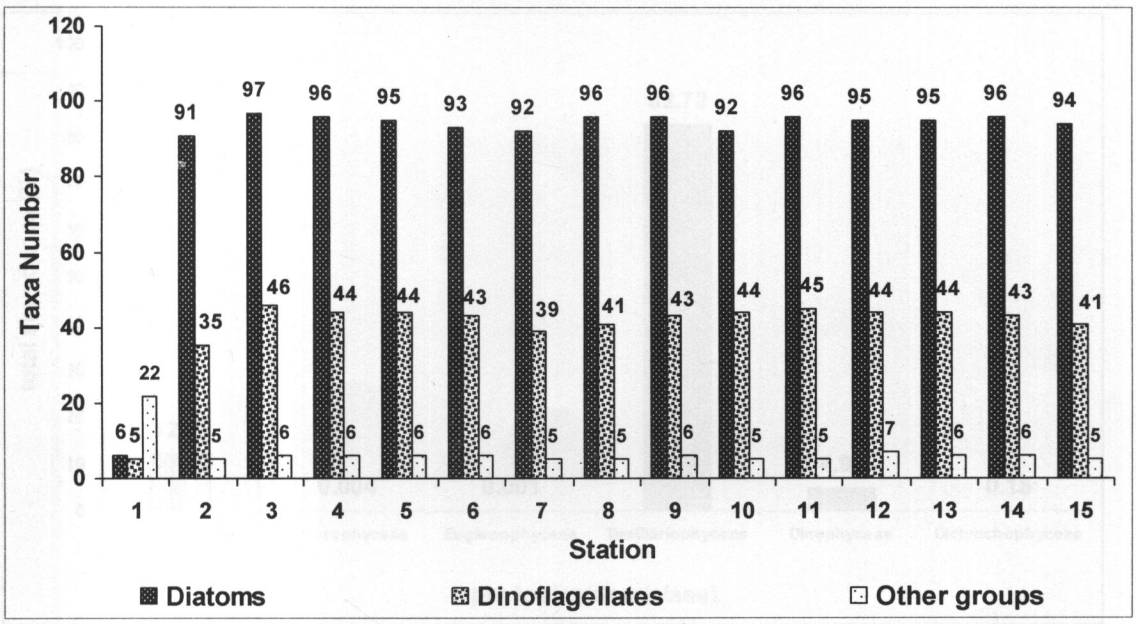


Figure 4 taxa number of phytoplankton groups at each station throughout the sampling period.

Throughout the sampling period, diatoms were the most diverse taxa number (97-104 taxa) followed by dinoflagellates (46-50 taxa) and other groups (18-28 taxa), respectively (fig.5). Diatoms and other groups were highest in June 2007 but lowest in January 2007 and March 2007, respectively. While dinoflagellates were highest in September 2007 and lowest in March 2007.

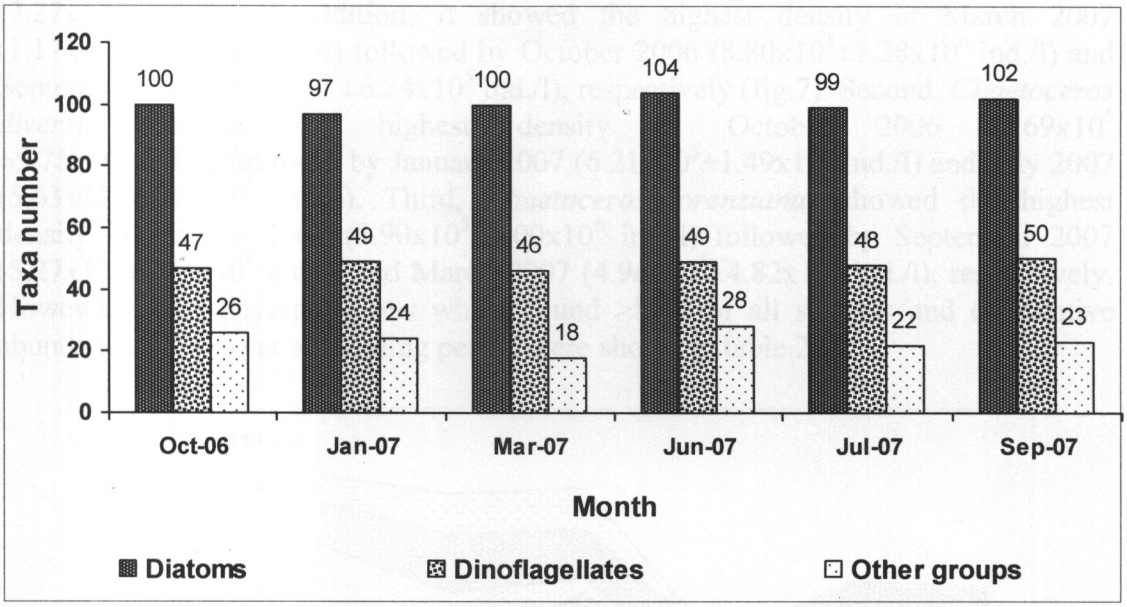


Figure 5 taxa number of phytoplankton group throughout the sampling period.

The most total abundance class of phytoplankton during sampling period was Class Bacillariophyceae (82.72%) followed by Class Cyanophyceae (12.20%) and Class Dinophyceae (4.92%), respectively (fig.6).

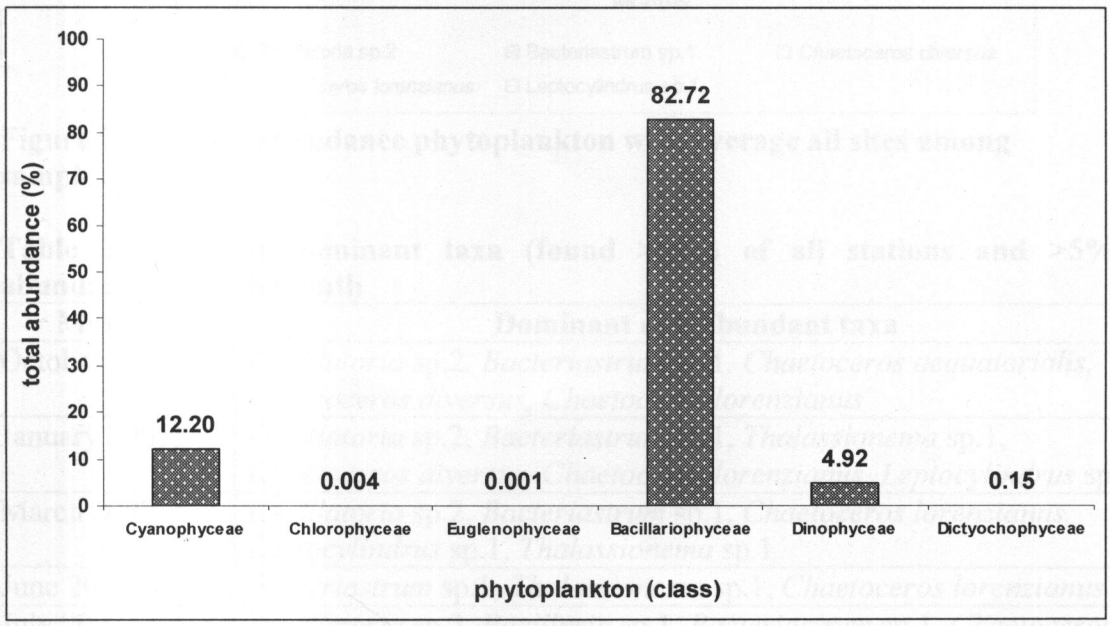


Figure 6 Percentage of total abundance of phytoplankton (class) during sampling periods.

Moreover, it was obviously shown that *Bacteriastrum* sp1, *Chaetoceros diversus* and *Chaetoceros lorenzianus* were the high frequently found taxa throughout sampling periods. However, based on the density, *Bacteriastrum* sp.1 was the most frequently found taxa at all station and highest abundance throughout sampling period (93.33% found at station and >5% abundance of all taxa). *Bacteriastrum* sp1 dominated phytoplankton of all stations sampled through out sampling period ($7.27x10^7$ ind./l). In addition, it showed the highest density in March 2007 ($1.17x10^6 \pm 2.21x10^6$ ind./l) followed by October 2006 ($8.80x10^5 \pm 1.28x10^6$ ind./l) and September 2007 ($8.68x10^5 \pm 6.24x10^5$ ind./l), respectively (fig.7). Second, *Chaetoceros diversus* showed the highest density in October 2006 ($9.69x10^5 \pm 9.75x10^5$ ind./l) followed by January 2007 ($6.21x10^5 \pm 1.49x10^6$ ind./l) and July 2007 ($5.63x10^5 \pm 5.39x10^5$ ind./l). Third, *Chaetoceros lorenzianus* showed the highest density in January 2007 ($5.90x10^5 \pm 1.00x10^6$ ind./l) followed by September 2007 ($5.27x10^5 \pm 4.26x10^5$ ind./l) and March 2007 ($4.96x10^5 \pm 4.82x10^5$ ind./l), respectively. However, other phytoplanktons which found >80% of all stations and cumulative abundance >5% in each sampling period were shown in table 2.

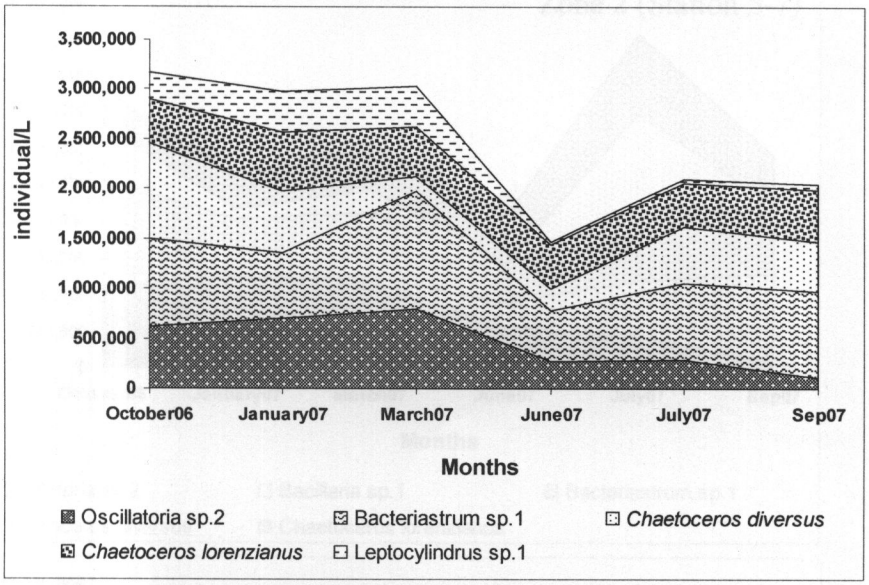
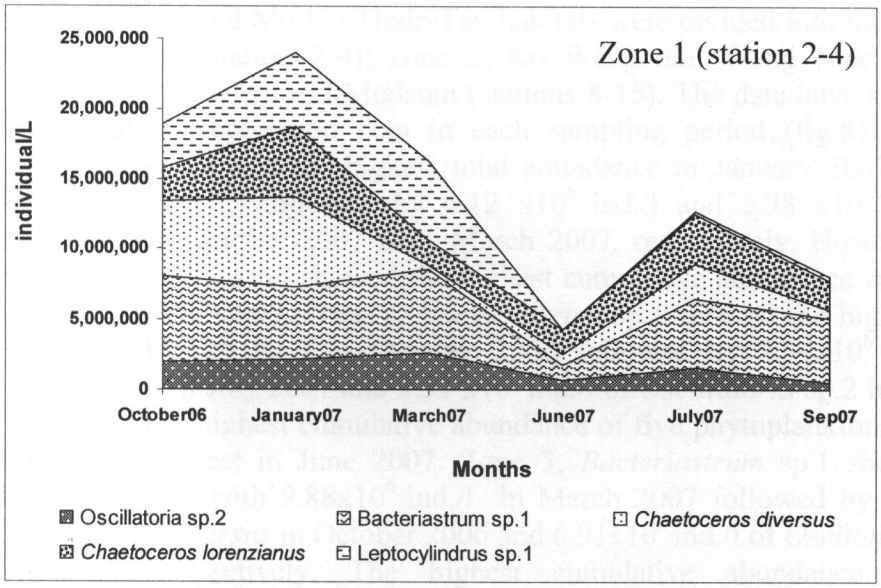
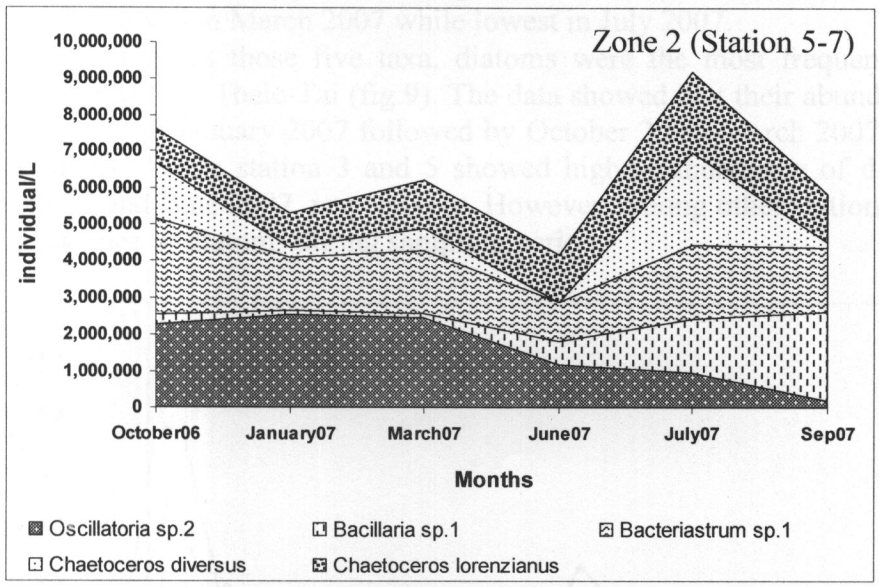


Figure 7 five most abundance phytoplankton with average all sites among sampling period

Table 2 the most dominant taxa (found >80% of all stations and >5% abundance) in each month

Months	Dominant and abundant taxa
October 2006	*Oscillatoria* sp.2, *Bacteriastrum* sp.1, *Chaetoceros aequatorialis, Chaetoceros diversus, Chaetoceros lorenzianus*
January 2007	*Oscillatoria* sp.2, *Bacteriastrum* sp.1, *Thalassionema* sp.1, *Chaetoceros diversus, Chaetoceros lorenzianus, Leptocylindrus* sp.1
March 2007	*Oscillatoria* sp.2, *Bacteriastrum* sp.1, *Chaetoceros lorenzianus, Leptocylindrus* sp.1, *Thalassionema* sp.1
June 2007	*Bacteriastrum* sp.1, *Thalassionema* sp.1, *Chaetoceros lorenzianus*
July 2007	*Oscillatoria* sp.2, *Bacillaria* sp.1, *Bacteriastrum* sp.1, *Chaetoceros diversus, Chaetoceros lorenzianus*
September 2007	*Oscillatoria erythraeum, Bacillaria* sp.1, *Bacteriastrum* sp.1, *Chaetoceros lorenzianus, Rhizosolenia pungens*





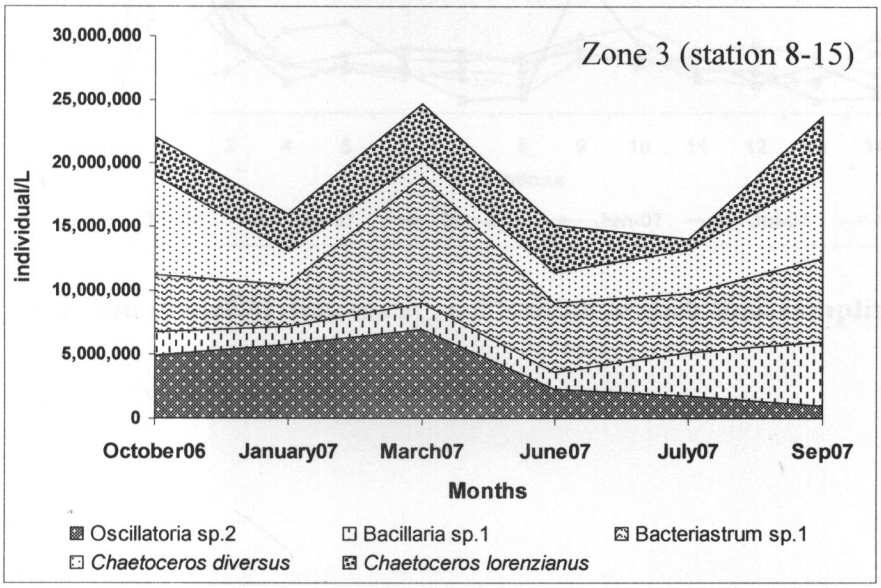


Figure 8 five most abundance phytoplankton during sampling period at three zone

In Kanom canal and Mo Ko Thale-Tai, habitats were divided into three zones; zone 1, Kanom canal (station 2-4); zone 2, Ko Wang nai, Wang Nok and Rap (stations 5-7); zone 3, Ko Tan and Mudsum (stations 8-15). The data have shown the different dominant phytoplankton taxa in each sampling period (fig.8). Zone 1, *Chaetoceros diversus* showed the highest total abundance in January 2007 with in excess of 6.45×10^6 ind./l followed by 6.12×10^6 ind./l and 5.98×10^6 ind./l of *Bacteriastrum* sp.1 in October 2007 and March 2007, respectively. However, five most abundance phytoplankton showed the highest cumulative abundance in January 2007 and lowest in June 2007. Zone 2, *Bacteriastrum* sp.1 showed the highest total abundance with 2.62×10^6 ind./l in October 2006 followed by 2.54×10^6 ind./l of *Chaetoceros diversus* in July 2007 and 2.53×10^6 ind./l of *Oscillatoria* sp.2 in January 2007, respectively. The highest cumulative abundance of five phytoplanktons showed in July 2007 while lowest in June 2007. Zone 3, *Bacteriastrum* sp.1 showed the highest total abundance with 9.88×10^6 ind./l in March 2007 followed by 7.75×10^6 ind./l of *Chaetoceros diversus* in October 2006 and 6.91×10^6 ind./l of *Oscillatoria* sp.2 in March 2007, respectively. The highest cumulative abundance of five phytoplanktons showed in March 2007 while lowest in July 2007.

However, besides those five taxa, diatoms were the most frequency found phytoplankton at Mo Ko Thale-Tai (fig.9). The data showed that their abundance was highest at station 2 in January 2007 followed by October 2006, March 2007 and July 2007, respectively. While station 3 and 5 showed highest abundance of diatoms in September 2007 and June 2007, respectively. However, among other stations showed similarly abundance of diatoms during sampling period.

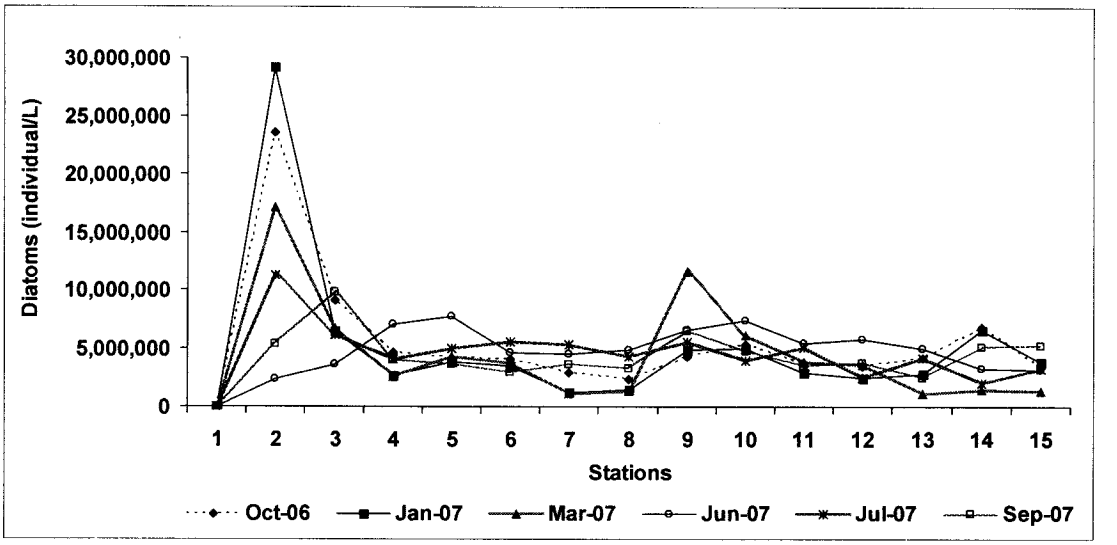


Figure 9 Total abundance of diatoms at each station in each time sampling.

The zooplankton species composition and abundance along Kanom canal, Kanom beach, Mo Ko Thale-Tai

A total of 61 zooplankton taxa in 11 Phylum were identified (table 3). The most diverse phylum was Arthropoda, comprising of 24 taxa. The representatives of zooplankton recorded in the present study were shown in figure 10.

Table 3 zooplankton found at each station throughout sampling period.

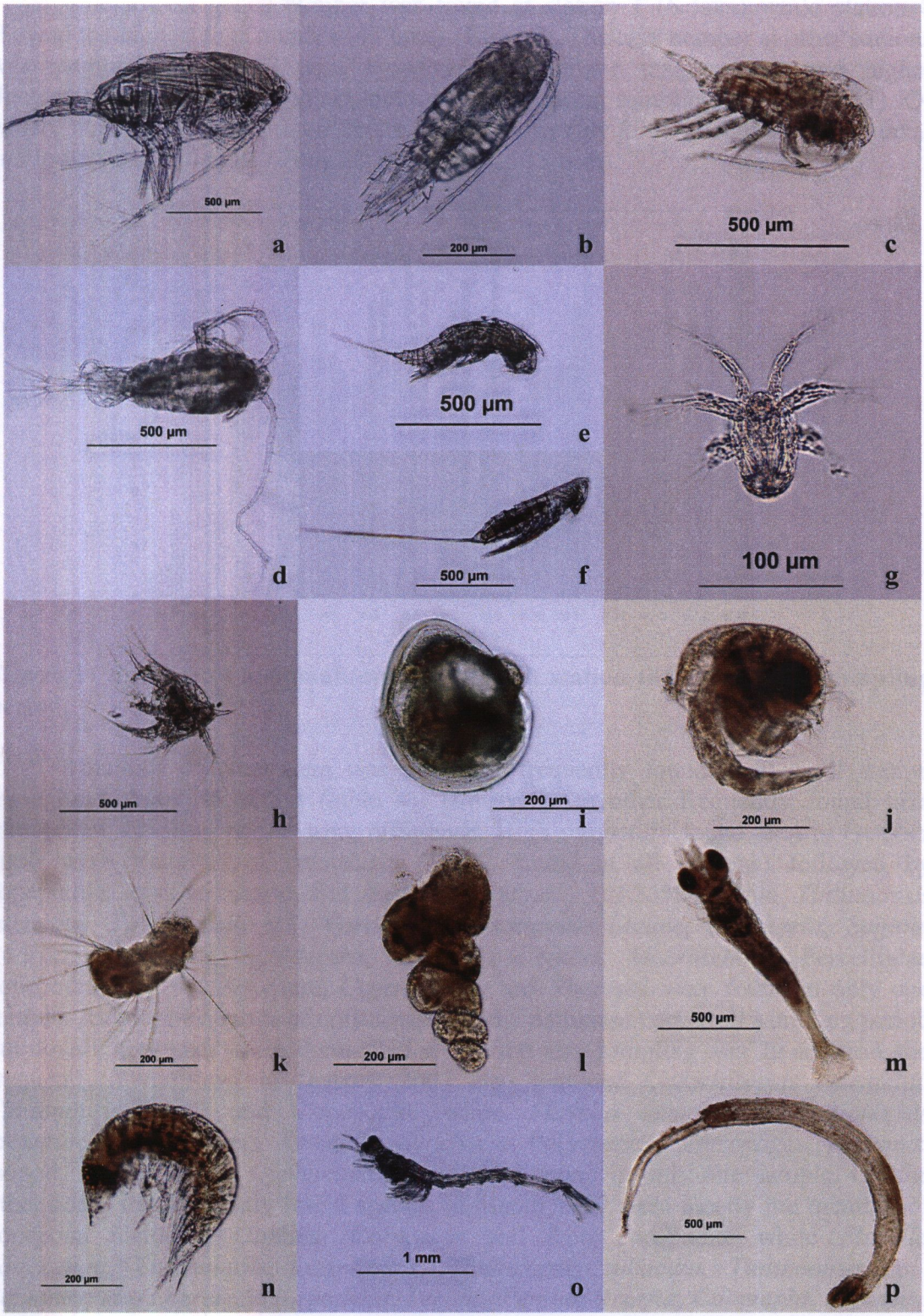
	stations														
zooplankton	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Phylum Protozoa															
Class Sarcodina															
Radiolarida				+	+	+	+	+	+	+	+	+		+	+
Class Ciliata															
Codonella aspera											+	+		+	
Codonellopsis ostenfeldi	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dictyocysta		+	+	+							+				
Eutintinus									+						
Flavella campanula		+	+	+		+	+		+	+	+	+		+	
Leprotintinnus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhadonella					+		+	+	+	+	+	+	+	+	+
Tintinnopsis tocantinesis		+	+	+	+	+		+	+				+	+	+
Tintinnopsis gracilis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis mortensii		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis orientalis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis directa		+			+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis subacuta		+	+	+	+		+		+						
Tintinnopsis sp1		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis sp2		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis sp3	+	+		+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis sp4		+	+	+	+	+	+		+				+	+	
Tintinnopsis sp5		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tintinnopsis sp6					+			+		+	+	+			
Vorticella														+	
Order Foraminifera		+	+	+	+		+		+			+	+	+	+
Phylum Cnidaria															
Class Hydrozoa															
Leptomedudae														+	
Siphonophora						+		+			+	+			+
Phylum Rotifera															
Brachionus		+	+	+						+					
Keratella		+	+	+		+	+	+		+	+				
Lecane	+	+		+			+	+		+	+			+	
Lepadella	+														
Synchaeta								+		+					

Table 3 (continued)

zooplankton	stations														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phylum Chaetognatha															
Family Sagittidae															
Sagitta		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Phylum Annelida															
Class Polychaeta															
Polychaete larvae		+	+	+	+	+	+	+	+	+		+	+	+	+
Polychaete		+	+	+	+	+	+	+	+	+	+		+	+	+
Phylum Arthropoda															
Class Crustacea															
Penilia						+									
Copepoda															
Order Calanoida															
Acartia		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Acrocalanus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Calanopia				+		+	+	+						+	
Centropages					+	+		+		+	+				+
Eucalanus					+	+	+	+	+	+	+	+	+		+
Labidocera				+	+	+	+	+			+	+	+		
Paracalanus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tortanus		+						+			+		+	+	
Pontella						+	+	+						+	
Order Cyclopoid															
Oithona		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Order Harpacticoid															
Clytemnestra											+				
Euterpina		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Macrosetella			+			+	+	+	+		+	+	+		+
Microsetella		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Order Poecilostomatoida															
Corycaeus		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oncaea				+	+	+	+	+			+	+	+		+
Nauplius of crustacea		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Copepodite		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Malacostaca															
Order Isopoda															
Order Decapoda															
Lucifer		+	+	+		+	+		+	+	+	+			+
Protozoea of *Lucifer*		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Crab zoea			+	+		+	+	+	+						+
Shrimp larvae					+	+		+		+					+
Cirripedia															
Barnacle nauplius		+	+	+	+	+	+	+	+	+	+	+	+	+	+

Table 3 (continued)

zooplankton	stations														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Cypris larvae			+	+		+		+	+						+
Phylum Phoronida															
Actinotrocha larvae					+									+	
Phoronid			+												
Phylum Ectoprocta (Bryozoa)															
Cyphonautes larva		+	+					+							
Phylum Mollusca															
Cavoliniidae				+	+	+	+	+	+	+	+	+		+	+
Bivalve larvae		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Gastropod larvae		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Phylum Echinodermata															
Ophiopluteus		+	+	+	+	+		+	+	+	+			+	+
Phylum Chordata															
Oikopleura		+	+	+	+	+	+	+	+	+	+	+	+	+	+
Fish egg			+	+	+	+			+	+		+	+	+	+
Total	**6**	**40**	**41**	**45**	**42**	**47**	**44**	**49**	**42**	**41**	**45**	**40**	**37**	**44**	**43**



Figures 10a-p: The representatives of zooplankton at Mo Ko Thale-Tai recorded from the present study: a) *Acartia* b) *Acrocalanus* c) *Paracalanus* d) *Tortanus* e) *Euterpina* f) *Microsetella* g) nauplius of crustacean h) barnacle nauplius i) bivalve larvae j) crab zoea k) polycheate larvae l) gastropod larvae m) shrimp larvae n) isopod o) *Sagitt*a p) *Oikopleura.*

The lowest genus number was found at station 1 (6 taxa) while station 8 showed the highest taxa number (49 taxa) (Table 3). The taxa number at other stations was ranging from 37-47 taxa. However, zooplankton taxa number was higher fluctuated than number of phytoplankton genera during sampling period (fig.11). Of which, number of zooplankton taxa was highest in July 2007 at station 15 (35 taxa) and lowest during January-June 2007 at station 1 (3 taxa).

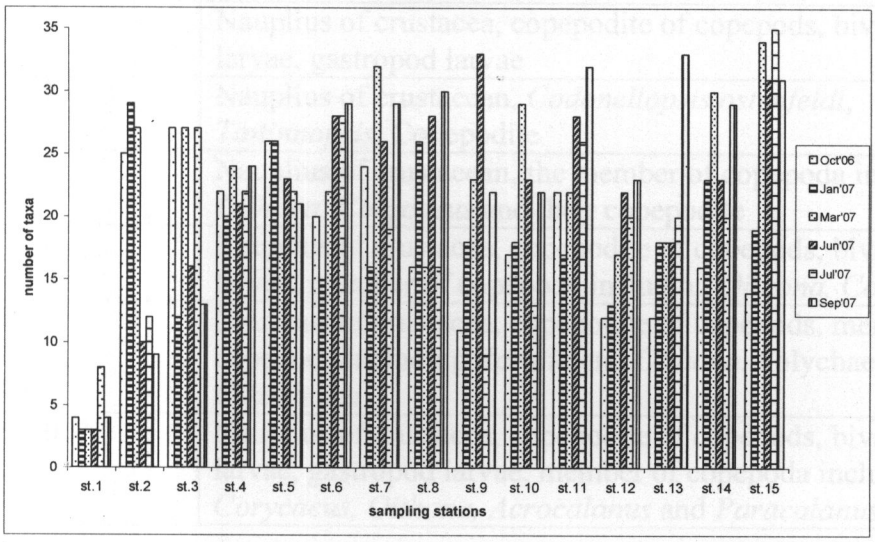


Figure 11 number of zooplankton taxa at each station throughout the sampling period.

Nauplius of crustacean was the most frequently found taxa at all station throughout sampling period (table 4). However, the other frequently found taxa throughout sampling period were difference. High frequently found taxa in October 2006 were Nauplius of crustacean (100%, found at all stations) followed by copepodite, bivalve larvae and gastropod larvae (93.33%), while *Tintinnopsis subacuta, Tintinnopsis* sp4, *Vorticella*, *Brachionus*, *Lecane*, *Synchaeta*, *Sagitta*, *Acartia* copepodite, *Labidocera*, *Pontella*, *Copilia*, *Macrosetella*, Percelliidae copepodite, *Lucifer*, Anomura, *Cypris* larvae and Phoronid were found in only one sample. Although nauplius of crustacean was the dominant taxa at all sampling period but not all other taxa which dominated in the first time sampling was. In addition, the frequently found taxa in January 2007 also included *Codonellopsis ostenfeldi*, *Tintinnopsis* sp 2 and Copepodite while *Flavella campanula, Tintinnopsis tocantinesis, Brachionus, Keratella, Synchaeta,* Polychaete, *Centropages*, *Tortanus*, isopod, shrimp larvae, *Cyphonautes* larva were found in only one sample. On the other hand, the frequently found species in March 2007 were mostly the member of copepoda including *Oithona, Corycaeus* and their copepodite while *Flavella campanula*, *Tintinnopsis tocantinesis*, *Tintinnopsis subacuta*, *Tintinnopsis* sp6, *Leptomedudae*, *Keratella*, *Lepadella*, *Lecane*, *Penilia*, *Acartia*, *Calanopia*, *Tortanus*, Amphipod, Actinotrocha larvae and *Ophiopluteus* were found in only one sample. The most frequently found taxa in June 2007 were Nauplius of crustacea, copepodite of copepods, bivalve larvae, member of copepoda including *Oithona* and *Corycaeus* while the Ciliata such as *Eutintinus*, *Rhadonella* and *Tintinopsis* including the harpacticoida; *Clytemnestra*, *Macrosetella* and shrimp larvae were found in only one sample. The most frequently found taxa in July 2007 were Nauplius of crustacea, copepodite of copepods, member of copepoda including *Acratia* and *Oithona*, Polychaete and *Oikopleura* whereas *Codonella, Tintinopsis, Brachionus, Lecane,*

Pontella, *Clytemnestra*, *Lucifer* and Ophiopluteus were found in only one sample. And the most frequently found taxa in September 2007 were Nauplius of crustacea, copepodite of copepods.

Table 4 the most dominant taxa (>80% found of all stations and >5% abundance) in each month

Months	Dominant and abundant taxa
October 2006	Nauplius of crustacea, copepodite of copepods, bivalve larvae, gastropod larvae
January 2007	Nauplius of crustacean, *Codonellopsis ostenfeldi*, *Tintinnopsis*, Copepodite
March 2007	Nauplius of crustacean, the member of copepoda including *Oithona, Corycaeus* and their copepodite
June 2007	Nauplius of crustacea, copepodite of copepods, bivalve larvae, member of copepoda including *Oithona, Corycaeus*
July 2007	Nauplius of crustacea, copepodite of copepods, member of copepoda including *Acratia* and *Oithona*, Polychaete and *Oikopleura*
September 2007	Nauplius of crustacea, copepodite of copepods, bivalve larvae, gastropod larvae, member of copepoda including *Corycaeus, Oithona, Acrocalanus* and *Paracalanus*

The most abundance Phylum during sampling period was Arthropoda (73.38%) followed by Phylum Protozoa (16.88%) and Phylum Mollusca (8.48%), respectively (fig.12).

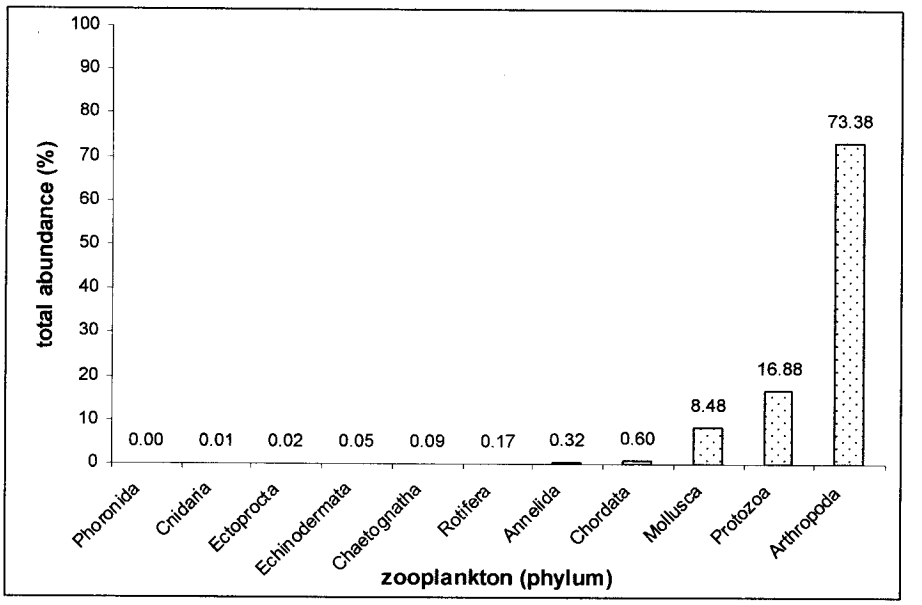
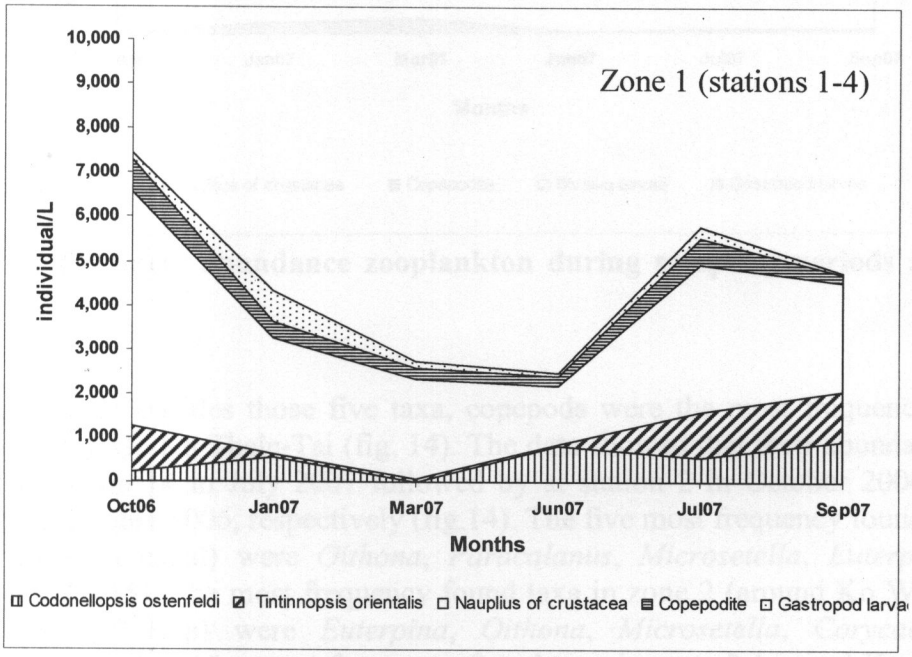
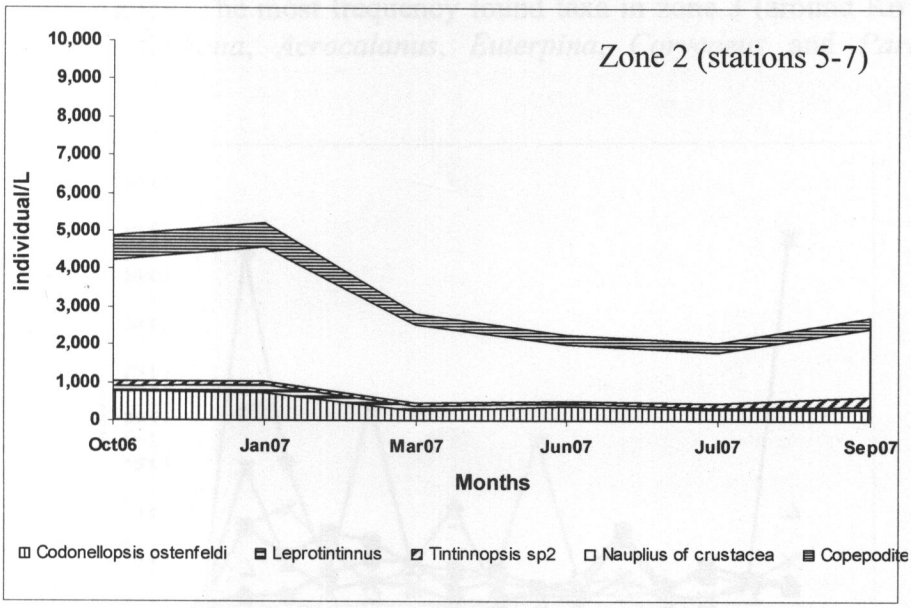


Figure 12 Percentage of zooplankton total abundance (phylum) during sampling periods.

Moreover, based on the density, nauplius of crustacean also dominated zooplankton of all stations sampled over sampling period (1,316.67-5,293.02 ind./l). In addition, it showed the highest density in January 2007 (5,297±8,387 ind./l) followed by March 2007 (4,662±6,315 ind./l) and September 2007 (3,437±4,279 ind./l), respectively.

If we divided the stations into three zones; zone 1, Kanom canal (station 2-4); zone 2, Ko Wang nai, Wang Nok and Rap (stations 5-7); zone 3, Ko Tan and Mudsum (stations 8-15), the data have shown the different dominant zooplankton taxa in each time sampling. In zone 1, nauplius of crustacean showed the highest density at all times during sampling period followed by *Tintinnopsis orientalis* and *Codonellopsis ostenfeldi*, respectively (fig. 13A). In zone 2, nauplius of crustacean showed the highest density at all times during sampling period followed by *Codonellopsis ostenfeldi* and *Tintinnopsis orientalis*, respectively (fig. 13B) and in zone 3, nauplius of crustacean showed the highest density at all times during sampling period followed by *Codonellopsis ostenfeldi* and *Tintinnopsis orientalis*, respectively (fig. 13C).





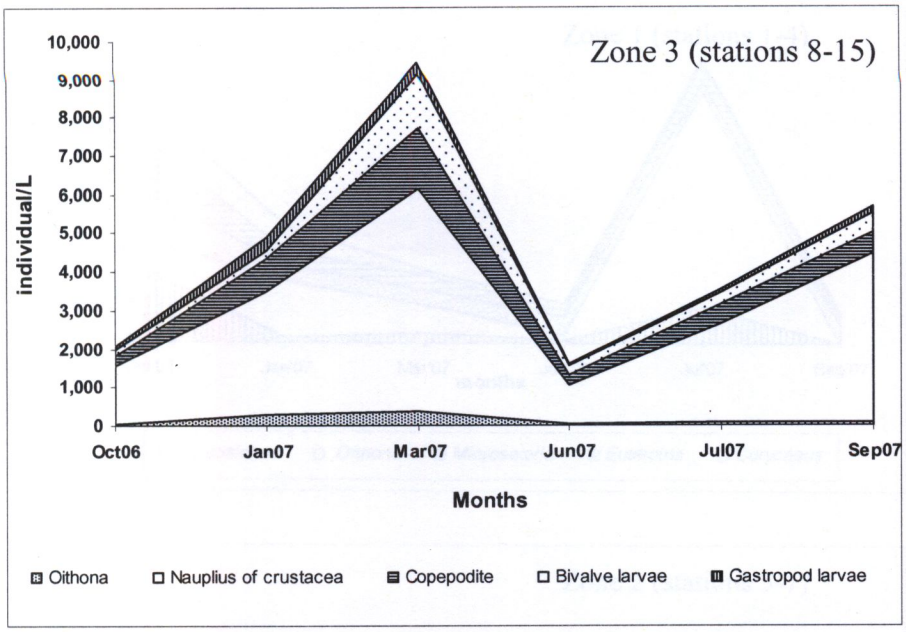


Figure 13 The most abundance zooplankton during sampling periods at three zones

However, besides those five taxa, copepods were the most frequency found zooplankton at Mo Ko Thale-Tai (fig. 14). The data showed that their abundance was highest at station 14 in July 2007 followed by at station 2 in October 2006 and at station 5 in October 2006, respectively (fig.14). The five most frequency found taxa in zone 1 (Kanom canal) were *Oithona*, *Paracalanus*, *Microsetella*, *Euterpina* and *Corycaeus* (fig.15). The most frequency found taxa in zone 2 (around Ko Wang nai, Wang nok and Rap) were *Euterpina*, *Oithona*, *Microsetella*, *Corycaeus* and *Acrocalanus* (fig.15). The most frequency found taxa in zone 3 (around Ko Tan and Mudsum) were *Oithona*, *Acrocalanus*, *Euterpina*, *Corycaeus* and *Paracalanus* (fig.15).

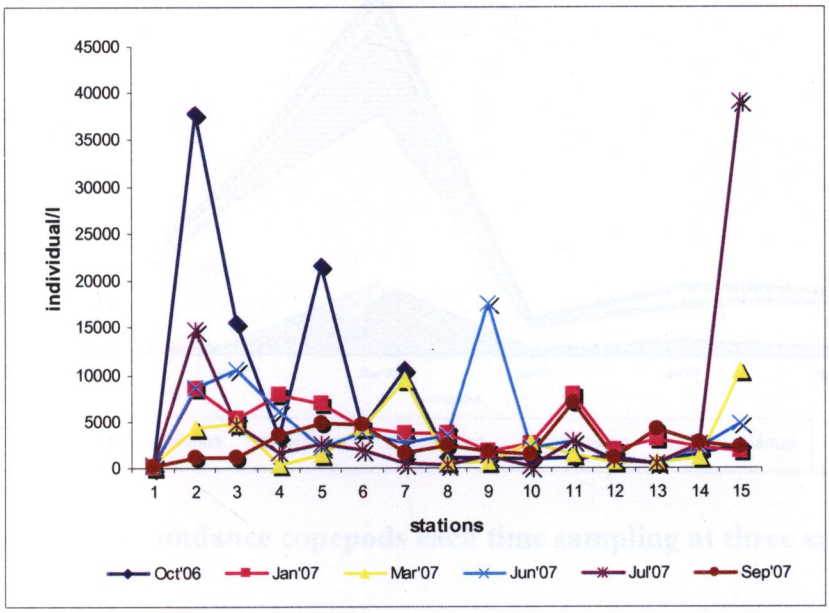
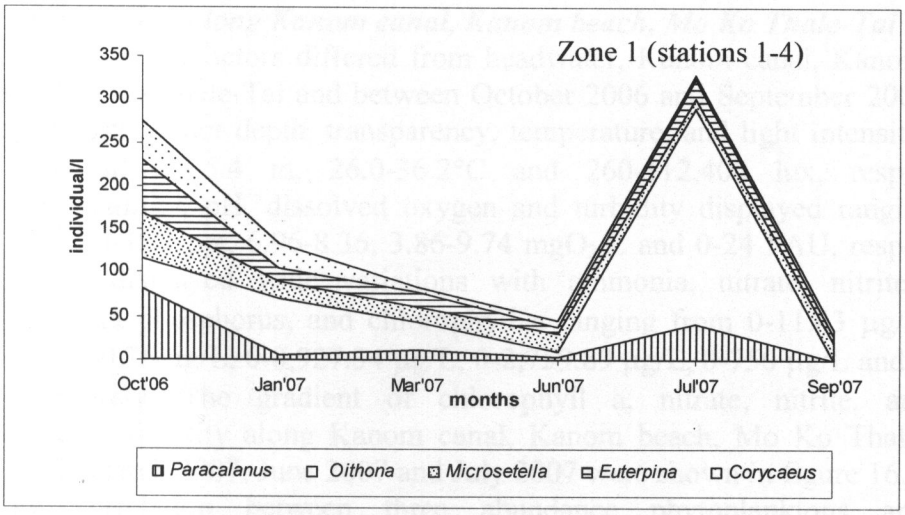
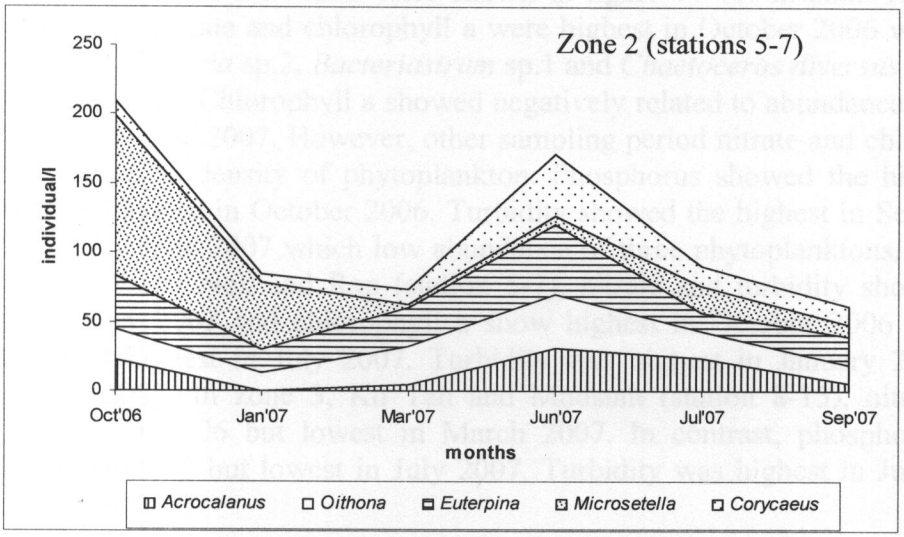


Figure 14 total abundance of copepods at each station in each time sampling.





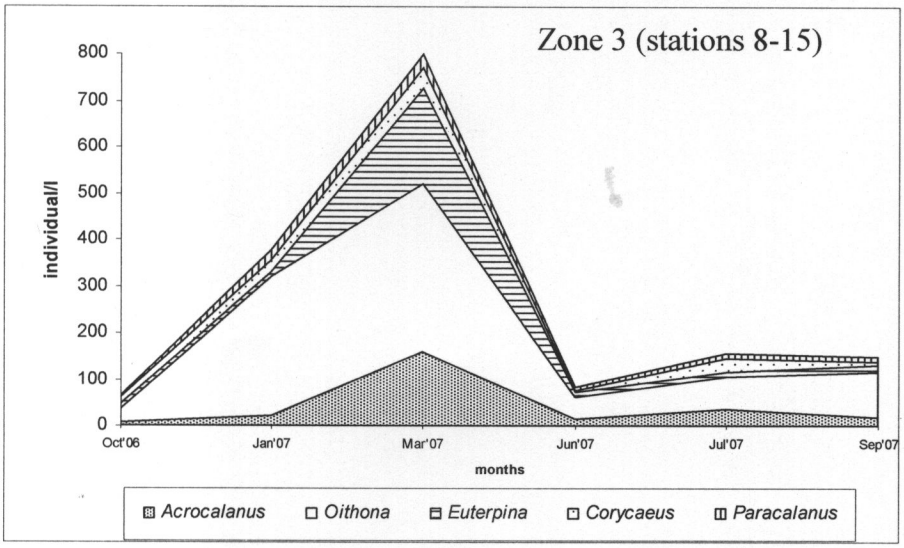


Figure 15 five most abundance copepods each time sampling at three zones.

Evironmental factors along Kanom canal, Kanom beach, Mo Ko Thale-Tai

Environmental factors differed from headwater, Kanom canal, Kanom beach and around Mo Ko Thale-Tai and between October 2006 and September 2007 (table 5, 6). For example water depth, transparency, temperature, and light intensity varied from 0.5-26 m, 0.5-5.4 m, 26.0-36.2°C and 260-112,400 lux, respectively. Conductivity, salinity, pH, dissolved oxygen and turbidity displayed ranging from 0.46-54.7 mS, 0-36.7 ppt, 6.96-8.36, 3.86-9.74 mgO_2/L and 0-24 FAU, respectively. Nutrients also displayed wide variations with ammonia, nitrate, nitrite, silica, phosphorus, total phosphorus, and chlorophyll a ranging from 0-11.43 μg/L, 3.23-642.86 μg/L, 0-0.75 μg/L, 0-8,927.34 μg/L, 0-2,759.89 μg/L, 0-750 μg/L and 3.22-78 μg/L, respectively. The gradient of chlorophyll a, nitrate, nitrite, ammonia, phosphorus and turbidity along Kanom canal, Kanom beach, Mo Ko Thale-Tai in January 2007, March 2007, June 2007 and July 2007 were shown in figure 16.

The correlation between three abundance phytoplanktons and four environmental factors in each zone were shown in figure 17-19. In zone 1, Kanom canal (station 2-4), nitrate and chlorophyll a were highest in October 2006 with high abundance of *Oscillatoria* sp.2, *Bacteriastrum* sp.1 and *Chaetoceros diversus* (fig 17). In contrast, nitrate and Chlorophyll a showed negatively related to abundance of three phytoplanktons in June 2007. However, other sampling period nitrate and chlorophyll a were not related to density of phytoplankton. Phosphorus showed the highest in March 2007 and lowest in October 2006. Turbidity showed the highest in September 2007 followed by June 2007 which low abundance of three phytoplanktons. Zone 2, Ko Wang Nai, Wang Nok and Rap (station 5-7), nitrate and turbidity showed the highest in January 2007 and chlorophyll a show highest in October 2006 (fig.18). Phosphorus was highest in July 2007. Turbidity was highest in January 2007 but lowest in July 2007. In zone 3, Ko Tan and Mudsum (station 8-15), nitrate was highest in October 2006 but lowest in March 2007. In contrast, phosphorus was highest in March 2007 but lowest in July 2007. Turbidity was highest in June 2007 but lowest in July 2007.

Table 5 Range of environmental factors along Kanom canal, Kanom beach, Mo Ko Thale-Tai, between October 2006 and September 2007.

ST.	Depth (m)	Trans. (m)	Temperature (°C)	Light intensity (lux)	Conduct (mS)	Salinity (ppt)	pH	DO (mgO_2/L)	Turbid (FAU)	NH_3-N (µg/L)	NO_3-N (µg/L)	NO_2-N (µg/L)	Si (µg/L)	Phosphorus (µg/L)	Total P (µg/l)	Chl a (µg/L)
1	0.5-1.5	0.5-1.5	26.0-30.5	260-2900	0.46-0.76	0-0.3	7.32-7.72	5.24-7.86	5-13	0-2.14	4.84-57.14	0.09-0.75	3785.94-7000	88.05-1900	0-700	4-39
2	3.8-6.0	0.6-1.0	28.0-32.3	7800-47800	26.1-50.2	13.1-32.7	7.46-8.13	4.8-8.13	8-16.00	0-10	8.07-42.86	0.07-0.71	1308.72-3178.32	30.67-2453.24	0-750	8.88-78
3	2.4-5.0	0.7-1.3	28.0-32.8	20000-65200	31.2-51	15.5-33.3	7.07-8.18	7.27-8.16	9-24.00	0-11.43	16.13-57.14	0.04-0.33	701.10-2430.00	80.00-2460	0-530	8.11-41
4	2.0-5.2	0.6-1.3	28.4-33.9	9580-79400	38.3-50.9	19.1-33.2	7.63-8.22	7-8.17	8.00-19	0-10	3.23-157.14	0.09-0.38	514.14-1822.86	0-1625.27	0-470	11-32
5	6.8-26.0	1.1-3.0	27.5-31.4	31000-61800	41.2-54.7	20.8-36.7	7.27-8.22	7.27-8.62	2-7.0	0	6.45-642.86	0-0.33	514.00-2009.82	331.19-2700	0-730	5-24
6	8.3-20.0	1.1-3.8	27.3-32.7	47900-96900	41.2-50.5	31.4-33.8	7.26-8.36	7.26-8.2	0-6.0	0	11.29-142.86	0.06-0.33	467.40-1075.02	50.00-1620	0-190	5-27
7	10.8-18.0	1.6-4.0	27.4-32.6	10900-94700	45.5-54.2	31.6-33.7	6.96-8.24	6.96-7.86	2-6.0	0	6.45-78.57	0.06-0.29	280-1308.72	50.00-1810	0-240	3.22-23
8	26	1.9-5.4	26.9-31.3	2780-70500	19.99-50.7	31.7-33.8	7.55-8.22	5.69-8.16	0-7.0	0	14.52-78.57	0.05-0.24	187-5234.88	183.99-2600	0-200	3.95-43
9	1.1-3.0	1.1-3.0	26.5-30.9	4150-89800	39.1-54.5	21-33.4	8.01-8.24	5.44-7.86	2-6.0	0	4.84-64.29	0.07-0.28	467.40-1916.34	61.33-1042.62	0-230	4-10.82
10	5.0-15.0	1.3-4.5	27.2-30.9	15100-96900	39.8-54.1	31.6-33.6	7.99-8.25	3.86-8.33	1-10.0	0	3.23-85.71	0.01-0.33	420.66-5188.14	30.00-1594.60	0-310	4-7.57
11	9.2-20.0	2.3-3.7	27.4-34.7	23300-112400	30.4-49.8	19.8-33.5	8.04-8.22	4.99-7.86	1.0-7.0	0-1.17	11.29-64.29	0-0.38	0-8927.34	20.00-1195.95	0-250	5-19
12	6.0-7.9	1.9-5.0	27.4-36.2	26100-104500	40.3-50.4	31.9-33.4	7.54-8.23	5.74-7.86	0-11	0-0.59	3.23-135.71	0.10-0.29	420.66-2056.56	50-2759.89	0-310	4-21
13	3.9-6.3	1.8-4.3	27.6-33.7	51500-91200	40.6-54.6	31.5-33	7.89-8.22	5.76-7.86	1-4.0	0	12.91-64.29	0-0.23	200.00-3225.06	130.00-1079.42	0-230	4.91-13
14	0.9-2.6	0.9-2.6	27.4-32.7	11300-97300	40.7-50.6	31.6-32.9	8.1-8.3	5.73-9.74	0-6.0	0	14.52-100	0.09-0.33	420.66-1355.46	60-390	0-270	4.96-17
15	7.5-14.2	1.8-3.5	27.5-33.9	23800-95900	41.6-50.1	29.9-32.7	7.99-8.22	5.69-7.86	1-7.0	0	17.75-64.29	0.09-0.24	280.44-1355.46	122.66-2030	0-190	5. -26

Table 6 Environmental factors along Kanom canal, Kanom beach, Mo Ko Thale-Tai, between October 2006 and September 2007.

ST.	Month	Depth (m)	Trans. (m)	Temperature (°C)	Light intensity (lux)	Conduct (mS)	Salinity (ppt)	pH	DO (mgO_2/L)	Turbid (FAU)	NH_3-N (µg/L)	NO_3-N (µg/L)	NO_2-N (µg/L)	Si (µg/L)	P (µg/L)	Total P (µg/l)	Chl a (µg/L)
1	Oct-06	1.5	1.5	26.5	1000	0.46	0.2	7.53	6.43	6	0.00	35.71	0.19	3926.16	88.05	0.00	39.00
	Jan-07	1.0	1.0	26.0	1500	0.56	0.3	7.43	5.24	5	0.00	57.14	0.10	3926.16	945.69	0.00	9.23
	Mar-07	1.0	1.0	26.0	1500	0.47	0.3	7.43	5.24	5	0.00	4.84	0.09	7000.00	110.00	0.00	7.22
	Jun-07	0.5	0.5	30.5	2900	0.648	0.3	7.58	7.86	7	1.43	17.14	0.28	3785.94	1170.00	0.00	6.00
	Jul-07	0.5	0.5	27.8	880	0.76	0	7.72	7.86	6	2.14	35.71	0.75	4159.86	1900.00	700.00	4.00
	Sep-07	0.7	0.7	29.3	260	0.75	0.3	7.32	7.86	13	1.43	14.28	0.15	4066.00	438.52	40.00	4.74
2	Oct-06	6.0	0.6	31.1	11200	50.2	32.7	8.12	6.86	8	2.86	42.86	0.29	1542.42	250.00	100.00	78.00
	Jan-07	5.0	0.9	28.0	21400	47.6	30.9	8.13	8.13	14	0.00	42.86	0.33	1308.72	520.00	100.00	11.98
	Mar-07	4.6	0.9	30.6	70600	47.1	30.4	7.68	4.8	12	6.46	8.07	0.07	2400.00	2453.24	200.00	8.88
	Jun-07	3.8	0.6	31.8	7800	26.1	13.1	7.48	7.86	16	1.43	21.43	0.28	3178.32	400.00	0.00	29.00
	Jul-07	5.2	1.0	31.4	26200	36.2	23.6	7.6	7.86	10	10.00	35.71	0.71	2150.04	280.00	750.00	15.00
	Sep-07	4.0	0.8	32.3	47800	27.9	17.1	8.07	7.86	12	9.28	14.28	0.23	2711.00	30.67	330.00	15.08
3	Oct-06	5.0	0.9	31.3	48300	51	33.3	8.18	7.27	17	1.43	57.14	0.33	841.32	80.00	0.00	19.00
	Jan-07	5.0	1.1	28.0	30200	47.8	31	8.16	8.16	10	0.00	28.57	0.14	2150.04	600.00	0.00	8.11
	Mar-07	4.2	1.3	30.7	65200	50.2	32.7	8.11	7.34	9	1.76	16.13	0.04	1600.00	490.65	0.00	17.84
	Jun-07	3.3	0.7	31.8	23900	31.2	15.5	7.07	7.86	16	8.57	42.86	0.14	2150.04	430.00	0.00	41.00
	Jul-07	2.4	0.9	31.8	20000	42	21.8	7.52	7.86	10	11.43	21.43	0.14	701.10	2460.00	370.00	13.00
	Sep-07	4.5	0.7	32.8	64800	31.7	21.5	7.42	7.86	24	2.23	21.43	0.33	2430.00	898.50	530.00	15.67
4	Oct-06	5.0	1.0	31.6	34200	50.5	32.9	8.15	7	16	0.00	157.14	0.38	1215.24	320.00	0.00	11.00
	Jan-07	5.2	1.1	28.4	32700	47.8	31	8.17	8.17	14	0.71	71.43	0.38	1822.86	520.00	0.00	12.05
	Mar-07	4.0	1.3	31.3	45100	50.9	33.2	8.22	7.75	13	0.59	3.23	0.09	1200.00	1625.27	0.00	17.20
	Jun-07	3.8	0.6	32.0	9580	38.3	19.1	7.63	7.86	19	10.00	35.71	0.14	1589.16	180.00	0.00	32.00
	Jul-07	3.1	1.2	33.9	61600	48.7	32.5	8.14	7.86	8	0.00	28.57	0.14	514.14	360.00	100	13.00
	Sep-07	2.0	0.7	32.6	79400	41.2	29.2	7.79	7.86	19	1.90	28.57	0.33	1542.00	0.00	470.00	15.67

Table 6 (continued.)

ST.	Month	Depth	Trans.	Temperature	Light intensity	Conduct	Salinity	pH	DO	Turbid	NH_3-N	NO_3-N	NO_2-N	Si	P	Total P	Chl a
		(m)	(m)	(°C)	(lux)	(mS)	(ppt)		(mgO_2/L)	(FAU)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/l)	(µg/L)
5	Oct-06	8.0	1.9	30.1	57800	50	32.6	8.19	7.72	5	0.00	85.71	0.19	981.54	670.00	100.00	24.00
	Jan-07	6.8	1.1	27.5	31000	48.2	31.4	7.27	7.27	7	0.00	642.86	0.14	2009.82	2700.00	200.00	8.28
	Mar-07	18.0	3.0	29.4	55700	54.7	33.1	8.22	8.62	2	0.00	6.45	0.00	900.00	490.65	100.00	5.89
	Jun-07	16.0	2.0	31.4	46800	41.2	20.8	8.12	7.86	3	0.00	78.57	0.33	1635.90	600.00	0.00	5.00
	Jul-07	19.6	2.7	30.5	61800	45.6	32.8	8.16	7.86	3	0.00	42.86	0.28	514.14	2390.00	99	6.00
	Sep-07	26.0	2.0	30.4	36800	47.4	36.7	8.22	7.86	6	0.00	14.28	0.33	514.00	331.19	730.00	7.24
6	Oct-06	9.0	3.5	30.0	47900	50.2	32.7	8.23	7.74	4	0.00	57.14	0.19	747.84	530.00	0.00	27.00
	Jan-07	11.4	1.1	27.3	52700	48.3	31.4	7.26	7.26	6	0.00	142.86	0.19	1075.02	50.00	0.00	9.42
	Mar-07	8.3	3.8	29.7	96900	50.6	33	8.22	8.2	5	0.00	11.29	0.06	900.00	1103.96	0.00	5.89
	Jun-07	16.8	1.9	32.7	61900	41.2	32.9	7.93	7.86	6	0.00	64.29	0.33	1028.28	60.00	0.00	9.00
	Jul-07	10.7	3.2	32.1	82900	50.5	32.9	8.26	7.86	0	0.00	28.57	0.09	560.88	1620.00	99	5.00
	Sep-07	20.0	2.5	30.7	87600	47.8	33.8	8.36	7.86	3	0.00	57.15	0.10	467.40	380.25	190.00	6.00
7	Oct-06	18.0	3.8	30.2	54900	49.8	32.4	8.19	7.83	6	0.00	78.57	0.24	467.40	50.00	0.00	23.00
	Jan-07	15.8	1.6	27.4	10900	48.5	31.6	6.96	6.96	5	0.00	71.43	0.29	1308.72	290.00	0.00	8.21
	Mar-07	16.0	4.0	29.2	63600	54.2	32.9	8.23	7.36	2	0.00	6.45	0.06	500.00	551.98	0.00	6.00
	Jun-07	10.8	3.8	32.6	40000	46	32.8	8.09	7.86	6	0.00	78.57	0.19	747.84	170.00	0.00	5.00
	Jul-07	15.2	2.5	30.4	82000	50.4	32.9	7.68	7.86	3	0.00	42.86	0.19	560.88	1810.00	99	5.00
	Sep-07	14.0	3.0	30.8	94700	45.5	33.7	8.24	7.86	3	0.00	42.85	0.23	280.00	659.31	240.00	3.22
8	Oct-06	26	3.6	29.9	32700	35.7	33.8	8.12	7.66	5	0.00	71.43	0.14	280.44	2600.00	0.00	43.00
	Jan-07	26	1.9	26.9	2780	48.7	31.7	8.14	5.69	4	0.00	78.57	0.24	5234.88	2150.00	0.00	8.28
	Mar-07	26	5.4	28.8	29900	50.7	33.1	8.22	8.16	4	0.00	14.52	0.07	1100.00	183.99	100.00	3.95
	Jun-07	26	3.0	31.3	42500	36.8	32.9	8.06	7.86	7	0.00	64.29	0.19	1075.02	390.00	100.00	4.00
	Jul-07	26	3.2	30.4	63300	39.9	32.8	7.98	7.86	0	0.00	71.43	0.05	560.88	320.00	99	4.00
	Sep-07	26	2.5	30.7	70500	19.99	33.7	7.55	7.86	1	0.00	28.57	0.23	187.00	371.05	200.00	4.31
9	Oct-06	2.5	2.5	29.9	80000	50.9	33.3	8.23	7.53	3	0.00	42.86	0.19	514.14	70.00	0.00	4.00
	Jan-07	2.5	2.0	26.5	4150	48.6	31.7	8.13	5.44	6	0.00	57.14	0.14	1916.34	110.00	0.00	10.82

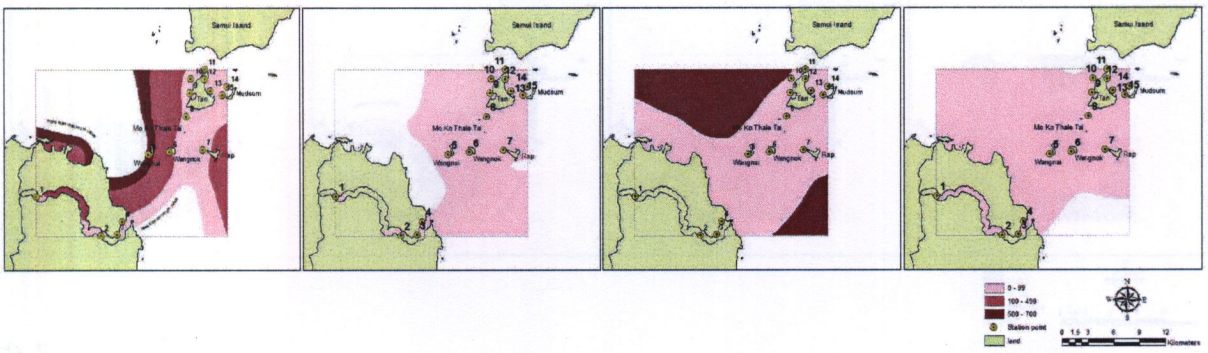
Table 6 (continued.)

ST.	Month	Depth	Trans.	Temperature	Light intensity	Conduct	Salinity	pH	DO	Turbid	NH_3-N	NO_3-N	NO_2-N	Si	P	Total P	Chl a
		(m)	(m)	(°C)	(lux)	(mS)	(ppt)		(mgO_2/L)	(FAU)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/l)	(µg/L)
	Mar-07	3.0	3.0	29.0	63100	54.5	33.1	8.24	7.54	6	0.00	4.84	0.07	900.00	1042.62	0.00	6.29
	Jun-07	1.1	1.1	30.9	35900	39.1	32.8	8.01	7.86	5	0.00	64.29	0.28	701.10	100.00	0.00	5.00
	Jul-07	1.1	1.1	30.3	89800	41.8	21	8.08	7.86	4	0.00	50.00	0.19	467.40	350.00	99	4.00
	Sep-07	2.0	2.0	30.8	78900	40.4	33.4	8.23	7.86	2	0.00	42.85	0.23	654.00	61.33	230.00	4.07
10	Oct-06	5.0	4.5	30.5	96900	49.2	32	8.21	7.8	7	0.00	50.00	0.33	1168.50	450.00	100.00	4.00
	Jan-07	7.9	2.7	27.2	15100	48.7	31.6	8.02	3.86	4	0.00	64.29	0.19	934.80	150.00	0.00	7.57
	Mar-07	13.3	4.0	29.0	45400	54.1	32.8	8.25	8.33	1	0.00	3.23	0.01	1100.00	1594.60	0.00	4.15
	Jun-07	9.0	3.5	30.9	35500	39.8	32.5	8.06	7.86	3	0.00	85.71	0.09	5188.14	70.00	0.00	5.00
	Jul-07	8.4	3.3	30.5	74800	43.3	32.6	7.99	7.86	3	0.00	35.71	0.19	420.66	30.00	99	5.00
	Sep-07	15.0	1.3	30.2	81600	43.3	33.6	8.19	7.86	10	0.00	64.28	0.33	748.00	159.46	310.00	4.83
11	Oct-06	12.0	2.5	30.0	112400	49.8	32.5	8.2	7.5	5	0.00	64.29	0.19	560.88	450.00	0.00	19.00
	Jan-07	19.3	2.3	27.4	23300	48.8	31.8	8.17	4.99	2	0.00	64.29	0.19	1075.02	320.00	0.00	6.53
	Mar-07	20.0	3.7	29.0	44200	30.4	33	8.22	6.89	1	1.17	11.29	0.00	0.00	1195.95	0.00	6.07
	Jun-07	14.0	2.8	30.8	54000	40.4	32.7	8.04	7.86	7	0.00	64.29	0.19	8927.34	120.00	0.00	5.00
	Jul-07	9.2	2.3	34.7	91000	38.5	19.8	8.15	7.86	2	0.00	50.00	0.24	467.40	20.00	99	7.00
	Sep-07	20.0	2.5	30.3	70000	42.3	33.5	8.18	7.86	1	0.00	57.15	0.38	467.40	141.06	250.00	6.11
12	Oct-06	6.0	2.0	30.0	104500	49.4	32.2	8.15	7.34	0	0.00	135.71	0.14	981.54	300.00	0.00	21.00
	Jan-07	7.1	1.9	27.4	26100	48.9	31.9	8.16	5.74	5	0.00	50.00	0.29	514.14	1010.00	0.00	7.98
	Mar-07	7.9	5.0	29.4	40000	50.4	32.3	8.23	6.83	5	0.59	3.23	0.10	900.00	2759.89	0.00	4.14
	Jun-07	6.2	3.5	31.3	79200	40.3	32.8	8.03	7.86	11	0.00	57.14	0.28	2056.56	50.00	0.00	5.00
	Jul-07	7.6	2.5	36.2	88400	42.1	32.7	7.54	7.86	0	0.00	57.14	0.14	420.66	110.00	40.00	4.00
	Sep-07	7.0	3.0	32.3	98800	42.3	33.4	8.2	7.86	6	0.00	64.28	0.29	421.00	229.99	310.00	5.08
13	Oct-06	6.0	2.7	30.1	74900	49.5	32.2	8.16	7.66	3	0.00	57.14	0.19	3178.32	660.00	0.00	13.00
	Jan-07	6.3	1.8	27.6	51500	48.4	31.5	8.15	5.76	2	0.00	42.86	0.10	3225.06	760.00	100.00	5.91
	Mar-07	6.3	4.3	29.3	58800	54.6	32.9	8.22	7.23	2	0.00	12.91	0.00	200.00	183.99	100.00	4.91
	Jun-07	3.9	3.3	30.9	79900	40.6	32.7	8.09	7.86	2	0.00	64.29	0.19	794.58	170.00	0.00	5.00

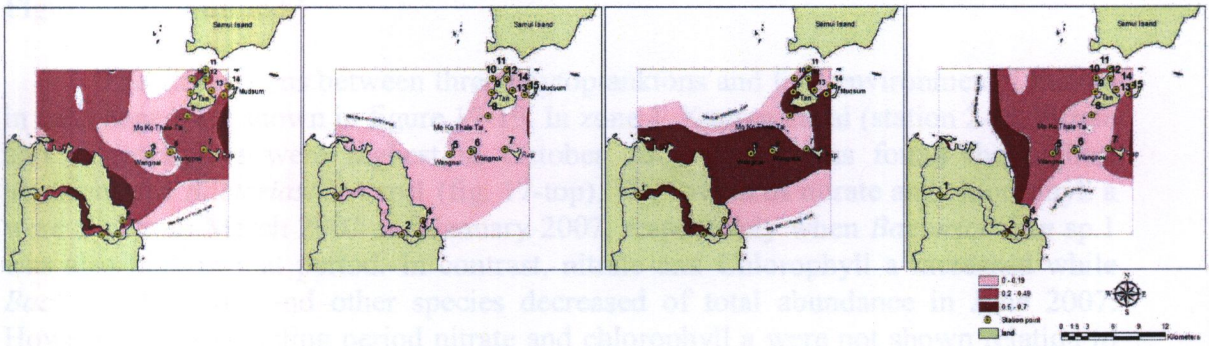
Table 6 (continued.)

ST.	Month	Depth	Trans.	Temperature	Light intensity	Conduct	Salinity	pH	DO	Turbid	NH_3-N	NO_3-N	NO_2-N	Si	P	Total P	Chl a
		(m)	(m)	(°C)	(lux)	(mS)	(ppt)		(mgO_2/L)	(FAU)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/l)	(µg/L)
	Jul-07	4.5	2.0	33.7	82800	44.4	32.7	7.89	7.86	4	0.00	35.71	0.09	654.36	130.00	99	5.00
	Sep-07	5.0	2.5	33.5	91200	44.4	33	8.19	7.86	1	0.00	64.28	0.23	374.00	1079.42	230.00	5.25
14	Oct-06	2.6	2.6	30.0	11300	49.9	32.5	8.19	7.53	4	0.00	100.00	0.14	1355.46	60.00	0.00	17.00
	Jan-07	1.8	1.8	27.4	28900	48.5	31.6	8.17	5.73	3	0.00	50.00	0.14	701.10	320.00	200.00	7.74
	Mar-07	2.0	2.0	29.5	64400	50.6	32.9	8.15	9.74	6	0.00	14.52	0.09	1300.00	153.33	200.00	4.99
	Jun-07	0.9	0.9	32.2	95800	40.7	32.6	8.15	7.86	0	0.00	50.00	0.14	747.84	380.00	0.00	5.00
	Jul-07	1.2	1.2	32.7	83400	43.3	32.6	8.1	7.86	4	0.00	42.86	0.19	420.66	390.00	99	5.00
	Sep-07	1.5	1.5	31.8	97300	47.8	32.9	8.3	7.86	6	0.00	35.72	0.33	654.00	190.13	270.00	4.96
15	Oct-06	14.0	2.6	30.1	90900	50	32.6	8.18	7.7	1	0.00	64.29	0.14	654.36	340.00	0.00	26.00
	Jan-07	12.1	1.8	27.5	23800	48.4	31.5	8.12	5.69	2	0.00	50.00	0.29	1355.46	2030.00	0.00	7.86
	Mar-07	14.2	4.0	29.3	64500	50.1	32.7	8.22	7.25	7	0.00	17.75	0.09	800.00	122.66	0.00	5.66
	Jun-07	10.0	3.0	32.6	56400	41.6	32.6	8.09	7.86	4	0.00	50.00	0.24	280.44	760.00	0.00	6.00
	Jul-07	9.6	2.1	30.9	86900	43.1	32.7	7.99	7.86	2	0.00	50.00	0.24	373.92	260.00	99	5.00
	Sep-07	7.5	3.5	33.9	95900	49	29.9	8.18	7.86	7	0.00	42.85	0.23	701.00	229.99	190.00	5.18

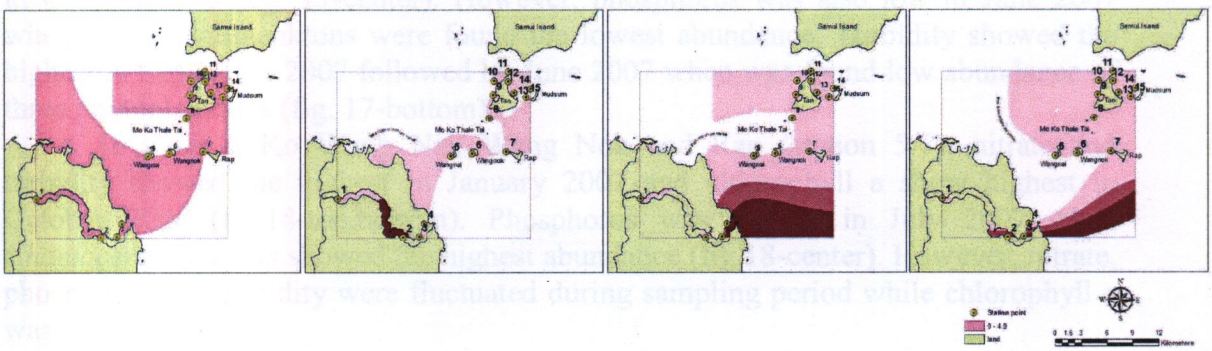
a) Chlorophyll a



b) Nitrate

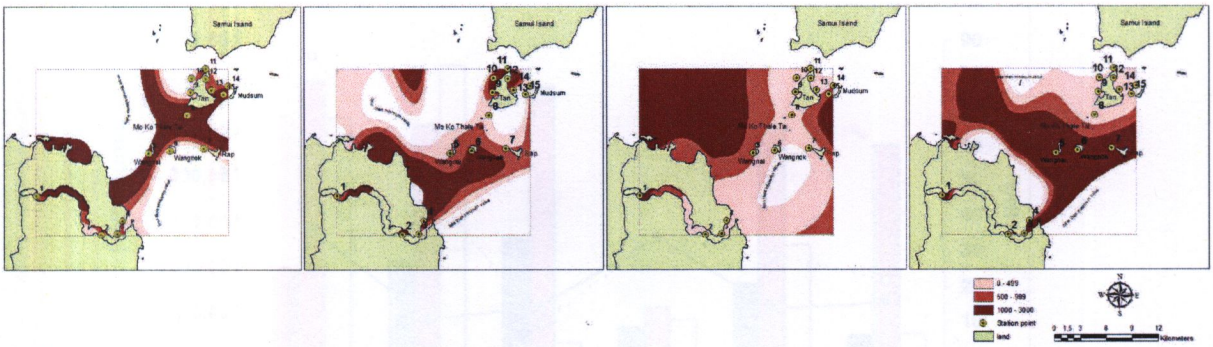


c) Nitrite

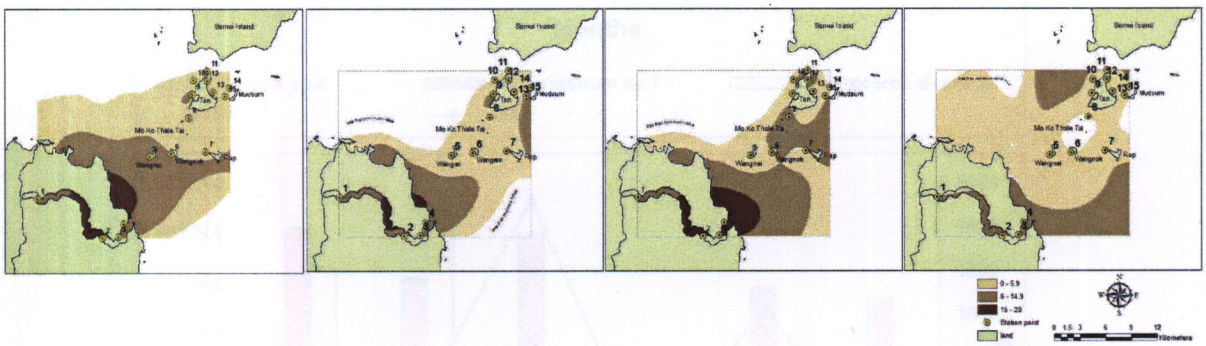


d) Ammonia

Figure 16 Environmental factors along Kanom canal, Kanom beach, Mo Ko Thale-Tai, measuring in January 2007, March 2007, June 2007 and July 2007



e) Phosphorus



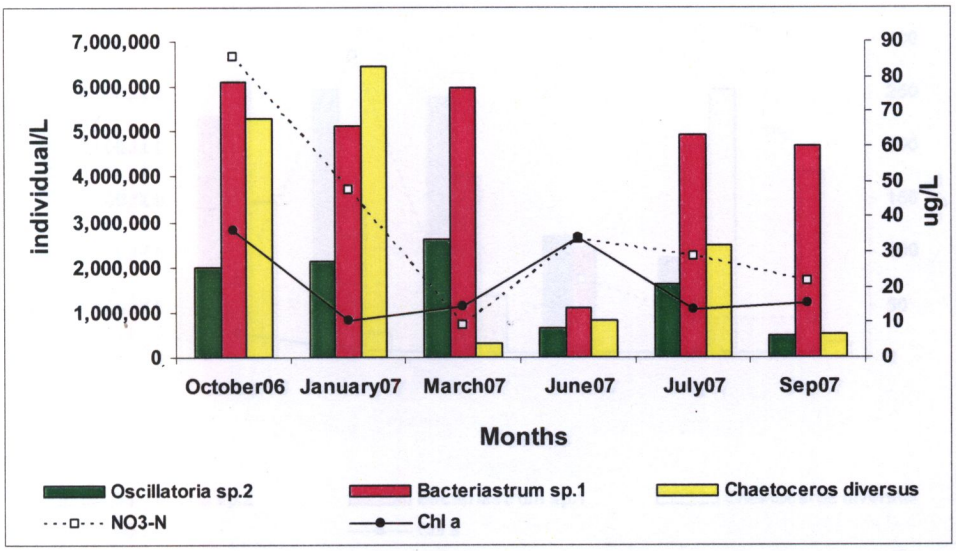
f) Turbidity

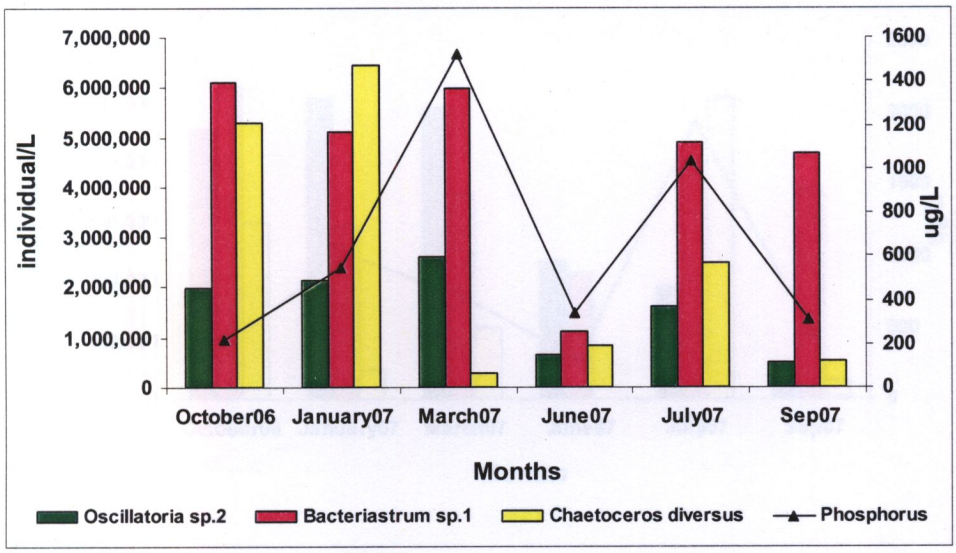
Figure 16 (continued.)

The correlations between three phytoplanktons and four environmental factors in each zone were shown in figure 17-19. In zone 1, Kanom canal (station 2-4), nitrate and chlorophyll a were highest in October 2006 which was found the highest abundance of *Bacteriastrum* sp.1 (fig. 17-top). The lowest of nitrate and chlorophyll a were shown in March 2007 and January 2007, respectively when *Bacteriastrum* sp.1 was also high in that period. In contrast, nitrate and Chlorophyll a increased while *Bacteriastrum* sp.1 and other species decreased of total abundance in June 2007. However, other sampling period nitrate and chlorophyll a were not shown relation to density of phytoplankton. Phosphorus showed the highest in March 2007 and lowest in October 2006 (fig. 17-center). However, phosphorus was also low in June 2007 when three phytoplanktons were found the lowest abundance. Turbidity showed the highest in September 2007 followed by June 2007 when was found low abundance of three phytoplanktons (fig. 17-bottom).

In zone 2, Ko Wang Nai, Wang Nok and Rap (station 5-7), nitrate and turbidity showed the highest in January 2007 and chlorophyll a show highest in October 2006 (fig.18-top,bottom). Phosphorus was highest in July 2007 when *Chaetoceros diversus* showed the highest abundance (fig.18-center). However, nitrate, phosphorus and turbidity were fluctuated during sampling period while chlorophyll a was quite stable.

In zone 3, Ko Tan and Mudsum (station 8-15), nitrate and chlorophyll a were the highest in October 2006 (fig.19-top). In contrast, nitrate was the lowest in March 2007 when phosphorus and *Bacteriastrum* sp1 were the highest. Turbidity was highest in June 2007 but lowest in July 2007. However, similar pattern with zone 2, nitrate, phosphorus and turbidity were fluctuated during sampling period while chlorophyll a was quite stable.





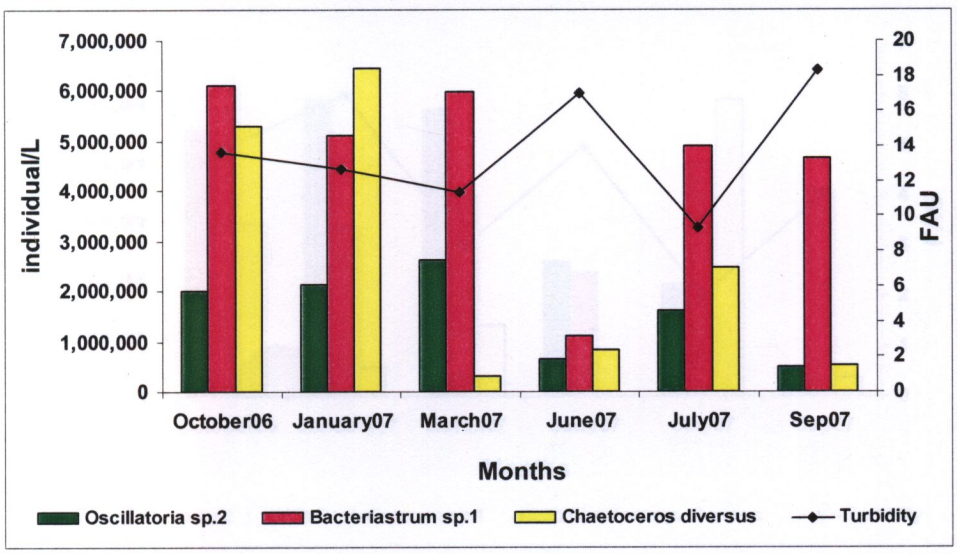
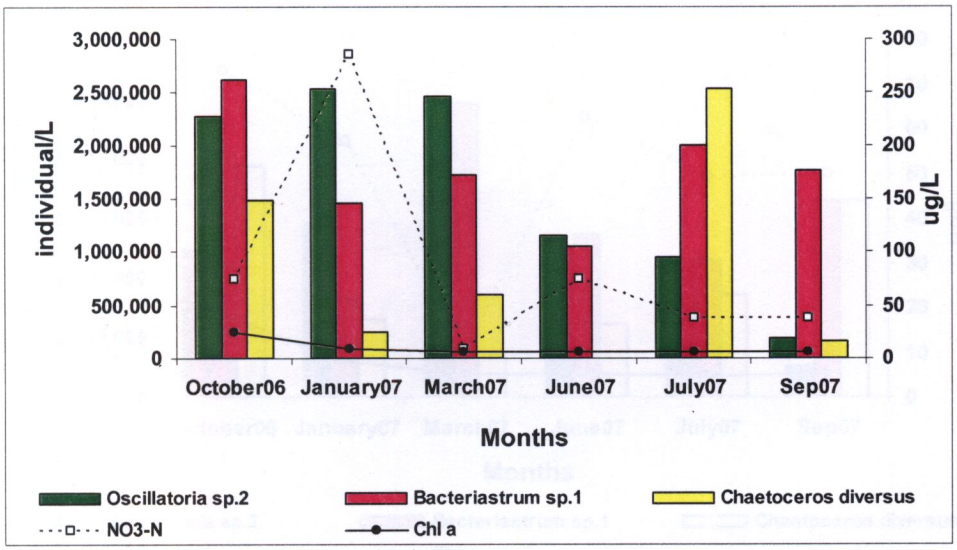
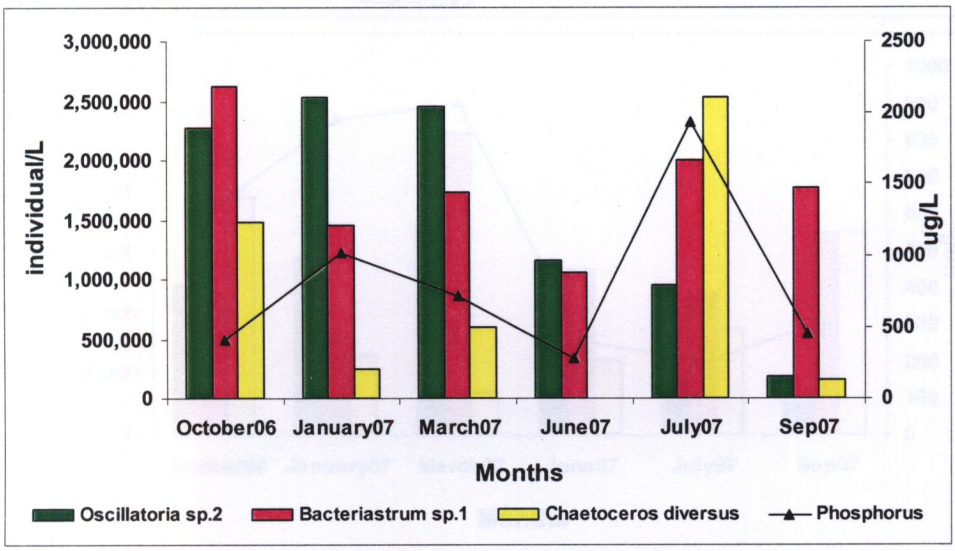


Figure 17 correlations between three abundance phytoplanktons and environmental factors in zone 1- Kanom canal (station 2-4)





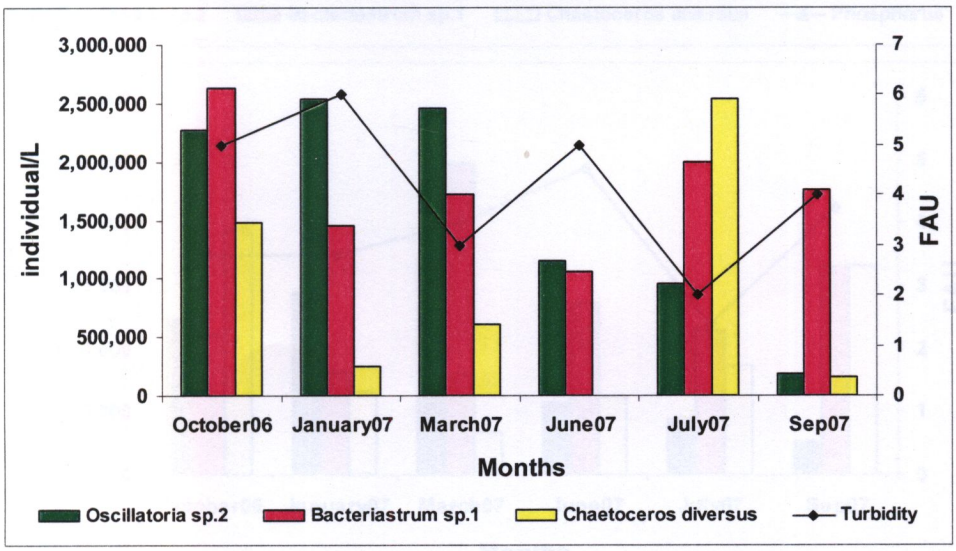
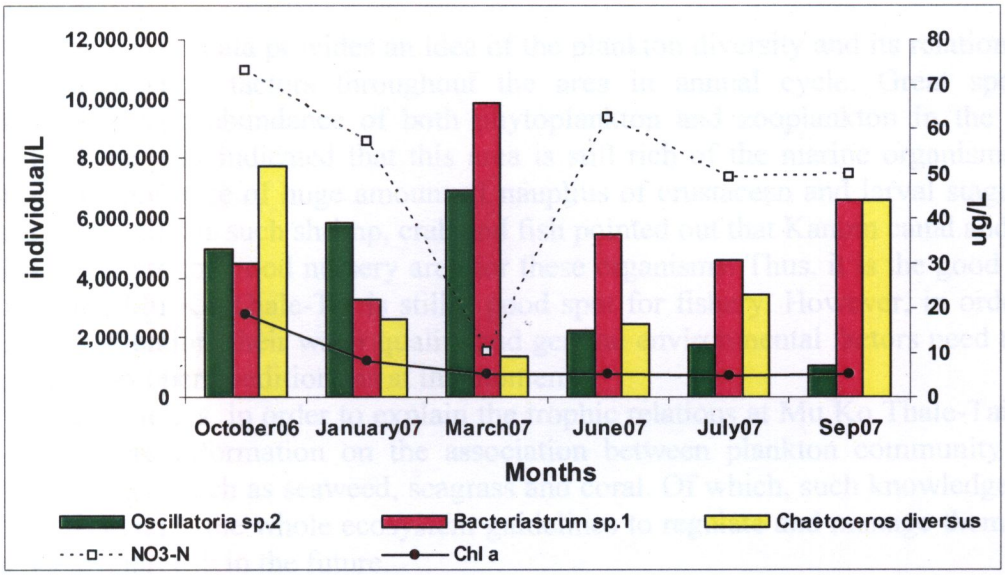
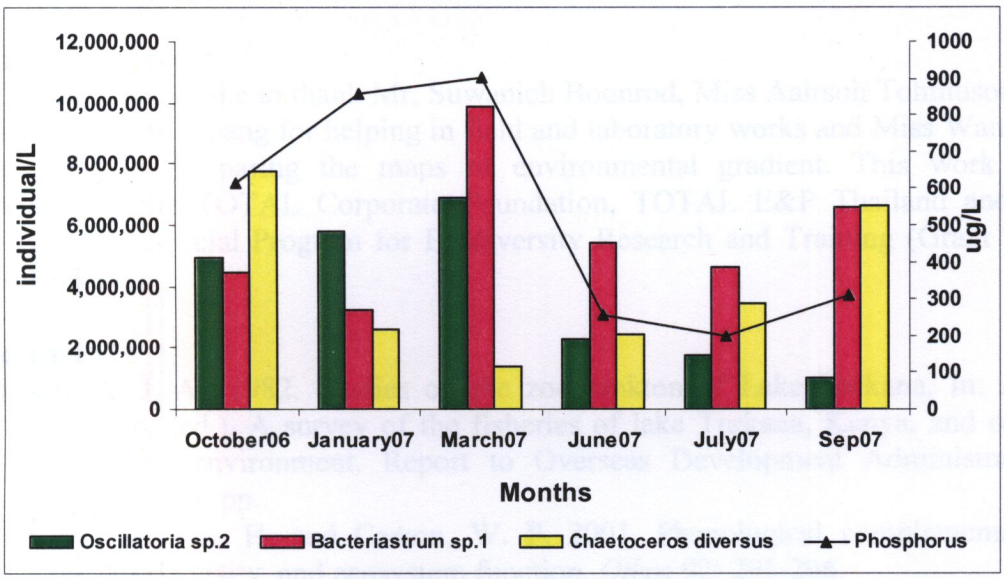


Figure 18 correlations between three abundance phytoplanktons and environmental factors in zone 2- Ko Wang Nai, Wang Nok and Rap (station 5-7)





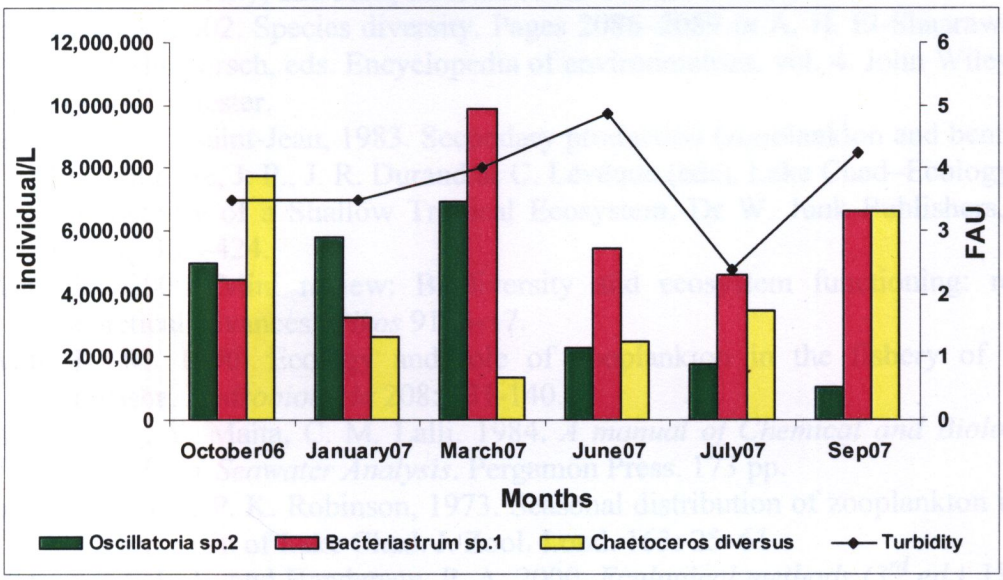


Figure 19 correlations between three abundance phytoplanktons and environmental factors in zone 3- Ko Tan and Mudsum (station 8-15)

Conclusion

The present data provides an idea of the plankton diversity and its relationship with environmental factors throughout the area in annual cycle. Great species diversity and high abundance of both phytoplankton and zooplankton in the area throughout the year indicated that this area is still rich of the marine organisms. In addition, the presence of huge amount of nauplius of crustacean and larval stages of other marine animals such shrimp, crab and fish pointed out that Kanom canal and Mu Ko Thale-Tai are the good nursery area for these organisms. Thus, it is the good sign to show that Mu Ko Thale-Tai is still a good spot for fishery. However, in order to sustain this situation, their water quality and general environmental factors need to be conserved in proper conditions as at the moment.

Nevertheless, in order to explain the trophic relations at Mu Ko Thale-Tai, we also need more information on the association between plankton community and others ecosystem such as seaweed, seagrass and coral. Of which, such knowledge can be used to produce the whole ecosystem guidelines to regulate and manage them in a sustainable approach in the future.

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References

Ferguson, A. J. A., 1982. Studies on the zooplankton of Lake Turkana, In: A. J. Hopson, (ed.). A survey of the fisheries of lake Turkana, Kenya, and of the lacustrine environment. Report to Overseas Development Administration, London. 826 pp.

Henry, M., Stevens, H. and Carson, W. P. 2001. Phenological complementarity, species diversity, and ecosystem function. *Oikos* 92: 291-296.

Kempton, R. A. 2002. Species diversity. Pages 2086–2089 *in* A. H. El-Shaarawi and W. W. Piegorsch, eds. Encyclopedia of environmetrics, vol. 4. John Wiley and Sons, Chichester.

Lévêque, C. & L. Saint-Jean, 1983. Secondary production (zooplankton and benthos). In Carmouze, J. P., J. R. Durand & C. Lévêque (eds), Lake Chad–Ecology and Productivity of a Shallow Tropical Ecosystem, Dr W. Junk Publishers, The Hague: 385–424.

Loreau, M. 2000. Mini review: Biodiversity and ecosystem functioning: recent theoretical advances. *Oikos* 91: 3-17.

Mavuti, K. M. 1990. Ecology and role of zooplankton in the fishery of Lake Naivasha. *Hydrobiologia* 208: 131-140.

Parsons, T. R., Y. Maita, C. M. Lalli. 1984. *A manual of Chemical and Biological Methods for Seawater Analysis*. Pergamon Press. 173 pp.

Robinson, A. H. & P. K. Robinson, 1973. Seasonal distribution of zooplankton in the northern basin of Lake Chad. J. Zool. Lond. 163: 25–61.

Southwood, T. R. E. and Henderson, P. A. 2000. *Ecological methods (3rd ed.)*. United Kingdom. Blackwell Science. 575 pp.

Strickland, J.D. H. and T. R. Parsons. 1972. *A Practical Handbook of Seawater Analysis*. Fisheries Resource Board of Canada. Bull. 167. 2nd ed. Ottawa, 308 pp.

http://www.fisheries.go.th/fpo-nakhon/stat.htm. Nakhon Si Thammarat Fishery Office. 2003